



Preliminary Geotechnical Investigations for Danish Offshore Wind Farm 2030 Lot 2 | Danish Sector, North Sea

Records of Operations – Excalibur

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Executive Summary

Following a decision in the Danish Parliament, Denmark is on the path to establish multiple offshore wind farms in the Danish sectors of the North Sea, Kattegat, and the Baltic Sea. The offshore wind farms will provide offshore energy to the Danish mainland and neighbouring countries.

The offshore part of the project in the North Sea includes the following:

- Multiple offshore wind farms;
- Offshore platforms for substations;
- Subsea cables between offshore wind farms and the Danish mainland.

Energinet Eltransmission A/S has requested Fugro to perform a geotechnical site investigation for the North Sea 1 offshore wind farm area. The planned developments are located in the Danish sector of the North Sea, approximately 20 km off the west coast of Jutland, Denmark. The investigation area is divided into two subareas (Subarea 1 and Subarea 2). The geotechnical site investigation intends to provide relevant geotechnical data to improve the geological and geotechnical understanding of the area, and to support the design and installation requirements for the planned offshore wind farms.

The various site phases of the geotechnical investigation include seafloor in situ testing, geotechnical borehole drilling with downhole sampling, downhole in situ testing, borehole geophysical logging, and offshore geotechnical laboratory testing. An office programme of geotechnical laboratory testing and reporting of results follows the site phase.

This report presents the operations and calibration records of the seafloor and downhole scope conducted by Excalibur in Subarea 1, between 28 April and 25 June 2024. Water depths at the investigated locations, range from approximately 17 m to 20 m reduced to mean sea level.

1. Introduction

Energinet Eltransmission A/S (Energinet) are performing a large number of site investigations in preparation for development of the Danish offshore wind farm (OWF) 2030 project in the North Sea. Energinet has contracted Fugro to perform a geotechnical site investigation for the developments of the North Sea 1 offshore wind farm area. The planned developments are situated in the Danish sector of the North Sea, approximately 20 km off the west coast of Jutland, Denmark.

The purpose of this geotechnical site investigations is to gather geotechnical data and information as basis for:

- Development of 3D ground models, integrating the results of the geotechnical investigations and the geophysical surveys,
- Evaluation of possibilities to jack up on the seafloor when installing wind turbines,
- Preliminary engineering site assessments,
- General risk assessments for foundation conditions of the wind farms.

This document comprises the operations and calibration records of the seafloor and downhole scope performed by Excalibur, not included in and supplementing the 'Geotechnical Site Investigation Results Subarea 1' (F217703-03, F217703-04).

The operations and calibration records of the seafloor and downhole scope performed by MV Normand Mermaid, Fugro Voyager and Gargano will be covered in separate documents (F217703-01-OPS-NMM, F217703-02-OPS-VOY and F217703-03-OPS-GAR, respectively).

1.1 Geotechnical Survey Objectives with Excalibur

The aim of the offshore geotechnical survey was providing the soil types and geotechnical properties of the soil units down to 70 m below seafloor (BSF).

The geotechnical part of the survey with Excalibur included the following:

- 16 CPT testing of the seafloor to target depth 55 m BSF.
- 6 geotechnical boreholes to a target depth of 70 m BSF.
- 2 geotechnical boreholes including blind drilling from seafloor to refusal depth of the seafloor CPT and downhole CPT to target depth 55 m BSF.

1.2 Detailed Site Information

1.2.1 Location

Figure 1.1 presents a project location map.

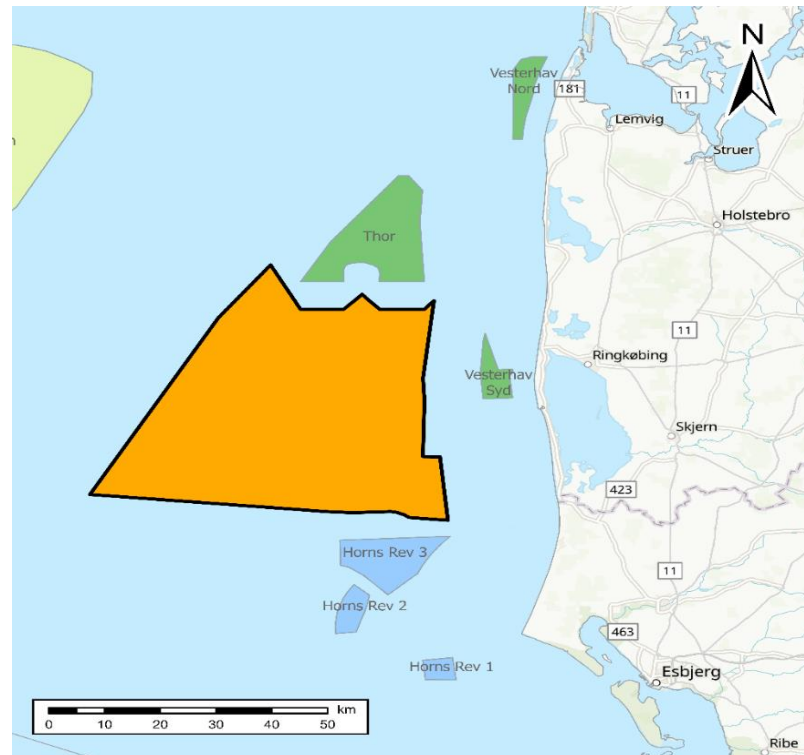


Figure 1.1: North Sea 1 (LOT 2) site in orange shown with neighbouring wind farms either operational (blue) or under construction (green)

1.2.2 Area of Investigation: LOT 2 Site

1.2.2.1 Description

The investigation area covers 2200 km² and is divided into two sub-areas: Subarea 1, covering 1420 km², and Subarea 2, covering 796 km². The water depths range between 10 and 40 meters mean sea level (MSL).

Approximately 3.5 percent of the project scope falls within the 12 nautical mile (NM) zone. None of the locations in the 12 nm zone were under Excalibur's scope.

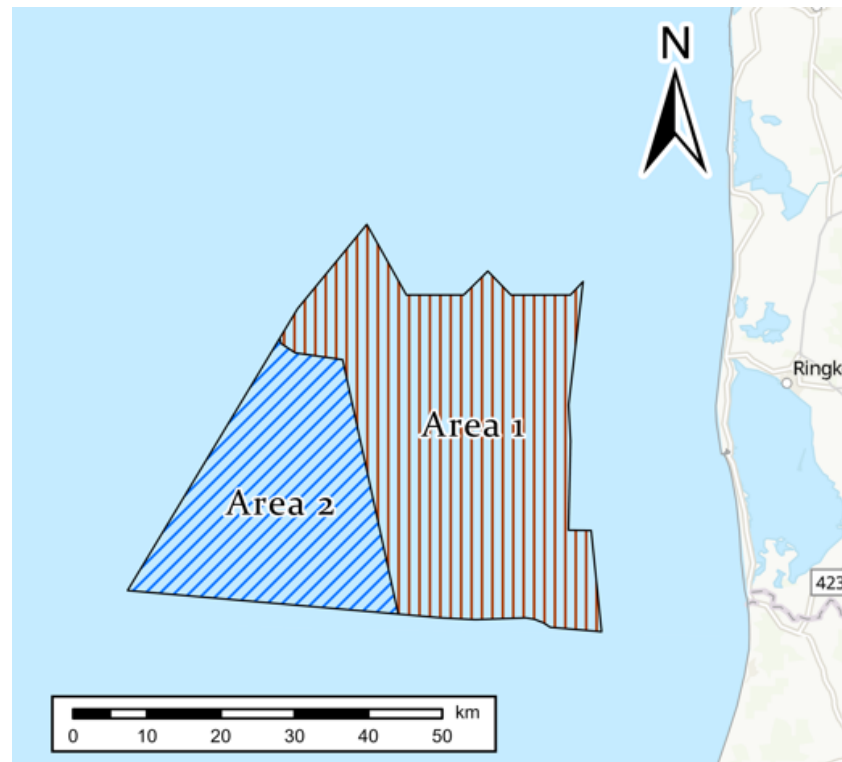


Figure 1.2: Sub-area distribution for the LOT 2 area

1.3 Geospatial Information, Vertical, Horizontal Control and Positioning

Table 1.1 presents the project geodesy and Table 1.2 presents the validation calculation. (Refer to Appendix D.3 Positioning Survey Equipment Calibration for details)

Table 1.1: Geodetic parameters

Name: ETRS89 / UTM zone 32N [ETRF2000-ITRF2014], DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters*		
Datum	International Terrestrial Reference Frame 2014 EPSG:1165	
Ellipsoid	GRS 1980	
Semi major axis	a = 6 378 137.00 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989 EPSG:6258	
Ellipsoid	GRS 1980	
Semi major axis	a = 6 378 137.00 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation - 0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation - 0.01666"	Coordinate Frame rotation

Z-axis translation - 0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map projection	Transverse Mercator	
Grid system	UTM zone 32N	EPSG:16032
Latitude origin	00° 00' 00.000" N	
Central meridian	009° 00' 00.000" E	
Scale factor on central meridian	0.9996	
False easting	500 000 m	
False northing	0 m	
Project Vertical Parameters		
Vertical coordinate reference system	DTU21 MSS height	
Datum	DTU21 MSS height	
Transformation	WGS 84 to DTU21 MSS height	
Notes		
* The geodetic datum of Fugro's global GNSS correction data is ITRF2014, epoch 2023. 001982 (01/01/2023)		

Table 1.2: Validation calculation

TRF2014	Test Point [Position]	Computed Point
Latitude	56° 18' 54.00000" N	56° 18' 54.00000" N
Longitude	008° 30' 18.00000" E	008° 30' 18.00000" E
Ellipsoidal height	0.000 m Ell.	0.000 m Ell.
ETRS89		
Latitude	56° 18' 53.98049" N	56° 18' 53.98049" N
Longitude	008° 30' 17.96794" E	008° 30' 17.96794" E
Ellipsoidal height	-0.026 m Ell.	-0.026 m Ell.
UTM zone 32N		
Easting	469 379.097 m	469 379.097 m
Northing	6 241 248.598 m	6 241 248.598 m
Mean sea surface height	-39.937 m	-39.937 m

1.4 Scope of Report

The information presented in this report relates to operational details of the site investigation, as follows:

- Milestone Certificates,
- Data acquisition calibration records for the positioning systems,

- Recovery Lists,
- Calibration Certificates,
- Positioning Data,
- Health, Safety and Environment performance.

1.5 Project Responsibilities and Use of Report

This document presents information according to a project specification determined and monitored by Energinet Eltransmission A/S.

Fugro understands that this report will be used for the purpose described in this Main Text section. That purpose was a significant factor in determining the scope and level of the services. Results must not be used if the purpose for which the report was prepared or the client's proposed development or activity changes. Results may possibly suit alternative use. Suitability must be verified.

2. Operations

2.1 Mobilisation and Calibrations

From now on, Excalibur Jack-Up will be referred to as "Vessel" in the report. Vessel mobilization was completed on 18 April 2024 in Holyhead, UK. Mobilisation was conducted in port and details of this are outlined in the Excalibur mobilisation report (Document No. F217703-MOB-01B). Appendix A.1 presents signed copies of the milestone certificates. After the completion of mobilization, Excalibur was towed from Holyhead and jacked up at the North Sea 1 area on 28 April 2024.

The survey equipment supplied in the frame agreement was mobilised on the Excalibur prior to the start of this project. Dimensional control survey of the installed sensors and series of alongside checks and calibrations were undertaken between 8 and 9 March 2024, while the Excalibur JUB was alongside Holyhead.

Positioning Survey Mobilisation and Calibration report for Subarea 1 is presented in Appendix D.4.

Excalibur offsets have been provided in Table 2.1 and a corresponding offset diagram in Figure 2.1.

Table 2.1: Excalibur Offsets

Description	X [m] + STBD	Y [m] + FWD	Z [m] +UP	Notes
Moonpool 1 CRP	0.00	0.00	0.00	Common Reference Point, deck level
GNSS Antenna Aft 1	4.63	-18.86	6.83	SPK2 primary, Phase centre
GNSS Antenna Aft 2	2.04	-15.81	6.97	SPK2 secondary, Phase centre
GNSS Antenna Bow Port	-13.67	8.65	11.73	SPK1 primary, Phase centre
GNSS Antenna Bow Starboard	-0.91	8.72	12.01	SPK1 secondary, Phase centre
LEG 1	-20.86	9.94	0.00	Centre
LEG 2	7.04	9.92	0.00	Centre
LEG 3	-20.93	-8.04	0.00	Centre
LEG 4	6.94	-7.96	0.00	Centre
LEG 5	-20.90	-14.53	0.00	Centre
LEG 6	6.97	-14.52	0.00	Centre
LEG 7	-20.96	-37.40	0.00	Centre
LEG 8	7.07	-37.38	0.00	Centre
Moonpool 2	-2.44	-5.66	-0.03	Centre
Crane 1	-6.81	-19.14	0.00	Centre
Crane 2	-20.46	-0.71	0.00	Centre

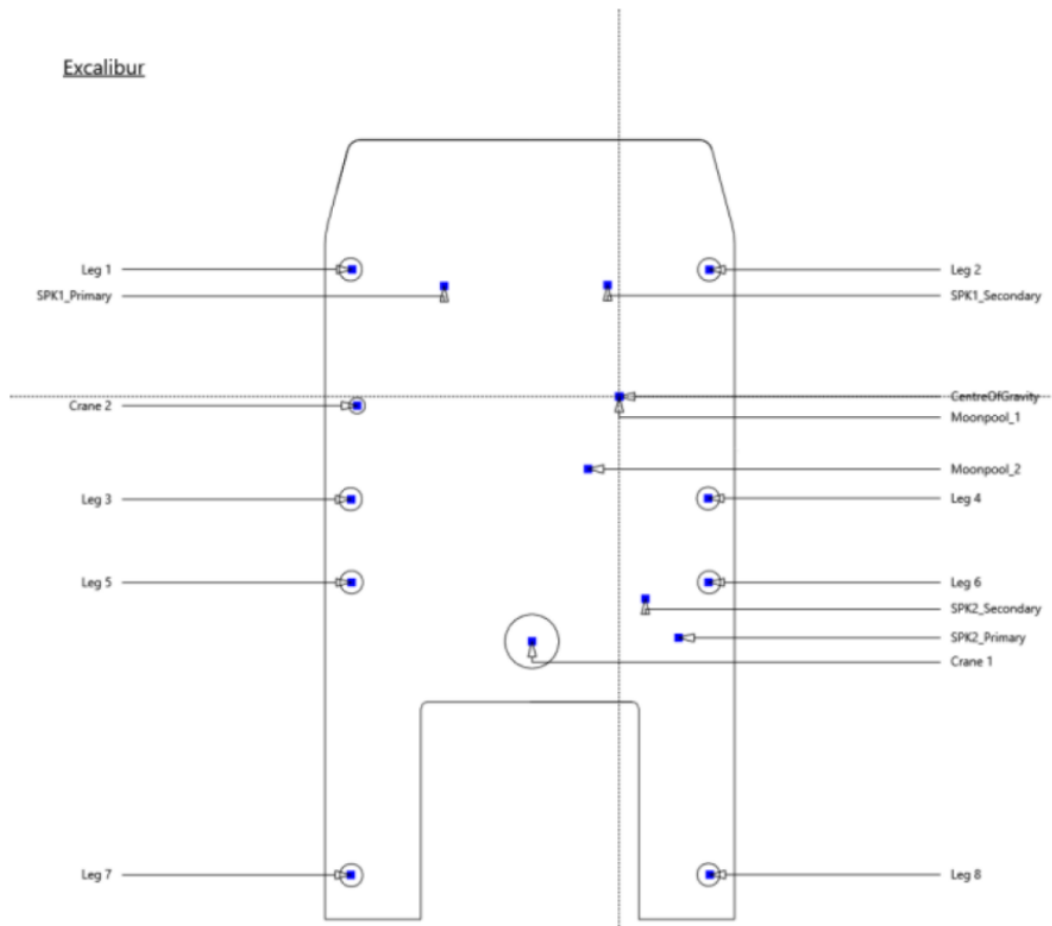


Figure 2.1: Excalibur offset diagram

2.1.1 Navigation and Vertical Control

Table 2.2: Vessel Navigation and Vertical Control

Vessel Navigation and Vertical Control	
Requirement	<ul style="list-style-type: none"> ■ The horizontal and vertical uncertainty of the vessel position shall be less than 0.5 m. The accuracy of the horizontal positioning shall be better than 0.2 m for 95% of time (2σ). ■ Horizontal: The horizontal position of borehole and CPT locations shall be determined with an accuracy better than 0.5m. ■ The elevation of the seabed at the investigation positions shall be determined with an accuracy better than 0.1m.
Equipment	<ul style="list-style-type: none"> ■ Primary Positioning System: 2x Starfix.G4+ signal; ■ Secondary Positioning System: 2x Starfix.GNSS signal (Starfix.XP2/HP); ■ Heading: 1x StarPack SP1 ProTrack vector heading system ■ Navigation Software: Starfix NG.
Data Collection	<ul style="list-style-type: none"> ■ All global navigation satellite system (GNSS) positions were acquired in geographic coordinates relative to the World Geodetic System 1984 (WGS84) datum. ■ Fugro navigated and positioned the Excalibur to the intended positions given by the client. ■ Two StarPack GNSS receivers were used for the surface positioning during the project. All depth measurements were reduced to MSL. Real-time GNSS tides were used throughout the project.

Vessel Navigation and Vertical Control	
	<ul style="list-style-type: none"> All positions and peripheral data were sent to the navigation computer which calculated the various offset's positions in the local geodesy and projection, ETRS89 / UTM zone 32N (EPSG::25832), ITRF2014 to ETRS89 (FUGRO::41366). (refer to Appendix B.4 for positioning report)

2.2 Equipment

2.2.1 Drilling Equipment

A Fraste CompactRotoSonic (CRS) XL170 MAX DUO drill rig deployed on 'Fugro Excalibur' was used for drilling and downhole sampling activities. The rig has a pull down force capacity of 50 kN (with sonic mode active) or 55 kN. A single-wall core barrel was used to recover samples using the sonic drilling capability of the drill rig. Various types of Shelby tubes for push sampling were selected accordingly to ensure sample quality. Rotary coring was carried out using the Geobor S triple walled coring system with plastic core liners. Various drill bits were provided and core catchers/lifters were supplied for use in sampler tubes and core barrels as required.

2.2.2 Top Push CPT System

A jacking unit comprising a pair of hydraulic rams with a thrust capacity of 20 tonnes is mounted on a removable beam attached to a CR2 marine derrick positioned over the moonpool.

CPTs were performed using Fugro Deepcone® piezocone penetrometers with an approximate tip area of 1500 mm². The Fugro Deepcone® is a heavy-duty piezocone penetrometer designed to enhance penetration capacity. The jacking unit is used to lower/push the cone in 1 m increments by adding sections of 25.5 mm hollow stem rod at deck level. The jacking unit pushes the cone at a rate of 2 cm/s.

2.2.3 WISON® Deep Line System

The WISON® Deep Line tool comprises a hydraulic jacking unit with 36 mm OD push rod. The tool is lowered on a hydraulic-electric umbilical via a sheave mounted over the moonpool on a CR2 marine derrick and latches into Geobor S drill pipe. The tool provides a 1.5 m stroke and a thrust capacity of 100 kN which ensures the cone is pushed into the soil at a constant rate of 2 cm/s.

CPTs were performed using standard piezocone penetrometers with an approximate tip area of 1000 mm².

2.3 Vessel Details

2.3.1 Excalibur

The Excalibur Barge is a Fugro owned and operated barge adapted to specialist geotechnical investigation. The vessel uses a crane to efficiently deploy various systems through the moonpool.

A total of 40 bunks are available on this vessel. Survey offsets were determined during vessel mobilisation.



Figure 2.2: Excalibur

Table 2.3 below shows the Excalibur vessel characteristics.

Table 2.3: Vessel Details – Excalibur

Vessel	Excalibur (24 Hrs)
Length	90.1 m
Beam	20.5 m
Gross Tonnage	5528 ton
Draught	7 m
Legs	8
Transit speed	Up to 5 knots

3. Field Procedures

3.1 Summary of Events

The work covered under the contract comprises a combination of seafloor in situ testing and downhole sampling onboard the Excalibur, and downhole sampling and in situ testing spread over multiple separate vessels, namely and Fugro Voyager, Gargano and MV Normand Mermaid.

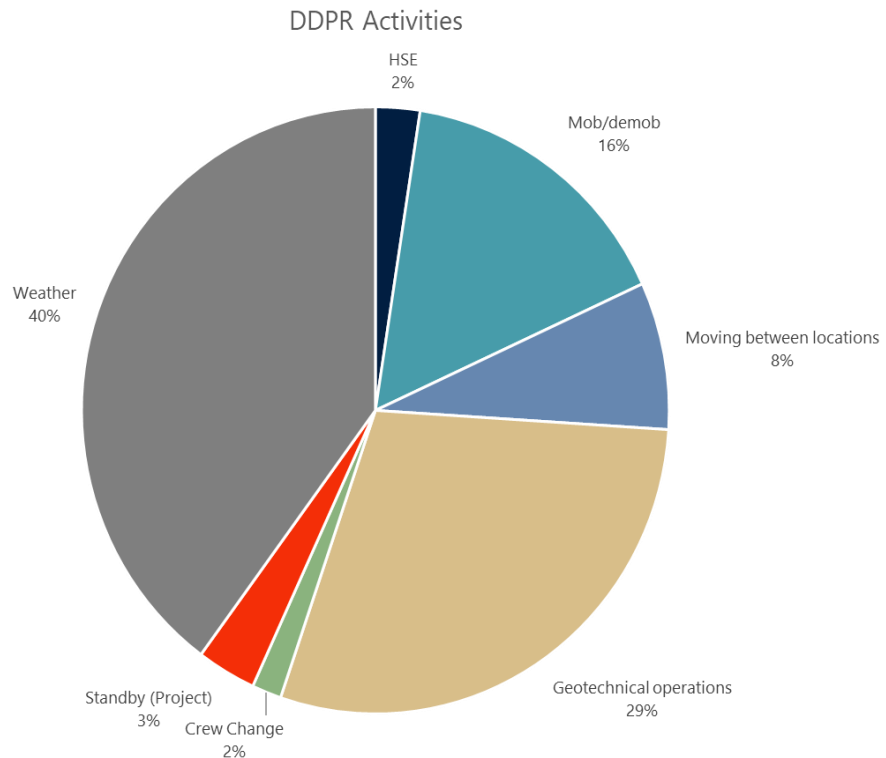
Seafloor In situ testing and downhole sampling operations with Excalibur for the Danish offshore wind farm (OWF) 2030 project commenced on 30 April 2024. Survey operations were run on a 24-hour operational basis with data being QC'd and processed offshore. Geotechnical operations were completed on 25 June 2024. The vessel transmitted to Great Yarmouth for demobilisation.

A summary of key events has been provided in Table 3.1, a break-down of geotechnical operational time (days) for Excalibur is provided in Figure 3.1.

Table 3.1: Summary of Key Events (Geotechnical)

Event	Dates
Mobilisation of Excalibur (Holyhead, UK)	08-09 March 2024
Towing from UK to North Sea 1 - Subarea 1	18 April – 24 April 2024
Commencement of Geotechnical operations in Subarea 1	30 April 2024
Completion of Geotechnical operations in Subarea 1	25 June 2024
Activity	Days
HSE	1.7
Mob/demob	11.0
Moving between locations	5.5
Geotechnical operations	20.5
Crew Change	1.1
Standby (Project)	2.3
Weather	27.9
HSE	1.7

Figure 3.1: Excalibur project breakdown (%days)



3.2 Work Package C – Excalibur

Fieldwork operations onboard the Excalibur were performed between 30 April 2024 and 25 June 2024. Data was processed onboard and preliminary results for individual locations were issued to the onboard client representative. Daily progress reports (DPRs) were issued daily during the mobilisation of the fieldwork and during execution of the scope of work.

The work scope performed by Excalibur in Subarea 1 comprises of:

- 16 CPT testing of the seafloor to target depth 55 m BSF.
- 6 geotechnical boreholes to a target depth of 70 m BSF.
- 2 geotechnical boreholes including blind drilling from seafloor to refusal depth of the seafloor CPT and downhole CPT to target depth 55 m BSF.

Table 3.2: Geotechnical Scope of Work

Scope	Tendered Number	Acquired Number
Subarea 1 - CPT	20	16
Subarea 1 - BH	6	6
Subarea 1 – DTH CPT	2	2
1 BH and 4 CPT locations have been removed from Excalibur scope (exc. bird protection zone, locations with shallow gas risk)		

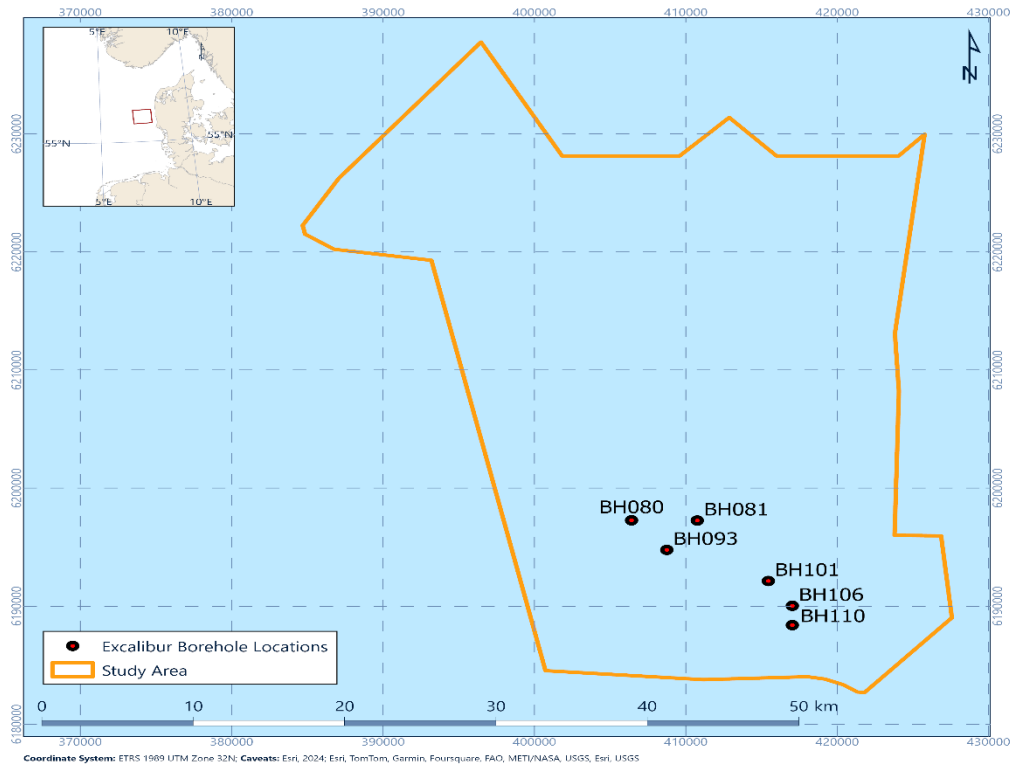


Figure 3.2: Completed BH locations with Excalibur

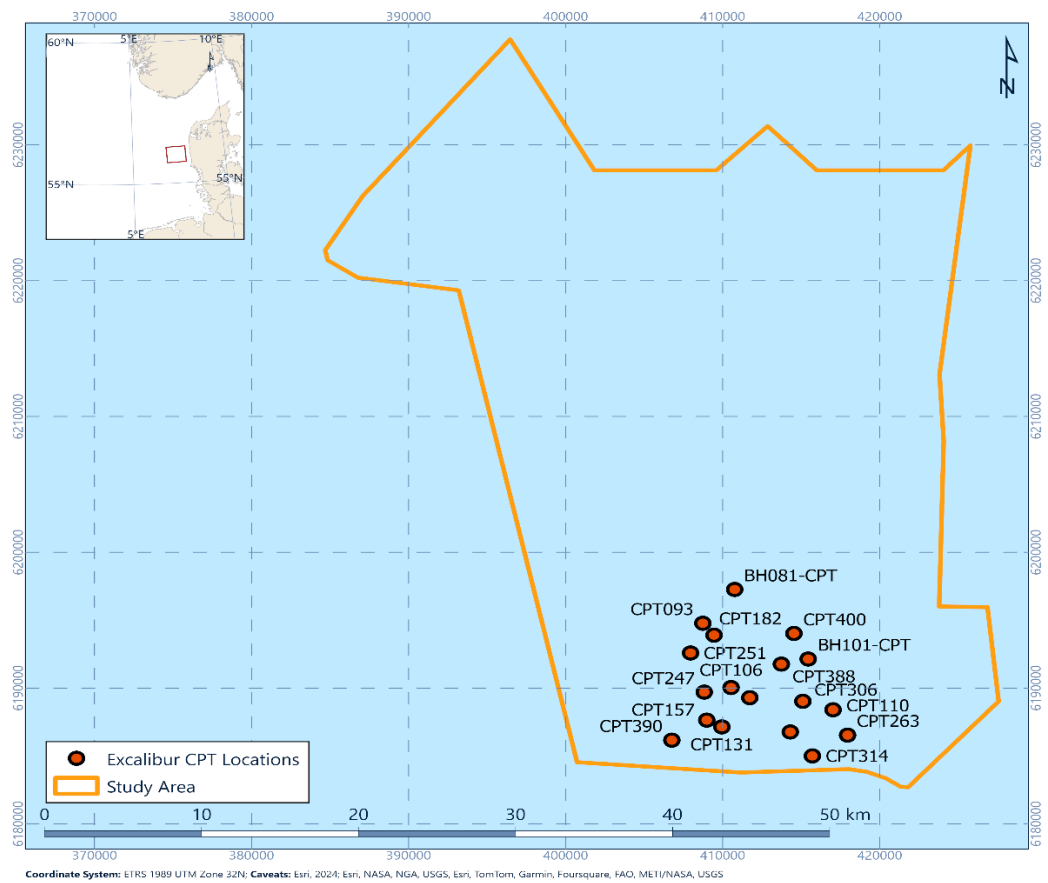


Figure 3.3: Completed CPT locations with Excalibur

The below table illustrates the components of the Work Package C – Excalibur (Fieldwork Phase – Seafloor and Downhole) scope.

Table 3.3: Work Package C – Excalibur methodology

Item	Description
Scope	<ul style="list-style-type: none"> • Six geotechnical boreholes including downhole sampling to target depth of 70 m below seafloor (BSF); • Sixteen seafloor CPT testing to a target depth of 55 m BSF; • Two borehole locations including blind drilling from seafloor to refusal depth of the seafloor CPT and downhole CPT to target depth 55 m BSF.
Methodology	<p>Once the vessel is on location a flanged 10" conductor casing is deployed through the moonpool. A 7" casing is then deployed and is advanced during drilling to prevent borehole collapse in the overburden strata. Downhole drilling is performed using either sonic sampler deployed on 3" hollow rods or rotary drilling using Geobor S pipe with a wireline core barrel of non-coring device. Drilling flush comprising seawater or seawater with a polymer additive is used. A selection of drill bits is supplied to cope with the expected range of possible soil conditions.</p> <p>Upon completion of a borehole, the pipes withdrawn.</p> <p>Boreholes will be positioned within a 5 m radius of the target coordinates. Boreholes will be located at least 3 m away from supplied centre coordinates of seafloor in situ testing investigation locations of Subarea 1. In case an obstruction is encountered on the seafloor the borehole location will be repositioned as close to the target coordinates as possible with client approval.</p> <p>Downhole Sampling</p> <p>Downhole sampling will be performed using a Fraste CRS XL170 MAX DUO drill rig and either sonic sampling, push sampling (top push and wireline) or rotary coring methods depending on ground conditions.</p> <p>Sonic sampling is carried out in coarse-grained cohesionless soils using either a single-wall or dual-wall core barrel deployed on 3" hollow rods. Continuous sampling of at least Quality class 4, typically Quality class 3 (CEN ISO 22475-1 (or equivalent)), can be achieved with two approximately 1.5 m samples for every 3.05 m length of casing advanced. 7" casing is advanced with the sonic sampler. Ground penetration is achieved using self-weight of the sampler barrel and rods, and the rig pull down force of up to 50 kN combined with sonic vibration of up to 150 Hz. Plastic core catcher is used to prevent sample loss during retrieval of the sampler barrel. Sample is extruded from the barrel into a purpose-built sample trough using the self-weight of the sample and sonic vibration from the rig.</p> <p>Rotary coring is carried out using the Geobor S triple-tube coring system in competent ground such as stiff or very stiff cohesive soil or rock. Continuous core samples of up to 102 mm diameter and 1.5 m length can be recovered. Geobor core barrel is loaded with clear plastic liner and various fingered and non-fingered core lifters are available to use. The core lowered on a winch wire through the Geobor drill pipe until it latches into the bottom of the pipe. The borehole is then advanced using the rotary drilling mode of the rig. The core barrel is retrieved to deck and after the core retainer is removed from the barrel the liner containing the core is extracted and handed to the geotechnical engineer for processing. Where recovery is less than 90% the following core run length will be reduced by half to recover dropped core and improve recovery. Where recovery does not improve the run length will be reduced again to a minimum of 0.5 m.</p> <p>Push sampling is carried out where recovery of high quality fine-grained cohesive soil is required. When the drill string is setup for sonic drilling the push sampler tube is deployed on the end of a string of 3" hollow rods, when setup for rotary drilling the</p>

Item	Description
	<p>sample tube is attached to a wireline latching tool that is lowered on a winch wire until it latched into the bottom of the Geobor drill pipe. Ground penetration is achieved using the self-weight of the sampler and rods / drill pipe combined with the rig pull down force of up to 55 kN. The connector between the sampler tube and the rods or wireline latching tool incorporates a non-return valve. After the borehole has been advanced to the required test level, it is cleaned by mud flushing. A range of thin-walled and thick-walled Shelby tubes will be supplied for use as sampler tubes. These are to be without core catchers for fine-grained cohesive soils and equipped with a core catcher for coarse-grained cohesionless soils. Push sample tubes have a 3 inch outer diameter (OD). For use in very dense granular soils, where 3 inch OD tubes have been unable to achieve the necessary recovery, tubes of 2 inch OD are available. Types of Shelby tubes will be selected accordingly to ensure sample quality. In fined grained soils intact soil samples of at least Quality class 2 (CEN ISO 22475-1 (or equivalent)) will be taken, where possible. In coarse grained soils intact soil samples of at least Quality class 4 (CEN ISO 22475-1 (or equivalent)) will be taken.</p> <p>Push samples will be acquired in intervals of 1.0 m. While sampling cohesive soil material minimum required recovery is 0.3 m. If recovery less than 0.3 m is acquired, a 0.5 m drill-out will follow.</p> <p>Offshore Laboratory Testing</p> <p>Recovered samples are handled and processed in the offshore laboratory. The various stages that are scheduled to be performed on-site include:</p> <ul style="list-style-type: none"> • On-deck removal of sample tube from sampler; • Measurement of sample recovery in the sample tube; • Transfer of the sample tube to the site laboratory; • Sample extrusion or liner cutting; • Laboratory testing, e.g. sample photography, sample description/ classification and other laboratory testing (refer to Section 'Site Laboratory Testing' for details); • Selection and labelling of geotechnical sample sections for undisturbed preservation and/or disturbed preservation: <ul style="list-style-type: none"> – undisturbed sample sections wrapped in aluminium and plastic foil, and waxed into labelled cardboard tubes; – disturbed sample sections placed in double set of labelled plastic bags. • Placement in labelled shipping container (sample box); • Storage of shipping containers in onboard storage area with a storage temperature between +5 °C and +10 °C and protected from direct sunlight; • Transfer of shipping containers from geotechnical drilling vessel. <p>The following laboratory testing is scheduled to be performed on site:</p> <ul style="list-style-type: none"> • Soil classification and description of samples in general accordance with Larsen et. al.(1995); • Photography of complete sample (intact and split) and selected sample sections for detailed photography; • Geotechnical index testing: <ul style="list-style-type: none"> – water content and unit weight (unit weight derived from volume-mass calculation and water content measurements) – carbonate content – HCl reaction • Strength index testing (where applicable): <ul style="list-style-type: none"> – Torvane;

Item	Description
	<ul style="list-style-type: none"> – Pocket Penetrometer; • Unconsolidated Undrained triaxial compression testing (where applicable) <p>Top Push In Situ Testing</p> <p>Top push CPTs will be performed using deck-mounted Geomil GB19 rams with a nominal thrust capacity of 20 tonnes of force and quasi-continuous stroke length in increments of 1 m.</p> <p>Once on position a flanged 10" conductor casing is set in the seabed to a depth appropriate for the ground conditions and anticipated wave and current loading. Then 7" casing and Geobor drill pipe are lowered to seabed, these may be advanced by mud flushing to the penetration depth of the 10" casing if the sediment plug inside the 10" casing may cause early refusal of the CPT. 3.5" OD hollow HWY rods are lowered to just above the tip of the Geobor drill pipe. Together these drill string elements provide centralisation and lateral support for the CPT rods. Once the drill string elements are secured in the deck clamps the top push rams are craned into position over the moonpool and the CPT operator sets up the cone for the test. The cone is lowered to the bottom of the borehole using the rams by adding 1 m lengths of 25.5 mm OD rods. Once the cone is at seabed level the operator initiates the recording phase for the push and further rod lengths are added to push the cone into the soil at a rate of 20 mm/s.</p> <p>Top push CPT will be performed using Fugro Deepcone® peizocone penetrometers with a 15 cm² cone area. Throughout the test, measurements of cone resistance, sleeve friction, pore pressure and inclination are displayed graphically on the operators control panel. These data are simultaneously recorded. The test is terminated when target penetration depth is reached or the limiting trust capacity of the rams is reached. The test can also be terminated at any time at the discretion of the operator in case the safety of the operation or damage to equipment are at stake.</p> <p>After termination the cone is extracted and raised to deck level by operating the rams and removing rod sections in reverse. Finally, the rams are removed off of the moonpool and the rig is used to remove the HWY rods. If a subsequent CPT push is required, then a non-coring device is lowered through and latched into the Geobor drill pipe. The borehole is then drilled to the next test depth. The non-coring device is removed, and the HWY rods and rams are setup for the next push.</p> <p>Top push in situ testing will be performed according to ISO 19901-8:2014 (ISO, 2014). Performed CPTs should be as minimum classified as Class 2 according to ISO (2014). Maximum allowable data gap between pushes is 0.5 m.</p> <p>The following top push CPT termination criteria apply:</p> <ul style="list-style-type: none"> ■ As instructed by client; ■ Reaching maximum stroke length; ■ Reaching maximum capacity of the thrust machine, and/or measuring sensors, typically: <ul style="list-style-type: none"> • 20 tonnes of force applied by the GB19 rams; • Cone resistance reaches 100 MPa; • inclination is more than 3° in 1 m, inclination is more than 10° over the entire penetration length; ■ Risk of damage to apparatus or safety of personnel, at discretion of equipment operator or as determined by software algorithms. <p>Downhole In Situ Testing</p> <p>Downhole CPTs will be performed using a Fugro WISON® Deep Line system consisting of a wireline downhole jacking unit with a 1.5 m stroke and a thrust capacity of 100 kN.</p> <p>After the borehole has been advanced to the required test level, it is cleaned by mud flushing. The tool is lowered by its umbilical cable to the bottom of the drill pipe, where it seats just behind the drill bit and latches under its own weight. The test sequence is then activated from a surface control cabin and the cone penetrometer is pushed into</p>

Item	Description
	<p>the soil by pressurizing the umbilical at a constant rate of 20 mm/s. Throughout the test, measurements of cone resistance, sleeve friction and pore pressure are displayed graphically on the operator’s control panel. These data are simultaneously recorded.</p> <p>CPTs will be performed using cone penetrometers with a 10 cm² cone area and a nominal stroke length of 1.5 m. Upon reaching the maximum achievable stroke, or the limiting thrust capacity of 100 kN, the test is terminated, and the system depressurised. The test can also be terminated at any time at the discretion of the operator in case the safety of the operation or damage to equipment are at stake. The drill string is lifted to extract the cone penetrometer and test rod from the ground and the WISON® unit is retrieved. Downhole in situ testing will be performed according to ISO 19901-8:2014 (ISO, 2014). Performed CPTs should be as minimum classified as Class 2 according to ISO (2014). Maximum allowable data gap is 0.5 m.</p> <p>The following downhole CPT termination criteria apply:</p> <ul style="list-style-type: none"> ■ As instructed by client; ■ Reaching maximum stroke length; ■ Reaching maximum capacity of the thrust machine, and/or measuring sensors, typically: <ul style="list-style-type: none"> • Total thrust of 100 kN; • Cone resistance reaches 80 MPa (10 cm² cone), 100 MPa (5 cm² cone) or 100 MPa (heavy duty 5 cm² cone); • Sudden increase of inclination more than 3° per stroke; ■ Risk of damage to apparatus or safety of personnel, at discretion of equipment operator or as determined by software algorithms. <p>Operations are conducted on a continuous basis, 24 hours per day, and 7 days per week.</p>
Team composition	Project Manager, Vessel crew, Drill Team, CPT Operators, Geotechnical Engineers
Equipment	<ul style="list-style-type: none"> ■ The geotechnical scope of work will be performed using: <ul style="list-style-type: none"> • Geotechnical drilling vessel: Excalibur jack-up barge • 10” conductor casing handling: Excalibur’s Huisman PMOC 6200-300 main deck crane • Drilling Rig: Fraste CRS XL170 MAX DUO • Soil sampling: Sonic sampler, Geobor S rotary coring or push sampler (top push or wireline) systems • CPT Testing: Top push or Fugro Deep Line® downhole system • Deep Line umbilical handling: CR2 marine derrick • Cone penetrometers (10 cm² and 15 cm²)
Preliminary field deliverables	<ul style="list-style-type: none"> ■ Within 48 hours after completion of a location, the following preliminary deliverables will be issued to the client offshore: ■ Preliminary geotechnical borehole log including: <ul style="list-style-type: none"> • Strata descriptions; • A selection of laboratory test results (water content, unit weight, strength index); ■ Preliminary laboratory classification test results including: <ul style="list-style-type: none"> • Sample descriptions; • Classification and strength index laboratory test results; ■ Preliminary CPT data. <ul style="list-style-type: none"> • Examples of the above deliverables will be issued to client for approval, prior to commencement of fieldwork.

Item	Description
Deliverables	<ul style="list-style-type: none"> ■ Acceptance Test Report <p>Documentation for all equipment will be included in the Excalibur mobilization report, covering, but not limited to:</p> <ul style="list-style-type: none"> • Documentation of the positioning system and accuracy. • Documentation and description of the applied vertical and horizontal reference systems including tidal correction. • Calibration reports for CPT cones and CPT equipment. <p>The Acceptance Test Report will be delivered to the OCRs prior to commencement of the Scope.</p> <ul style="list-style-type: none"> ■ Daily Progress Reports ■ For each applied vessel, a separate Daily Progress Report (DPR) will be prepared and submitted from the Party Chief and the Clients Representative not later than 12 hours after end of a day. <ul style="list-style-type: none"> • The format and the recipients of the DPRs will be agreed between Fugro and the Client at the kick-off meeting. ■ Daily Progress Reports for a vessel will be from start of mobilization and uninterrupted until end of demobilization. ■ The Daily Progress Reports must include information regarding: <ul style="list-style-type: none"> • Status of works: Completed quantities (current day and cumulated) and remaining quantities. • Time break down: Mobilization, Operation, Standby, Tow, etc. (current day and cumulated). ■ Weather observations (sea state, wind and visibility). <ul style="list-style-type: none"> • Weather forecast – next 24 hours. ■ Deviations from normal operation (break downs, calibration issues, etc.). <ul style="list-style-type: none"> • HSSE incidents. ■ Mobilisation Report – Excalibur <ul style="list-style-type: none"> • Document Number: F217703-MOB-01B ■ Records of Operations – Excalibur <ul style="list-style-type: none"> • Document Number: F217703-04-OPS-EXC <p>The records of operations will in general describe how the investigations were performed. As such the record of operations will at least include the following:</p> <ul style="list-style-type: none"> • Executive summary • Field work completion certificate • Mean position reports • Borehole coordinates confirmation report • Positioning report • Recovery list • Cone calibration certificates • Laboratory equipment calibration certificates • Positioning survey equipment calibrations • Positioning survey mobilisation and calibration report • Leg Penetrations <ul style="list-style-type: none"> ■ Weekly Management Reports ■ Monthly HSSE Reports

Item	Description
Task-specific RAMS	<ul style="list-style-type: none"> ■ MS-002 Positioning and Jacking Operations ■ MS-004 Drilling Operations ■ MS-005 Sampling Operations ■ MS-009 CT Operations ■ UK-LSC-OPL-RA-007 Cone Penetration Testing (Deep Line - Nearshore) ■ UK-LSI-OPL-RA-001 Drilling Mast/Winch Operations ■ UK-LSI-OPL-RA-002 Drilling Operations in High Wind Conditions ■ UK-LSI-OPL-RA-003 Drilling/Free Fall Winch Operations ■ UK-LSI-OPL-RA-004 Fishing Down Hole Tools ■ UK-LSI-OPL-RA-006 Removing Core Sample from Inner Barrel ■ UK-LSI-OPL-RA-007 Sample Preparation and Testing ■ UK-MDG-OPL-RA-013 Geobor Drill Pipe Running in and Tripping out
<p>Notes</p> <p>BSF = Below seafloor</p> <p>RAMS = Risk assessments and method statements</p>	

4. Health, Safety and Environment

Fugro performed the geotechnical operations with high regard for health and safety and the environment. A health, safety and environmental plan was completed prior to the start of the project operations (refer to F217703-PEP-Vol4_HSSE Plan and 219660-Environmental Management Plan). This was produced in accordance with the company's Health Safety and Environmental Management System manual. All survey and crew members were required to read and sign this plan, to ensure they understood the work to be performed and the mitigating measures employed to minimise the identified risks.

During mobilisation and at regular intervals thereafter, safety briefings and toolbox talks were conducted to reiterate the risks relating to survey operations and steps taken to minimise these risks. A full safety briefing was also undertaken after each crew change. Further details have been provided in Table 4.1.

Table 4.1: Summary of HSE

Meeting	Number
Vessel Kick off meeting	1
Two-part HIRA	1
Vessel Inductions	56
Vessel Drills	15
Cross department tours	13
Sound Bite Training	2
Pre-shift meeting	114
Toolbox talks (TBT)	119
Hazard Observation Cards (HOC)	124
Vessel Safety Meetings	2
Audits / inspections	0
Incidents	1

All crew were required to wear coveralls, hardhats, safety boots, safety glasses, and gloves for all deck operations.

During operations a hazard observation card (HOC) system was operated on board allowing crew to report unsafe acts, unsafe conditions, safe acts, or make HSE suggestions. In total 124 HOCs were submitted.

The incidents and quality events reported during the project have been listed in Table 4.2.

Table 4.2: Summary of Project Related Incidents and Quality Events

Date of Occurrence	Type	Fugro Ref #	Details
30-04-2024	High Potential Incident	16809	Wave 4 (Personnel Transfer Device) Incident

Appendix A

Offshore Activities and Agreements

Contents Appendix A: Offshore Activities and Agreements

A.1: Fieldwork and (De)Mobilisation Acceptance Certificates

A.2: Fieldwork Progress (DDPR)

A.1 Fieldwork and Mobilisation Acceptance Certificates

List of Plates

Acceptance of Mobilisation	1 Plate
Certificate of Completion of Fieldwork	1 Plate

Project Milestone Completion Acceptance Certificate

Contractor	Fugro Netherlands Marine B.V.
Client	Energinet Eltransmission A/S
Contract Number	F217703 - 219660
Milestone	Fugro Excalibur - Mobilisation Completion
Completion Date	01 May 2024

The undersigned PARTIES agree that Fugro Excalibur. (CONTRACTOR) has completed and fulfilled all mobilisation and calibration obligations under the above mentioned contract to the satisfaction of Energinet Eltransmission A/S (CLIENT).

GLOB-MALA-PRM-TP-003 | Project Milestone Completion Acceptance Certificate | Version 0.0



For and on behalf of CONTRACTOR

Name: Jamie Davison
Title: Project Engineer
Date: 14 May 2024



For and on behalf of CLIENT

Name: Rob Harwood
Title: Offshore Client Representative
Date: 15/05/24

Project Milestone Completion Acceptance Certificate

Contractor	Fugro Netherlands Marine B.V.
Client	Energinet Eltransmission A/S
Contract Number	F217703
Milestone	Excalibur JUB – Completion of Field Work
Completion Date	25th June 2024

The undersigned PARTIES agree that Fugro Netherlands Marine B.V. (CONTRACTOR) has completed and fulfilled the required fieldwork on site under the above mentioned contract to the satisfaction of Energinet Eltransmission A/S (CLIENT).
The vessel will proceed to demobilise from the project in the Port of Great Yarmouth, UK.

GLOB-MALA-PRM-TP-003 | Project Milestone Completion Acceptance Certificate | Version 0.0



For and on behalf of CONTRACTOR

Name: James Hills
Title: Party Chief
Date: 25 June 2024



For and on behalf of CLIENT

Name: Leumman Dos Santos
Title: Offshore Client Representative
Date: 25 June 2024

A.2 Fieldwork Progress (DDPR)

Daily Progress Reports have been shared with Energinet Eltransmission A/S separately.

Appendix B

Location and Positioning Survey

Contents Appendix B: Location and Positioning Survey

B.1: Mean Positioning Reports

B.2: Point Report

B.3: Leg Penetrations

B.4: Positioning Data Report

B.1 Mean Position Reports

List of Plates

Mean Position Reports

78 Plates

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240527144240-v23
Start Time	27 May 2024, 15:44:07+01:00
End Time	27 May 2024, 15:54:06+01:00
Session Length	9m 59s (600 of 600 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 54' 42.5727" N	55° 54' 42.5923" N
Longitude	007° 30' 10.1370" E	007° 30' 10.1685" E
Height	48.77m Ell., 0.00m ISS	48.79m Ell., 7.59m Ort.
Easting	406 415.37m E (± 0.01 m)	
Northing	6 197 278.82m N (± 0.02 m)	
Height	8.03m MSS (± 0.14 m) , 0.00m ISS (± 0.03 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	204.90° T, 206.14° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	Deck To Mud 29.20m, Water Depth 21.30m.	

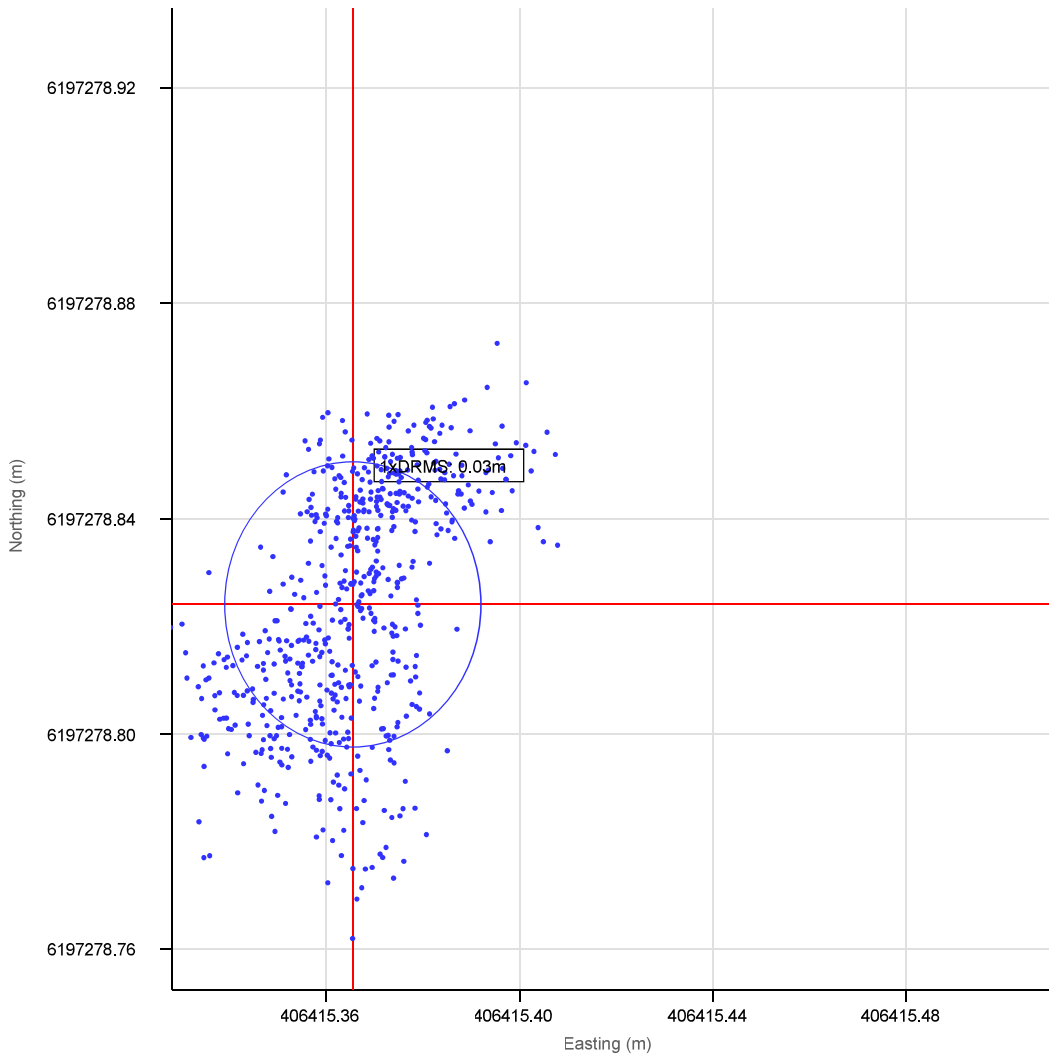
Table 5: Mean Position to Target

Target	BH080		
Position	406 417.00m E, 6 197 280.00m N		
Range	2.01 m Grid		
Bearing To	54.27° G	Bearing From	234.27° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	600 of 600
Position	406 415.37m E, 6 197 278.82m N ,8.03m MSS
Heading	204.90° T, 206.14° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	406 415.37m E	6 197 278.82m N

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North
 Marine)

Leumman Dos Santos
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240525150147-v22
Start Time	25 May 2024, 16:01:56+01:00
End Time	25 May 2024, 16:11:55+01:00
Session Length	9m 59s (600 of 600 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 54' 44.9594" N	55° 54' 44.9790" N
Longitude	007° 34' 20.5120" E	007° 34' 20.5436" E
Height	48.36m Ell., 0.00m ISS	48.38m Ell., 7.20m Ort.
Easting	410 763.83m E (± 0.01 m)	
Northing	6 197 260.70m N (± 0.01 m)	
Height	7.63m MSS (± 0.13 m) , 0.00m ISS (± 0.02 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	269.33° T, 270.51° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	Deck to Mud 27.70m, Water Depth 20.10m.	

Table 5: Mean Position to Target

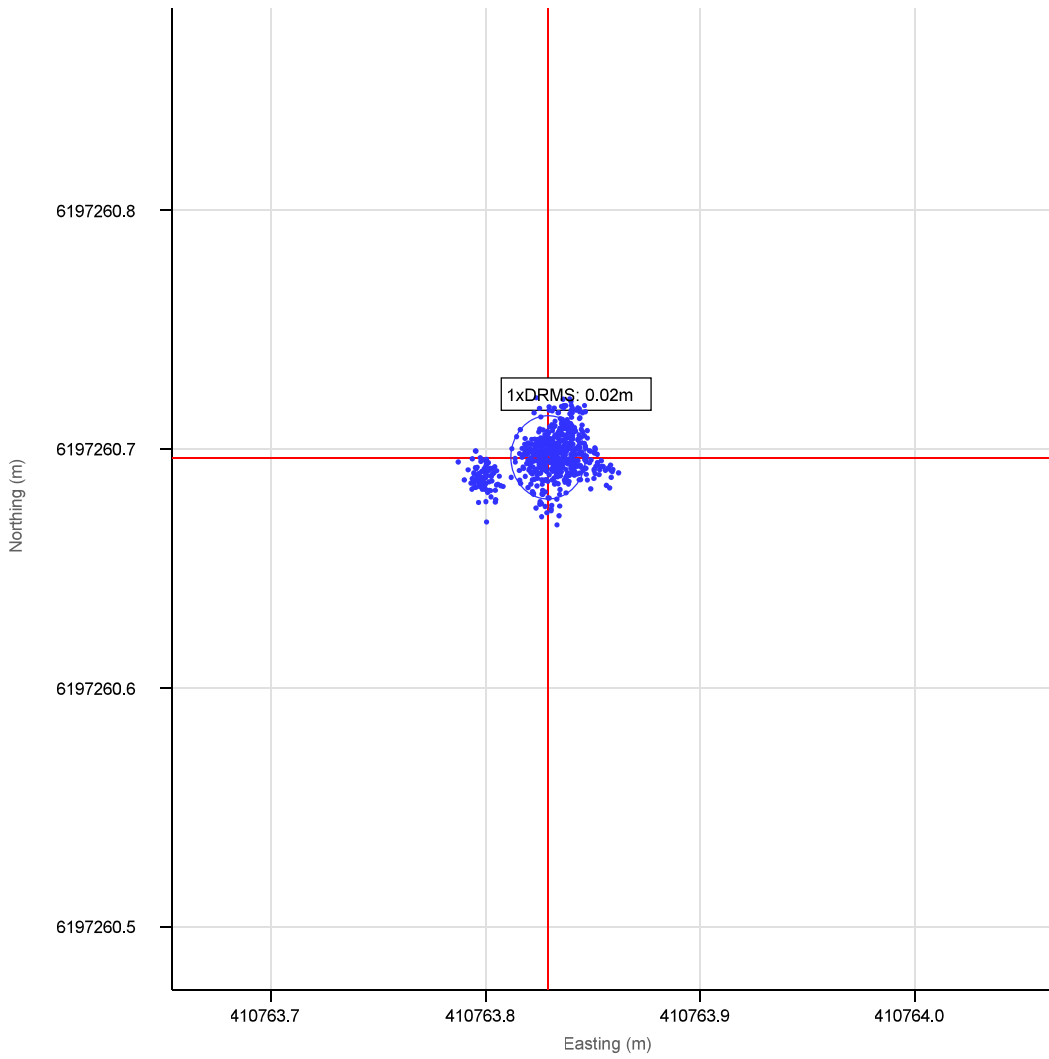
Target	BH081		
Position	410 760.00m E, 6 197 260.00m N		
Range	3.89 m Grid		
Bearing To	259.69° G	Bearing From	79.69° G



Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	600 of 600
Position	410 763.83m E, 6 197 260.70m N ,7.63m MSS
Heading	269.33° T, 270.51° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	410 763.83m E	6 197 260.70m N

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North
 Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240525150147-v22
Start Time	25 May 2024, 16:01:56+01:00
End Time	25 May 2024, 16:11:55+01:00
Session Length	9m 59s (600 of 600 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 54' 44.9594" N	55° 54' 44.9790" N
Longitude	007° 34' 20.5120" E	007° 34' 20.5436" E
Height	48.36m Ell., 0.00m ISS	48.38m Ell., 7.20m Ort.
Easting	410 763.83m E (± 0.01 m)	
Northing	6 197 260.70m N (± 0.01 m)	
Height	7.63m MSS (± 0.13 m) , 0.00m ISS (± 0.02 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	269.33° T, 270.51° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	0.0 m	

Table 5: Mean Position to Target

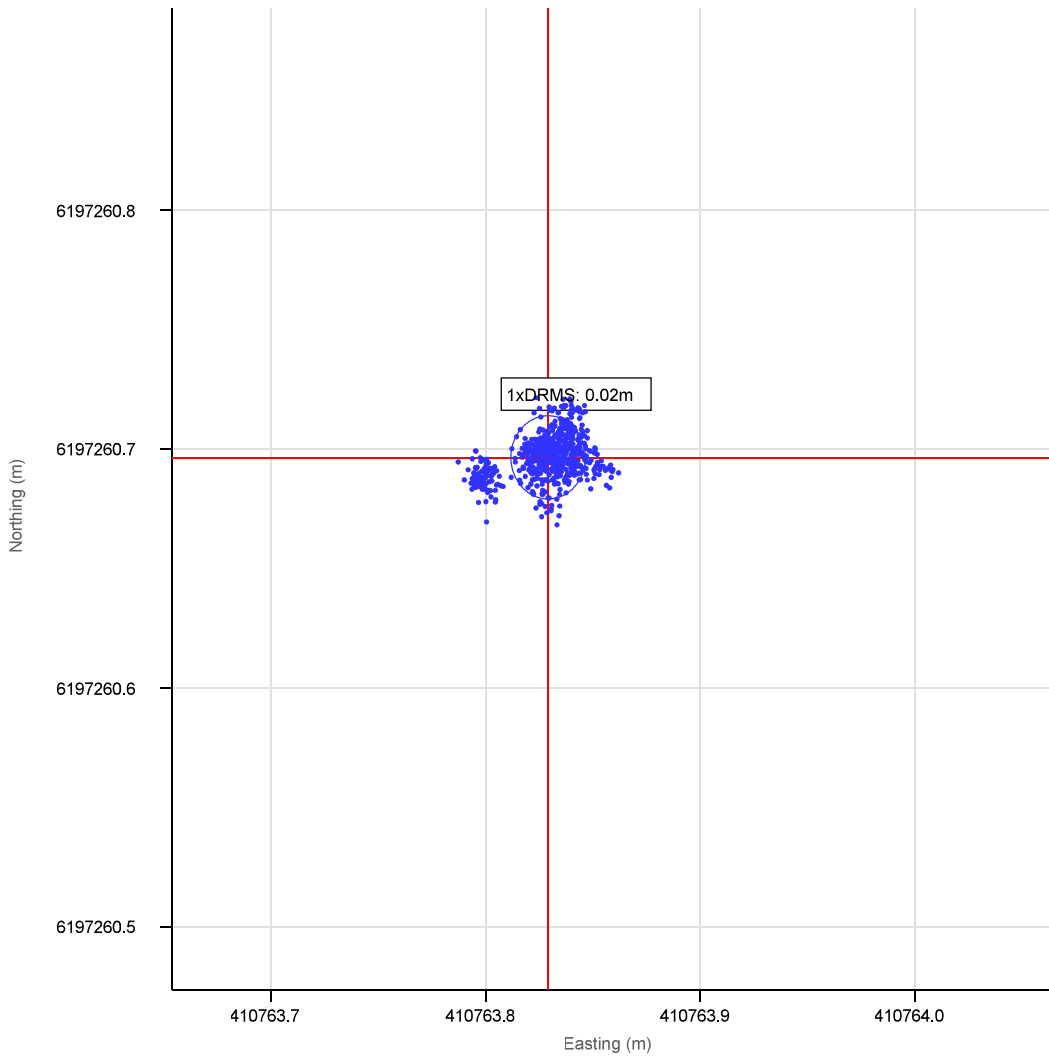
Target	BH081		
Position	410 760.00m E, 6 197 260.00m N		
Range	3.89 m Grid		
Bearing To	259.69° G	Bearing From	79.69° G



Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	600 of 600
Position	410 763.83m E, 6 197 260.70m N ,7.63m MSS
Heading	269.33° T, 270.51° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	410 763.83m E	6 197 260.70m N

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North
 Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240524060159-v21
Start Time	24 May 2024, 07:02:21+01:00
End Time	24 May 2024, 07:12:20+01:00
Session Length	9m 59s (599 of 599 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 54' 44.8089" N	55° 54' 44.8285" N
Longitude	007° 34' 20.3844" E	007° 34' 20.4159" E
Height	47.86m Ell., 0.00m ISS	47.89m Ell., 6.70m Ort.
Easting	410 761.52m E (± 0.01 m)	
Northing	6 197 256.09m N (± 0.01 m)	
Height	7.14m MSS (± 0.13 m) , 0.00m ISS (± 0.02 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	262.27° T, 263.45° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	Deck To Mud 27.70m, Water Depth 20.20m.	

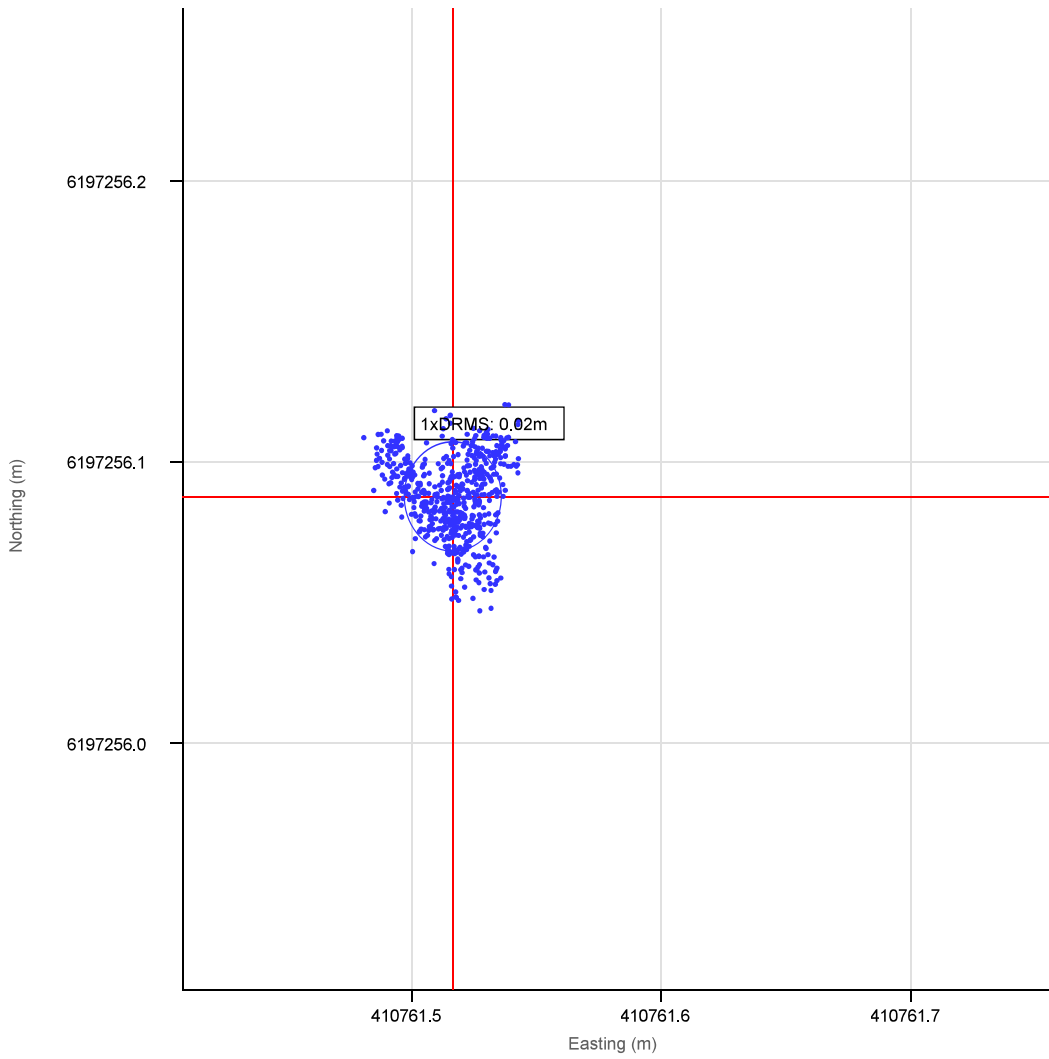
Table 5: Mean Position to Target

Target	BH081-CPT		
Position	410 760.00m E, 6 197 260.00m N		
Range	4.20 m Grid		
Bearing To	338.81° G	Bearing From	158.81° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	599 of 599
Position	410 761.52m E, 6 197 256.09m N ,7.14m MSS
Heading	262.27° T, 263.45° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	410 761.52m E	6 197 256.09m N

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North
 Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240618201420-v27
Start Time	18 Jun 2024, 21:14:49+01:00
End Time	18 Jun 2024, 21:24:48+01:00
Session Length	9m 59s (599 of 599 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 53' 23.1133" N	55° 53' 23.1329" N
Longitude	007° 32' 27.3010" E	007° 32' 27.3325" E
Height	49.77m Ell., 0.00m ISS	49.80m Ell., 8.61m Ort.
Easting	408 744.95m E (± 0.03 m)	
Northing	6 194 771.71m N (± 0.01 m)	
Height	9.04m MSS (± 0.13 m) , 0.00m ISS (± 0.01 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	205.05° T, 206.26° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	0.0 m	DTM = 28.7m WD = 19.7m

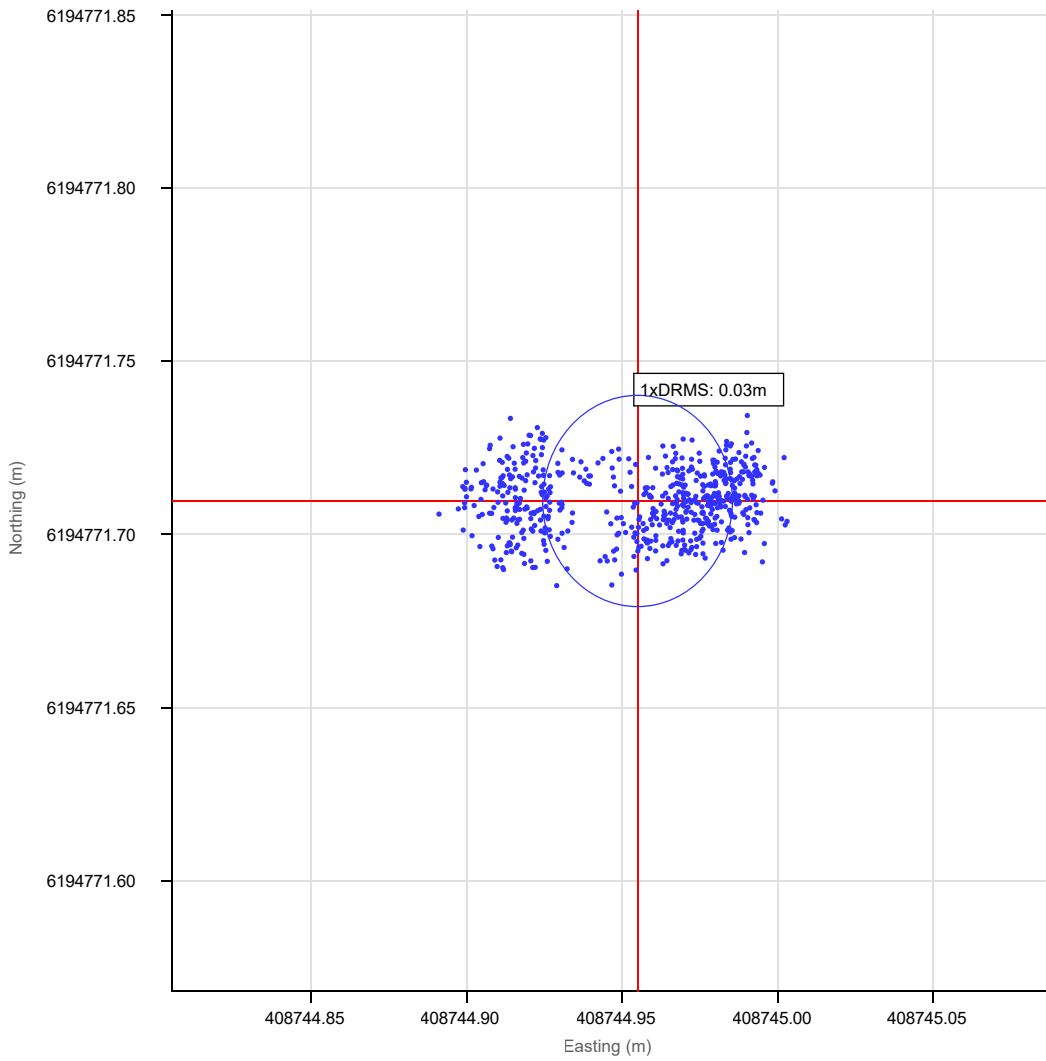
Table 5: Mean Position to Target

Target	BH093		
Position	408 742.00m E, 6 194 770.00m N		
Range	3.41 m Grid		
Bearing To	239.95° G	Bearing From	59.95° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	599 of 599
Position	408 744.95m E, 6 194 771.71m N ,9.04m MSS
Heading	205.05° T, 206.26° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	408 744.95m E	6 194 771.71m N

James Hills
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OCR
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	BH101-v29
Start Time	21 Jun 2024, 01:45:08+01:00
End Time	21 Jun 2024, 01:55:07+01:00
Session Length	9m 59s (599 of 599 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 52' 02.4158" N	55° 52' 02.4354" N
Longitude	007° 38' 56.4172" E	007° 38' 56.4487" E
Height	48.28m Ell., 0.01m ISS	48.30m Ell., 7.14m Ort.
Easting	415 455.88m E (± 0.01 m)	
Northing	6 192 139.90m N (± 0.01 m)	
Height	7.57m MSS (± 0.13 m) , 0.01m ISS (± 0.02 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	138.53° T, 139.65° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	0.0 m	DTM = 27.8m WD = 20.4m

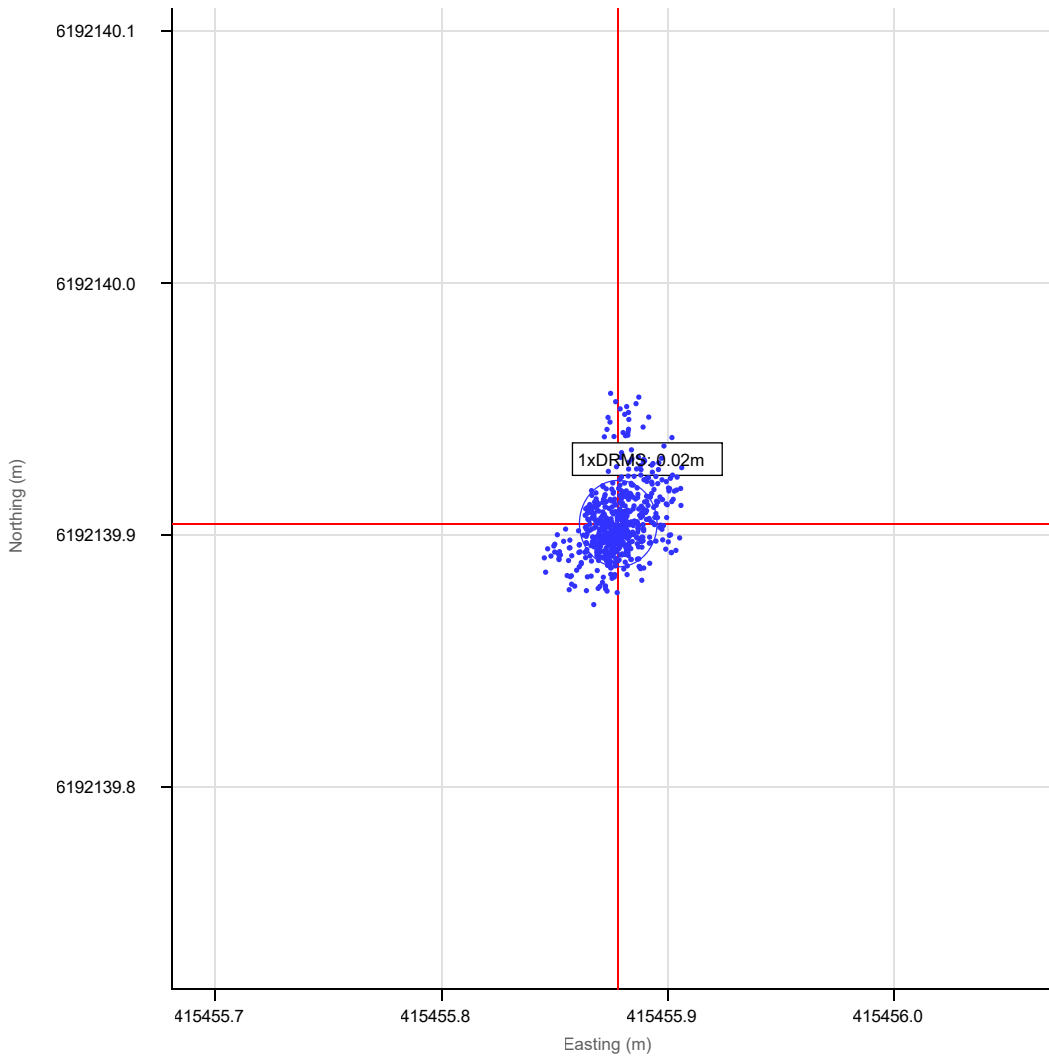
Table 5: Mean Position to Target

Target	BH101		
Position	415 453.00m E, 6 192 140.00m N		
Range	2.88 m Grid		
Bearing To	271.90° G	Bearing From	91.90° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	599 of 599
Position	415 455.88m E, 6 192 139.90m N ,7.57m MSS
Heading	138.53° T, 139.65° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	415 455.88m E	6 192 139.90m N

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 Marine)

OCR
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240508164359-v7
Start Time	08 May 2024, 17:44:39+01:00
End Time	08 May 2024, 17:54:38+01:00
Session Length	9m 59s (598 of 598 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 52' 02.3998" N	55° 52' 02.4194" N
Longitude	007° 38' 56.1986" E	007° 38' 56.2302" E
Height	48.65m Ell., 0.00m ISS	48.68m Ell., 7.52m Ort.
Easting	415 452.07m E (± 0.02 m)	
Northing	6 192 139.49m N (± 0.01 m)	
Height	7.94m MSS (± 0.13 m) , 0.00m ISS (± 0.02 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	245.53° T, 246.65° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	Deck to Mud 28.20, Water Depth 19.60m	

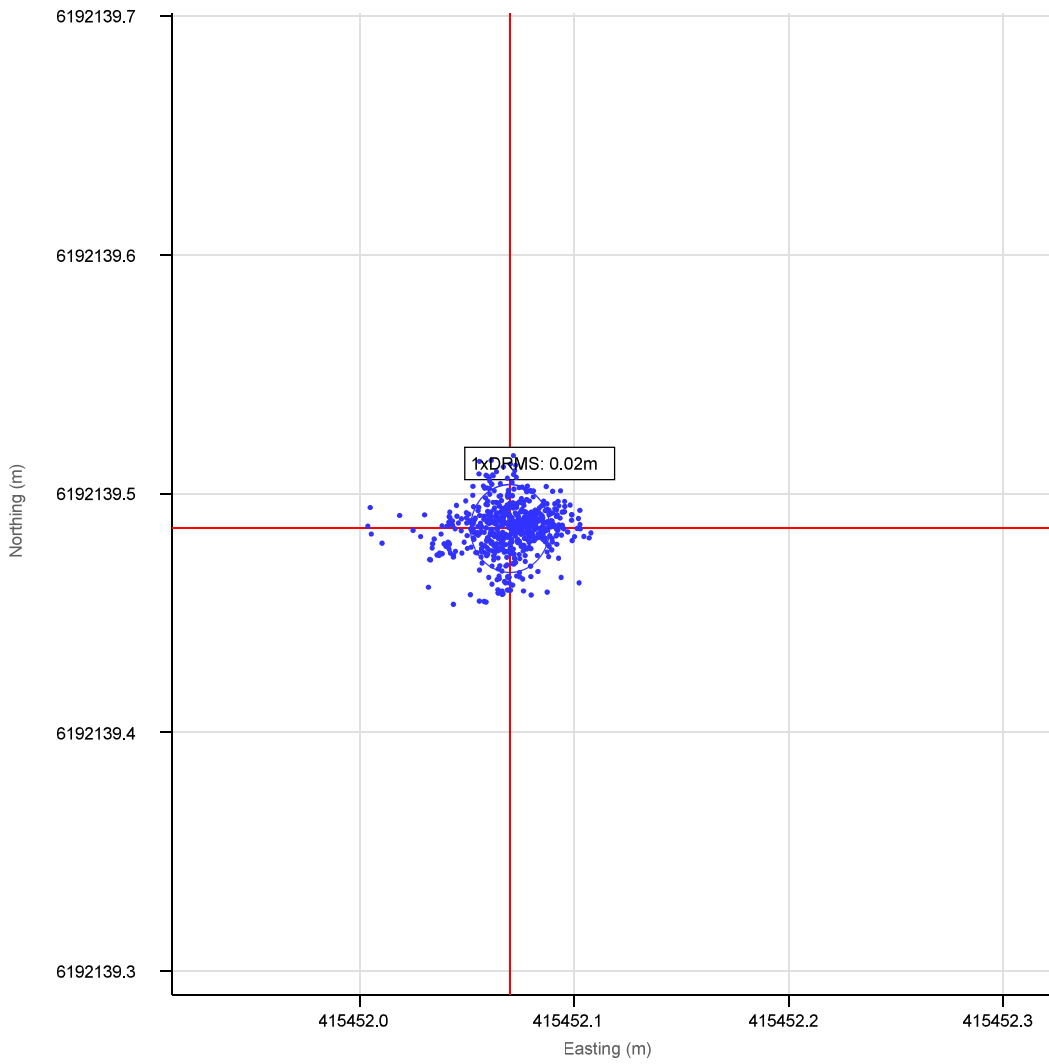
Table 5: Mean Position to Target

Target	BH101-CPT		
Position	415 453.00m E, 6 192 140.00m N		
Range	1.06 m Grid		
Bearing To	61.04° G	Bearing From	241.04° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	598 of 598
Position	415 452.07m E, 6 192 139.49m N ,7.94m MSS
Heading	245.53° T, 246.65° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	415 452.07m E	6 192 139.49m N

Jamie Davison
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 FGBNM (Fugro Great Britain North
 Marine)

Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240519104951-v18
Start Time	19 May 2024, 11:50:03+01:00
End Time	19 May 2024, 12:00:02+01:00
Session Length	9m 59s (598 of 598 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 50' 51.2798" N	55° 50' 51.2993" N
Longitude	007° 34' 16.1611" E	007° 34' 16.1926" E
Height	48.75m Ell., 0.00m ISS	48.77m Ell., 7.61m Ort.
Easting	410 539.13m E (± 0.01 m)	
Northing	6 190 038.81m N (± 0.01 m)	
Height	8.04m MSS (± 0.13 m) , 0.00m ISS (± 0.02 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	94.59° T, 95.77° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	Deck To Mud 26.80m, Water Depth 18.70m	

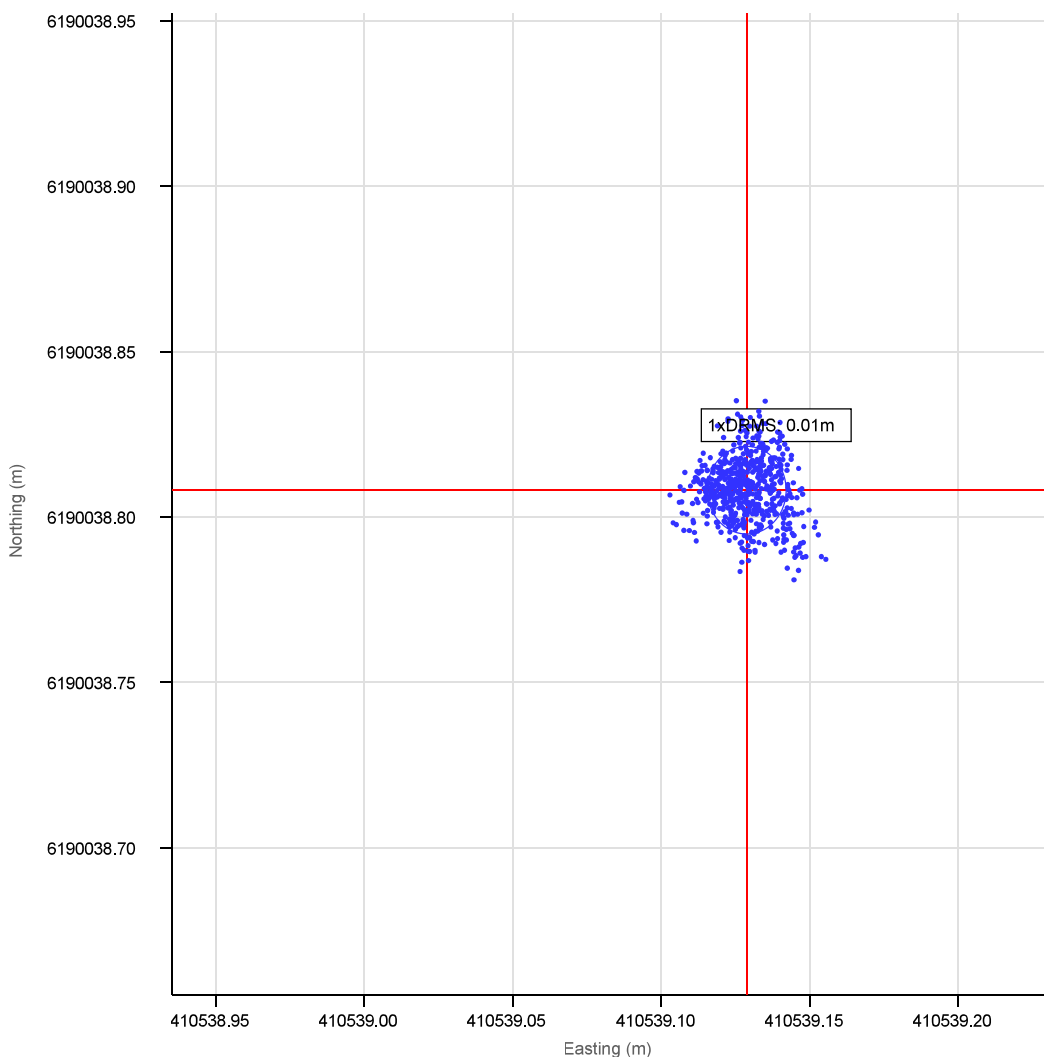
Table 5: Mean Position to Target

Target	BH106		
Position	410 536.00m E, 6 190 040.00m N		
Range	3.35 m Grid		
Bearing To	290.85° G	Bearing From	110.85° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	598 of 598
Position	410 539.13m E, 6 190 038.81m N ,8.04m MSS
Heading	94.59° T, 95.77° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	410 539.13m E	6 190 038.81m N

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Rob Harwood
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 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240505151357_BH110-v6
Start Time	05 May 2024, 16:14:51+01:00
End Time	05 May 2024, 16:24:50+01:00
Session Length	9m 59s (599 of 599 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 50' 02.1444" N	55° 50' 02.1639" N
Longitude	007° 40' 31.5030" E	007° 40' 31.5346" E
Height	48.36m Ell., 0.00m ISS	48.38m Ell., 7.23m Ort.
Easting	417 037.51m E (± 0.01 m)	
Northing	6 188 390.11m N (± 0.02 m)	
Height	7.65m MSS (± 0.14 m) , 0.00m ISS (± 0.05 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	201.62° T, 202.72° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	Deck to Mud = 27.50, Water Depth 19.70	

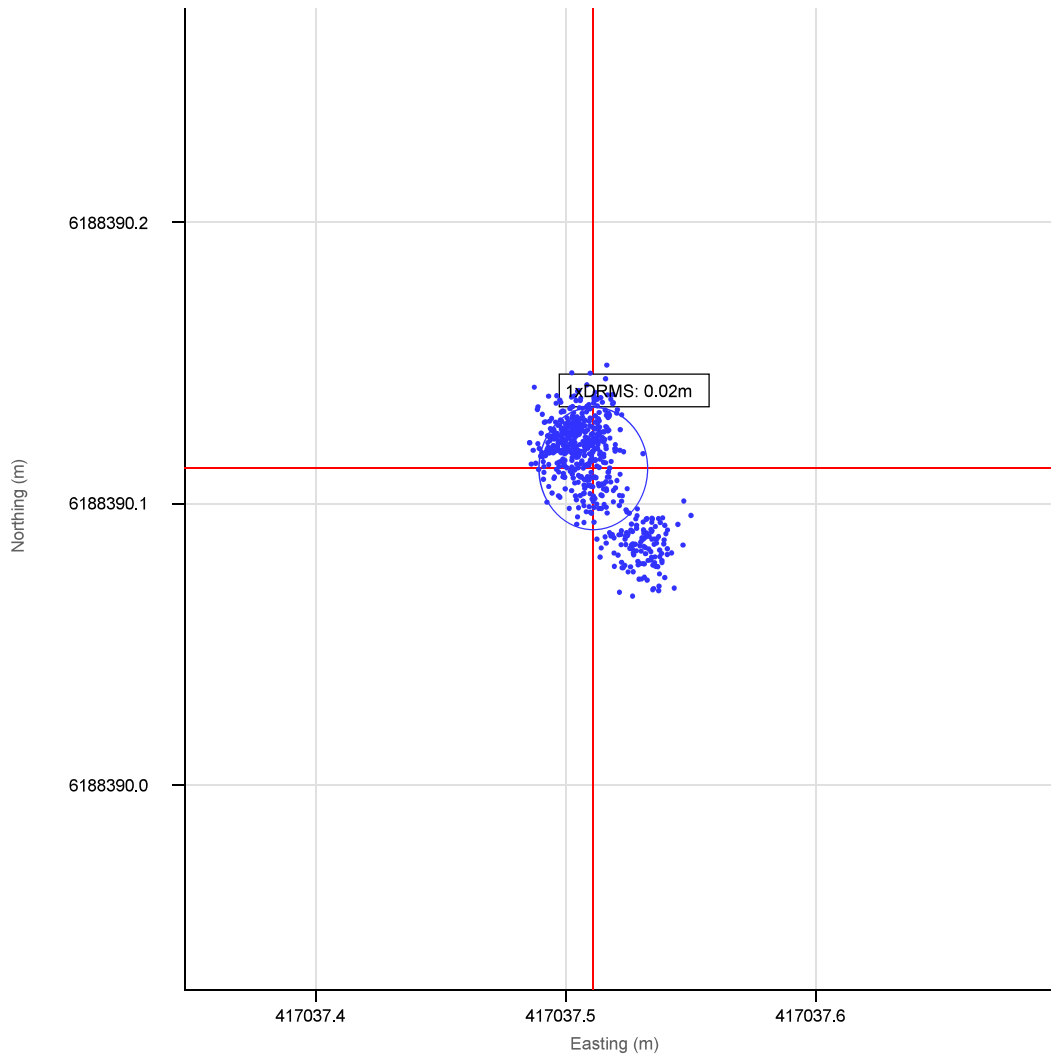
Table 5: Mean Position to Target

Target	BH110		
Position	417 034.00m E, 6 188 390.00m N		
Range	3.51 m Grid		
Bearing To	268.17° G	Bearing From	88.17° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	599 of 599
Position	417 037.51m E, 6 188 390.11m N ,7.65m MSS
Heading	201.62° T, 202.72° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	417 037.51m E	6 188 390.11m N

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Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	CPT251-v34
Start Time	25 Jun 2024, 07:11:15+01:00
End Time	25 Jun 2024, 07:21:14+01:00
Session Length	9m 59s (599 of 599 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 52' 11.4671" N	55° 52' 11.4866" N
Longitude	007° 31' 44.2873" E	007° 31' 44.3188" E
Height	48.31m Ell., 0.00m ISS	48.34m Ell., 7.15m Ort.
Easting	407 950.66m E (± 0.02 m)	
Northing	6 192 572.84m N (± 0.02 m)	
Height	7.59m MSS (± 0.14 m) , 0.00m ISS (± 0.03 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	225.94° T, 227.15° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	0.0 m	DTM = 26.9m DTW 7.9 WD = 19.0m

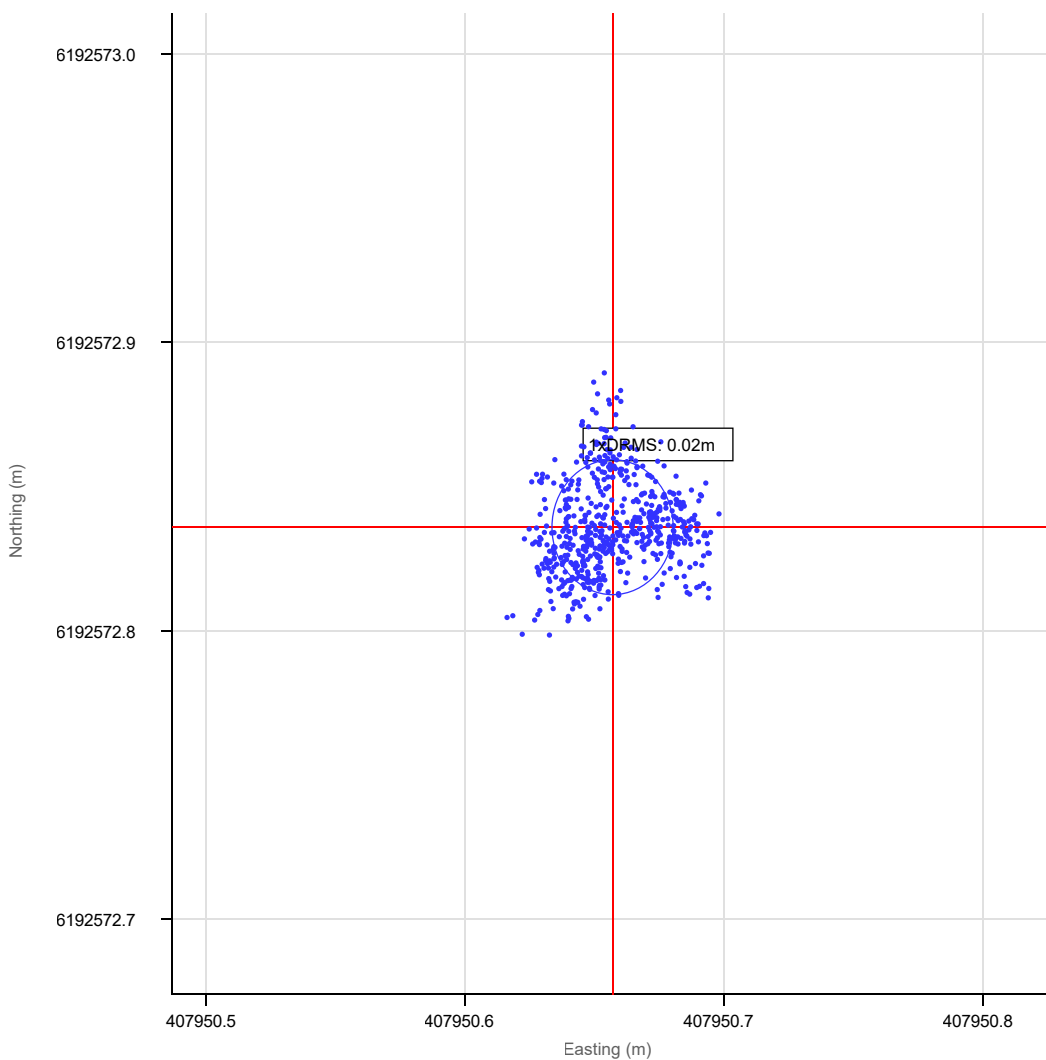
Table 5: Mean Position to Target

Target	CPT251		
Position	407 948.00m E, 6 192 570.00m N		
Range	3.89 m Grid		
Bearing To	223.13° G	Bearing From	43.13° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	599 of 599
Position	407 950.66m E, 6 192 572.84m N ,7.59m MSS
Heading	225.94° T, 227.15° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	407 950.66m E	6 192 572.84m N

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Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	CPT400-v30
Start Time	24 Jun 2024, 08:17:13+01:00
End Time	24 Jun 2024, 08:27:12+01:00
Session Length	9m 59s (600 of 600 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 53' 02.3918" N	55° 53' 02.4114" N
Longitude	007° 38' 01.5108" E	007° 38' 01.5424" E
Height	47.88m Ell., 0.00m ISS	47.91m Ell., 6.74m Ort.
Easting	414 538.11m E (± 0.01 m)	
Northing	6 194 012.62m N (± 0.01 m)	
Height	7.17m MSS (± 0.13 m) , 0.00m ISS (± 0.02 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	311.38° T, 312.51° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	0.0 m	DTM = 26.7m WD = 19.5m

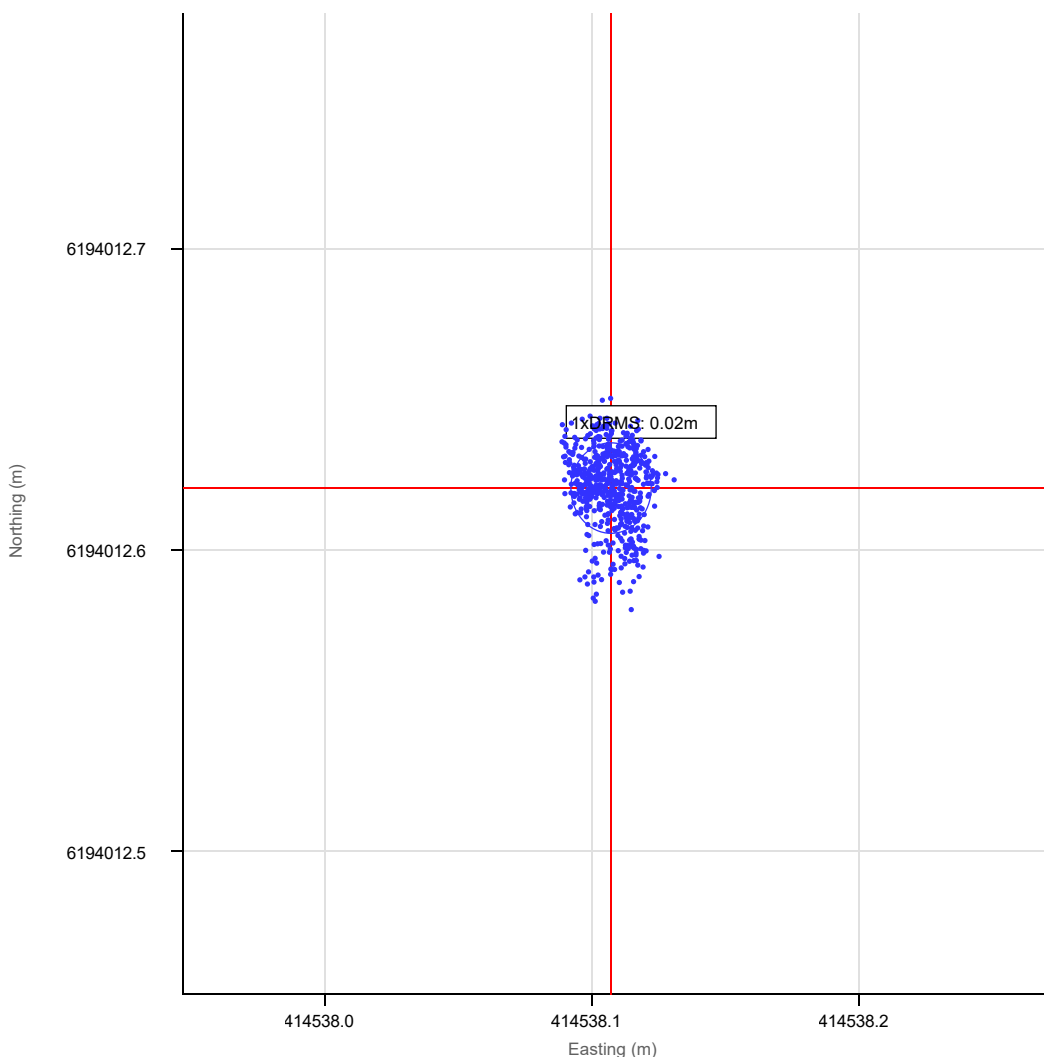
Table 5: Mean Position to Target

Target	CPT400		
Position	414 541.00m E, 6 194 010.00m N		
Range	3.90 m Grid		
Bearing To	132.17° G	Bearing From	312.17° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	600 of 600
Position	414 538.11m E, 6 194 012.62m N ,7.17m MSS
Heading	311.38° T, 312.51° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	414 538.11m E	6 194 012.62m N

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Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240617151735-v24
Start Time	17 Jun 2024, 16:17:58+01:00
End Time	17 Jun 2024, 16:27:57+01:00
Session Length	9m 59s (599 of 599 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 53' 23.1386" N	55° 53' 23.1582" N
Longitude	007° 32' 27.1303" E	007° 32' 27.1618" E
Height	48.63m Ell., -0.01m ISS	48.66m Ell., 7.47m Ort.
Easting	408 742.01m E (± 0.01 m)	
Northing	6 194 772.55m N (± 0.01 m)	
Height	7.91m MSS (± 0.13 m) , -0.01m ISS (± 0.02 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	209.37° T, 210.58° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	0.0 m	

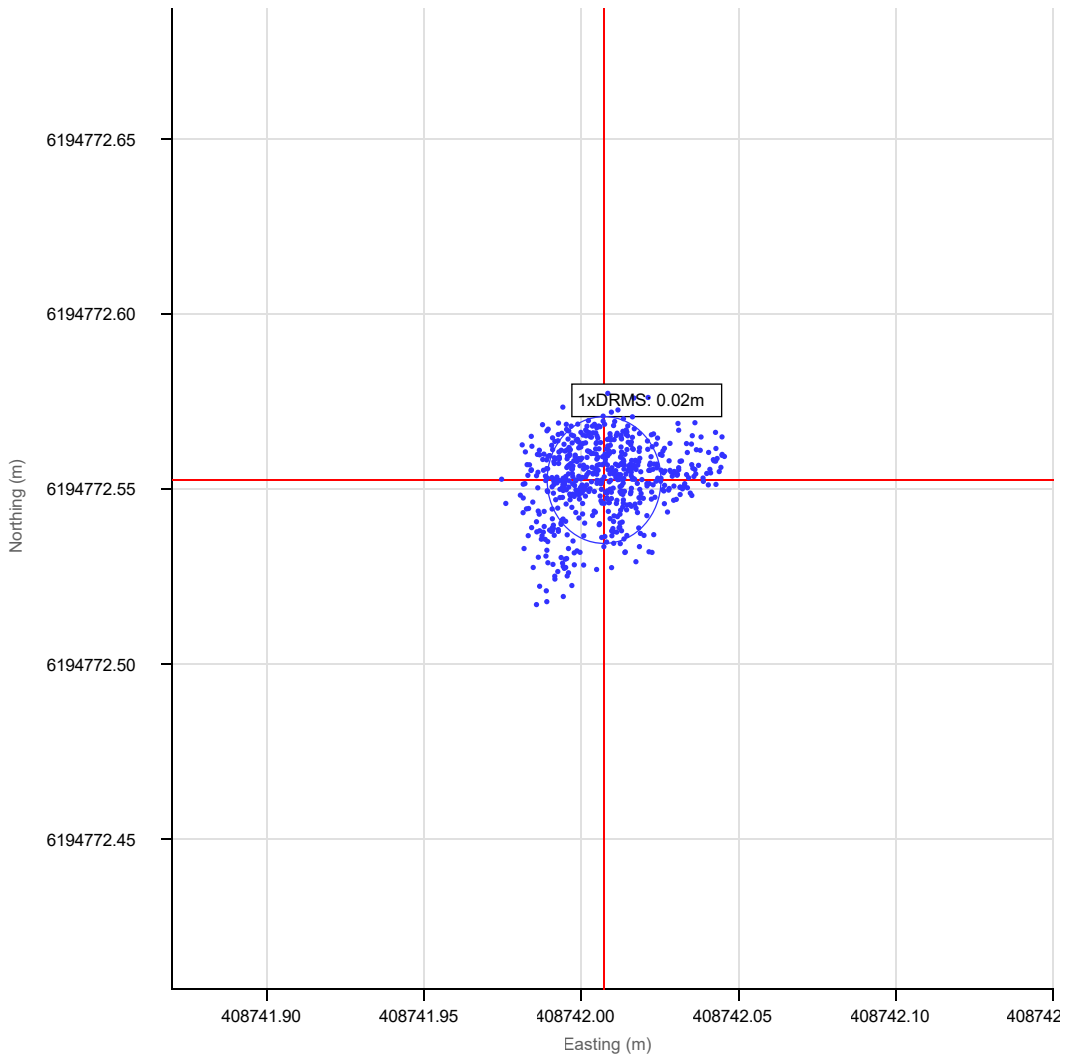
Table 5: Mean Position to Target

Target	CPT093		
Position	408 742.00m E, 6 194 770.00m N		
Range	2.55 m Grid		
Bearing To	180.16° G	Bearing From	0.16° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	599 of 599
Position	408 742.01m E, 6 194 772.55m N ,7.91m MSS
Heading	209.37° T, 210.58° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	408 742.01m E	6 194 772.55m N

James Hills
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 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240518144426-v17
Start Time	18 May 2024, 15:45:40+01:00
End Time	18 May 2024, 15:55:39+01:00
Session Length	9m 59s (599 of 599 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 50' 51.3798" N	55° 50' 51.3994" N
Longitude	007° 34' 15.9209" E	007° 34' 15.9525" E
Height	48.02m Ell., 0.00m ISS	48.05m Ell., 6.88m Ort.
Easting	410 535.02m E (± 0.01 m)	
Northing	6 190 041.99m N (± 0.01 m)	
Height	7.32m MSS (± 0.13 m) , 0.00m ISS (± 0.01 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	107.58° T, 108.76° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	Deck to mud 26.00m, Deck to water 18.70m	

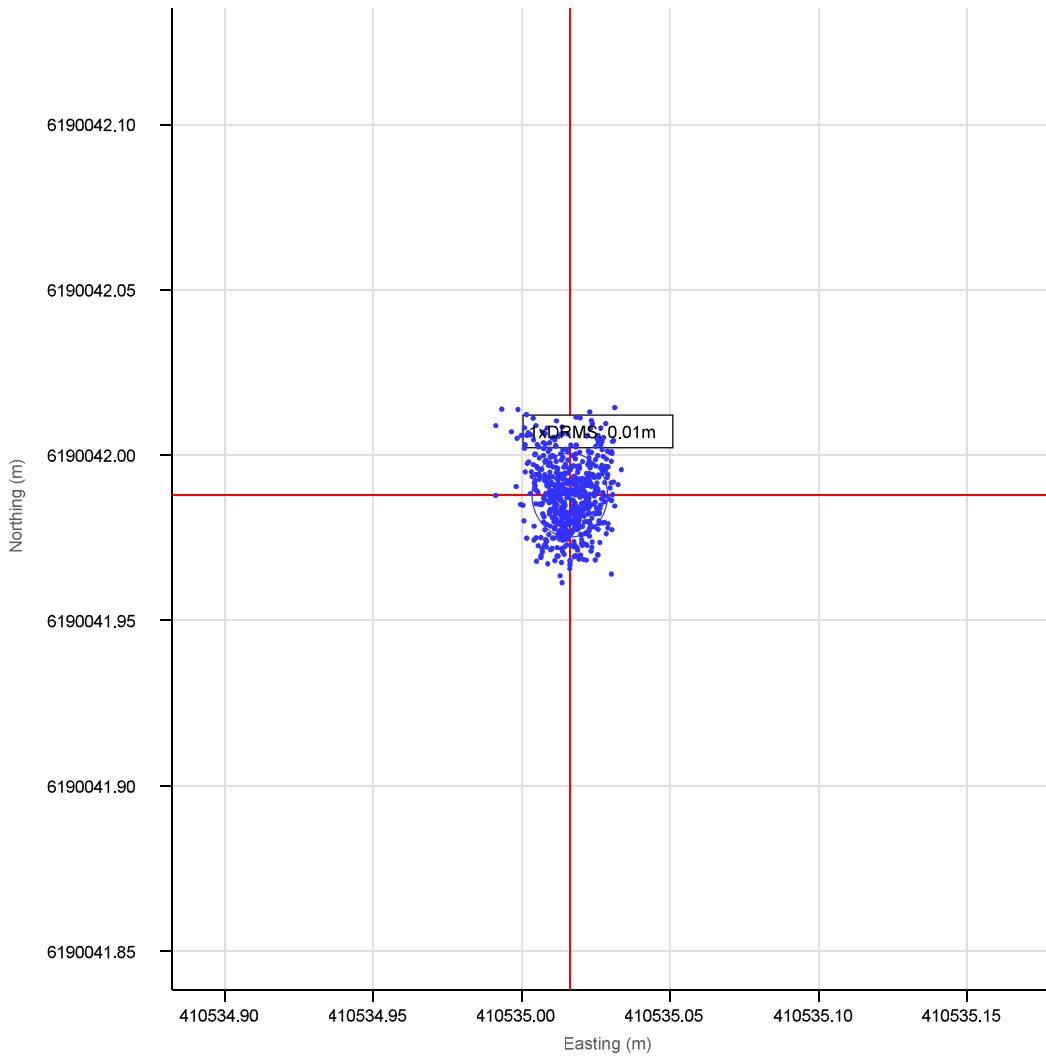
Table 5: Mean Position to Target

Target	CPT106		
Position	410 536.00m E, 6 190 040.00m N		
Range	2.22 m Grid		
Bearing To	153.67° G	Bearing From	333.67° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	599 of 599
Position	410 535.02m E, 6 190 041.99m N ,7.32m MSS
Heading	107.58° T, 108.76° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	410 535.02m E	6 190 041.99m N

Jamie Davison
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 FGBNM (Fugro Great Britain North
 Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240505050858 CPT110-v5
Start Time	05 May 2024, 06:12:36+01:00
End Time	05 May 2024, 06:22:35+01:00
Session Length	9m 59s (600 of 600 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 50' 02.2061" N	55° 50' 02.2257" N
Longitude	007° 40' 31.2453" E	007° 40' 31.2769" E
Height	47.81m Ell., 0.01m ISS	47.83m Ell., 6.68m Ort.
Easting	417 033.06m E (± 0.04 m)	
Northing	6 188 392.11m N (± 0.02 m)	
Height	7.10m MSS (± 0.13 m) , 0.01m ISS (± 0.02 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	209.26° T, 210.36° G	± 0.2°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	Deck to Mud 26.80, Water Depth 18.30	

Table 5: Mean Position to Target

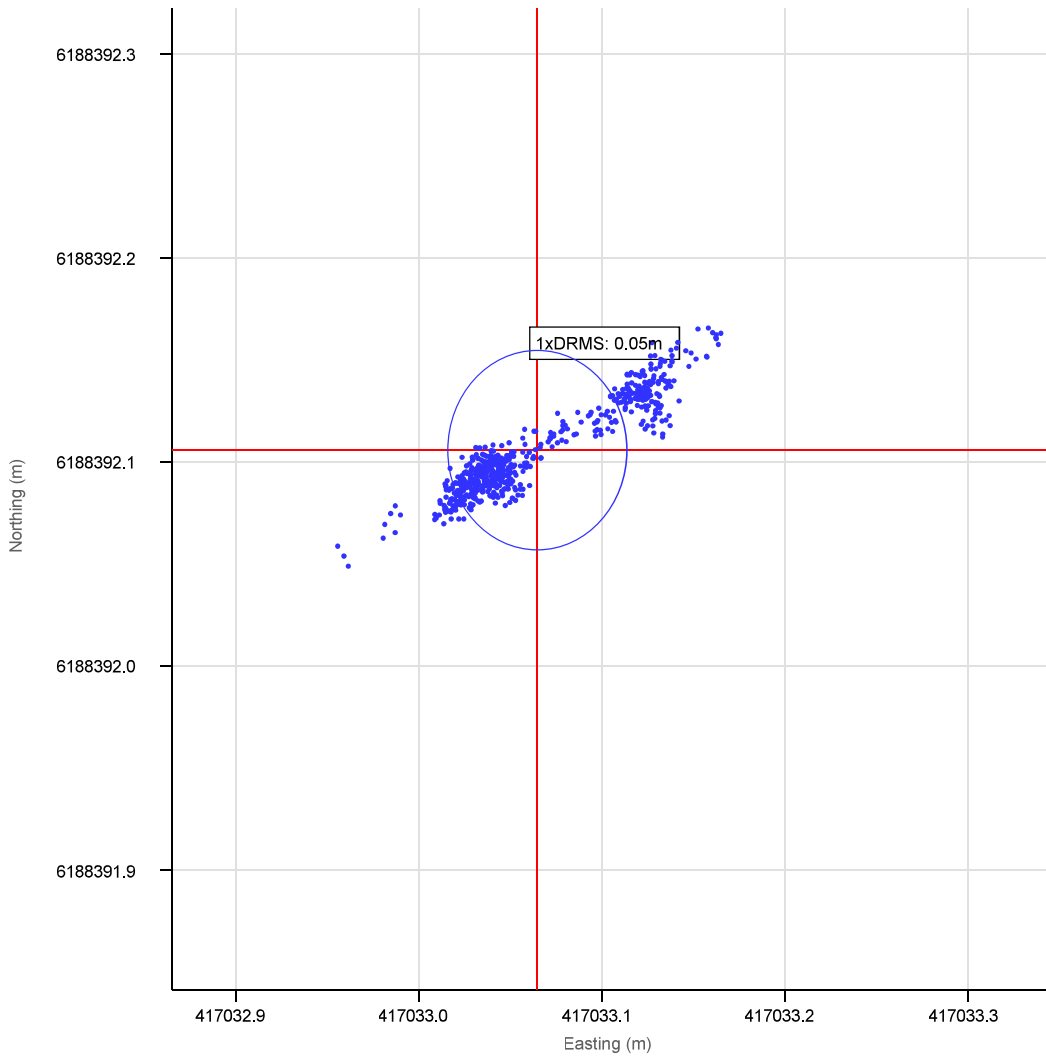
Target	CPT110		
Position	417 034.00m E, 6 188 390.00m N		
Range	2.30 m Grid		
Bearing To	156.05° G	Bearing From	336.05° G



Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	600 of 600
Position	417 033.06m E, 6 188 392.11m N ,7.10m MSS
Heading	209.26° T, 210.36° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	417 033.06m E	6 188 392.11m N

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North
 Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240511211757-v10
Start Time	11 May 2024, 22:18:27+01:00
End Time	11 May 2024, 22:28:26+01:00
Session Length	9m 59s (600 of 600 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 49' 16.7718" N	55° 49' 16.7913" N
Longitude	007° 33' 45.9565" E	007° 33' 45.9880" E
Height	47.64m Ell., -0.01m ISS	47.67m Ell., 6.52m Ort.
Easting	409 953.21m E (± 0.02 m)	
Northing	6 187 128.30m N (± 0.02 m)	
Height	6.93m MSS (± 0.14 m) , -0.01m ISS (± 0.04 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	135.59° T, 136.78° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	Deck to mud 24.20m, Water Depth 16.60m.	

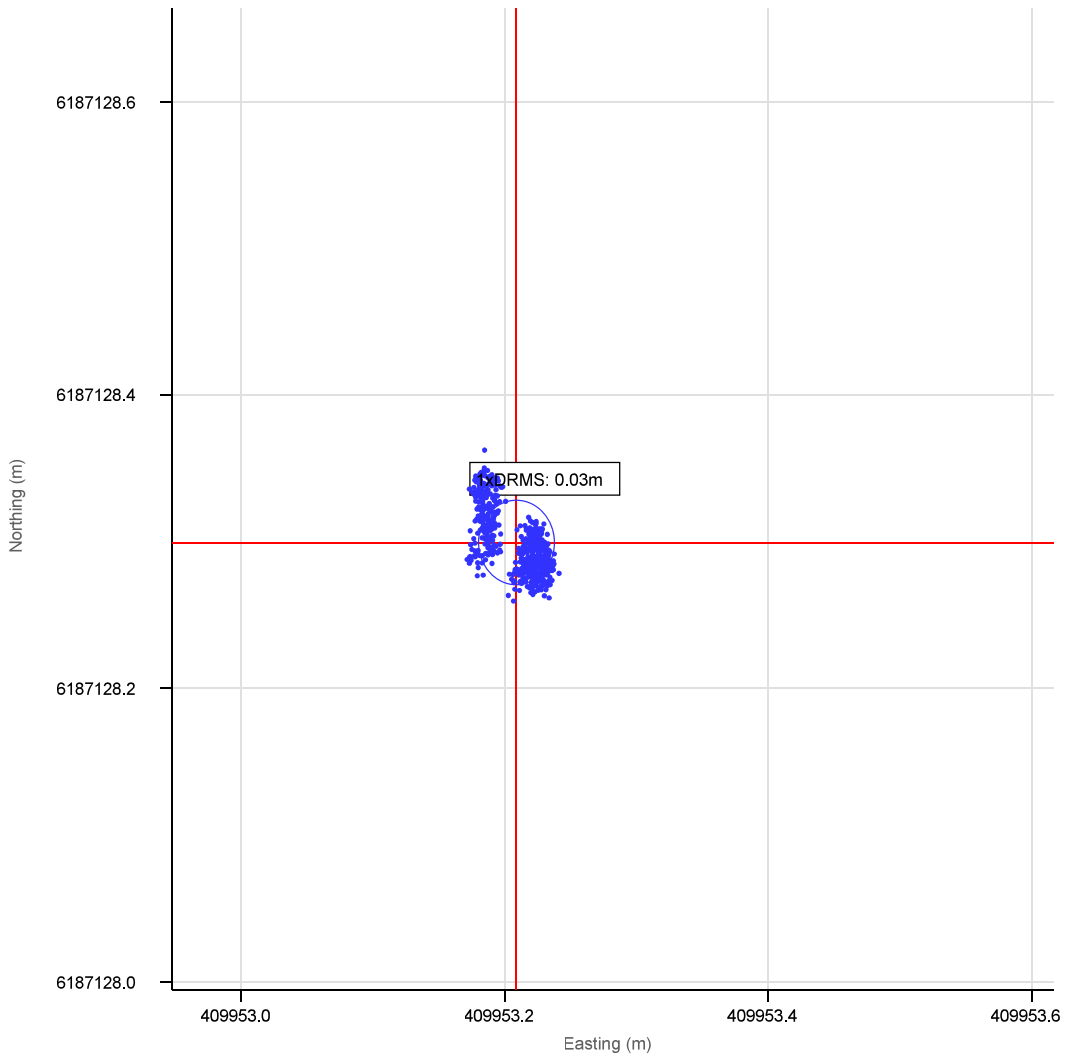
Table 5: Mean Position to Target

Target	CPT131		
Position	409 952.00m E, 6 187 130.00m N		
Range	2.09 m Grid		
Bearing To	324.59° G	Bearing From	144.59° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	600 of 600
Position	409 953.21m E, 6 187 128.30m N ,6.93m MSS
Heading	135.59° T, 136.78° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	409 953.21m E	6 187 128.30m N

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North
 Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240515155603-v14
Start Time	15 May 2024, 16:56:36+01:00
End Time	15 May 2024, 17:06:35+01:00
Session Length	9m 59s (600 of 600 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 49' 32.7263" N	55° 49' 32.7459" N
Longitude	007° 32' 50.2133" E	007° 32' 50.2448" E
Height	48.65m Ell., 0.01m ISS	48.67m Ell., 7.51m Ort.
Easting	408 993.50m E (± 0.01 m)	
Northing	6 187 641.72m N (± 0.01 m)	
Height	7.93m MSS (± 0.14 m) , 0.01m ISS (± 0.02 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	141.49° T, 142.70° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	Deck to Mud 25.30m Water Depth 17.50m	

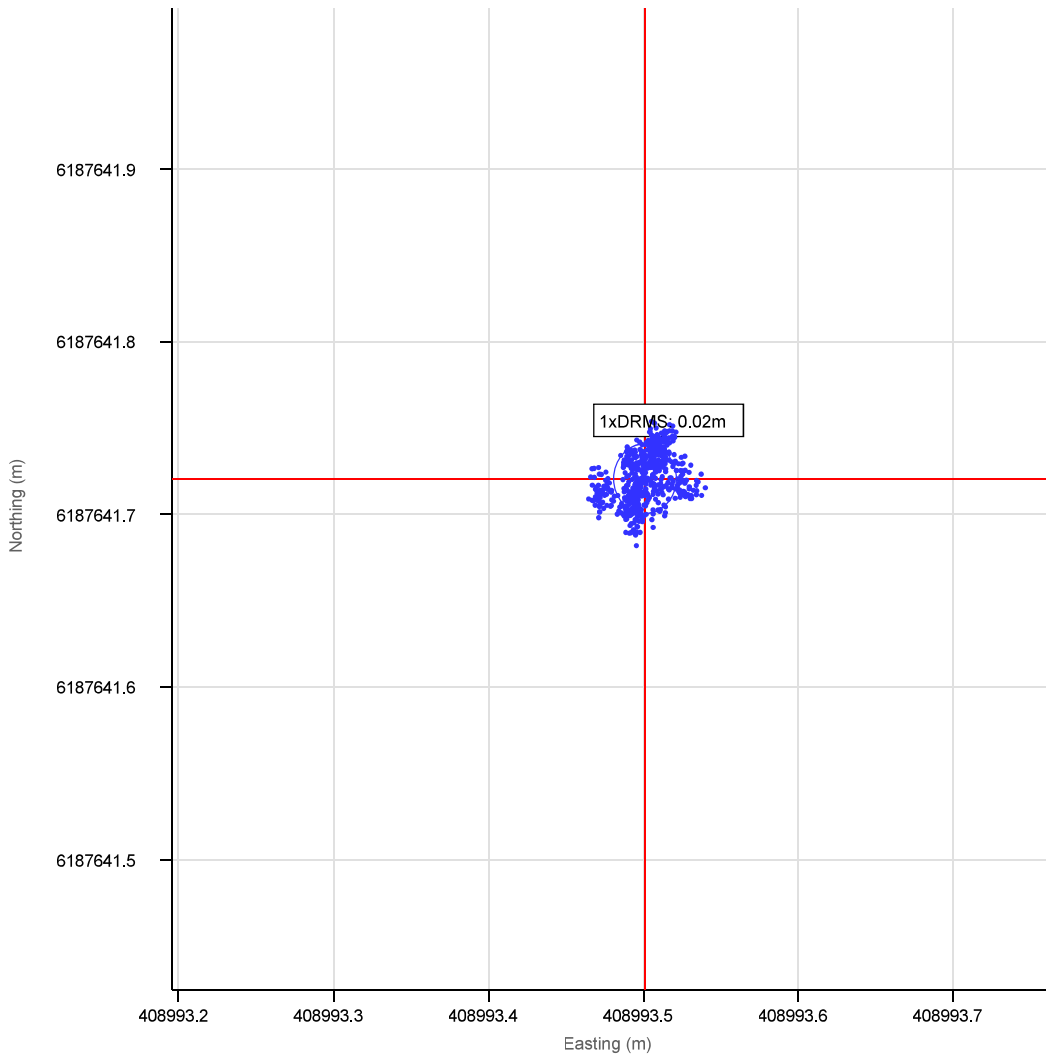
Table 5: Mean Position to Target

Target	CPT157		
Position	408 994.00m E, 6 187 640.00m N		
Range	1.79 m Grid		
Bearing To	163.83° G	Bearing From	343.83° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	600 of 600
Position	408 993.50m E, 6 187 641.72m N ,7.93m MSS
Heading	141.49° T, 142.70° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	408 993.50m E	6 187 641.72m N

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North
 Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	CPT182-v31
Start Time	24 Jun 2024, 19:19:06+01:00
End Time	24 Jun 2024, 19:29:05+01:00
Session Length	9m 59s (599 of 599 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 52' 55.4792" N	55° 52' 55.4988" N
Longitude	007° 33' 08.7033" E	007° 33' 08.7348" E
Height	48.02m Ell., 0.00m ISS	48.05m Ell., 6.86m Ort.
Easting	409 446.31m E (± 0.02 m)	
Northing	6 193 902.39m N (± 0.03 m)	
Height	7.30m MSS (± 0.13 m) , 0.00m ISS (± 0.03 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	282.13° T, 283.33° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	0.0 m	DTM = 27.1m WD = 20.0m

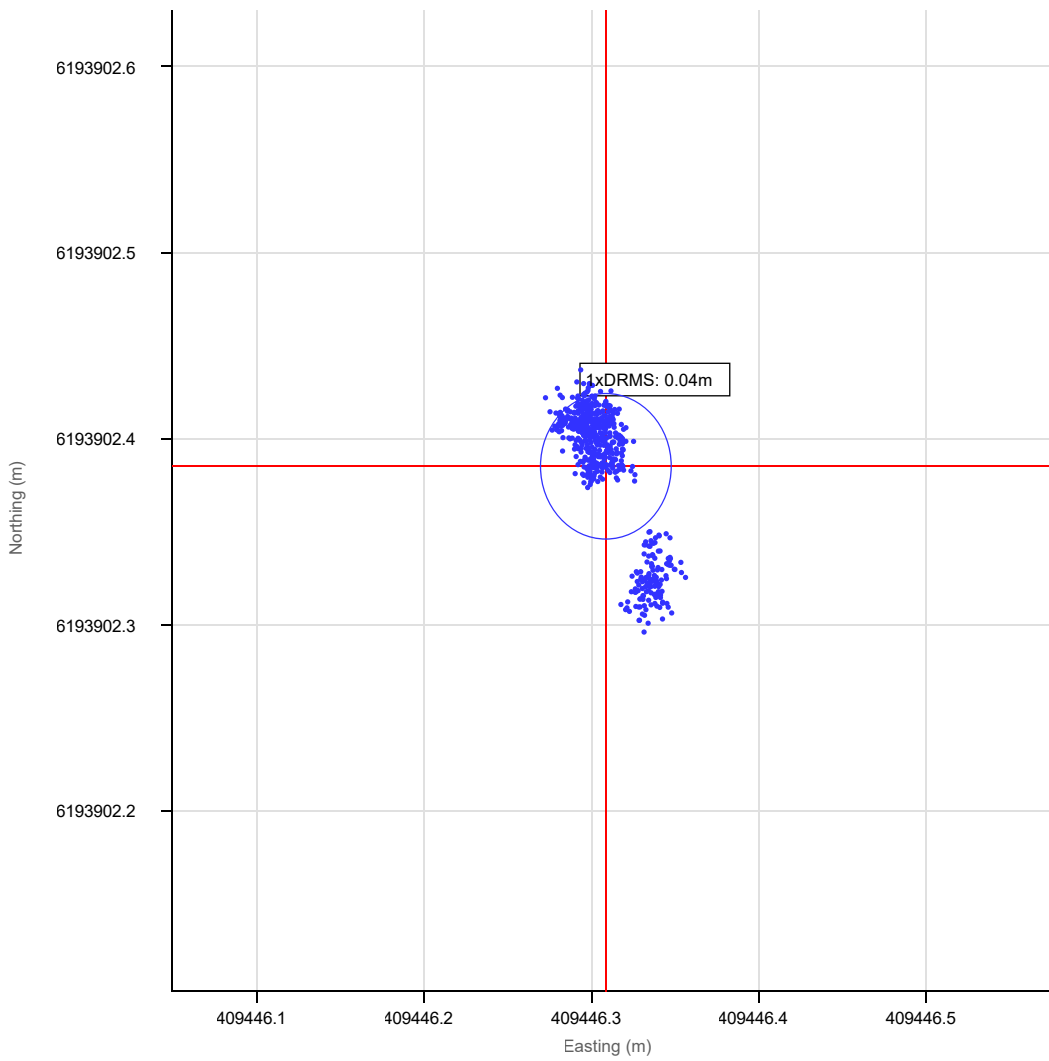
Table 5: Mean Position to Target

Target	CPT182		
Position	409 447.00m E, 6 193 900.00m N		
Range	2.48 m Grid		
Bearing To	163.83° G	Bearing From	343.83° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	599 of 599
Position	409 446.31m E, 6 193 902.39m N ,7.30m MSS
Heading	282.13° T, 283.33° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	409 446.31m E	6 193 902.39m N

David Lloyd
 Party Chief
 FGBNM (Fugro Great Britain North
 Marine)

OCR
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240504091352-v4
Start Time	04 May 2024, 10:20:21+01:00
End Time	04 May 2024, 10:30:20+01:00
Session Length	9m 59s (598 of 598 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 49' 08.0182" N	55° 49' 08.0378" N
Longitude	007° 37' 56.8394" E	007° 37' 56.8709" E
Height	48.85m Ell., 0.00m ISS	48.88m Ell., 7.73m Ort.
Easting	414 313.81m E (± 0.02 m)	
Northing	6 186 769.29m N (± 0.02 m)	
Height	8.15m MSS (± 0.13 m) , 0.00m ISS (± 0.02 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	86.04° T, 87.17° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	Deck to Mud 26.8, Water Depth 18.70	

Table 5: Mean Position to Target

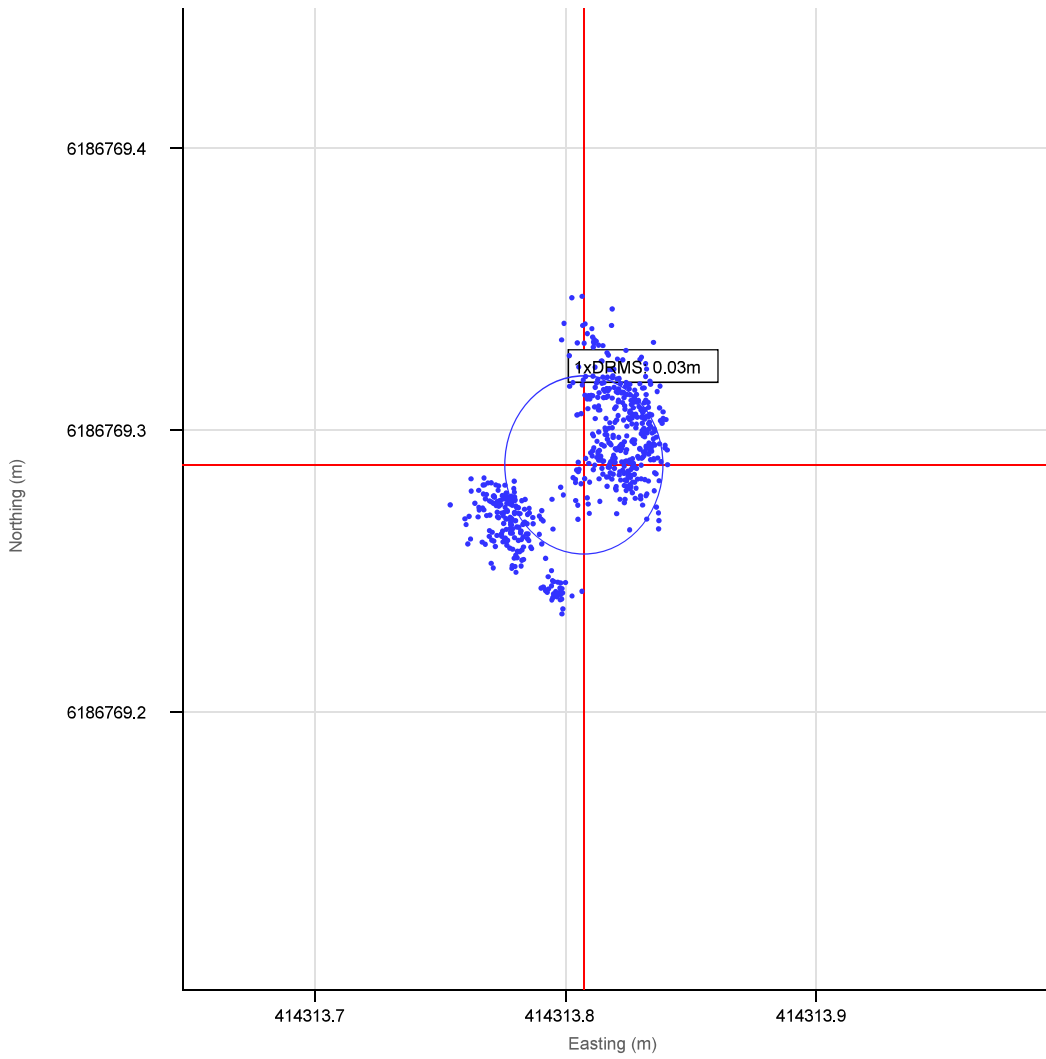
Target	CPT221		
Position	414 314.00m E, 6 186 770.00m N		
Range	0.74 m Grid		
Bearing To	15.14° G	Bearing From	195.14° G



Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	598 of 598
Position	414 313.81m E, 6 186 769.29m N ,8.15m MSS
Heading	86.04° T, 87.17° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	414 313.81m E	6 186 769.29m N

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North
 Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240517181007-v15
Start Time	17 May 2024, 19:10:30+01:00
End Time	17 May 2024, 19:20:29+01:00
Session Length	9m 59s (600 of 600 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 50' 38.8340" N	55° 50' 38.8536" N
Longitude	007° 32' 37.7857" E	007° 32' 37.8172" E
Height	47.90m Ell., -0.01m ISS	47.93m Ell., 6.76m Ort.
Easting	408 820.24m E (± 0.02 m)	
Northing	6 189 689.74m N (± 0.02 m)	
Height	7.18m MSS (± 0.14 m) , -0.01m ISS (± 0.03 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	83.20° T, 84.41° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	Deck To Mud 25.50m, Water Depth 18.30m.	

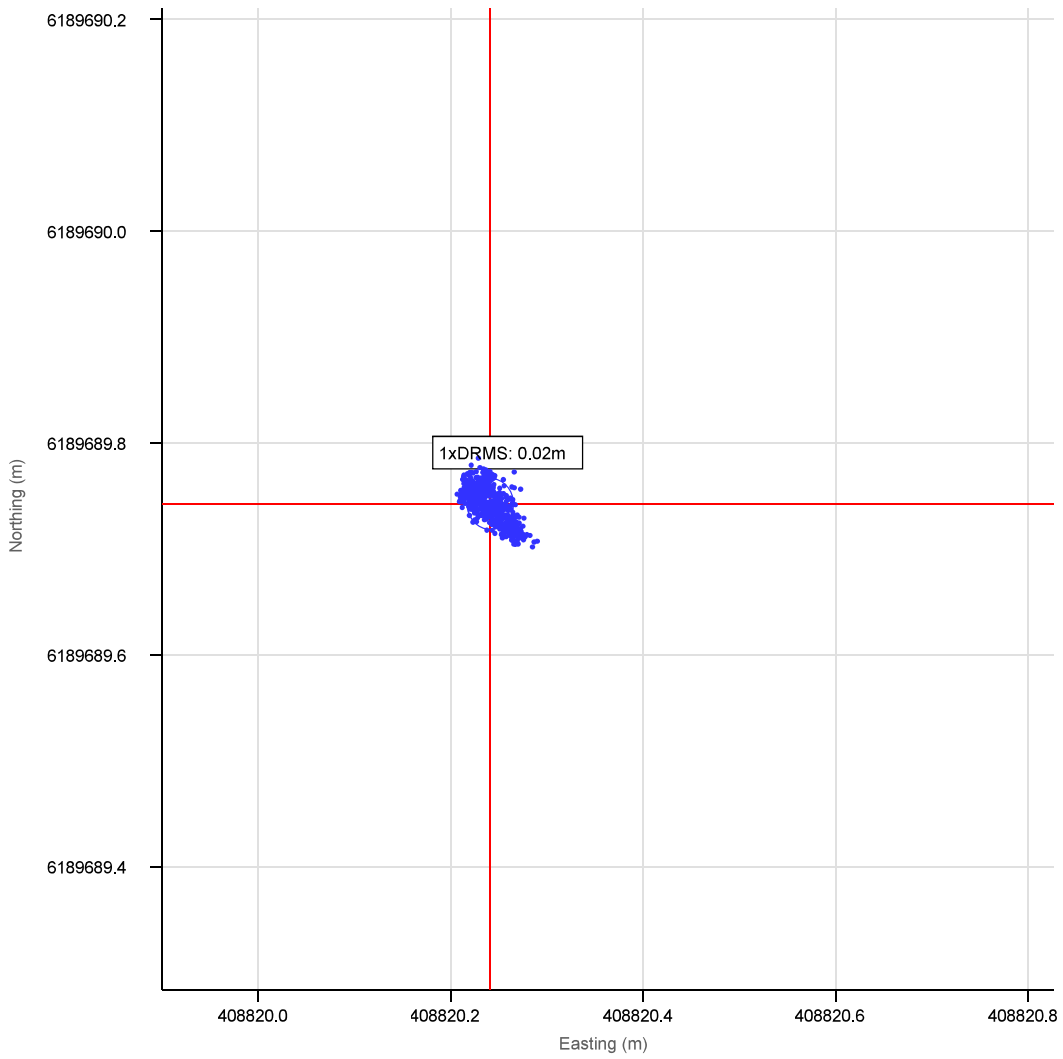
Table 5: Mean Position to Target

Target	CPT247		
Position	408 820.00m E, 6 189 690.00m N		
Range	0.35 m Grid		
Bearing To	316.85° G	Bearing From	136.85° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	600 of 600
Position	408 820.24m E, 6 189 689.74m N ,7.18m MSS
Heading	83.20° T, 84.41° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	408 820.24m E	6 189 689.74m N

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North
 Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240523112007-v20
Start Time	23 May 2024, 12:20:24+01:00
End Time	23 May 2024, 12:30:23+01:00
Session Length	9m 59s (600 of 600 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 49' 02.7827" N	55° 49' 02.8023" N
Longitude	007° 41' 25.7981" E	007° 41' 25.8297" E
Height	47.63m Ell., 0.00m ISS	47.66m Ell., 6.51m Ort.
Easting	417 947.38m E (± 0.02 m)	
Northing	6 186 537.15m N (± 0.02 m)	
Height	6.93m MSS (± 0.13 m) , 0.00m ISS (± 0.01 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	352.49° T, 353.57° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	0.0 m	

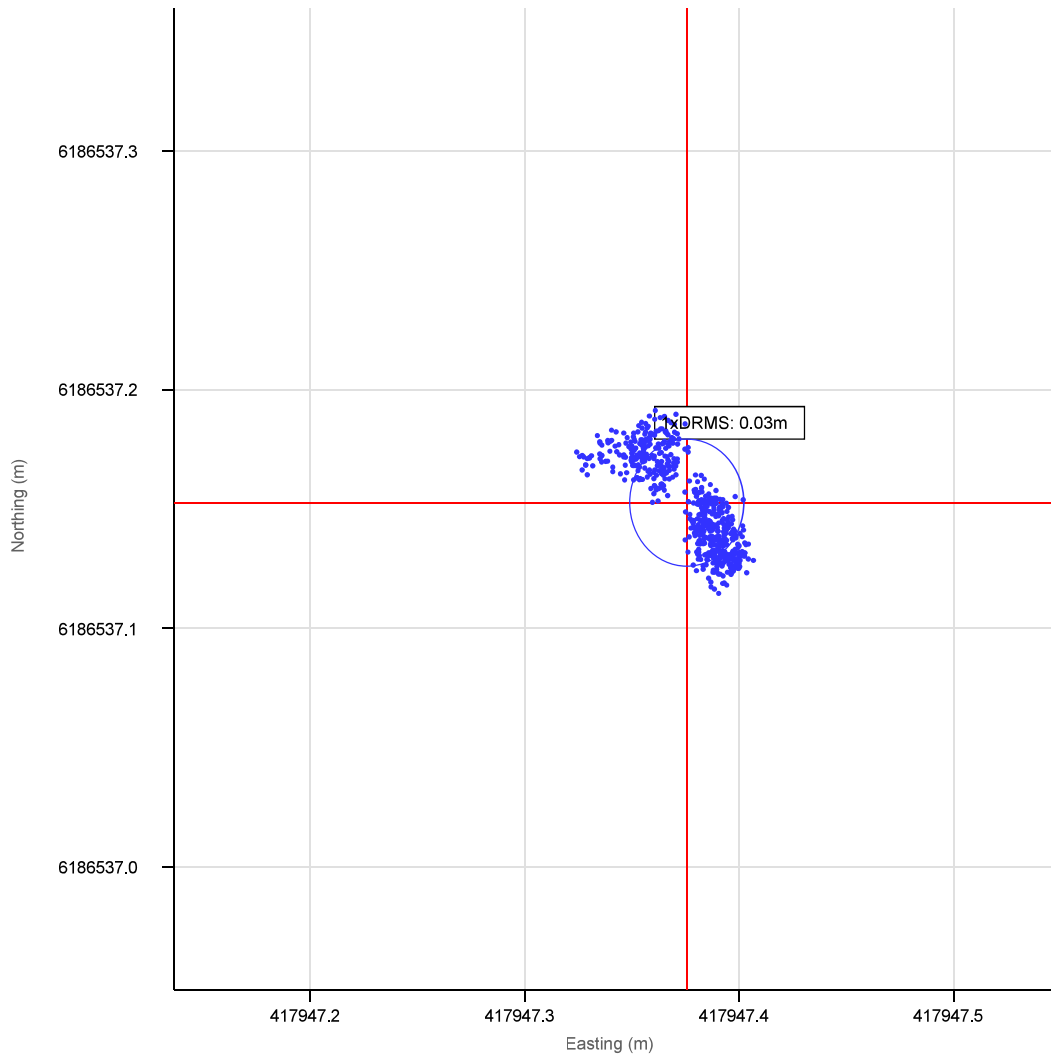
Table 5: Mean Position to Target

Target	CPT263		
Position	417 947.00m E, 6 186 540.00m N		
Range	2.87 m Grid		
Bearing To	352.49° G	Bearing From	172.49° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	600 of 600
Position	417 947.38m E, 6 186 537.15m N ,6.93m MSS
Heading	352.49° T, 353.57° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	417 947.38m E	6 186 537.15m N

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North
 Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240522163734-v19
Start Time	22 May 2024, 17:37:46+01:00
End Time	22 May 2024, 17:47:45+01:00
Session Length	9m 59s (600 of 600 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 50' 21.2791" N	55° 50' 21.2987" N
Longitude	007° 38' 40.2500" E	007° 38' 40.2816" E
Height	48.61m Ell., 0.01m ISS	48.64m Ell., 7.48m Ort.
Easting	415 113.64m E (± 0.02 m)	
Northing	6 189 019.06m N (± 0.01 m)	
Height	7.91m MSS (± 0.13 m) , 0.01m ISS (± 0.03 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	128.17° T, 129.29° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	0.0 m	

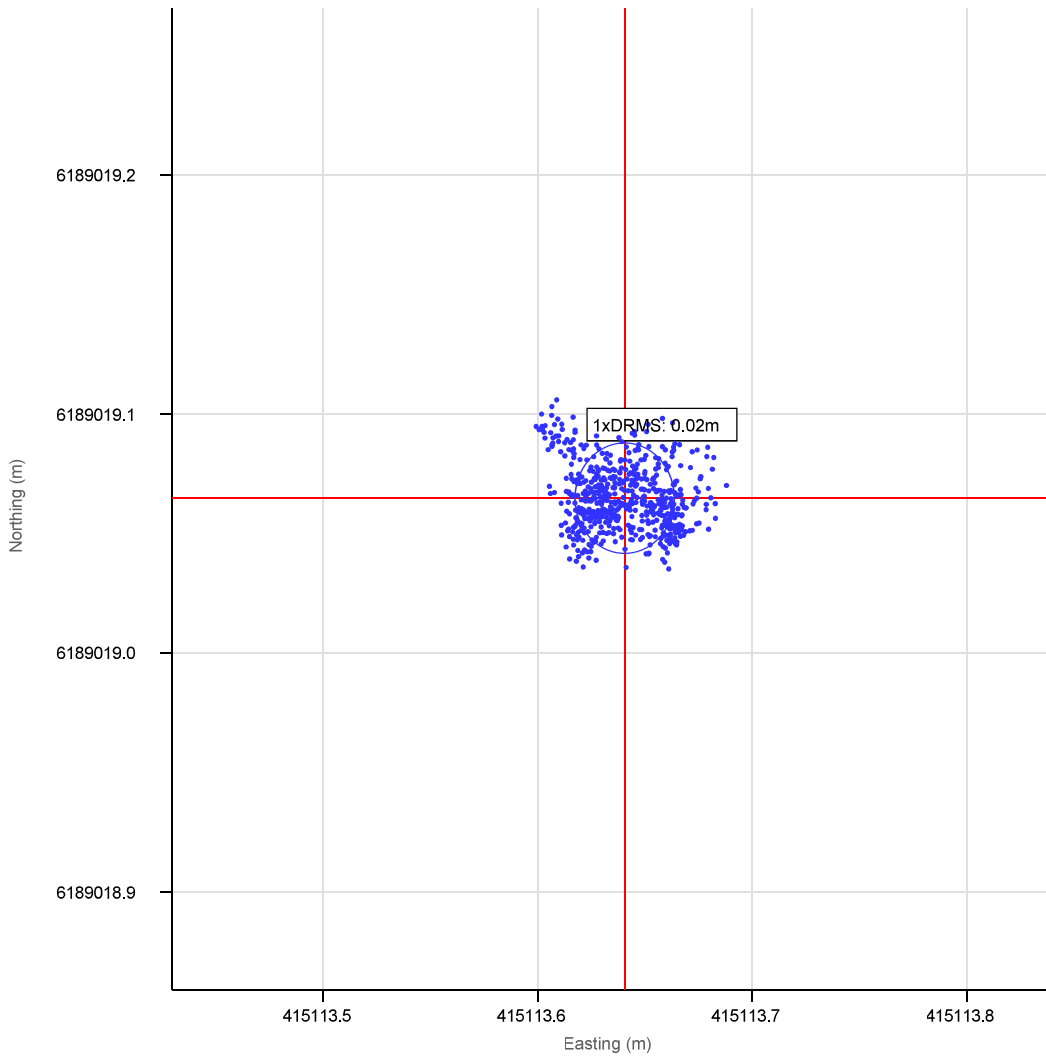
Table 5: Mean Position to Target

Target	CPT306		
Position	415 112.00m E, 6 189 020.00m N		
Range	1.89 m Grid		
Bearing To	299.69° G	Bearing From	119.69° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	600 of 600
Position	415 113.64m E, 6 189 019.06m N ,7.91m MSS
Heading	128.17° T, 129.29° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	415 113.64m E	6 189 019.06m N

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North
 Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	CPT314-v3
Start Time	01 May 2024, 19:15:14+01:00
End Time	01 May 2024, 19:25:13+01:00
Session Length	9m 59s (599 of 599 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 48' 11.6612" N	55° 48' 11.6808" N
Longitude	007° 39' 19.4979" E	007° 39' 19.5294" E
Height	48.89m Ell., 0.00m ISS	48.91m Ell., 7.77m Ort.
Easting	415 718.53m E (± 0.01 m)	
Northing	6 184 999.02m N (± 0.01 m)	
Height	8.18m MSS (± 0.13 m) , 0.00m ISS (± 0.02 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	156.80° T, 157.92° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	Deck to mud 26.80, Water Depth 18.50	

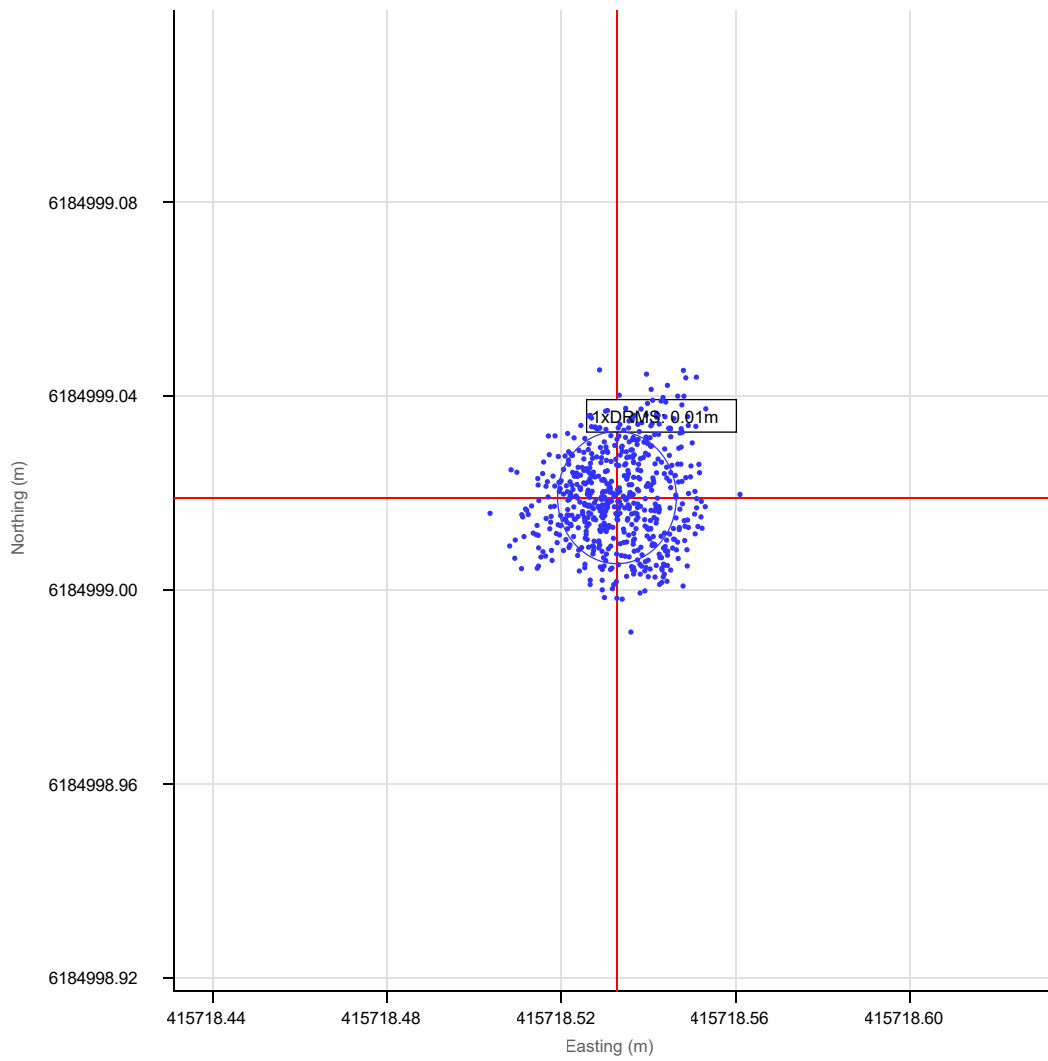
Table 5: Mean Position to Target

Target	CPT314		
Position	415 718.00m E, 6 185 000.00m N		
Range	1.12 m Grid		
Bearing To	331.50° G	Bearing From	151.50° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	599 of 599
Position	415 718.53m E, 6 184 999.02m N ,8.18m MSS
Heading	156.80° T, 157.92° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	415 718.53m E	6 184 999.02m N

Project Engineer
Jamie Davison

Client Representative
Rob Harwood / Ieumman Dos Santos

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240511072333-v9
Start Time	11 May 2024, 08:24:11+01:00
End Time	11 May 2024, 08:34:10+01:00
Session Length	9m 59s (599 of 599 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 50' 27.5516" N	55° 50' 27.5711" N
Longitude	007° 35' 25.1287" E	007° 35' 25.1603" E
Height	48.38m Ell., 0.00m ISS	48.40m Ell., 7.24m Ort.
Easting	411 723.58m E (± 0.01 m)	
Northing	6 189 280.74m N (± 0.01 m)	
Height	7.67m MSS (± 0.14 m) , 0.00m ISS (± 0.02 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	9.32° T, 10.49° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	Deck to Mud 27.10m, Water Depth 18.90m	

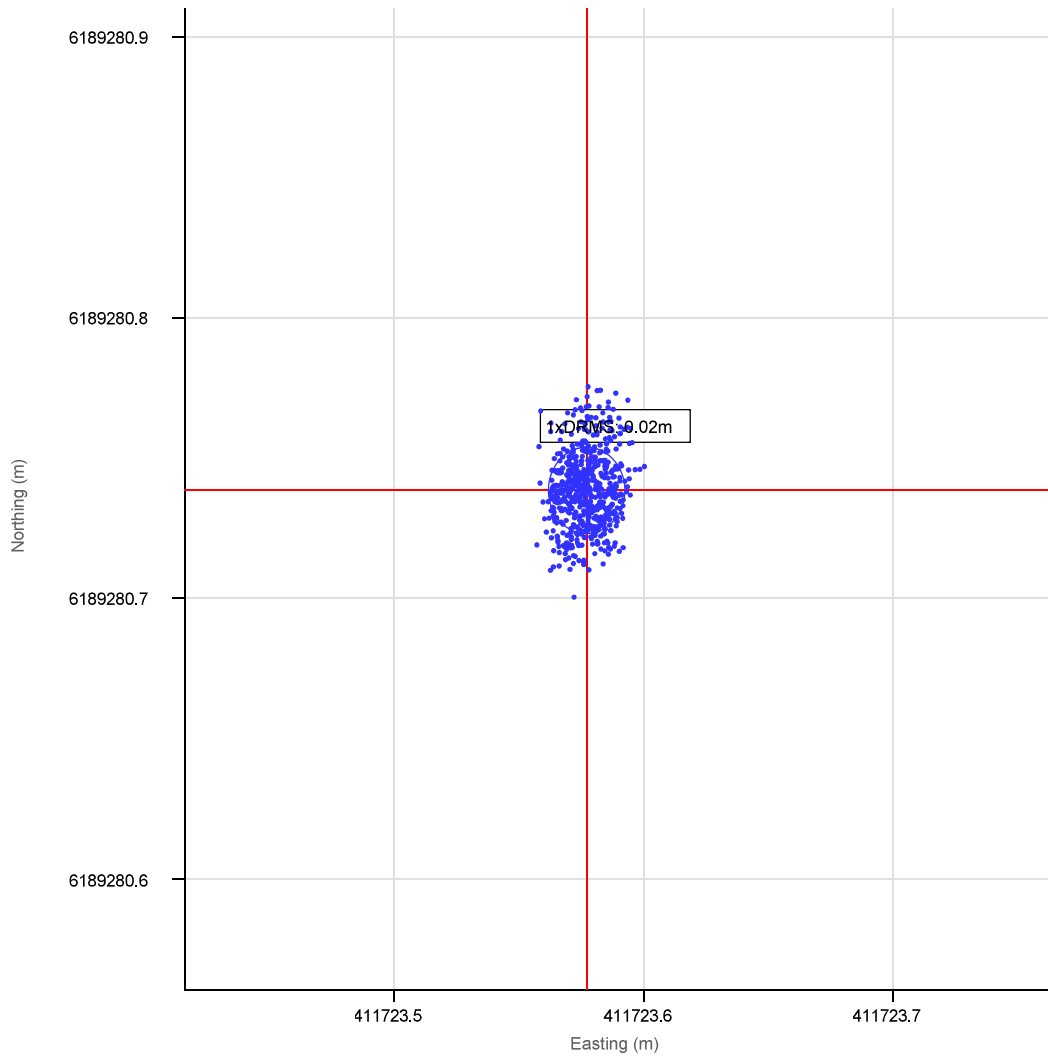
Table 5: Mean Position to Target

Target	CPT316		
Position	411 723.00m E, 6 189 280.00m N		
Range	0.94 m Grid		
Bearing To	218.00° G	Bearing From	38.00° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	599 of 599
Position	411 723.58m E, 6 189 280.74m N ,7.67m MSS
Heading	9.32° T, 10.49° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	411 723.58m E	6 189 280.74m N

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North
 Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240510110115-v8
Start Time	10 May 2024, 12:01:34+01:00
End Time	10 May 2024, 12:11:33+01:00
Session Length	9m 59s (599 of 599 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 51' 49.0034" N	55° 51' 49.0230" N
Longitude	007° 37' 18.4517" E	007° 37' 18.4833" E
Height	48.54m Ell., -0.01m ISS	48.57m Ell., 7.40m Ort.
Easting	413 744.80m E (± 0.02 m)	
Northing	6 191 758.88m N (± 0.02 m)	
Height	7.83m MSS (± 0.14 m) , -0.01m ISS (± 0.04 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	101.86° T, 103.00° G	± 0.1°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	Deck to mud 27.10, Water Depth 19.40m	

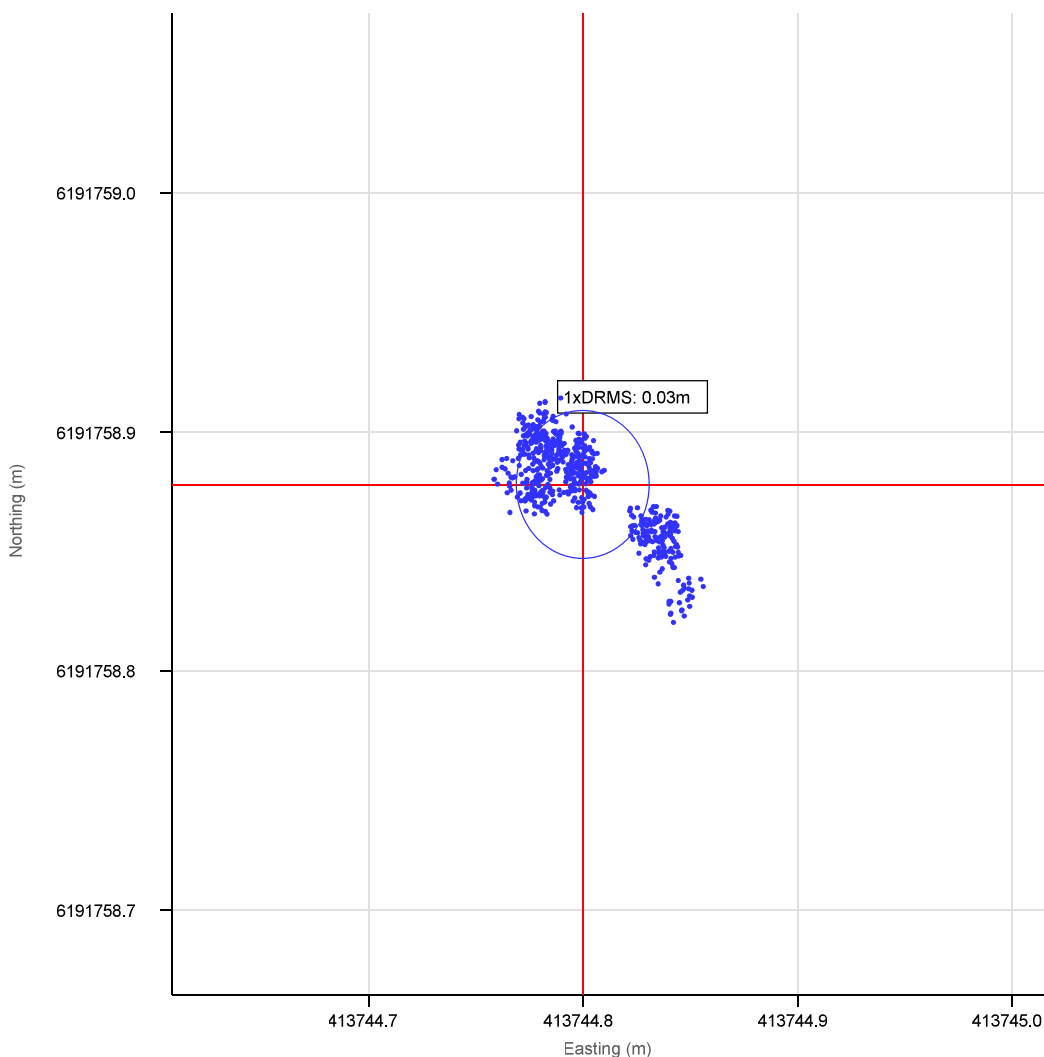
Table 5: Mean Position to Target

Target	CPT388		
Position	413 744.00m E, 6 191 760.00m N		
Range	1.38 m Grid		
Bearing To	324.52° G	Bearing From	144.52° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	599 of 599
Position	413 744.80m E, 6 191 758.88m N ,7.83m MSS
Heading	101.86° T, 103.00° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	413 744.80m E	6 191 758.88m N

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North
 Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	MPR-20240512103701-v12
Start Time	12 May 2024, 11:37:45+01:00
End Time	12 May 2024, 11:47:44+01:00
Session Length	9m 59s (600 of 600 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 48' 43.3187" N	55° 48' 43.3383" N
Longitude	007° 30' 44.3939" E	007° 30' 44.4254" E
Height	48.42m Ell., -0.01m ISS	48.44m Ell., 7.29m Ort.
Easting	406 771.41m E (± 0.01 m)	
Northing	6 186 160.96m N (± 0.01 m)	
Height	7.71m MSS (± 0.14 m) , -0.01m ISS (± 0.02 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	161.13° T, 162.36° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	Deck to mud 27.60m, Water Depth 19.30m.	

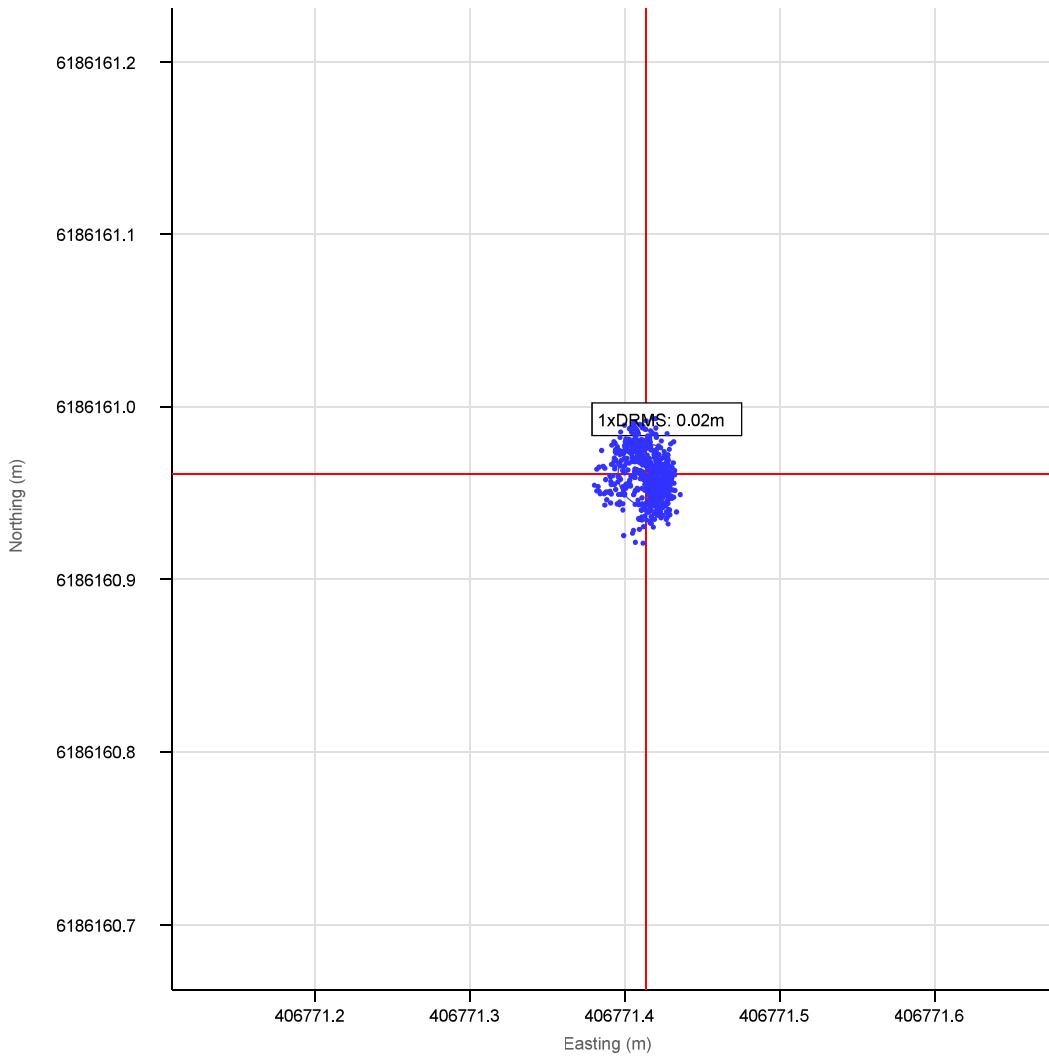
Table 5: Mean Position to Target

Target	CPT390		
Position	406 771.00m E, 6 186 160.00m N		
Range	1.05 m Grid		
Bearing To	203.30° G	Bearing From	23.30° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	600 of 600
Position	406 771.41m E, 6 186 160.96m N ,7.71m MSS
Heading	161.13° T, 162.36° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	406 771.41m E	6 186 160.96m N

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North
 Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc

Mean Position Report

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Session Details

Session	CPT400-v30
Start Time	24 Jun 2024, 08:17:13+01:00
End Time	24 Jun 2024, 08:27:12+01:00
Session Length	9m 59s (600 of 600 records for Excalibur)

Table 3: Mean Position for Excalibur at Moonpool_1

	ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 ...	ITRF2014 (EGM2008)
Latitude	55° 53' 02.3918" N	55° 53' 02.4114" N
Longitude	007° 38' 01.5108" E	007° 38' 01.5424" E
Height	47.88m Ell., 0.00m ISS	47.91m Ell., 6.74m Ort.
Easting	414 538.11m E (± 0.01 m)	
Northing	6 194 012.62m N (± 0.01 m)	
Height	7.17m MSS (± 0.13 m) , 0.00m ISS (± 0.02 m)	

Table 4: Sensor Averages

Sensor	Average	SD
Heading	311.38° T, 312.51° G	± 0.0°
Pitch	0.00 °	± 0.00 °
Roll	0.00 °	± 0.00°
Depth (Manual)	0.0 m	DTM = 26.7m WD = 19.5m

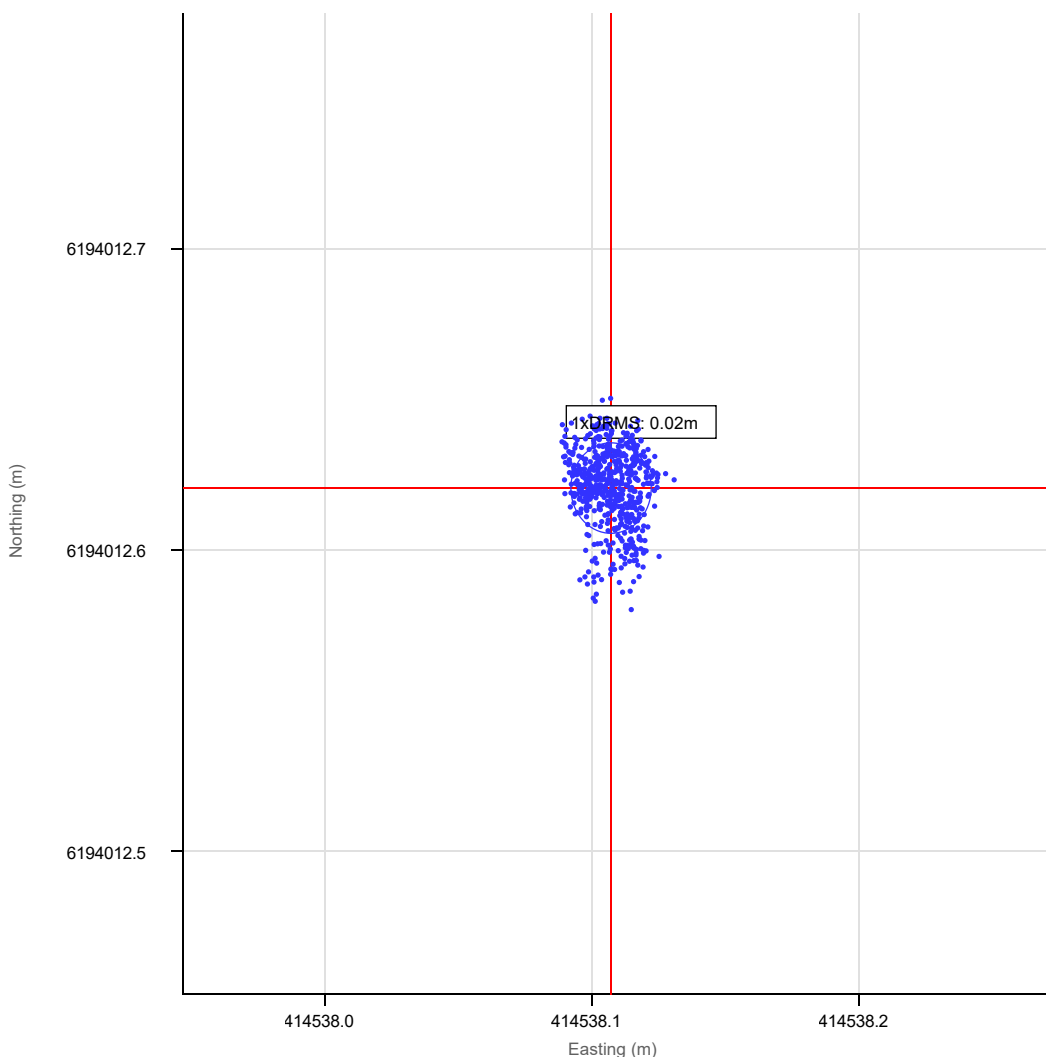
Table 5: Mean Position to Target

Target	CPT400		
Position	414 541.00m E, 6 194 010.00m N		
Range	3.90 m Grid		
Bearing To	132.17° G	Bearing From	312.17° G

Table 6: Excalibur - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]

Position Source	Excalibur/Selector/InUse/Navigation Result
Records	600 of 600
Position	414 538.11m E, 6 194 012.62m N ,7.17m MSS
Heading	311.38° T, 312.51° G
Pitch	0.00 °
Roll	0.00 °

Figure 1: Scatter Plot - ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Easting	Northing
Excalibur	414 538.11m E	6 194 012.62m N

David Lloyd
 Party Chief
 FGBNM (Fugro Great Britain North
 Marine)

OCR
 Client Representative
 Fugro Geoservices Inc

B.2 Way Point Report

List of Plates

Point Report

4 Plates

Point Report

Table 1: Project Details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Client	Fugro Geoservices Inc
Project Type	Positioning
Starfix Version	v2022.1110.9 (build 0)

Table 2: Geodetic parameters

Name: ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters*		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6 378 137.00 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6 378 137.00 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map projection	Transverse Mercator	
Grid system	UTM zone 32N	EPSG:16032
Latitude origin	00° 00' 00.000" N	
Central meridian	009° 00' 00.000" E	
Scale factor on central meridian	0.9996	
False easting	500 000 m	
False northing	0 m	
Project Vertical Parameters		
Vertical coordinate reference system	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478
Notes		
* The geodetic datum of Fugro's global GNSS correction data is ITRF2014, epoch 2023 (01/01/2023 00:00:00)		

Table 3: Waypoints

ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS] EPSG:25832			
Point Name	Easting [m]	Northing [m]	Height [m Ell.]
BH080	406 417.00	6 197 280.00	0.00
BH081	410 760.00	6 197 260.00	0.00
BH081-CPT	410 760.00	6 197 260.00	0.00
BH093	408 742.00	6 194 770.00	0.00
BH101	415 453.00	6 192 140.00	0.00
BH101-CPT	415 453.00	6 192 140.00	0.00
BH106	410 536.00	6 190 040.00	0.00
BH110	417 034.00	6 188 390.00	0.00
CPT093	408 742.00	6 194 770.00	0.00
CPT106	410 536.00	6 190 040.00	0.00
CPT110	417 034.00	6 188 390.00	0.00
CPT131	409 952.00	6 187 130.00	0.00
CPT157	408 994.00	6 187 640.00	0.00
CPT182	409 447.00	6 193 900.00	0.00
CPT221	414 314.00	6 186 770.00	0.00
CPT247	408 820.00	6 189 690.00	0.00
CPT251	407 948.00	6 192 570.00	0.00
CPT263	417 947.00	6 186 540.00	0.00
CPT306	415 112.00	6 189 020.00	0.00
CPT314	415 718.00	6 185 000.00	0.00
CPT316	411 723.00	6 189 280.00	0.00
CPT388	413 744.00	6 191 760.00	0.00
CPT390	406 771.00	6 186 160.00	0.00
CPT400	414 541.00	6 194 010.00	0.00



Table 4: Waypoints

ETRS89 EPSG:4258			
Point Name	Latitude	Longitude	Height [m Ell.]
BH080	55° 54' 42.6119" N	007° 30' 10.2296" E	0.00
BH081	55° 54' 44.9344" N	007° 34' 20.2924" E	0.00
BH081-CPT	55° 54' 44.9344" N	007° 34' 20.2924" E	0.00
BH093	55° 53' 23.0560" N	007° 32' 27.1330" E	0.00
BH101	55° 52' 02.4171" N	007° 38' 56.2515" E	0.00
BH101-CPT	55° 52' 02.4171" N	007° 38' 56.2515" E	0.00
BH106	55° 50' 51.3162" N	007° 34' 15.9799" E	0.00
BH110	55° 50' 02.1386" N	007° 40' 31.3014" E	0.00
CPT093	55° 53' 23.0560" N	007° 32' 27.1330" E	0.00
CPT106	55° 50' 51.3162" N	007° 34' 15.9799" E	0.00
CPT110	55° 50' 02.1386" N	007° 40' 31.3014" E	0.00
CPT131	55° 49' 16.8259" N	007° 33' 45.8851" E	0.00
CPT157	55° 49' 32.6710" N	007° 32' 50.2440" E	0.00
CPT182	55° 52' 55.4026" N	007° 33' 08.7460" E	0.00
CPT221	55° 49' 08.0414" N	007° 37' 56.8496" E	0.00
CPT247	55° 50' 38.8421" N	007° 32' 37.7716" E	0.00
CPT251	55° 52' 11.3735" N	007° 31' 44.1380" E	0.00
CPT263	55° 49' 02.8745" N	007° 41' 25.7735" E	0.00
CPT306	55° 50' 21.3083" N	007° 38' 40.1547" E	0.00
CPT314	55° 48' 11.6926" N	007° 39' 19.4662" E	0.00
CPT316	55° 50' 27.5273" N	007° 35' 25.0964" E	0.00
CPT388	55° 51' 49.0392" N	007° 37' 18.4045" E	0.00
CPT390	55° 48' 43.2874" N	007° 30' 44.3713" E	0.00
CPT400	55° 53' 02.3089" N	007° 38' 01.6803" E	0.00



Table 5: Waypoints

ITRF2014 EPSG:7789			
Point Name	Latitude	Longitude	Height [m Ell.]
BH080	55° 54' 42.6314" N	007° 30' 10.2611" E	0.03
BH081	55° 54' 44.9539" N	007° 34' 20.3239" E	0.03
BH081-CPT	55° 54' 44.9539" N	007° 34' 20.3239" E	0.03
BH093	55° 53' 23.0756" N	007° 32' 27.1645" E	0.03
BH101	55° 52' 02.4366" N	007° 38' 56.2831" E	0.03
BH101-CPT	55° 52' 02.4366" N	007° 38' 56.2831" E	0.03
BH106	55° 50' 51.3358" N	007° 34' 16.0114" E	0.03
BH110	55° 50' 02.1581" N	007° 40' 31.3329" E	0.03
CPT093	55° 53' 23.0756" N	007° 32' 27.1645" E	0.03
CPT106	55° 50' 51.3358" N	007° 34' 16.0114" E	0.03
CPT110	55° 50' 02.1581" N	007° 40' 31.3329" E	0.03
CPT131	55° 49' 16.8455" N	007° 33' 45.9166" E	0.03
CPT157	55° 49' 32.6906" N	007° 32' 50.2755" E	0.03
CPT182	55° 52' 55.4222" N	007° 33' 08.7775" E	0.03
CPT221	55° 49' 08.0609" N	007° 37' 56.8812" E	0.03
CPT247	55° 50' 38.8617" N	007° 32' 37.8031" E	0.03
CPT251	55° 52' 11.3931" N	007° 31' 44.1695" E	0.03
CPT263	55° 49' 02.8941" N	007° 41' 25.8050" E	0.03
CPT306	55° 50' 21.3279" N	007° 38' 40.1863" E	0.03
CPT314	55° 48' 11.7122" N	007° 39' 19.4977" E	0.03
CPT316	55° 50' 27.5469" N	007° 35' 25.1280" E	0.03
CPT388	55° 51' 49.0588" N	007° 37' 18.4360" E	0.03
CPT390	55° 48' 43.3070" N	007° 30' 44.4028" E	0.03
CPT400	55° 53' 02.3285" N	007° 38' 01.7118" E	0.03

Party Chief
FGBNM (Fugro Great Britain North
Marine)

Client Representative
Fugro Geoservices Inc

B.3 Leg Penetrations

List of Plates

Leg Penetrations

1 Plate

Location	Sand Thickness [m]		Leg Pen [m]		
	Predicted	Actual	Max	Avg	Min
BH080	3.9	5.5	2.1	1.925	1.8
BH081	2.2	3.7	8.9	4.825	2.7
BH081-CPT	2.2	3.7	8.2	4.4875	2.9
BH093	3.6	3.6	1.5	1.4125	1.3
CPT093	3.6	8	1.6	1.4375	1.3
BH101	2.6	2.75	2.3	2.0125	1.9
BH101-CPT	2.6	2.75	2.5	2.3375	2.2
BH106	3.9	5	1.8	1.575	1.4
CPT106	3.9	5	1.4	1.175	1
BH110	4.1	5.5	1.2	1.0875	1
CPT110	4.1	5.5	1.1	0.95	0.9
CPT131	4.2	5.5	1.3	1.125	1
CPT157	6.3	6	1.7	1.55	1.4
CPT182	4.3	4.5	1.9	1.8	1.7
CPT221	5.7	6	1.5	1.1375	1
CPT247	5.1	5	1.4	1.3	1.2
CPT251	4.6	4.5	2.3	2.1125	1.9
CPT263	4.2	3.7	0.8	0.75	0.7
CPT306	5	6	1.5	1.4375	1.3
CPT314	5.1	5	1.6	1.075	0.8
CPT316	3.2	6	1.4	1.35	1.2
CPT388	3.6	5	2.9	1.7375	1.2
CPT390	5.2	5	1.3	1.1125	0.9
CPT400	2.4	2.9	9.2	8.6625	8.4

B.4 Positioning Data Reports

List of Plates

Positioning Data Report Subarea 1

23 Plates

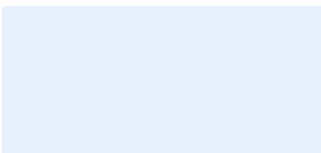


Excalibur – Subarea 1 Positioning Report

FGBNM-240149-R02 01 | 19 July 2024

For review

Fugro GeoServices Limited



Document Control

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Revision History

Issue	Date	Status	Comments on Content	Prepared By	Checked By	Approved By
01	23 July 2024	For Review		MT	KBG	CL

Project Team

Initials	Name	Role
CL	Callum Law	Project Manager
MT	Marketa Thornhill	Project Surveyor
ROC	Remote Operations Centre	Remote Operations Surveyor
KBG	Ken Banner-Green	Client Deliverables Lead

Executive Summary

Fugro GB (North) Marine Limited (FGBNM) was subcontracted by Fugro GeoServices Limited (FGSL) to provide, install and calibrate surface positioning equipment and software onboard the Excalibur jack-up barge (JUB) whilst alongside Holyhead.

FGBNM provided Excalibur with surface positioning and survey services during operations. FGSL utilised the FGBNM supplied equipment for all operations and positioning.

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Appendices

Appendix A Sequence of Events

A.1 Sequence of Events

Appendix B Offset Diagram

B.1 Excalibur

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Abbreviations

CRP	Common Reference Point
CRS	Coordinate Reference System
DGNSS	Differential Global Navigation Satellite System
G4+	Starfix position solutions
GLONASS	Russian Federation GNSS
GNSS	Global Navigation Satellite System
GPS	United States GNSS
ITRF	International Terrestrial Reference Frame
PC	Personal Computer
PDOP	Position Dilution of Precision
PPE	Personal Protective Equipment
PPP	Precise Point Positioning
QA	Quality Assurance
QHSSE	Quality, Health, Safety, Security, Environment
ROC	Remote Operations Centre
UTC	Universal Time Coordinated
UTM	Universal Transverse Mercator
WGS 84	World Geodetic System 1984
XP2	Starfix position solution

1. Introduction and Scope of Work

1.1 Introduction

Fugro was contracted by FGSL to provide positioning support during the geotechnical site investigation for the North Sea 1 offshore wind farm area. The positioning of the barge was supported from the Remote Operations Centre (ROC) in Aberdeen, UK.

1.2 Scope of Work Summary

Tasks included (but were not limited to):

- Mobilised personnel and positioning equipment to JUB;
- Conducted risk assessment, toolbox talk, installation and system checks;
- Conducted offset determination using dimensional control techniques;
- Conducted heading alignment checks using a DGNSS validated baseline;
- Configured the position and elevation logging of CRP in Starfix.;
- Configured the MPR;
- Configured logging and monitoring of position quality data (HDOP, PDOP, SD, number of satellites in view, etc.);
- Provided remote support for the positioning;
- Produced final report.

1.3 Definitions

Table 1.1: Definitions

Client	Fugro Geoservices Limited
Survey Sub-Contractor	Fugro GB (North) Marine Limited
Project Type	Geotechnical Investigations
Location	Danish sector of the North Sea 1 offshore wind farm area (Subarea1), approximately 20 km off the west coast of Jutland, Denmark
JUB	Excalibur
Coordinates	Geographical coordinates are referenced to ETRS89. Grid coordinates are referenced to Universal Transverse Mercator Projection, Northern Hemisphere with Central Meridian of 09° East. Details of the coordinate systems are described in Table 4.1.
Units	metre

1.4 Reference Documentation

Table 1.2: Reference Documentation

Filename	Description
FGBNM-240149-R01	Excalibur mobilisation and calibration report
20240309_EUAF-FGBNM-MPC-FO-023	Excalibur - Vessel Information Sheet
FGBNM-240149-R02	Excalibur positioning report (this report)

2. Results

2.1 Field Locations

Table 2.1 shows the final BH and CPT positions at location Subarea 1.

Unless otherwise specified all positions reported are relative to the JUB CRP.

Table 2.1: Actual coordinates (ETRS89, UTM 32N, DTU21 MSS)

Location	Easting [m]	Northing [m]	Latitude	Longitude	Height [m]
BH080	406415.37	6197278.82	55°54'42.5727"N	007°30'10.1370"E	-21.17
BH081	410763.83	6197260.70	55°54'44.9594"N	007°34'20.5120"E	-20.07
BH081-CPT	410761.52	6197256.09	55°54'44.8089"N	007°34'20.3844"E	-20.56
BH093	408744.95	6194771.71	55°53'23.1133"N	007°32'27.3010"E	-19.66
BH101	415455.88	6192139.90	55° 52' 02.4158" N	007° 38' 56.4172" E	-20.23
BH101-CPT	415452.07	6192139.49	55°52'02.3998"N	007°38'56.1986"E	-20.26
BH106	410539.13	6190038.81	55°50'51.2798"N	007°34'16.1611"E	-18.76
BH110	417037.51	6188390.11	55°50'02.1444"N	007°40'31.5030"E	-19.85
CPT093	408742.01	6194772.55	55° 53' 23.1386" N	007° 32' 27.1303" E	N/A*
CPT106	410535.02	6190041.99	55°50'51.3798"N	007°34'15.9209"E	-18.68
CPT110	417033.06	6188392.11	55°50'02.2061"N	007°40'31.2453"E	-19.70
CPT131	409953.21	6187128.30	55°49'16.7718"N	007°33'45.9565"E	-17.27
CPT157	408993.50	6187641.72	55°49'32.7263"N	007°32'50.2133"E	-17.37
CPT182	409446.31	6193902.39	55° 52' 55.4792" N	007° 33' 08.7033" E	-19.80
CPT221	414313.81	6186769.29	55°49'08.0182"N	007°37'56.8394"E	-18.65
CPT247	408820.24	6189689.74	55°50'38.8340"N	007°32'37.7857"E	-18.32
CPT251	407950.66	6192572.84	55°52'11.4671"N	007°31'44.2873"E	-19.31
CPT263	417947.38	6186537.15	55° 49' 02.7827" N	007° 41' 25.7981" E	N/A*
CPT306	415113.64	6189019.06	55° 50' 21.2791" N	007° 38' 40.2500" E	N/A*
CPT314	415718.53	6184999.02	55°48'11.6612"N	007°39'19.4979"E	-18.62
CPT316	411723.58	6189280.74	55°50'27.5516"N	007°35'25.1287"E	-19.43
CPT388	413744.80	6191758.88	55°51'49.0034"N	007°37'18.4517"E	-19.27
CPT390	406771.41	6186160.96	55°48'43.3187"N	007°30'44.3939"E	-19.89

Location	Easting [m]	Northing [m]	Latitude	Longitude	Height [m]
CPT400	414538.11	6194012.62	55°53'02.3918"N	007°38'01.5108"E	-19.53
CPT400	414538.11	6194012.62	55° 53' 02.3918" N	007° 38' 01.5108" E	-19.53

* No Deck to mud measurement

Table 2.2: Actual location details (ETRS89, UTM 32N, DTU21 MSS)

Location	Actual		Proposed		Actual to Proposed	
	Easting [m]	Northing [m]	Easting [m]	Northing [m]	Range [m]	Bearing [°]
BH080	406415.37	6197278.82	406417.00	6197280.00	2.01	54.27
BH081	410763.83	6197260.70	410760.00	6197260.00	3.89	259.69
BH081-CPT	410761.52	6197256.09	410760.00	6197260.00	4.20	338.81
BH093	408744.95	6194771.71	408742.00	6194770.00	3.41	239.95
BH101	415455.88	6192139.90	415453.00	6192140.00	2.88	271.90
BH101-CPT	415452.07	6192139.49	415453.00	6192140.00	1.06	61.04
BH106	410539.13	6190038.81	410536.00	6190040.00	3.35	290.85
BH110	417037.51	6188390.11	417034.00	6188390.00	3.51	268.17
CPT093	408742.01	6194772.55	408742.00	6194770.00	2.55	180.16
CPT106	410535.02	6190041.99	410536.00	6190040.00	2.22	153.67
CPT110	417033.06	6188392.11	417034.00	6188390.00	2.31	156.05
CPT131	409953.21	6187128.30	409952.00	6187130.00	2.09	324.59
CPT157	408993.50	6187641.72	408994.00	6187640.00	1.79	163.83
CPT182	409446.31	6193902.39	409447.00	6193900.00	2.49	163.83
CPT221	414313.81	6186769.29	414314.00	6186770.00	0.73	15.14
CPT247	408820.24	6189689.74	408820.00	6189690.00	0.35	316.85
CPT251	407950.66	6192572.84	407948.00	6192570.00	3.89	223.13
CPT263	417947.38	6186537.15	417947.00	6186540.00	2.88	352.49
CPT306	415113.64	6189019.06	415112.00	6189020.00	1.89	299.69
CPT314	415718.53	6184999.02	415718.00	6185000.00	1.11	331.50
CPT316	411723.58	6189280.74	411723.00	6189280.00	0.94	218.00
CPT388	413744.80	6191758.88	413744.00	6191760.00	1.38	324.52

Location	Actual		Proposed		Actual to Proposed	
	Easting [m]	Northing [m]	Easting [m]	Northing [m]	Range [m]	Bearing [°]
CPT390	406771.41	6186160.96	406771.00	6186160.00	1.04	203.30
CPT400	414538.11	6194012.62	414541.00	6194010.00	3.90	132.17
CPT400	414538.11	6194012.62	414541.00	6194010.00	3.90	132.17

3. Summary of Events

A series of alongside checks and calibrations were undertaken between 8 and 9 March 2024, while the Excalibur JUB was alongside Holyhead. Refer to report FGBNM-240149-R0 01.

The scope was conducted by Excalibur in Subarea 1, between 28 April and 25 June 2024.

The position of the JUB at each location was recorded by FGSL personnel onboard the JUB.

A 10-minute Mean Position Report was run at each location along with measurement of the deck to mud depth.

4. Survey Control

4.1 Geodetic Parameters

Table 4.1: Geodetic Parameters

Name: ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters*		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6 378 137.00 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6 378 137.00 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map projection	Transverse Mercator	
Grid system	UTM zone 32N	EPSG:16032
Latitude origin	00° 00' 00.000" N	
Central meridian	009° 00' 00.000" E	
Scale factor on central meridian	0.9996	
False easting	500 000 m	
False northing	0 m	
Project Vertical Parameters		
Vertical coordinate reference system	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478
Notes		
* The geodetic datum of Fugro's global GNSS correction data is ITRF2014, epoch 2023 (01/01/2023 00:00:00)		

4.2 Heading Systems

The following heading solutions were utilised to position the Excalibur JUB:

Table 4.2: Heading Systems

Primary	Starfix GNSS Heading [SPK1]
Secondary	Starfix GNSS Heading [SPK2]
Tertiary	Meridian Surveyor Gyrocompass

4.3 DGNSS Positioning Systems

The following Fugro DGNSS solutions were utilised to position the Excalibur JUB:

Table 4.3: Primary Navigation – SPK1 Starfix.G4+

GNSS Receiver	Fugro StarPod L1/L2 GPS and GLONASS receiver with integrated demodulator
Antenna	AD492
Correction Data	Differential carrier Precise point positioning (PPP) GPS and GLONASS positioning solution using clock and orbit corrections from Fugro Starfix.G4+ network
Data Output	Fugro G4+ computation telegram to Starfix.NG

Table 4.4: Secondary Navigation – SPK2 Starfix.G4+

GNSS Receiver	Fugro StarPod L1/L2 GPS and GLONASS receiver with integrated demodulator
Antenna	AD492
Correction Data	Differential carrier Precise point positioning (PPP) GPS and GLONASS positioning solution using clock and orbit corrections from Fugro Starfix.G4+ network
Data Output	Fugro G4+ computation telegram to Starfix.NG

5. Personnel and Equipment

5.1 Personnel

Table 5.1: Personnel

Survey Personnel	Position	On	Off
ROC	ROC	-	-

5.2 Equipment

Table 5.2: Positioning Equipment

Item	Quantity	Spare
Dual StarPack	2	1
Starpack	1	1
AD492 antenna	5	1
Starfix PC	4	1
Rig rack	1	
Samsung Galaxy A7 tablet	1	
IP Phone + headset (for ROC)	1	
Juniper switch (for ROC)	1	
Toolbox	1	
UPS	1	1
24" monitor	4	2
Satel	3	1
100m belden cable	3	
60m belden cable	3	
25m belden cable	1	
20m Belden cable	2	
In-line amplifier	1	
Network cable reel	2	
USB Hub	?	
Tug pack Europod Europod PSU Europod cable WLAN access point WLAN omni antenna UPS Monitor	1	1

6. Health and Safety

Fugro personnel discussed and conducted job specific risk assessments. All hazards and risks were identified, and control measures discussed and put in place to enable the rig move to be conducted in a safe manner.

Fugro personnel adhered to safety management systems at all times. There were no incidents involving Fugro personnel during the project.

Working hours were planned and controlled in accordance with Fugro procedures, to provide cover as required.

7. Performance, Conclusions and Recommendations

General

From a survey positioning perspective, the operations were carried out safely, without incident and in accordance with the positioning requirements.

Starfix.NG Software and Associated Hardware

All systems performed well, delivering the scope of the project successfully.

DGNSS Positioning Systems

The primary (SPK1 G4+) and secondary (SPK2 G4+) DGNSS positioning systems performed well throughout the majority of the project with all systems generally showing a correlation of ± 0.20 m. Good performance was indicated by the low PDOP values (generally < 2).

Appendix A

Sequence of Events

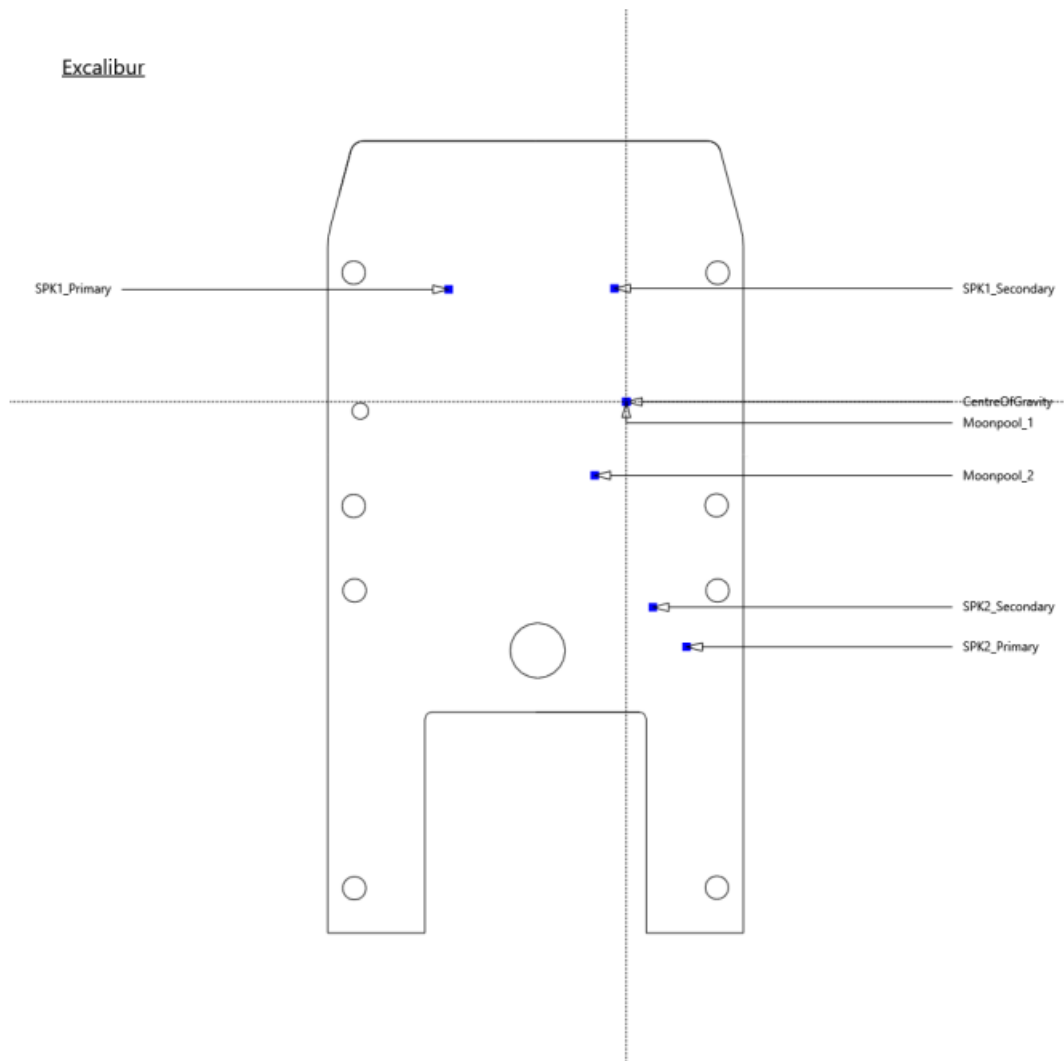
A.1 Sequence of Events

Date	Event
08/03/24 to 09/03/24	Mobilisation and calibrations in Holyhead
28/04/24 to 25/06/24	Geotechnical investigations in Subarea1

Appendix B

Offset Diagram

B.1 Excalibur



Name	Purpose	X offset [m]	Y offset [m]	Z offset [m]
CentreOfGravity	Centre of gravity	0.00	0.00	0.00
Moonpool_1	The common reference point of the vessel.	0.00	0.00	0.00
Moonpool_2		-2.44	-5.66	-0.03
SPK1_Primary		-13.67	8.65	11.73
SPK1_Secondary		-0.91	8.72	12.01
SPK2_Primary		4.63	-18.86	6.83
SPK2_Secondary		2.04	-15.81	6.97

Appendix C

**Drilling, Testing and Sampling
Records**

Contents Appendix C: Drilling, Testing and Sampling Records

- C.1: Recovery Lists
- C.2: Operator Logs
- C.2: Driller Logs

C.1 Recovery Lists

List of Plates

Recovery List

34 Plates

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
SNC	SC01	0.00	130	0.00	60	
SNC	SC02	1.30	150	1.30	140	
SNC	SC03	2.80	155	2.80	155	
SNC	SC04	4.35	150	4.35	150	
SNC	SC05	5.85	155	5.85	120	
PUS	PS01	7.40	100	7.40	95	3-inch thick walled sample tube with core catcher
PUS	PS02	8.40	100	8.40	95	3-inch thick walled sample tube with core catcher
PUS	PS03	9.40	100	9.40	100	3-inch thick walled sample tube with core catcher
PUS	PS04	10.40	100	10.40	95	3-inch thick walled sample tube with core catcher
SNC	SC06	11.40	155	11.40	55	
SNC	SC07	11.95	155	11.95	120	
SNC	SC08	13.50	150	13.50	140	
SNC	SC09	15.00	155	15.00	155	
SNC	SC10	16.55	150	16.55	135	
SNC	SC11	18.05	155	18.05	155	
SNC	SC12	19.60	150	19.60	125	
SNC	SC13	21.10	155	21.10	155	
SNC	SC14	22.65	150	22.65	150	
SNC	SC15	24.15	155	24.15	155	
SNC	SC16	25.70	150	25.70	150	
SNC	SC17	27.20	155	27.20	155	
SNC	SC18	28.75	150	28.75	150	
SNC	SC19	30.25	155	30.25	155	
SNC	SC20	31.80	150	31.80	140	
SNC	SC21	33.30	155	33.30	155	
SNC	SC22	34.85	150	34.85	145	
SNC	SC23	36.35	155	36.35	145	
SNC	SC24	37.90	150	37.90	150	
SNC	SC25	39.40	155	39.40	155	
SNC	SC26	40.95	150	40.95	150	
SNC	SC27	42.45	155	42.45	155	
SNC	SC28	44.00	150	44.00	150	
SNC	SC29	45.50	155	45.50	155	
SNC	SC30	47.05	150	47.05	150	
SNC	SC31	48.55	155	48.55	155	
SNC	SC32	50.10	150	50.10	150	

Notes

BSF : Below seafloor

Borehole Summary:

Total drilled depth	: 70.10 m	Final recovery depth	: 70.00 m
Total cone penetration test recovery	: 0 cm	Total sample recovery	: 6760 cm
Number of cone penetration tests	: 0	Number of samples	: 48
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0

Remarks:

Client Representative:
Leumman Dos Santos / Maurizo Prodan

Fugro Representative:
Christopher Smith

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
SNC	SC33	51.60	155	51.60	155	
SNC	SC34	53.15	150	53.15	150	
SNC	SC35	54.65	155	54.65	155	
SNC	SC36	56.20	150	56.20	150	
SNC	SC37	57.70	155	57.70	155	
SNC	SC38	59.25	150	59.25	150	
SNC	SC39	60.75	155	60.75	155	
SNC	SC40	62.30	150	62.30	150	
SNC	SC41	63.80	155	63.80	155	
SNC	SC42	65.35	150	65.35	150	
SNC	SC43	66.85	155	66.85	155	
SNC	SC44	68.40	170	68.40	160	

Notes
BSF : Below seafloor

Borehole Summary:			
Total drilled depth	: 70.10 m	Final recovery depth	: 70.00 m
Total cone penetration test recovery	: 0 cm	Total sample recovery	: 6760 cm
Number of cone penetration tests	: 0	Number of samples	: 48
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Leumman Dos Santos / Maurizo Prodan		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
SNC	SC01	0.25	150	0.25	25	
SNC	SC02	1.75	155	1.75	30	
SNC	SC03	3.30	150	3.30	60	
PUS	PS01	4.80	100	4.80	80	3-inch thick walled sample tube with core catcher
PUS	PS02	5.80	100	5.80	85	3-inch thick walled sample tube with core catcher
PUS	PS03	6.80	100	6.80	85	3-inch thick walled sample tube with core catcher
PUS	PS04	7.80	100	7.80	90	3-inch thin walled sample tube
PUS	PS05	8.80	50	8.80	40	3-inch thin walled sample tube
SNC	SC04	9.30	150	9.30	150	
SNC	SC05	10.80	155	10.80	155	
SNC	SC06	12.35	150	12.35	150	
SNC	SC07	13.85	155	13.85	25	
SNC	SC08	13.85	155	14.10	110	
SNC	SC09	15.40	150	15.40	150	
SNC	SC10	16.90	155	16.90	155	
SNC	SC11	18.45	150	18.45	150	
SNC	SC12	19.95	155	19.95	155	
RC	RC01	21.50	100	21.50	40	LINER_102_MM
RC	RC02	22.50	150	22.50	150	LINER_102_MM
RC	RC03	24.00	150	24.00	150	LINER_102_MM
RC	RC04	25.50	75	25.50	75	LINER_102_MM
RC	RC05	26.25	75	26.25	75	LINER_102_MM
RC	RC06	27.00	75	27.00	75	LINER_102_MM
RC	RC07	27.75	75	27.75	75	LINER_102_MM
RC	RC08	28.50	150	28.50	140	LINER_102_MM
RC	RC09	30.00	150	30.00	0	LINER_102_MM
PUS	PS06	31.50	75	31.50	40	3-inch thick walled sample tube with core catcher
RC	RC10	31.50	75	31.90	20	LINER_102_MM
RC	RC11	32.25	75	32.25	75	LINER_102_MM
RC	RC12	33.00	150	33.00	150	LINER_102_MM
RC	RC13	34.50	150	34.50	135	LINER_102_MM
RC	RC14	36.00	150	36.00	150	LINER_102_MM
RC	RC15	37.50	150	37.50	150	LINER_102_MM
RC	RC16	39.00	150	39.00	150	LINER_102_MM
RC	RC17	40.50	150	40.50	150	LINER_102_MM
RC	RC18	42.00	150	42.00	150	LINER_102_MM

Notes

BSF : Below seafloor

Borehole Summary:

Total drilled depth	: 69.00 m	Final recovery depth	: 70.50 m
Total cone penetration test recovery	: 0 cm	Total sample recovery	: 6015 cm
Number of cone penetration tests	: 0	Number of samples	: 57
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0

Remarks:

Client Representative:
Leumman Dos Santos / Maurizo Prodan

Fugro Representative:
Christopher Smith

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
RC	RC19	43.50	150	43.50	150	LINER_102_MM
RC	RC20	45.00	150	45.00	130	LINER_102_MM
RC	RC21	46.50	150	46.50	150	LINER_102_MM
RC	RC22	48.00	150	48.00	150	LINER_102_MM
RC	RC23	49.50	150	49.50	115	LINER_102_MM
RC	RC24	51.00	150	51.00	130	LINER_102_MM
RC	RC25	52.50	150	52.50	150	LINER_102_MM
RC	RC26	54.00	150	54.00	150	LINER_102_MM
RC	RC27	55.50	150	55.50	150	LINER_102_MM
RC	RC28	57.00	150	57.00	150	LINER_102_MM
RC	RC29	58.50	150	58.50	150	LINER_102_MM
RC	RC30	60.00	150	60.00	150	LINER_102_MM
RC	RC31	61.50	150	61.50	20	LINER_102_MM
RC	RC32	63.00	150	63.00	150	LINER_102_MM
RC	RC33	64.50	75	64.50	20	LINER_102_MM
RC	RC34	65.25	75	65.25	20	LINER_102_MM
RC	RC35	66.00	75	66.00	75	LINER_102_MM
RC	RC36	66.75	75	66.75	75	LINER_102_MM
RC	RC37	67.50	75	67.50	60	LINER_102_MM
RC	RC38	68.25	75	68.25	75	LINER_102_MM
RC	RC39	69.00	150	69.00	150	LINER_102_MM

Notes
BSF : Below seafloor

Borehole Summary:			
Total drilled depth	: 69.00 m	Final recovery depth	: 70.50 m
Total cone penetration test recovery	: 0 cm	Total sample recovery	: 6015 cm
Number of cone penetration tests	: 0	Number of samples	: 57
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Leumman Dos Santos / Maurizo Prodan		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	01	15.00	145	15.80	65	CP10-CF100PB10SN2-1706-2788, Maximum total thrust limit exceeded, u2 stopped increasing during lowering of tool, possible unsaturated u2 filter, used theoretical hysrostatic offset for u2.
CPT	02	16.50	78	16.52	76	CP10-CF100PB10SN2-1706-2788, Maximum total thrust limit exceeded
CPT	03	17.50	56	17.56	50	CP10-CF100PB10SN2-1706-2788, Maximum tip resistance limit exceeded
CPT	04	18.00	25	18.05	20	CP10-CF100PB10SN2-1706-2788, Maximum tip resistance limit exceeded, Due to repeated early refusals the onboard client representative instructed to drillout 1.00 m for next test.
CPT	05	19.00	30	19.09	21	CP10-CF100PB10SN2-1706-2788, Maximum total thrust limit exceeded, Due to repeated early refusals the onboard client representative instructed to drillout 1.00 m for next test.
CPT	06	20.00	35	20.06	29	CP10-CF100PB10SN2-1706-2788, Maximum tip resistance limit exceeded, Due to repeated early refusals the onboard client representative instructed to drillout 1.00 m for next test.
CPT	07	21.00	68	21.10	58	CP10-CF100PB10SN2-1706-2788, Maximum tip resistance limit exceeded
CPT	08	22.00	148	22.22	126	CP10-CF100PB10SN2-1706-2788, Maximum stroke
CPT	09	23.50	121	23.60	111	CP10-CF100PB10SN2-1706-2788, Maximum total thrust limit exceeded, Tool didn't latch on first attemp, so raised to deck to check mechanism while borehole flushed. Operator forgot to stop and restart test while doing this.
CPT	10	25.00	98	25.09	89	CP10-CF100PB10SN2-1706-2788, Maximum total thrust limit exceeded
CPT	11	26.00	150	26.07	143	CP10-CF100PB10SN2-1706-2788, Maximum stroke
CPT	12	27.50	150	27.51	149	CP10-CF100PB10SN2-1706-2788, Maximum stroke
CPT	13	29.00	68	29.04	64	CP10-CF100PB10SN2-1706-2788, Maximum tip resistance limit exceeded
CPT	14	30.00	76	30.09	67	CP10-CF100PB10SN2-1706-2788, Maximum total thrust limit exceeded
CPT	15	31.00	143	31.07	136	CP10-CF100PB10SN2-1706-2788, Maximum total thrust limit exceeded

Notes

BSF : Below seafloor

Borehole Summary:			
Total drilled depth	: 54.00 m	Final recovery depth	: 55.37 m
Total cone penetration test recovery	: 3177 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 31	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Rob Harwood/ Leumman Dos Santos		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	16	32.50	81	32.59	72	CP10-CF100PB10SN2-1706-2788, Maximum total thrust limit exceeded
CPT	17	33.50	63	33.59	54	CP10-CF100PB10SN2-1706-2788, Maximum total thrust limit exceeded
CPT	18	34.50	110	34.59	101	CP10-CF100PB10SN2-1706-2788, Maximum total thrust limit exceeded
CPT	19	36.00	126	36.10	116	CP10-CF100PB10SN2-1706-2788, Maximum total thrust limit exceeded
CPT	20	37.50	149	37.58	141	CP10-CF100PB10SN2-1706-2788, Maximum tip resistance limit exceeded
CPT	21	39.00	147	39.09	138	CP10-CF100PB10SN2-1706-2788, Maximum total thrust limit exceeded
CPT	22	40.50	124	40.60	114	CP10-CF100PB10SN2-1706-2788, Maximum tip resistance limit exceeded, Due to increasing zero drift this cone was replaced before next test.
CPT	23	42.00	150	42.09	141	CP10-CF100PB10SN2-1706-2790, Maximum stroke
CPT	24	43.50	149	43.58	141	CP10-CF100PB10SN2-1706-2790, Maximum stroke
CPT	25	45.00	142	45.10	132	CP10-CF100PB10SN2-1706-2790, Maximum stroke
CPT	26	46.50	149	46.55	144	CP10-CF100PB10SN2-1706-2790, Maximum stroke
CPT	27	48.00	150	48.10	140	CP10-CF100PB10SN2-1706-2790, Maximum stroke
CPT	28	49.50	150	49.58	142	CP10-CF100PB10SN2-1706-2790, Maximum stroke
CPT	29	51.00	150	51.09	141	CP10-CF100PB10SN2-1706-2790, Maximum stroke, Second attempt to push at this depth after latching issue on lowering for first attempt.
CPT	30	52.50	129	52.55	124	CP10-CF100PB10SN2-1706-2790, Maximum tip resistance limit exceeded
CPT	31	54.00	137	54.05	132	CP10-CF100PB10SN2-1706-2790, Maximum tip resistance limit exceeded
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 54.00 m	Final recovery depth	: 55.37 m
Total cone penetration test recovery	: 3177 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 31	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Rob Harwood/ Leumman Dos Santos		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
SNC	SC01	0.00	87	0.00	0	null , No Recovery
SNC	SC02	0.87	87	1.15	60	null , Top of sample assumed to be lost due to disturbance from 10-inch riser casing installation. Desc;Photo;HCL;MC
SNC	SC03	1.75	155	1.75	155	null , Desc;Photo;HCL;MC;UW
SNC	SC04	3.30	150	3.30	0	null , No recovery. Core catcher broke and slipped out of barrel with sample.
SNC	SC05	4.80	155	4.80	145	null , Desc;Photo;HCL;MC;UW
SNC	SC06	6.35	150	6.35	110	null , Desc;Photo;HCL;MC
PUS	PS01	7.85	100	7.85	85	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS02	8.85	100	8.85	90	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS03	9.85	100	9.85	85	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS04	10.85	100	10.85	85	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS05	11.85	100	11.85	85	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS06	12.85	100	12.85	70	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS07	13.85	100	13.85	85	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS08	14.85	100	14.85	85	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS09	15.85	100	15.85	70	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS10	16.85	100	16.85	55	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS11	17.85	100	17.85	70	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS12	18.85	100	18.85	85	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW

Notes
BSF : Below seafloor

Borehole Summary:			
Total drilled depth	: 70.35 m	Final recovery depth	: 70.35 m
Total cone penetration test recovery	: 0 cm	Total sample recovery	: 5674 cm
Number of cone penetration tests	: 0	Number of samples	: 58
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Leumman Dos Santos / William Lowry		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
PUS	PS13	19.85	100	19.85	85	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS14	20.85	100	20.85	90	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS15	21.85	100	21.85	75	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS16	22.85	100	22.85	0	3-inch thick walled sample tube with core catcher, No recovery. Driller assumed ground too soft for metal catcher type, changed to plastic catcher for next push.
PUS	PS17	23.85	100	23.85	50	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC
PUS	PS18	24.85	100	24.85	90	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS19	25.85	100	25.85	90	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC
PUS	PS20	26.85	100	26.85	90	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS21	27.85	100	27.85	80	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC
PUS	PS22	28.85	100	28.85	92	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC
PUS	PS23	29.85	100	29.85	90	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC
PUS	PS24	30.85	100	30.85	90	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC
PUS	PS25	31.85	100	31.85	81	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS26	32.85	100	32.85	90	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS27	33.85	100	33.85	90	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW;PP;TV
PUS	PS28	34.85	100	34.85	83	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC
PUS	PS29	35.85	100	35.85	65	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
PUS	PS30	36.85	100	36.85	90	3-inch thick walled sample tube with core catcher, Core catcher pushed up into tube by sample. Desc;Photo;HCL;MC;UW;PP
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 70.35 m	Final recovery depth	: 70.35 m
Total cone penetration test recovery	: 0 cm	Total sample recovery	: 5674 cm
Number of cone penetration tests	: 0	Number of samples	: 58
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Leumman Dos Santos / William Lowry		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
PUS	PS31	37.85	100	37.85	85	3-inch thick walled sample tube with core catcher, Desc;Photo;HCL;MC;UW
SNC	SC07	38.85	100	38.85	100	Desc;Photo;HCL;MC
SNC	SC08	39.85	155	39.85	143	Desc;Photo;HCL;MC;UW
SNC	SC09	41.40	150	41.40	120	Desc;Photo;HCL;MC;UW
SNC	SC10	42.90	155	42.90	95	Desc;Photo;HCL;MC;UW
SNC	SC11	44.45	150	44.45	90	Desc;Photo;HCL;MC;UW
SNC	SC12	45.95	155	45.95	155	Desc;Photo;HCL;MC;UW
SNC	SC13	47.50	150	47.50	85	Desc;Photo;HCL;MC;UW
SNC	SC14	49.00	155	49.00	95	Desc;Photo;HCL;MC;UW
SNC	SC15	50.55	150	50.55	50	Desc;Photo;HCL;MC;UW
SNC	SC16	52.05	155	52.05	140	Desc;Photo;HCL;MC;UW
SNC	SC17	53.60	150	53.60	150	Desc;Photo;HCL;MC;UW
SNC	SC18	55.10	155	55.10	155	Desc;Photo;HCL;MC;UW
SNC	SC19	56.65	150	56.65	150	Desc;Photo;HCL;MC;UW
SNC	SC20	58.15	155	58.15	155	Desc;Photo;HCL;MC;UW
SNC	SC21	59.70	150	59.70	150	Desc;Photo;HCL;MC;UW
SNC	SC22	61.20	155	61.20	155	Desc;Photo;HCL;MC;UW
SNC	SC23	62.75	150	62.75	150	Desc;Photo;HCL;MC
SNC	SC24	64.25	155	64.25	155	Desc;Photo;HCL;MC;UW

Notes
BSF : Below seafloor

Borehole Summary:			
Total drilled depth	: 70.35 m	Final recovery depth	: 70.35 m
Total cone penetration test recovery	: 0 cm	Total sample recovery	: 5674 cm
Number of cone penetration tests	: 0	Number of samples	: 58
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Leumman Dos Santos / William Lowry		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
SNC	SC25	65.80	150	65.80	150	Desc;Photo;HCL;MC;UW
SNC	SC26	67.30	155	67.30	155	Desc;Photo;HCL;MC
SNC	SC27	68.85	150	68.85	150	Desc;Photo;HCL;MC
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 70.35 m	Final recovery depth	: 70.35 m
Total cone penetration test recovery	: 0 cm	Total sample recovery	: 5674 cm
Number of cone penetration tests	: 0	Number of samples	: 58
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Leumman Dos Santos / William Lowry		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
SNC	SC01	0.00	115	0.95	20	Desc;Photo;MC;HCL; 0.00 m to 0.95 m - assumed core loss due to disturbance from casing install
SNC	SC02	1.15	150	1.15	35	Desc;Photo;MC;HCL; 1.15 m to 2.65 m - assumed zone of core loss
SNC	SC03	2.65	155	2.65	10	Desc;Photo;HCL; Low recovery due to overpressuring of sonic barrel
SNC	SC04	4.20	150	4.20	145	Desc;Photo;MC;UW;HCL
SNC	SC05	5.70	155	5.70	120	Desc;Photo;MC;UW;HCL
SNC	SC06	7.25	150	7.25	150	Desc;Photo;MC;HCL
PUS	PS01	8.75	100	8.75	25	3-inch thick walled sample tube with core catcher, Desc;Photo;MC;HCL
PUS	PS02	9.75	100	9.75	95	3-inch thick walled sample tube with core catcher, Desc;Photo;MC;UW;HCL; Core catcher carried up into tube by sample
PUS	PS03	10.75	100	10.75	85	3-inch thick walled sample tube with core catcher, Desc;Photo;MC;UW;HCL
PUS	PS04	11.75	100	11.75	95	3-inch thick walled sample tube with core catcher, Desc;Photo;MC;UW;HCL
PUS	PS05	12.75	100	12.75	95	3-inch thick walled sample tube with core catcher, Desc;Photo;MC;UW;HCL;PP;TV;UU
PUS	PS06	13.75	100	13.75	85	3-inch thick walled sample tube with core catcher, Desc;Photo;MC;UW;HCL;PP
PUS	PS07	14.75	100	14.75	85	3-inch thick walled sample tube with core catcher, Desc;Photo;MC;UW;HCL;PP;TV
PUS	PS08	15.75	100	15.75	70	3-inch thin walled sample tube, Desc;Photo;MC;UW;HCL;PP;TV
PUS	PS09	16.75	100	16.75	60	3-inch thin walled sample tube, Desc;Photo;MC;UW;HCL;PP;TV;UU
PUS	PS10	17.75	100	17.75	70	3-inch thin walled sample tube, Desc;Photo;MC;UW;HCL;PP;TV
PUS	PS11	18.75	100	18.75	77	3-inch thin walled sample tube, Desc;Photo;MC;UW;HCL;PP;TV
PUS	PS12	19.75	100	19.75	83	3-inch thin walled sample tube, Desc;Photo;MC;HCL;PP;TV

Notes

BSF : Below seafloor

Borehole Summary:

Total drilled depth	: 70.80 m	Final recovery depth	: 70.80 m
Total cone penetration test recovery	: 0 cm	Total sample recovery	: 6319 cm
Number of cone penetration tests	: 0	Number of samples	: 53
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0

Remarks:

Client Representative:
Leumman Dos Santos / William Lowry

Fugro Representative:
Christopher Smith

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
PUS	PS13	20.75	100	20.75	79	3-inch thin walled sample tube, Desc;Photo;MC;UW;HCL;PP;TV
PUS	PS14	21.75	100	21.75	95	3-inch thick walled sample tube with core catcher, Desc;Photo;MC;HCL
PUS	PS15	22.75	100	22.75	90	3-inch thick walled sample tube with core catcher, Desc;Photo;MC;HCL
PUS	PS16	23.75	100	23.75	95	3-inch thick walled sample tube with core catcher, Desc;Photo;MC;UW;HCL;PP
PUS	PS17	24.75	75	24.75	25	3-inch thick walled sample tube with core catcher, Desc;Photo;MC;HCL
SNC	SC07	25.50	155	25.50	155	Desc;Photo;MC;UW;HCL;PP;TV
SNC	SC08	27.05	150	27.05	150	Desc;Photo;MC;HCL
SNC	SC09	28.55	155	28.55	155	Desc;Photo;MC;UW;HCL
SNC	SC10	30.10	150	30.10	150	Desc;Photo;MC;UW;HCL;PP
SNC	SC11	31.60	155	31.60	155	Desc;Photo;MC;UW;HCL
SNC	SC12	33.15	150	33.15	150	Desc;Photo;MC;UW;HCL
SNC	SC13	34.65	155	34.65	155	Desc;Photo;MC;HCL
SNC	SC14	36.20	150	36.20	150	Desc;Photo;MC;HCL
SNC	SC15	37.70	155	37.70	155	Desc;Photo;MC;UW;HCL
SNC	SC16	39.25	150	39.25	150	Desc;Photo;MC;UW;HCL
SNC	SC17	40.75	155	40.75	155	Desc;Photo;MC;HCL;PP
SNC	SC18	42.30	150	42.30	150	Desc;Photo;MC;HCL;PP
RC	RC01	43.80	150	43.80	150	LINER_102_MM, Desc;Photo;MC
RC	RC02	45.30	150	45.30	150	LINER_102_MM, Desc;Photo;MC

Notes
BSF : Below seafloor

Borehole Summary:			
Total drilled depth	: 70.80 m	Final recovery depth	: 70.80 m
Total cone penetration test recovery	: 0 cm	Total sample recovery	: 6319 cm
Number of cone penetration tests	: 0	Number of samples	: 53
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Leumman Dos Santos / William Lowry		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
RC	RC03	46.80	150	46.80	150	LINER_102_MM, Desc;Photo;MC
RC	RC04	48.30	150	48.30	150	LINER_102_MM, Desc;Photo;MC
RC	RC05	49.80	150	49.80	150	LINER_102_MM, Desc;Photo;MC
RC	RC06	51.30	150	51.30	150	LINER_102_MM, Desc;Photo;MC
RC	RC07	52.80	150	52.80	150	LINER_102_MM, Desc;Photo;MC
RC	RC08	54.30	150	54.30	150	LINER_102_MM, Desc;Photo;MC
RC	RC09	55.80	150	55.80	150	LINER_102_MM, Desc;Photo;MC
RC	RC10	57.30	150	57.30	150	LINER_102_MM, Desc;Photo;MC
RC	RC11	58.80	150	58.80	150	LINER_102_MM, Desc;Photo;MC
RC	RC12	60.30	150	60.30	150	LINER_102_MM, Desc;Photo;MC
RC	RC13	61.80	150	61.80	150	LINER_102_MM, Desc;Photo;MC
RC	RC14	63.30	150	63.30	150	LINER_102_MM, Desc;Photo;MC
RC	RC15	64.80	150	64.80	150	LINER_102_MM, Desc;Photo;MC
RC	RC16	66.30	150	66.30	150	LINER_102_MM, Desc;Photo;MC
RC	RC17	67.80	150	67.80	150	LINER_102_MM, Desc;Photo;MC
RC	RC18	69.30	150	69.30	150	LINER_102_MM, Desc;Photo;MC

Notes
BSF : Below seafloor

Borehole Summary:			
Total drilled depth	: 70.80 m	Final recovery depth	: 70.80 m
Total cone penetration test recovery	: 0 cm	Total sample recovery	: 6319 cm
Number of cone penetration tests	: 0	Number of samples	: 53
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Leumman Dos Santos / William Lowry		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	02	33.00	149	33.01	148	CP10-CF100PB10SN2-1706-2368, Maximum stroke
CPT	03	34.50	150	34.52	148	CP10-CF100PB10SN2-1706-2368, Maximum stroke
CPT	04	36.00	148	36.08	140	CP10-CF100PB10SN2-1706-2368, Maximum stroke
CPT	05	37.50	94	37.59	85	CP10-CF100PB10SN2-1706-2368, Maximum tip resistance limit exceeded
CPT	06	38.50	41	38.54	37	CP10-CF100PB10SN2-1706-2368, Maximum tip resistance limit exceeded
CPT	07	39.50	36	39.52	34	CP10-CF100PB10SN2-1706-2368, Other, Max pore pressure value
RC	RC01	40.00	100	40.00	40	LINER_102_MM
CPT	08	40.00	27	40.02	25	CP10-CF100PB10SN2-1706-2368, Maximum tip resistance limit exceeded
CPT	10	41.00	48	41.02	46	CP10-CF100PB10SN2-1706-2368, Maximum tip resistance limit exceeded
CPT	11	41.50	24	41.56	18	CP10-CF100PB10SN2-1706-2368, Maximum tip resistance limit exceeded
CPT	12	42.00	148	42.08	140	CP10-CF100PB10SN2-1706-2368, Maximum stroke
CPT	13	43.50	149	43.51	148	CP10-CF100PB10SN2-1706-2368, Maximum stroke
CPT	14	44.90	149	45.00	139	CP10-CF100PB10SN2-1706-2368, Maximum stroke
CPT	15	46.46	57	46.50	53	CP10-CF100PB10SN2-1706-2368, Maximum total thrust limit exceeded
CPT	16	47.40	147	47.50	137	CP10-CF100PB10SN2-1706-2368, Maximum total thrust limit exceeded
CPT	17	48.89	150	49.00	139	CP10-CF100PB10SN2-1706-2368, Maximum stroke
CPT	18	50.40	98	50.50	88	CP10-CF100PB10SN2-1706-2368, Maximum total thrust limit exceeded
CPT	19	51.40	78	51.50	68	CP10-CF100PB10SN2-1706-2368, Maximum total thrust limit exceeded
CPT	20	52.39	127	52.50	116	CP10-CF100PB10SN2-1706-2790, Maximum total thrust limit exceeded
CPT	21	53.93	69	54.00	62	CP10-CF100PB10SN2-1706-2790, Maximum total thrust limit exceeded

Notes
BSF : Below seafloor

Borehole Summary:			
Total drilled depth	: 54.00 m	Final recovery depth	: 54.62 m
Total cone penetration test recovery	: 1771 cm	Total sample recovery	: 40 cm
Number of cone penetration tests	: 19	Number of samples	: 1
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Rob Harwood/ Leumman Dos Santos		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
SNC	SC01	0.00	60	0.00	40	
SNC	SC02	0.60	155	0.60	110	
SNC	SC03	2.15	150	2.15	140	
SNC	SC04	3.65	155	3.65	145	
SNC	SC05	5.20	60	5.20	60	
PUS	PS01	5.80	100	5.80	95	3-inch thin walled sample tube
PUS	PS02	6.80	100	6.80	88	3-inch thin walled sample tube
SNC	SC06	6.80	150	7.80	50	
SNC	SC07	8.30	155	8.30	115	
SNC	SC08	9.85	150	9.85	150	
SNC	SC09	11.35	155	11.35	130	
SNC	SC10	12.90	150	12.90	150	
SNC	SC11	14.40	155	14.40	155	
SNC	SC12	15.95	150	15.95	150	
PUS	PS03	17.45	60	17.45	55	3-inch thin walled sample tube
SNC	SC13	17.45	155	18.05	95	
SNC	SC14	19.00	150	19.00	150	
SNC	SC15	20.50	155	20.50	155	
SNC	SC16	22.05	150	22.05	150	
SNC	SC17	23.55	155	23.55	155	
SNC	SC18	25.10	150	25.10	130	
SNC	SC19	26.60	155	26.60	155	
SNC	SC20	28.15	150	28.15	150	
SNC	SC21	29.65	155	29.65	155	
SNC	SC22	31.20	150	31.20	150	
SNC	SC23	32.70	155	32.70	155	
SNC	SC24	34.25	150	34.25	150	
SNC	SC25	35.75	155	35.75	155	
SNC	SC26	37.30	150	37.30	115	
SNC	SC27	38.80	155	38.80	155	
SNC	SC28	40.35	150	40.35	150	
SNC	SC29	41.85	155	41.85	155	
SNC	SC30	43.40	150	43.40	140	
SNC	SC31	44.90	155	44.90	115	
SNC	SC32	46.45	150	46.45	140	
SNC	SC33	47.95	155	47.95	140	

Notes

BSF : Below seafloor

Borehole Summary:

Total drilled depth	: 69.80 m	Final recovery depth	: 69.80 m
Total cone penetration test recovery	: 0 cm	Total sample recovery	: 6153 cm
Number of cone penetration tests	: 0	Number of samples	: 49
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0

Remarks:

Client Representative:
Rob Harwood/ Leumman Dos Santos

Fugro Representative:
Christopher Smith

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
SNC	SC34	49.50	150	49.50	30	
RC	RC01	53.80	100	53.80	90	LINER_102_MM
RC	RC02	54.80	100	54.80	90	LINER_102_MM
RC	RC03	55.80	150	55.80	115	LINER_102_MM
RC	RC04	57.30	100	57.30	60	LINER_102_MM
RC	RC05	58.30	150	58.30	140	LINER_102_MM
RC	RC06	59.80	150	59.80	150	LINER_102_MM
RC	RC07	61.30	150	61.30	140	LINER_102_MM
RC	RC08	62.80	150	62.80	140	LINER_102_MM
RC	RC09	64.30	100	64.30	100	LINER_102_MM
RC	RC10	65.30	150	65.30	150	LINER_102_MM
RC	RC11	66.80	150	66.80	150	LINER_102_MM
RC	RC12	68.30	150	68.30	150	LINER_102_MM

Notes
BSF : Below seafloor

Borehole Summary:			
Total drilled depth	: 69.80 m	Final recovery depth	: 69.80 m
Total cone penetration test recovery	: 0 cm	Total sample recovery	: 6153 cm
Number of cone penetration tests	: 0	Number of samples	: 49
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Rob Harwood/ Leumman Dos Santos		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
SNC	SC01	0.00	150	0.00	0	
SNC	SC02	1.50	155	1.50	155	
SNC	SC03	3.05	150	3.05	150	
SNC	SC04	4.55	155	4.55	155	
SNC	SC05	6.10	150	6.10	150	
SNC	SC06	7.60	155	7.60	75	
SNC	SC07	9.15	150	9.15	150	
SNC	SC08	10.65	155	10.65	155	
SNC	SC09	12.20	150	12.20	150	
PUS	PS01	13.70	100	13.70	90	3-inch thick walled sample tube
SNC	SC10	13.70	155	14.70	55	
PUS	PS02	15.25	100	15.25	90	3-inch thick walled sample tube
SNC	SC11	15.25	150	16.25	50	
PUS	PS03	16.75	100	16.75	90	3-inch thick walled sample tube
SNC	SC12	16.75	155	17.75	55	
PUS	PS04	18.30	100	18.30	80	3-inch thick walled sample tube
SNC	SC13	18.30	150	19.30	50	
PUS	PS05	19.80	100	19.80	75	3-inch thick walled sample tube
SNC	SC14	19.80	155	20.80	55	
PUS	PS06	21.35	100	21.35	65	3-inch thick walled sample tube
SNC	SC15	21.35	150	22.35	50	
SNC	SC16	22.85	155	22.85	140	
SNC	SC17	24.40	150	24.40	150	
SNC	SC18	25.90	155	25.90	155	
SNC	SC19	27.45	150	27.45	60	
SNC	SC20	28.95	155	28.95	155	
SNC	SC21	30.50	150	30.50	150	
SNC	SC22	32.00	155	32.00	155	
SNC	SC23	33.55	150	33.55	150	
SNC	SC24	35.05	155	35.05	145	
SNC	SC25	36.60	150	36.60	100	
SNC	SC26	38.10	155	38.10	155	
SNC	SC27	39.65	150	39.65	100	
SNC	SC28	41.15	155	41.15	110	
SNC	SC29	42.70	150	42.70	150	
SNC	SC30	44.20	155	44.20	120	

Notes

BSF : Below seafloor

Borehole Summary:

Total drilled depth	: 69.90 m	Final recovery depth	: 70.70 m
Total cone penetration test recovery	: 0 cm	Total sample recovery	: 5976 cm
Number of cone penetration tests	: 0	Number of samples	: 59
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0

Remarks:

Client Representative:
Rob Harwood/ Leumman Dos Santos

Fugro Representative:
Christopher Smith

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
SNC	SC31	45.75	150	45.75	120	
SNC	SC32	47.25	155	47.25	120	
SNC	SC33	48.80	150	48.80	150	
SNC	SC34	50.30	155	50.30	110	
SNC	SC35	51.85	150	51.85	150	
PUS	PS07	53.35	100	53.35	90	3-inch thick walled sample tube
SNC	SC36	54.35	55	54.35	0	
PUS	PS08	54.90	100	54.90	85	3-inch thick walled sample tube
PUS	PS09	55.90	100	55.90	70	3-inch thick walled sample tube
PUS	PS10	56.90	100	56.90	85	3-inch thick walled sample tube
PUS	PS11	57.90	100	57.90	85	3-inch thick walled sample tube
PUS	PS12	58.90	100	58.90	87	3-inch thick walled sample tube
PUS	PS13	59.90	100	59.90	85	3-inch thick walled sample tube
PUS	PS14	60.90	100	60.90	85	3-inch thick walled sample tube
PUS	PS15	61.90	100	61.90	80	3-inch thick walled sample tube
PUS	PS16	62.90	100	62.90	80	3-inch thick walled sample tube
PUS	PS17	63.90	100	63.90	85	3-inch thick walled sample tube with core catcher
PUS	PS18	64.90	100	64.90	80	3-inch thick walled sample tube
PUS	PS19	65.90	100	65.90	82	3-inch thick walled sample tube
PUS	PS20	66.90	100	66.90	75	3-inch thick walled sample tube
PUS	PS21	67.90	100	67.90	72	3-inch thick walled sample tube
PUS	PS22	68.90	100	68.90	80	3-inch thick walled sample tube
PUS	PS23	69.90	100	69.90	80	3-inch thick walled sample tube

Notes
BSF : Below seafloor

Borehole Summary:			
Total drilled depth	: 69.90 m	Final recovery depth	: 70.70 m
Total cone penetration test recovery	: 0 cm	Total sample recovery	: 5976 cm
Number of cone penetration tests	: 0	Number of samples	: 59
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Rob Harwood/ Leumman Dos Santos		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	01	0.00	3854	1.57	3697	CP15-CF200PB10SN2-1715-0056, Maximum total thrust limit exceeded
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 1.50 m	Final recovery depth	: 38.54 m
Total cone penetration test recovery	: 3697 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 1	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Leumman Dos Santos / William Lowry		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	01	0.00	1316	0.90	1226	CP15-CF200PB10SN2-1715-0057, Maximum total thrust limit exceeded
CPT	02	13.50	11	13.50	11	CP15-CF200PB10SN2-1715-0057, Maximum total thrust limit exceeded

Notes
BSF : Below seafloor

Borehole Summary:			
Total drilled depth	: 13.50 m	Final recovery depth	: 13.61 m
Total cone penetration test recovery	: 1237 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 2	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Rob Harwood/ Leumman Dos Santos		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	01	0.00	2278	1.26	2150	CP15-CF200PB10SN2-1715-0057, Maximum tip resistance limit exceeded
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 0.90 m	Final recovery depth	: 22.78 m
Total cone penetration test recovery	: 2152 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 1	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Rob Harwood/ Leumman Dos Santos		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	01	0.00	2804	0.82	2722	CP15-CF200PB10SN2-1715-0057, Risk of rod buckling
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 0.80 m	Final recovery depth	: 28.04 m
Total cone penetration test recovery	: 2722 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 1	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Rob Harwood/ Leumman Dos Santos		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	01	0.00	2337	0.35	2302	CP15-CF200PB10SN2-1715-0057, Maximum total thrust limit exceeded
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 0.35 m	Final recovery depth	: 23.37 m
Total cone penetration test recovery	: 2302 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 1	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Rob Harwood/ Leumman Dos Santos		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	01	0.00	1266	1.00	1166	CP15-CF200PB10SN2-1715-0056, Target depth reached
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 0.90 m	Final recovery depth	: 12.66 m
Total cone penetration test recovery	: 1166 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 1	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Leumman Dos Santos / William Lowry		Fugro Representative: Christopher Smith	

Project ID : F217703 - Subarea 1
 Project title : Danish Offshore Wind 2030 - North Sea I - Subarea 1
 Client : Energinet
 Project area : Danish Sector, North Sea

Date : 04-May-2024

Location	Type	Penetration [m]	Recovery [m]	Termination reason and comment
CPT221	CPT	22.86	21.51	Friction; CPT terminated due to excessive friction on rods

Number of vibrocore points	: 0	Total vibrocore recovery	: 0.00 m
Number of in situ test points	: 1	Total in situ test recovery	: 21.51 m
Number of cone penetration test points	: 1	Total cone penetration test recovery	: 21.51 m
Number of seismic cone penetration test points	: 0	Total seismic cone penetration test recovery	: 0.00 m
Number of thermal cone penetration test points	: 0	Total thermal cone penetration test recovery	: 0.00 m

Remarks: Uploaded auto processing data, we are currently experiencing technical issues with Discovery. Once issue is resolved preliminary logging sessions with further processing will be issued.

Client Representative:
 Rob Harwood/ Leumman Dos Santos

Fugro Representative:
 Megan Magrosky

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	01	0.00	1465	1.30	1335	CP15-CF200PB10SN2-1715-0057, Maximum total thrust limit exceeded
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 1.30 m	Final recovery depth	: 14.65 m
Total cone penetration test recovery	: 1335 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 1	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Rob Harwood/ Leumman Dos Santos		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	01	0.00	2324	1.20	2204	CP15-CF200PB10SN2-1715-0056, Maximum total thrust limit exceeded
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 0.00 m	Final recovery depth	: 23.24 m
Total cone penetration test recovery	: 2204 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 1	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Leumman Dos Santos / William Lowry		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	01	0.00	3161	1.00	3061	CP15-CF200PB10SN2-1715-0057, Maximum total thrust limit exceeded
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 1.00 m	Final recovery depth	: 31.61 m
Total cone penetration test recovery	: 3061 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 1	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Rob Harwood/ Leumman Dos Santos		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	01	0.00	2303	1.00	2203	CP15-CF200PB10SN2-1715-0057, Maximum total thrust limit exceeded
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 1.00 m	Final recovery depth	: 23.03 m
Total cone penetration test recovery	: 2203 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 1	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Rob Harwood/ Leumman Dos Santos		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	02	0.00	2477	0.93	2384	CP15-CF200PB10SN2-1715-0057
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 0.00 m	Final recovery depth	: 25.01 m
Total cone penetration test recovery	: 2408 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 1	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Rob Harwood/ Leumman Dos Santos		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	01	0.00	1911	0.97	1814	CP15-CF200PB10SN2-1715-0057, Risk of rod buckling
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 0.90 m	Final recovery depth	: 19.11 m
Total cone penetration test recovery	: 1814 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 1	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Rob Harwood/ Leumman Dos Santos		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	01	0.00	2563	0.74	2489	CP15-CF200PB10SN2-1715-0057, Maximum total thrust limit exceeded
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 1.20 m	Final recovery depth	: 25.63 m
Total cone penetration test recovery	: 2489 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 1	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Rob Harwood/ Leumman Dos Santos		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	01	0.00	1558	1.30	1429	CP15-CF200PB10SN2-1715-0057, Risk of rod buckling
CPT	02	16.00	908	16.00	908	CP15-CF200PB10SN2-1715-0057, Maximum total thrust limit exceeded
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 16.00 m	Final recovery depth	: 25.08 m
Total cone penetration test recovery	: 2337 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 2	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Rob Harwood/ Leumman Dos Santos		Fugro Representative: Christopher Smith	

Type	ID	Start Penetration BSF [m]	Penetration [cm]	Start Recovery BSF [m]	Recovery [cm]	Comment
CPT	01	0.00	1723	1.39	1584	CP15-CF200PB10SN2-1715-0056, Maximum total thrust limit exceeded
Notes						
BSF : Below seafloor						

Borehole Summary:			
Total drilled depth	: 1.40 m	Final recovery depth	: 17.23 m
Total cone penetration test recovery	: 1584 cm	Total sample recovery	: 0 cm
Number of cone penetration tests	: 1	Number of samples	: 0
Number of pore pressure dissipation tests	: 0	Number of vane shear tests	: 0
Number of seismic cone penetration tests	: 0	Number of seismic velocity tests	: 0
Remarks:			
Client Representative: Leumman Dos Santos / William Lowry		Fugro Representative: Christopher Smith	

C.2 Operator Logs

Operator logs have been shared with Energinet Eltransmission A/S separately.

C.3 Driller Logs

Driller logs have been shared with Energinet Eltransmission A/S separately.

Appendix D

System Performance

Contents Appendix D: System Performance

- D.1: Cone Penetrometer Calibration
- D.2: Laboratory Equipment Calibration
- D.3: Positioning Survey Equipment Calibration
- D.4: Survey Mobilisation and Calibration Report

D.1 Cone Penetrometer Calibration

List of Plates

Cone Penetrometer Calibration Certificates

50 Plates

Calibration Certificate

Applicant Fugro GeoServices Ltd.
Fugro House, Hithercroft Road
OX10 9RB, Wallingford
United Kingdom

Certificate Number
FCN24032914

Instrument Cone Penetrometer
Manufacturer Fugro
Type CP10-CF100PB10SN2-P1E1M4-V1
Serial Number 1706-2368

Calibration method The instrument was calibrated according to Fugro procedures using a comparison technique against a reference standard.

Environmental Conditions

Temperature during calibration 20.5 ± 3 °C
Atmospheric pressure during calibration 1000 ± 100 mbar

Result The condition of the cone penetrometer meets the requirements of ISO 22476-1:2012 Section 4.1 through 4.7. The calibration results are reported on the next page(s).

The calibration results indicate that the cone penetrometer meets the requirements for use in Application Class 1 as defined in ISO 22476-1:2012 Section 5.2.

Uncertainty The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, which provides a confidence level of approximately 95%. The standard uncertainty has been determined in accordance with EA-4/02.

Traceability Fugro reference standards are periodically recertified and are traceable to the International System of Units (SI). Fugro's calibration system meets or exceeds the requirements of ISO 9001:2008, ISO 10012:2003 and ISO/IEC 17025:2017.

Calibration date 04-Mar-2024

Calibrate before 04-Mar-2025

Calibrated Sensor	Manufacturer / Type	Calibrated Range	Maximum Rating	Procedure
Cone [Force]	Fugro Loadcell	0 to 100 kN	0 to 100 kN	EUAF-FNLM- CAL-PR-003
Cone+Fric. [Force]	Fugro Loadcell	0 to 100 kN	0 to 100 kN	EUAF-FNLM- CAL-PR-003
Pore 2 [Pressure]	Keller PA-8/100bar (8467.8)	0 to 10 MPa	0 to 15 MPa	EUAF-FNLM- CAL-PR-004
Slope [Inclination]	ADXL	0 to 15 Deg	0 to 20 Deg	EUAF-FNLM- CAL-PR-005

Calibrated Sensor	Before adjustment		After adjustment		Drift	
	Sensitivity	Zero Load	Sensitivity	Zero Load	Sensitivity	Zero Load
Cone [Force]	25.0 $\mu\text{V/V/kN}$	-2.42 $\mu\text{V/V}$	25.0 $\mu\text{V/V/kN}$	9.87 $\mu\text{V/V}$	0.02 %	0.49 %
Cone+Fric. [Force]	24.9 $\mu\text{V/V/kN}$	140 $\mu\text{V/V}$	24.9 $\mu\text{V/V/kN}$	158 $\mu\text{V/V}$	0.19 %	0.71 %
Pore 2 [Pressure]	3.44 mV/V/MPa	158 $\mu\text{V/V}$	3.44 mV/V/MPa	166 $\mu\text{V/V}$	0.04 %	0.02 %

Nootdorp, 07-Mar-2024

This certificate is issued provided that Fugro assumes no liability.

Ruud Schrijvers
Deputy Manager Transducer Workshop

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Cone Calibration Result [Force]

Instrument	
Manufacturer	Fugro
Type	CP10-CF100PB10SN2-P 1E1M4-V1
Serial Number	1706-2368
Electronics	6168
Node Type	7001
Hardware Version	4.00
Software Version	8.01

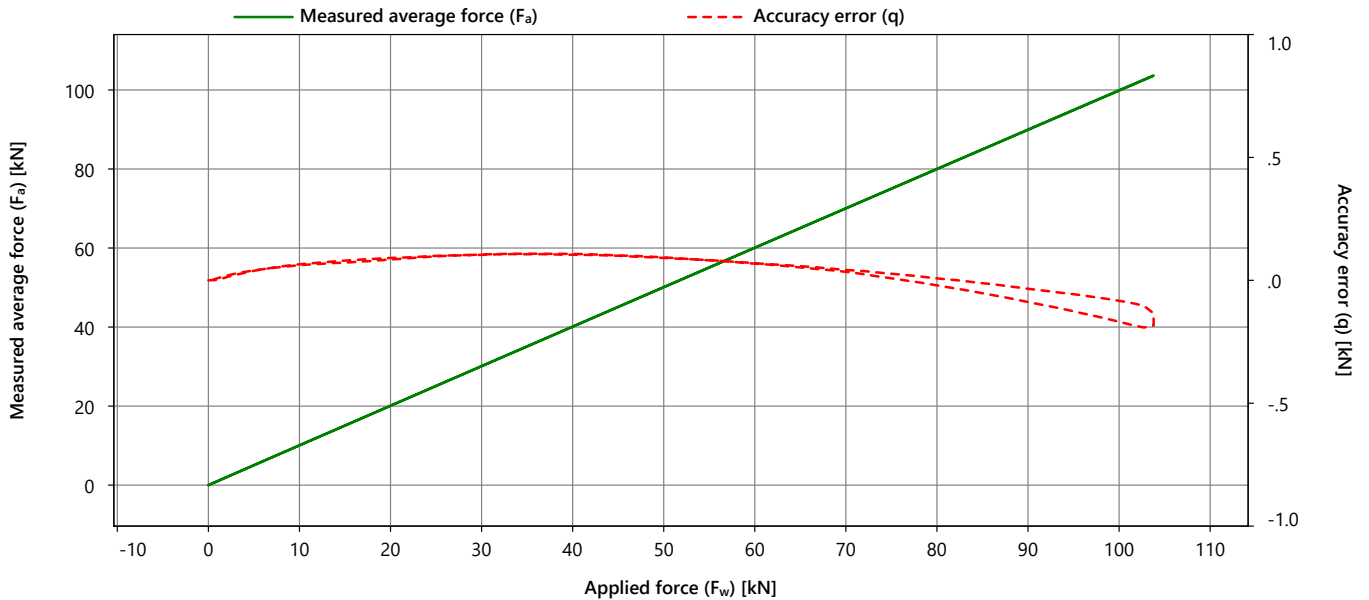
Reference	
Manufacturer	Zwick/Roell
Serial Number	6034-0002
Uncertainty	0.003•F _w +0.015 [kN]

Certificate Number
FCN24032914

Calibration Details	
Calibration Date	04 Mar 2024 08:00:47
Procedure	EUAF-FNLM- CAL-PR-003
Software Version	4.2.0.55751

Sensor	
Channel	Cone [Force]
Manufacturer	Fugro Loadcell
Calibrated Range	0 to 100 kN
Maximum Rating	0 to 100 kN

Characteristics	Unit	Value
Max accuracy error (q)	[kN]	0.168
Max repeatability error (b)	[kN]	0.020
Max reversibility error (v)	[kN]	0.028
Zero load error (F _{c0})	[kN]	0.003
Zero load offset (F ₀)	[kN]	-0.030
Resolution	[kN]	3.73E-05
Noise RMS	[kN]	0.000



Applied force (F _w)	Measured force 1 (F _{a,1})	Measured force 2 (F _{a,2})	Measured force 3 (F _{a,3})	Measured average force (F _a)	Accuracy error (q)	Repeatability error (b)	Reversibility error (v)	Expanded Uncertainty (U)
[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
0.000	-0.001	0.001	0.000	0.000	0.000	0.001		0.016
20.000	20.088	20.091	20.094	20.091	0.091	0.007	-0.006	0.078
40.000	40.099	40.102	40.111	40.104	0.104	0.012	0.003	0.139
60.000	60.064	60.066	60.074	60.068	0.068	0.011	0.002	0.200
80.000	79.971	79.979	79.988	79.979	-0.021	0.017	0.028	0.264
100.000	99.822	99.831	99.842	99.832	-0.168	0.020		0.324
80.000	80.006	80.008	80.010	80.008	0.008	0.004	0.028	0.264
60.000	60.069	60.070	60.071	60.070	0.070	0.001	0.002	0.200
40.000	40.104	40.108	40.110	40.107	0.107	0.007	0.003	0.139
20.000	20.081	20.085	20.089	20.085	0.085	0.009	-0.006	0.078
0.000	-0.002	-0.004	-0.003	-0.003	-0.003	0.002		0.016

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Cone+Fric. Calibration Result [Force]

Instrument	
Manufacturer	Fugro
Type	CP10-CF100PB10SN2-P 1E1M4-V1
Serial Number	1706-2368
Electronics	6168
Node Type	7001
Hardware Version	4.00
Software Version	8.01

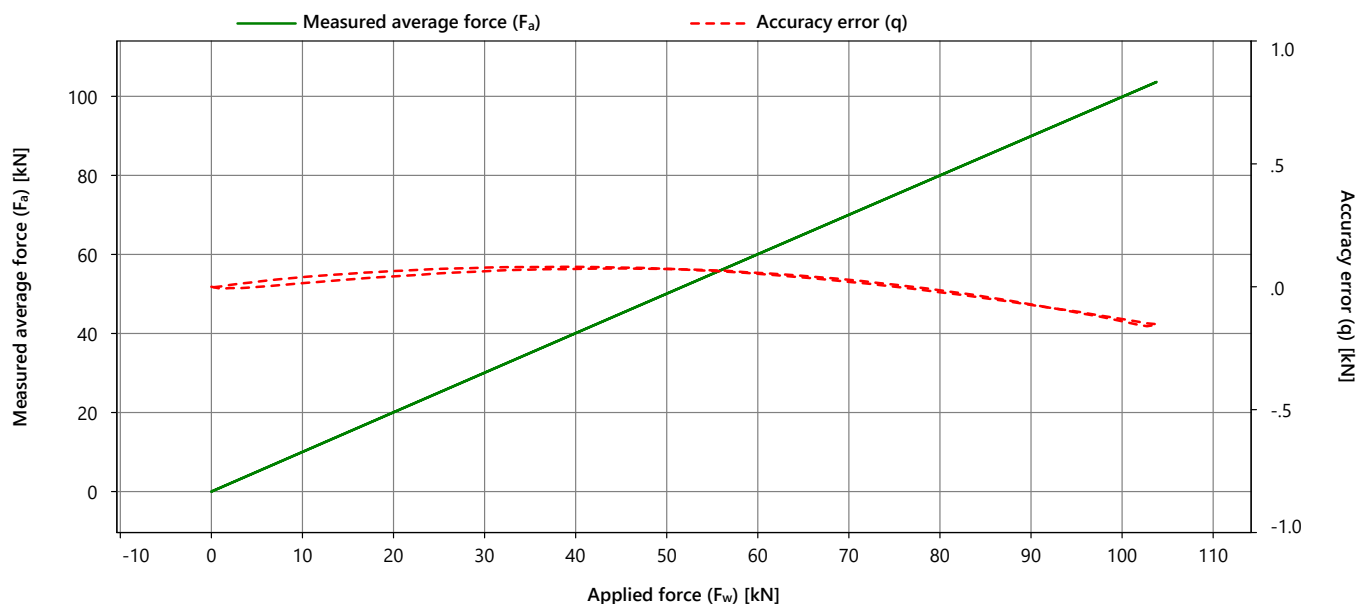
Reference	
Manufacturer	Zwick/Roell
Serial Number	6034-0002
Uncertainty	0.003•F _w +0.015 [kN]

Certificate Number
FCN24032914

Calibration Details	
Calibration Date	04 Mar 2024 08:00:47
Procedure	EUAF-FNLM- CAL-PR-003
Software Version	4.2.0.55751

Sensor	
Channel	Cone+Fric. [Force]
Manufacturer	Fugro Loadcell
Calibrated Range	0 to 100 kN
Maximum Rating	0 to 100 kN

Characteristics	Unit	Value
Max accuracy error (q)	[kN]	0.140
Max repeatability error (b)	[kN]	0.009
Max reversibility error (v)	[kN]	0.022
Zero load error (F _{c0})	[kN]	0.003
Zero load offset (F ₀)	[kN]	-0.012
Resolution	[kN]	3.74E-05
Noise RMS	[kN]	0.001
Tip-Sleeve Interaction %	[%]	0.064



Applied force (F _w) [kN]	Measured force 1 (F _{a,1}) [kN]	Measured force 2 (F _{a,2}) [kN]	Measured force 3 (F _{a,3}) [kN]	Measured average force (F _a) [kN]	Accuracy error (q) [kN]	Repeatability error (b) [kN]	Reversibility error (v) [kN]	Expanded Uncertainty (U) [kN]
0.000	-0.001	0.000	0.001	0.000	0.000	0.002		0.016
20.000	20.041	20.043	20.043	20.042	0.042	0.001	0.022	0.081
40.000	40.070	40.071	40.076	40.073	0.073	0.006	0.009	0.139
60.000	60.055	60.056	60.059	60.057	0.057	0.004	-0.004	0.200
80.000	79.981	79.986	79.990	79.986	-0.014	0.009	-0.008	0.262
100.000	99.857	99.858	99.864	99.860	-0.140	0.007		0.323
80.000	79.974	79.978	79.981	79.977	-0.023	0.007	-0.008	0.262
60.000	60.051	60.053	60.054	60.053	0.053	0.003	-0.004	0.200
40.000	40.080	40.082	40.081	40.081	0.081	0.002	0.009	0.139
20.000	20.062	20.064	20.066	20.064	0.064	0.004	0.022	0.081
0.000	-0.002	-0.003	-0.003	-0.003	-0.003	0.001		0.016

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Pore 2 Calibration Result [Pressure]

Instrument	
Manufacturer	Fugro
Type	CP10-CF100PB10SN2-P 1E1M4-V1
Serial Number	1706-2368
Electronics	6168
Node Type	7001
Hardware Version	4.00
Software Version	8.01

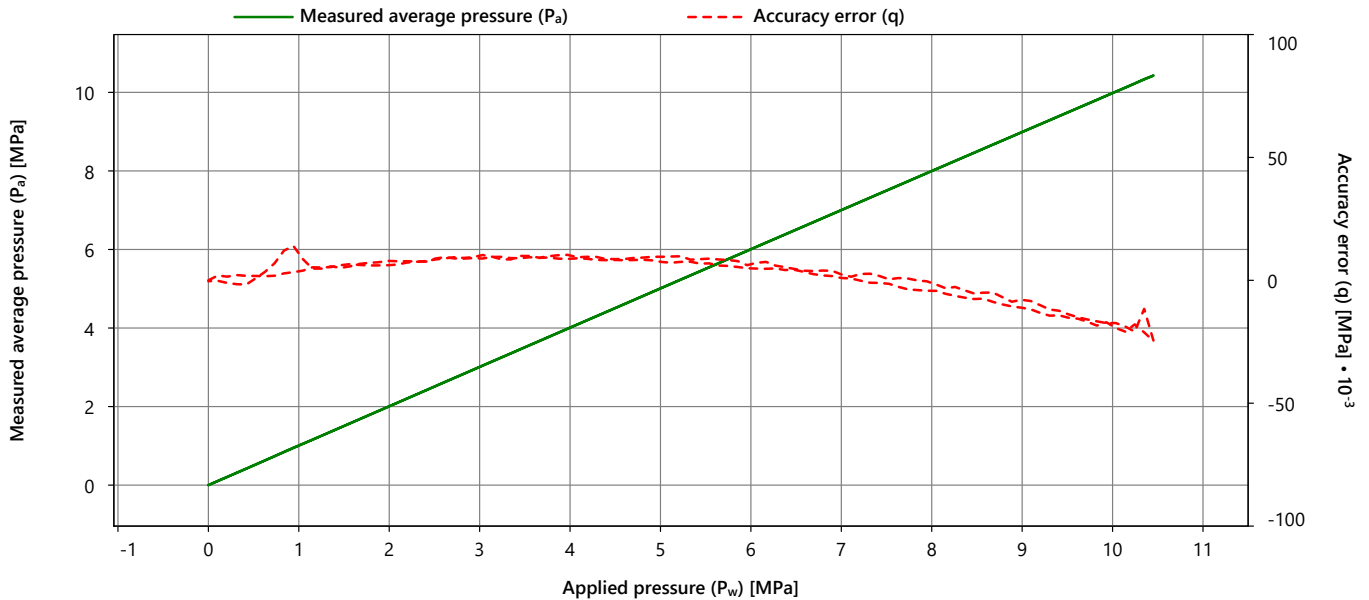
Reference	
Manufacturer	Keller PA-33X
Serial Number	3257-0002
Uncertainty	0.0005•P _w +0.002 [MPa]

Certificate Number
FCN24032914

Calibration Details	
Calibration Date	04 Mar 2024 09:08:06
Procedure	EUAF-FNLM- CAL-PR-004
Software Version	4.2.0.55751

Sensor	
Channel	Pore 2 [Pressure]
Manufacturer	Keller PA-8/100bar (8467.8)
Calibrated Range	0 to 10 MPa
Maximum Rating	0 to 15 MPa

Characteristics	Unit	Value
Max accuracy error (q)	[MPa]	0.017
Max repeatability error (b)	[MPa]	0.003
Max reversibility error (v)	[MPa]	0.003
Zero load error (P _{c0})	[MPa]	0.000
Zero load offset (P ₀)	[MPa]	0.000
Resolution	[MPa]	2.16E-06
Noise RMS	[MPa]	0.000



Applied pressure (P _w)	Measured pressure 1 (P _{a,1})	Measured pressure 2 (P _{a,2})	Measured pressure 3 (P _{a,3})	Measured average pressure (P _a)	Accuracy error (q)	Repeatability error (b)	Reversibility error (v)	Expanded Uncertainty (U)
[MPa]	[MPa]	[MPa]	[MPa]	[MPa]	[MPa]	[MPa]	[MPa]	[MPa]
0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.003
2.000	2.005	2.006	2.008	2.006	0.006	0.002	0.002	0.005
4.000	4.010	4.010	4.009	4.010	0.010	0.001	-0.001	0.005
6.000	6.005	6.008	6.006	6.006	0.006	0.003	-0.001	0.007
8.000	7.999	7.999	7.999	7.999	-0.001	0.001	-0.003	0.008
10.000	9.983	9.983	9.982	9.983	-0.017	0.001		0.007
8.000	7.995	7.996	7.997	7.996	-0.004	0.001	-0.003	0.008
6.000	6.005	6.004	6.006	6.005	0.005	0.002	-0.001	0.006
4.000	4.008	4.009	4.009	4.009	0.009	0.001	-0.001	0.005
2.000	2.008	2.007	2.008	2.008	0.008	0.001	0.002	0.004
0.000	-0.001	0.000	0.000	0.000	0.000	0.000		0.003

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Slope Calibration Result [Inclination]

Instrument	
Manufacturer	Fugro
Type	CP10-CF100PB10SN2-P 1E1M4-V1
Serial Number	1706-2368
Electronics	6168
Node Type	7001
Hardware Version	4.00
Software Version	8.01

Reference	
Manufacturer	Hoek-O-Mat
Serial Number	2109-0001
Uncertainty	0.6 [Deg]

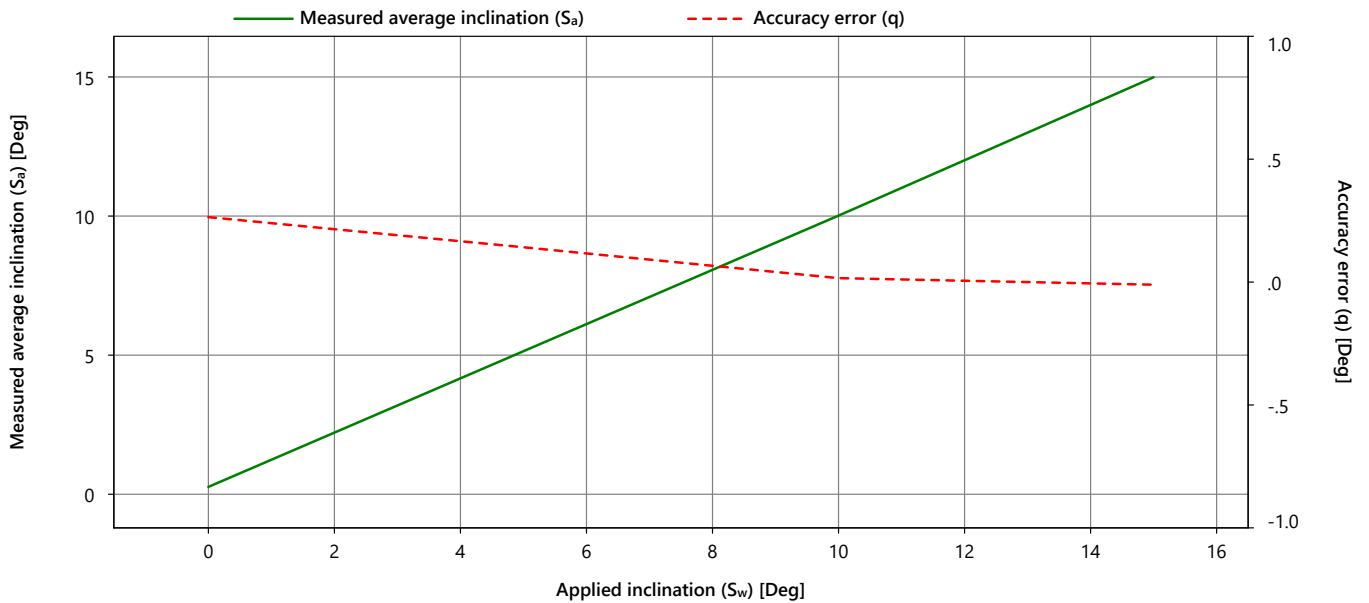
Certificate Number
FCN24032914

Calibration Details	
Calibration Date	04 Mar 2024 08:05:00
Procedure	EUAF-FNLM- CAL-PR-005
Software Version	4.2.0.55751

Sensor	
Channel	Slope [Inclination]
Manufacturer	ADXL
Calibrated Range	0 to 15 Deg
Maximum Rating	0 to 20 Deg

Characteristics	Unit	Value
Max accuracy error (q)	[Deg]	0.3
Max repeatability error (b)	[Deg]	0.3
Zero load error (S_{c0})	[Deg]	0.0
Zero load offset (S_0)	[Deg]	0.1
Resolution	[Deg]	1.28E-05
Noise RMS	[Deg]	0.0

Inclination is defined as the angular deviation of the cone penetrometer from the vertical.



Applied inclination (S_w) [Deg]	Measured inclination 1 ($S_{a,1}$) [Deg]	Measured inclination 2 ($S_{a,2}$) [Deg]	Measured inclination 3 ($S_{a,3}$) [Deg]	Measured average inclination (S_a) [Deg]	Accuracy error (q) [Deg]	Repeatability error (b) [Deg]	Expanded Uncertainty (U) [Deg]
0.0	0.1	0.3	0.4	0.3	0.3	0.3	0.8
5.0	5.0	5.2	5.2	5.1	0.1	0.2	0.7
10.0	10.0	10.0	10.0	10.0	0.0	0.0	0.7
15.0	15.1	14.9	14.9	15.0	0.0	0.2	0.8

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Symbols, Definitions and References

Certificate Number
FCN24032914

Symbols and Definitions (general)

b	Repeatability error, defined as the maximum difference between the measurements of the instrument at the applied value.
Noise RMS	Signal noise, defined as the quadratic mean when the sensor is not subjected to load.
q	Accuracy error, defined as the difference between the average indicated value by the instrument and the applied value.
Resolution	Smallest change in a quantity being measured that causes a perceptible change in the corresponding indication.
U	The stated uncertainty is that of the average indicated quantity, and includes the entire calibration method, including the reference and calibrated sensor, but excludes the difference between average indicated value by the instrument and the applied value.
v	Reversibility error, defined as the difference between the average indicated value by the instrument at a certain applied value when it was increased and when it was decreased.

Symbols and Definitions (quantity specific: Q may be substituted for F, P or S, as appropriate)

Q₀	Zero load offset, instrument output where the specified measured quantity value is zero.
Q_a	Average indicated quantity value by the instrument.
Q_{a,x}	Quantity value indicated by the instrument at measurement x.
Q_{c0}	Zero load error, defined as the difference between the average indicated value by the instrument before and after the load cycle has been applied.
Q_w	Applied reference quantity value.

Quantities

F	Force
P	Pressure
S	Inclination

References

International Organization for Standardization, 2012. *ISO 22476-1:2012 Geotechnical investigation and testing, Field testing, Electrical cone and piezocone penetration test*. Geneva: ISO.

European Co-operation For Accreditation, 2013. *Evaluation of the uncertainty of measurement in calibration*. European Co-operation For Accreditation, Publication; EA-4/02 M:2013.

International Organization for Standardization, 2005. *ISO 17025:2005 General requirements for the competence of testing and calibration laboratories*. Geneva: ISO.

International Organization for Standardization, 2003. *ISO 10012:2003 Measurement management systems - requirements for measurement processes and measuring equipment*. Geneva: ISO.

International Organization for Standardization, 2008. *ISO 9001:2008 Quality management systems - Requirements*. Geneva: ISO.

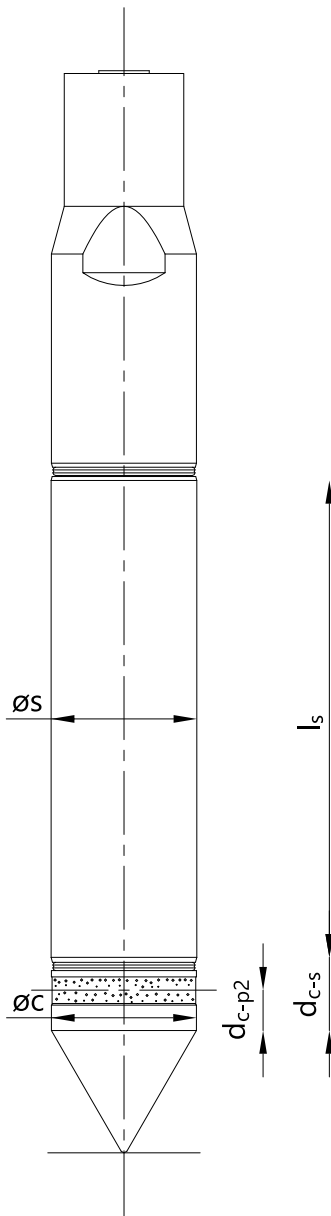
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Typical Dimensions

Instrument

Manufacturer	Fugro
Type	CP10-CF100PB10SN2-P1E1M4-V1
Serial Number	1706-2368

Appendix Applicable to
Certificate Number
FCN24032914



Typical Dimensions

A_c	Cross-sectional projected area of the cone	0.001 m ²
A_s	Surface area of the friction sleeve	0.015 m ²
a_f	Cone net area ratio	0.75
b_f	Friction sleeve net area ratio	0
$\varnothing c$	Diameter of the cylindrical part of the cone	35.8 mm
$\varnothing s$	Diameter of the friction sleeve	36.1 mm
l_s	Length of the friction sleeve	132.7 mm
d_{c-s}	Cone - friction sleeve distance	13.5 mm
d_{c-p2}	Cone - pore 2 distance	5 mm

Diagram is not to scale

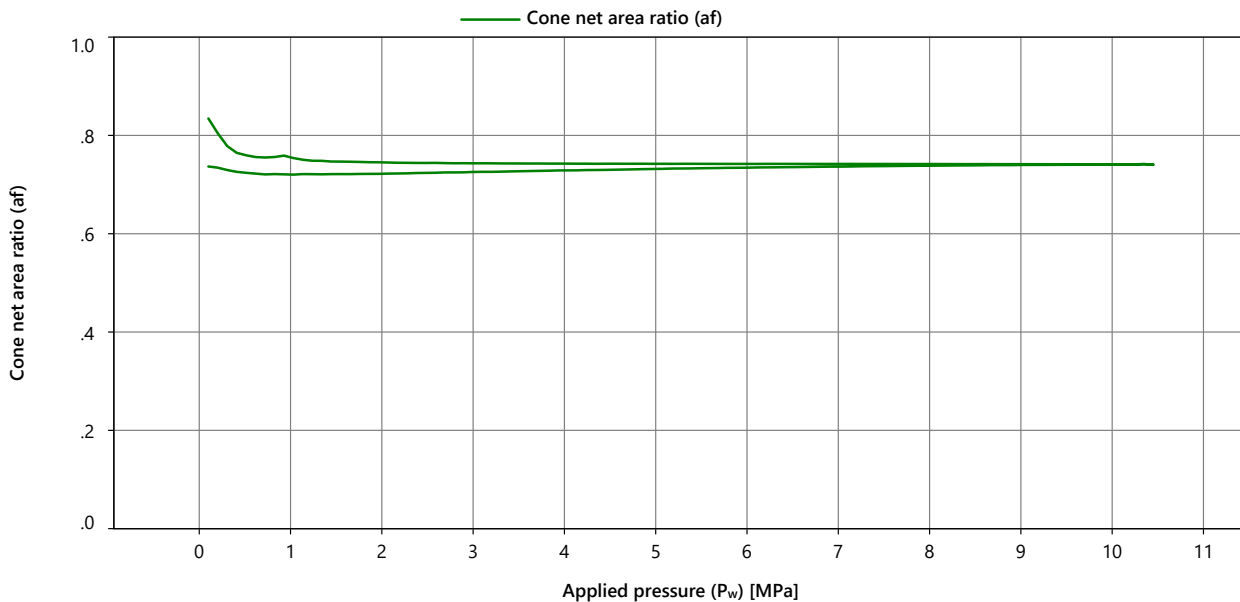
Cone Net Area Ratio Result

Instrument		Reference	
Manufacturer	Fugro	Manufacturer	Keller PA-33X
Type	CP10-CF100PB10SN2-P 1E1M4-V1	Serial Number	3257-0002
Serial Number	1706-2368	Uncertainty	0.0005•P _w +0.002 [MPa]
Electronics	6168	Measurement Details	
Node Type	7001	Measurement Date	04 Mar 2024 09:08:06
Hardware Version	4.00	Procedure	EUAF-FNLM- CAL-PR-003
Software Version	8.01	Software Version	4.2.0.55751

Appendix Applicable to
Certificate Number
FCN24032914

Characteristics	Unit	Value
Cone net area ratio (af)	[-]	0.74

The cone net area ratio presented above is determined at the maximum applied pressure during the measurement.



Applied pressure (P _w) [MPa]	Measured cone net area ratio 1 (af,1)	Measured cone net area ratio 2 (af,2)	Measured cone net area ratio 3 (af,3)	Measured average cone net area ratio (af)
2.000	0.722	0.722	0.723	0.722
4.000	0.729	0.729	0.729	0.729
6.000	0.734	0.735	0.734	0.734
8.000	0.738	0.738	0.738	0.738
10.000	0.741	0.741	0.741	0.741
8.000	0.742	0.742	0.742	0.742
6.000	0.742	0.742	0.742	0.742
4.000	0.742	0.743	0.743	0.743
2.000	0.745	0.745	0.745	0.745

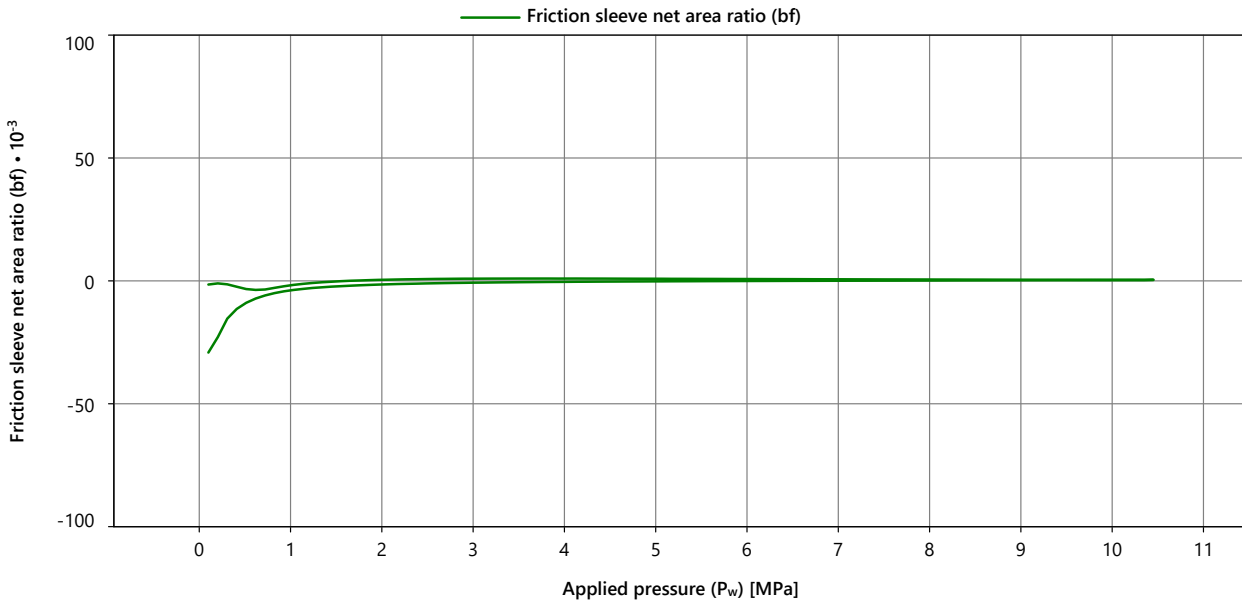
Friction Sleeve Net Area Ratio Result

Instrument		Reference	
Manufacturer	Fugro	Manufacturer	Keller PA-33X
Type	CP10-CF100PB10SN2-P 1E1M4-V1	Serial Number	3257-0002
Serial Number	1706-2368	Uncertainty	0.0005•P _w +0.002 [MPa]
Electronics	6168	Measurement Details	
Node Type	7001	Measurement Date	04 Mar 2024 09:08:06
Hardware Version	4.00	Procedure	EUAF-FNLM- CAL-PR-003
Software Version	8.01	Software Version	4.2.0.55751

Appendix Applicable to
Certificate Number
FCN24032914

Characteristics	Unit	Value
Friction sleeve net area ratio (bf)	[-]	0.00041

The friction sleeve net area ratio presented above is determined at the maximum applied pressure during the measurement.



Applied pressure (P _w) [MPa]	Measured friction sleeve net area ratio (bf) 1 (bf,1)	Measured friction sleeve net area ratio (bf) 2 (bf,2)	Measured friction sleeve net area ratio (bf) 3 (bf,3)	Measured average Friction sleeve net area ratio (bf)
2.000	0.000	0.000	0.000	0.000
4.000	0.001	0.001	0.001	0.001
6.000	0.001	0.001	0.001	0.001
8.000	0.001	0.001	0.001	0.001
10.000	0.000	0.000	0.000	0.000
8.000	0.000	0.000	0.000	0.000
6.000	0.000	0.000	0.000	0.000
4.000	0.000	0.000	0.000	0.000
2.000	-0.001	-0.001	-0.001	-0.001

Symbols and Definitions

Appendix Applicable to
Certificate Number
FCN24032914

Symbols and Definitions (general)

af	Cone net area ratio, defined as the factor between the applied pressure to the instrument and the indicated cone resistance.
af,x	Measured cone net area ratio at measurement x.
bf	Friction sleeve net area ratio, defined as the factor between the applied pressure to the instrument and the indicated sleeve friction.
bf,x	The measured friction sleeve net area ratio at measurement x.

Symbols and Definitions (quantity specific: Q may be substituted for P, as appropriate)

Q _w	Applied reference quantity value.
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Quantities

P	Pressure
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Calibration Certificate

Applicant Fugro GeoServices Ltd.
Fugro House, Hithercroft Road
OX10 9RB, Wallingford
United Kingdom

Certificate Number
FCN24032916

Instrument Cone Penetrometer
Manufacturer Fugro
Type CP10-CF100PB10SN2-P1E1M1-V1
Serial Number 1706-2788

Calibration method The instrument was calibrated according to Fugro procedures using a comparison technique against a reference standard.

Environmental Conditions
Temperature during calibration 20.5 ± 3 °C
Atmospheric pressure during calibration 1000 ± 100 mbar

Result The condition of the cone penetrometer meets the requirements of ISO 22476-1:2012 Section 4.1 through 4.7. The calibration results are reported on the next page(s).

The calibration results indicate that the cone penetrometer meets the requirements for use in Application Class 1 as defined in ISO 22476-1:2012 Section 5.2.

Uncertainty The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, which provides a confidence level of approximately 95%. The standard uncertainty has been determined in accordance with EA-4/02.

Traceability Fugro reference standards are periodically recertified and are traceable to the International System of Units (SI). Fugro's calibration system meets or exceeds the requirements of ISO 9001:2008, ISO 10012:2003 and ISO/IEC 17025:2017.

Calibration date 04-Mar-2024

Calibrate before 04-Mar-2025

Calibrated Sensor	Manufacturer / Type	Calibrated Range	Maximum Rating	Procedure
Cone [Force]	Fugro Loadcell	0 to 100 kN	0 to 100 kN	EUAF-FNLM- CAL-PR-003
Cone+Fric. [Force]	Fugro Loadcell	0 to 100 kN	0 to 100 kN	EUAF-FNLM- CAL-PR-003
Pore 2 [Pressure]	Keller PA-8/100bar (8467.8)	0 to 10 MPa	0 to 15 MPa	EUAF-FNLM- CAL-PR-004
Slope [Inclination]	ADXL	0 to 15 Deg	0 to 20 Deg	EUAF-FNLM- CAL-PR-005

Calibrated Sensor	Before adjustment		After adjustment		Drift	
	Sensitivity	Zero Load	Sensitivity	Zero Load	Sensitivity	Zero Load
Cone [Force]	25.1 $\mu\text{V/V/kN}$	16.6 $\mu\text{V/V}$	25.1 $\mu\text{V/V/kN}$	21.2 $\mu\text{V/V}$	0.23 %	0.18 %
Cone+Fric. [Force]	25.0 $\mu\text{V/V/kN}$	9.53 $\mu\text{V/V}$	25.1 $\mu\text{V/V/kN}$	16.9 $\mu\text{V/V}$	0.29 %	0.30 %
Pore 2 [Pressure]	3.12 mV/V/MPa	1.13 mV/V	3.12 mV/V/MPa	1.13 mV/V	-0.02 %	0.00 %

Nootdorp, 07-Mar-2024

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Ruud Schrijvers
Deputy Manager Transducer Workshop

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Cone Calibration Result [Force]

Instrument	
Manufacturer	Fugro
Type	CP10-CF100PB10SN2-P 1E1M1-V1
Serial Number	1706-2788
Electronics	9094
Node Type	7001
Hardware Version	6.00
Software Version	8.01

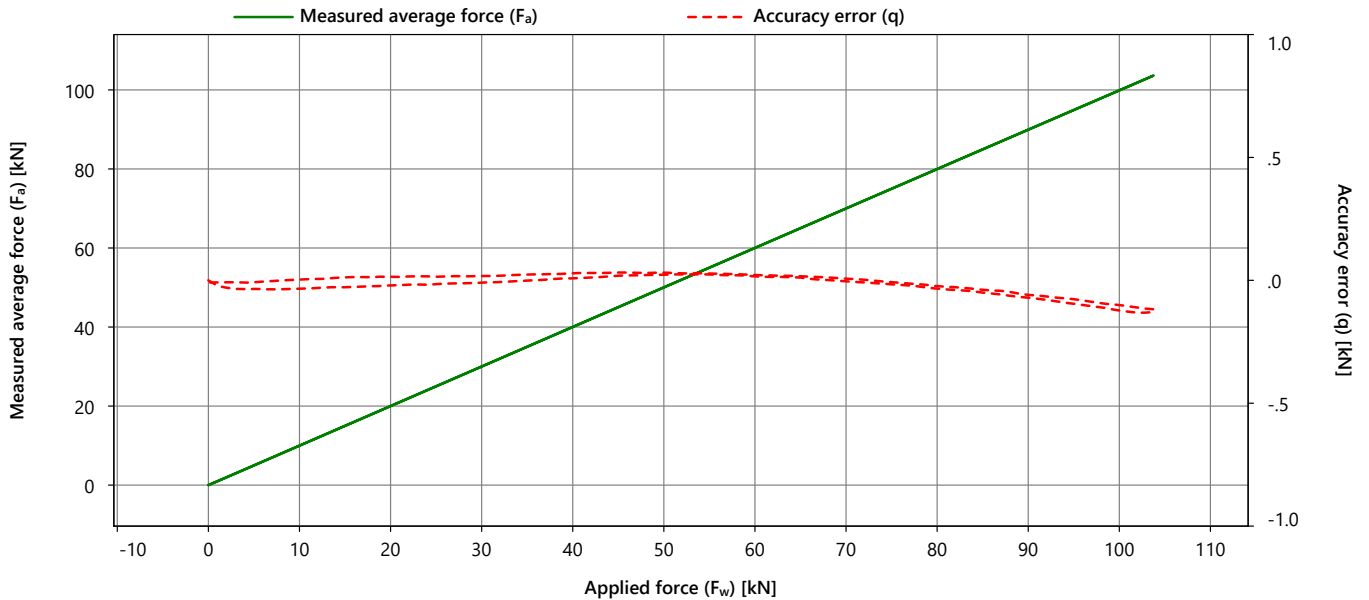
Reference	
Manufacturer	Zwick/Roell
Serial Number	6034-0002
Uncertainty	0.003•F _w +0.015 [kN]

Certificate Number
FCN24032916

Calibration Details	
Calibration Date	04 Mar 2024 08:16:27
Procedure	EUAF-FNLM- CAL-PR-003
Software Version	4.2.0.55751

Sensor	
Channel	Cone [Force]
Manufacturer	Fugro Loadcell
Calibrated Range	0 to 100 kN
Maximum Rating	0 to 100 kN

Characteristics	Unit	Value
Max accuracy error (q)	[kN]	0.123
Max repeatability error (b)	[kN]	0.011
Max reversibility error (v)	[kN]	0.035
Zero load error (F _{c0})	[kN]	0.009
Zero load offset (F ₀)	[kN]	0.014
Resolution	[kN]	3.7E-05
Noise RMS	[kN]	0.002



Applied force (F _w) [kN]	Measured force 1 (F _{a,1}) [kN]	Measured force 2 (F _{a,2}) [kN]	Measured force 3 (F _{a,3}) [kN]	Measured average force (F _a) [kN]	Accuracy error (q) [kN]	Repeatability error (b) [kN]	Reversibility error (v) [kN]	Expanded Uncertainty (U) [kN]
0.000	0.001	0.002	-0.003	0.000	0.000	0.005		0.021
20.000	19.981	19.982	19.976	19.979	-0.021	0.006	0.035	0.089
40.000	40.012	40.010	40.002	40.008	0.008	0.010	0.021	0.141
60.000	60.022	60.015	60.011	60.016	0.016	0.010	0.005	0.201
80.000	79.967	79.970	79.961	79.966	-0.034	0.009	0.010	0.262
100.000	99.878	99.881	99.872	99.877	-0.123	0.009		0.323
80.000	79.979	79.977	79.972	79.976	-0.024	0.007	0.010	0.262
60.000	60.027	60.021	60.016	60.021	0.021	0.011	0.005	0.201
40.000	40.033	40.029	40.024	40.029	0.029	0.009	0.021	0.141
20.000	20.018	20.014	20.010	20.014	0.014	0.008	0.035	0.089
0.000	-0.009	-0.009	-0.008	-0.009	-0.009	0.001		0.020

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Cone+Fric. Calibration Result [Force]

Instrument	
Manufacturer	Fugro
Type	CP10-CF100PB10SN2-P 1E1M1-V1
Serial Number	1706-2788
Electronics	9094
Node Type	7001
Hardware Version	6.00
Software Version	8.01

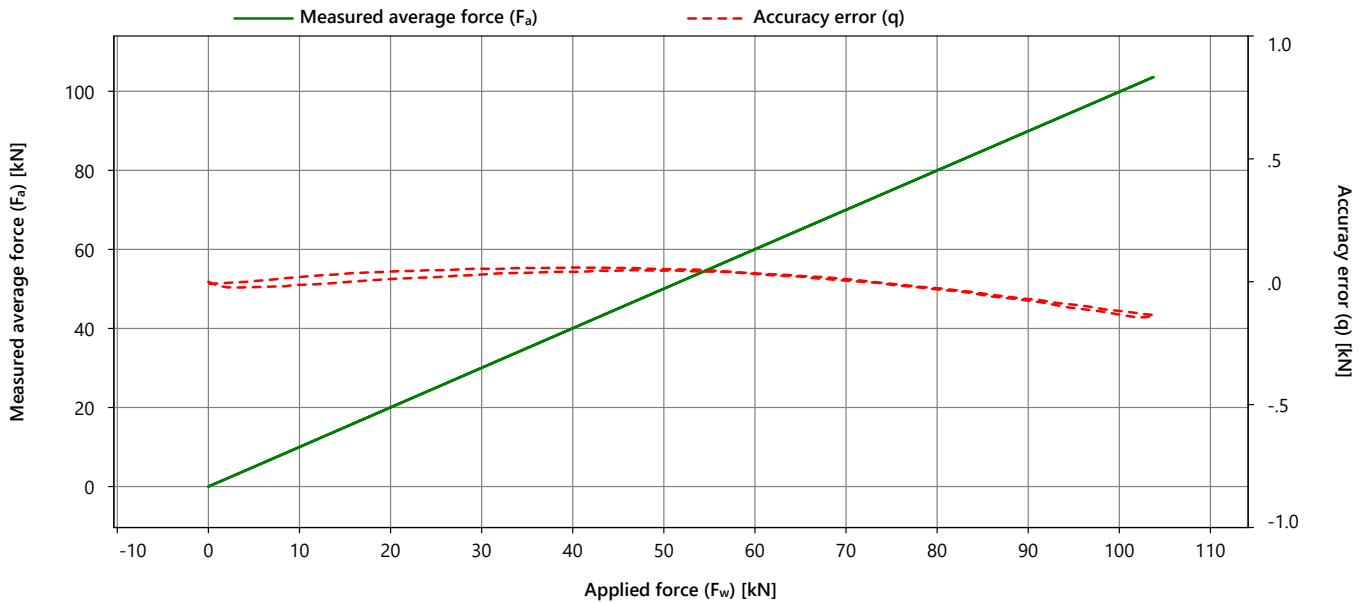
Reference	
Manufacturer	Zwick/Roell
Serial Number	6034-0002
Uncertainty	0.003•F _w +0.015 [kN]

Certificate Number
FCN24032916

Calibration Details	
Calibration Date	04 Mar 2024 08:16:27
Procedure	EUAF-FNLM- CAL-PR-003
Software Version	4.2.0.55751

Sensor	
Channel	Cone+Fric. [Force]
Manufacturer	Fugro Loadcell
Calibrated Range	0 to 100 kN
Maximum Rating	0 to 100 kN

Characteristics	Unit	Value
Max accuracy error (q)	[kN]	0.133
Max repeatability error (b)	[kN]	0.017
Max reversibility error (v)	[kN]	0.030
Zero load error (F _{c0})	[kN]	0.008
Zero load offset (F ₀)	[kN]	0.008
Resolution	[kN]	3.72E-05
Noise RMS	[kN]	0.002
Tip-Sleeve Interaction %	[%]	0.034



Applied force (F _w) [kN]	Measured force 1 (F _{a,1}) [kN]	Measured force 2 (F _{a,2}) [kN]	Measured force 3 (F _{a,3}) [kN]	Measured average force (F _a) [kN]	Accuracy error (q) [kN]	Repeatability error (b) [kN]	Reversibility error (v) [kN]	Expanded Uncertainty (U) [kN]
0.000	0.002	0.002	-0.004	0.000	0.000	0.006		0.020
20.000	20.014	20.012	20.008	20.011	0.011	0.006	0.030	0.086
40.000	40.043	40.042	40.036	40.040	0.040	0.007	0.018	0.141
60.000	60.036	60.032	60.028	60.032	0.032	0.008	0.003	0.200
80.000	79.973	79.971	79.963	79.969	-0.031	0.010	0.005	0.262
100.000	99.866	99.875	99.859	99.867	-0.133	0.016		0.324
80.000	79.981	79.978	79.964	79.974	-0.026	0.017	0.005	0.262
60.000	60.039	60.035	60.030	60.034	0.034	0.009	0.003	0.200
40.000	40.063	40.058	40.053	40.058	0.058	0.010	0.018	0.141
20.000	20.047	20.040	20.038	20.042	0.042	0.010	0.030	0.086
0.000	-0.008	-0.008	-0.009	-0.008	-0.008	0.001		0.019

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Pore 2 Calibration Result [Pressure]

Instrument	
Manufacturer	Fugro
Type	CP10-CF100PB10SN2-P 1E1M1-V1
Serial Number	1706-2788
Electronics	9094
Node Type	7001
Hardware Version	6.00
Software Version	8.01

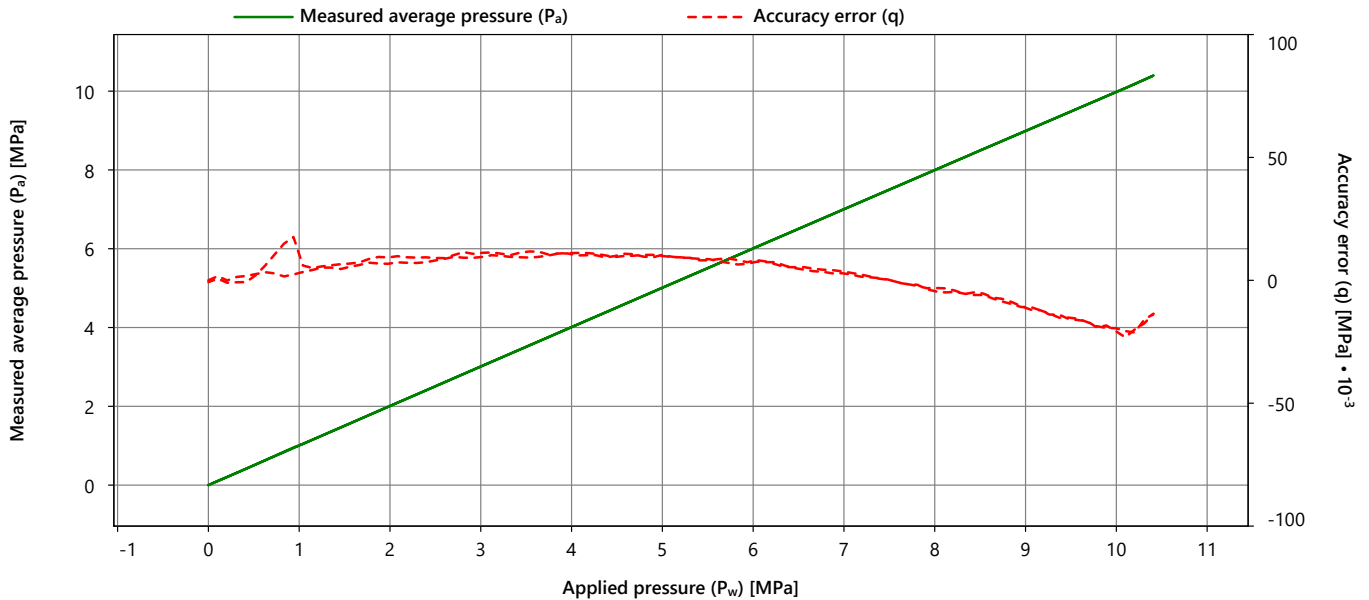
Reference	
Manufacturer	Keller PA-33X
Serial Number	3257-0002
Uncertainty	0.0005•P _w +0.002 [MPa]

Certificate Number
FCN24032916

Calibration Details	
Calibration Date	04 Mar 2024 08:51:57
Procedure	EUAF-FNLM- CAL-PR-004
Software Version	4.2.0.55751

Sensor	
Channel	Pore 2 [Pressure]
Manufacturer	Keller PA-8/100bar (8467.8)
Calibrated Range	0 to 10 MPa
Maximum Rating	0 to 15 MPa

Characteristics	Unit	Value
Max accuracy error (q)	[MPa]	0.020
Max repeatability error (b)	[MPa]	0.003
Max reversibility error (v)	[MPa]	0.003
Zero load error (P _{c0})	[MPa]	0.001
Zero load offset (P ₀)	[MPa]	0.001
Resolution	[MPa]	2.39E-06
Noise RMS	[MPa]	0.000



Applied pressure (P _w)	Measured pressure 1 (P _{a,1})	Measured pressure 2 (P _{a,2})	Measured pressure 3 (P _{a,3})	Measured average pressure (P _a)	Accuracy error (q)	Repeatability error (b)	Reversibility error (v)	Expanded Uncertainty (U)
[MPa]	[MPa]	[MPa]	[MPa]	[MPa]	[MPa]	[MPa]	[MPa]	[MPa]
0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.003
2.000	2.007	2.006	2.008	2.007	0.007	0.002	0.003	0.006
4.000	4.010	4.010	4.011	4.011	0.011	0.001	0.001	0.005
6.000	6.008	6.008	6.007	6.008	0.008	0.001	0.000	0.006
8.000	7.996	7.999	7.996	7.997	-0.003	0.003	-0.001	0.008
10.000	9.980	9.982	9.980	9.980	-0.020	0.002		0.008
8.000	7.996	7.996	7.995	7.996	-0.004	0.000	-0.001	0.007
6.000	6.007	6.007	6.008	6.007	0.007	0.001	0.000	0.006
4.000	4.009	4.012	4.012	4.011	0.011	0.003	0.001	0.006
2.000	2.010	2.010	2.009	2.009	0.009	0.001	0.003	0.005
0.000	-0.001	-0.001	-0.001	-0.001	-0.001	0.000		0.003

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Slope Calibration Result [Inclination]

Instrument	
Manufacturer	Fugro
Type	CP10-CF100PB10SN2-P 1E1M1-V1
Serial Number	1706-2788
Electronics	9094
Node Type	7001
Hardware Version	6.00
Software Version	8.01

Reference	
Manufacturer	Hoek-O-Mat
Serial Number	2109-0001
Uncertainty	0.6 [Deg]

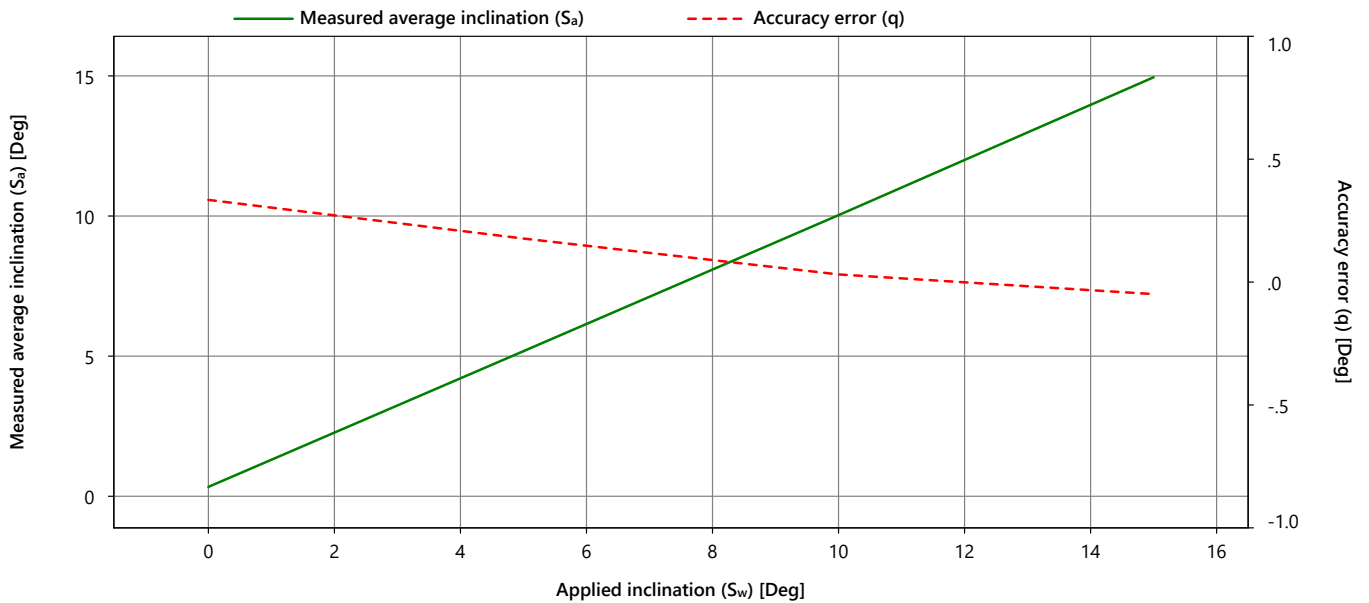
Certificate Number
FCN24032916

Calibration Details	
Calibration Date	04 Mar 2024 08:23:48
Procedure	EUAF-FNLM- CAL-PR-005
Software Version	4.2.0.55751

Sensor	
Channel	Slope [Inclination]
Manufacturer	ADXL
Calibrated Range	0 to 15 Deg
Maximum Rating	0 to 20 Deg

Characteristics	Unit	Value
Max accuracy error (q)	[Deg]	0.3
Max repeatability error (b)	[Deg]	0.5
Zero load error (S_{c0})	[Deg]	0.0
Zero load offset (S_0)	[Deg]	0.1
Resolution	[Deg]	1.31E-05
Noise RMS	[Deg]	0.0

Inclination is defined as the angular deviation of the cone penetrometer from the vertical.



Applied inclination (S_w) [Deg]	Measured inclination 1 ($S_{a,1}$) [Deg]	Measured inclination 2 ($S_{a,2}$) [Deg]	Measured inclination 3 ($S_{a,3}$) [Deg]	Measured average inclination (S_a) [Deg]	Accuracy error (q) [Deg]	Repeatability error (b) [Deg]	Expanded Uncertainty (U) [Deg]
0.0	0.1	0.4	0.5	0.3	0.3	0.5	1.0
5.0	5.0	5.3	5.3	5.2	0.2	0.2	0.8
10.0	10.0	10.0	10.0	10.0	0.0	0.0	0.7
15.0	15.1	14.9	14.9	15.0	0.0	0.2	0.7

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Symbols, Definitions and References

Certificate Number
FCN24032916

Symbols and Definitions (general)

b	Repeatability error, defined as the maximum difference between the measurements of the instrument at the applied value.
Noise RMS	Signal noise, defined as the quadratic mean when the sensor is not subjected to load.
q	Accuracy error, defined as the difference between the average indicated value by the instrument and the applied value.
Resolution	Smallest change in a quantity being measured that causes a perceptible change in the corresponding indication.
U	The stated uncertainty is that of the average indicated quantity, and includes the entire calibration method, including the reference and calibrated sensor, but excludes the difference between average indicated value by the instrument and the applied value.
v	Reversibility error, defined as the difference between the average indicated value by the instrument at a certain applied value when it was increased and when it was decreased.

Symbols and Definitions (quantity specific: Q may be substituted for F, P or S, as appropriate)

Q₀	Zero load offset, instrument output where the specified measured quantity value is zero.
Q_a	Average indicated quantity value by the instrument.
Q_{a,x}	Quantity value indicated by the instrument at measurement x.
Q_{c0}	Zero load error, defined as the difference between the average indicated value by the instrument before and after the load cycle has been applied.
Q_w	Applied reference quantity value.

Quantities

F	Force
P	Pressure
S	Inclination

References

International Organization for Standardization, 2012. *ISO 22476-1:2012 Geotechnical investigation and testing, Field testing, Electrical cone and piezocone penetration test*. Geneva: ISO.

European Co-operation For Accreditation, 2013. *Evaluation of the uncertainty of measurement in calibration*. European Co-operation For Accreditation, Publication; EA-4/02 M:2013.

International Organization for Standardization, 2005. *ISO 17025:2005 General requirements for the competence of testing and calibration laboratories*. Geneva: ISO.

International Organization for Standardization, 2003. *ISO 10012:2003 Measurement management systems - requirements for measurement processes and measuring equipment*. Geneva: ISO.

International Organization for Standardization, 2008. *ISO 9001:2008 Quality management systems - Requirements*. Geneva: ISO.

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Page 6 of 6

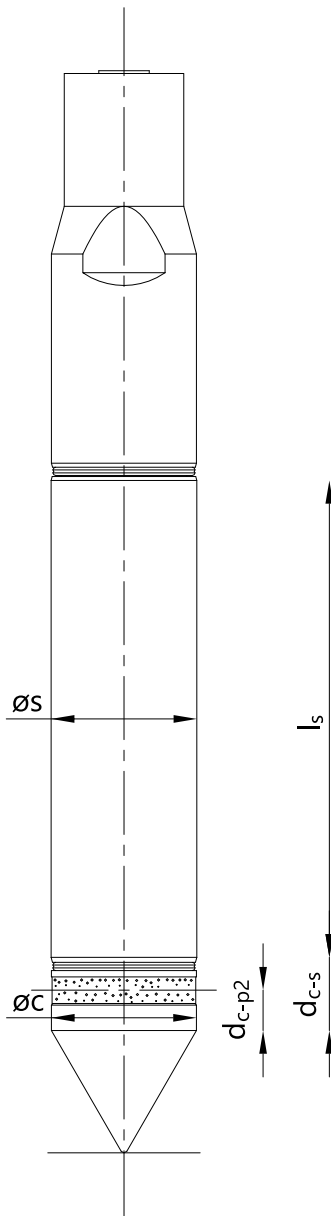


Typical Dimensions

Instrument

Manufacturer	Fugro
Type	CP10-CF100PB10SN2-P1E1M1-V1
Serial Number	1706-2788

Appendix Applicable to
Certificate Number
FCN24032916



Typical Dimensions

A_c	Cross-sectional projected area of the cone	0.001 m ²
A_s	Surface area of the friction sleeve	0.015 m ²
af	Cone net area ratio	0.75
bf	Friction sleeve net area ratio	0
\varnothing_c	Diameter of the cylindrical part of the cone	35.8 mm
\varnothing_s	Diameter of the friction sleeve	36.1 mm
l_s	Length of the friction sleeve	132.7 mm
d_{c-s}	Cone - friction sleeve distance	13.5 mm
d_{c-p2}	Cone - pore 2 distance	5 mm

Diagram is not to scale

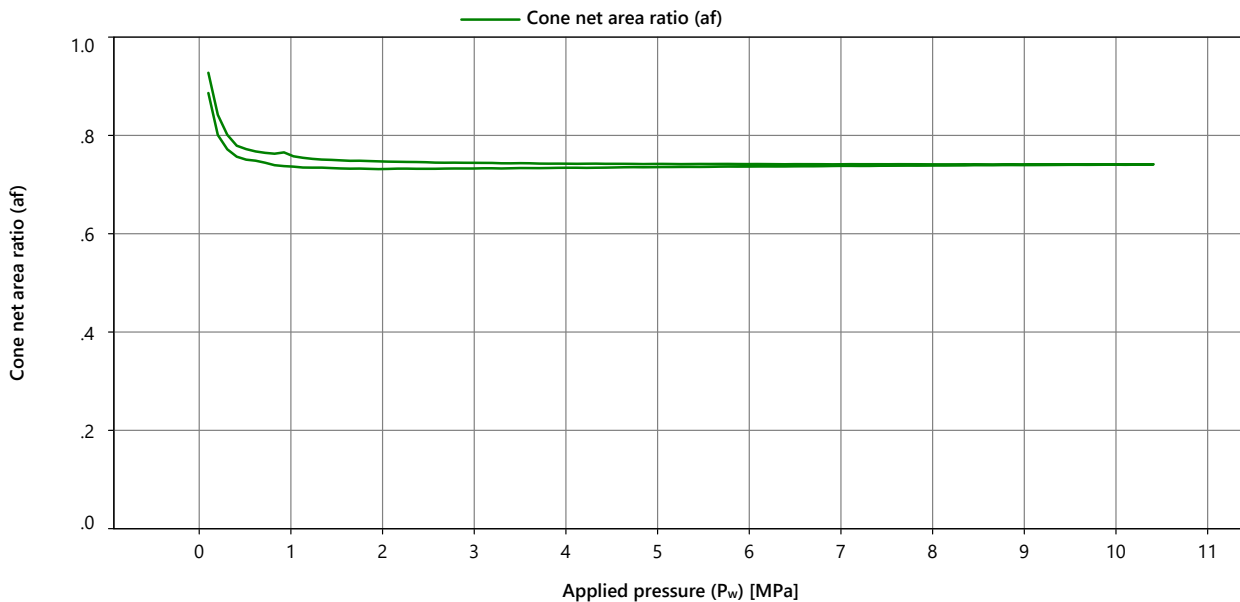
Cone Net Area Ratio Result

Instrument		Reference	
Manufacturer	Fugro	Manufacturer	Keller PA-33X
Type	CP10-CF100PB10SN2-P 1E1M1-V1	Serial Number	3257-0002
Serial Number	1706-2788	Uncertainty	0.0005•P _w +0.002 [MPa]
Electronics	9094	Measurement Details	
Node Type	7001	Measurement Date	04 Mar 2024 08:51:57
Hardware Version	6.00	Procedure	EUAF-FNLM- CAL-PR-003
Software Version	8.01	Software Version	4.2.0.55751

Appendix Applicable to
Certificate Number
FCN24032916

Characteristics	Unit	Value
Cone net area ratio (af)	[-]	0.74

The cone net area ratio presented above is determined at the maximum applied pressure during the measurement.



Applied pressure (P _w) [MPa]	Measured cone net area ratio 1 (af,1)	Measured cone net area ratio 2 (af,2)	Measured cone net area ratio 3 (af,3)	Measured average cone net area ratio (af)
2.000	0.729	0.732	0.734	0.732
4.000	0.733	0.735	0.735	0.734
6.000	0.735	0.737	0.738	0.737
8.000	0.738	0.739	0.739	0.739
10.000	0.740	0.741	0.741	0.741
8.000	0.740	0.741	0.742	0.741
6.000	0.741	0.742	0.742	0.742
4.000	0.741	0.743	0.743	0.742
2.000	0.745	0.747	0.749	0.747

Friction Sleeve Net Area Ratio Result

Instrument	
Manufacturer	Fugro
Type	CP10-CF100PB10SN2-P 1E1M1-V1
Serial Number	1706-2788
Electronics	9094
Node Type	7001
Hardware Version	6.00
Software Version	8.01

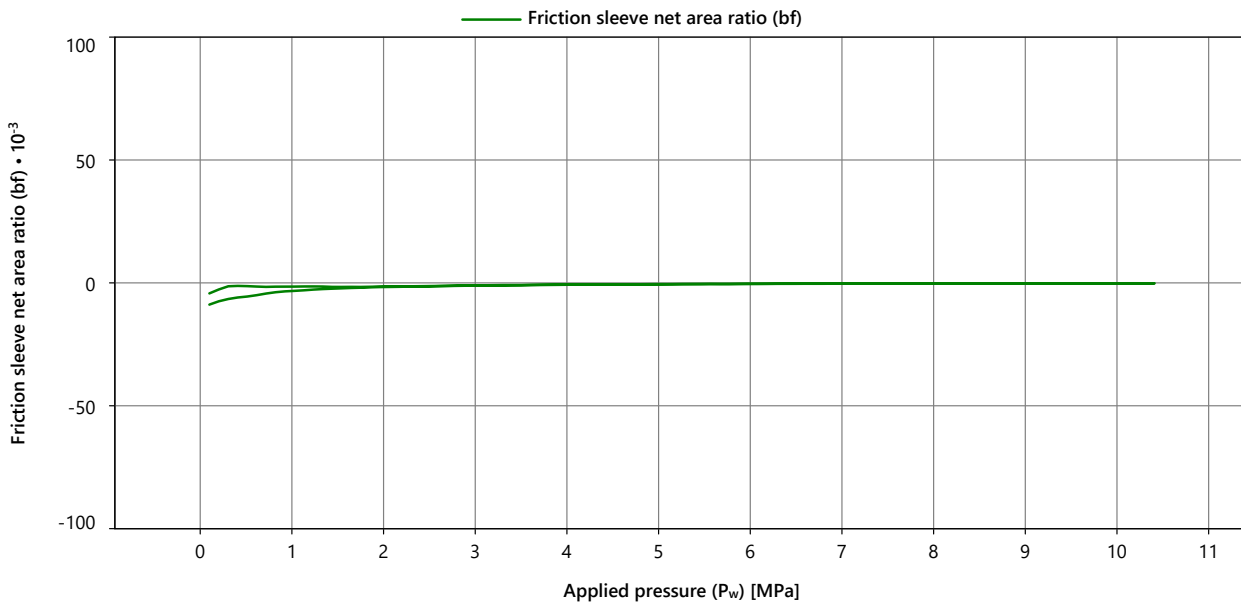
Reference	
Manufacturer	Keller PA-33X
Serial Number	3257-0002
Uncertainty	0.0005•P _w +0.002 [MPa]

Appendix Applicable to
Certificate Number
FCN24032916

Measurement Details	
Measurement Date	04 Mar 2024 08:51:57
Procedure	EUAF-FNLM- CAL-PR-003
Software Version	4.2.0.55751

Characteristics	Unit	Value
Friction sleeve net area ratio (bf)	[-]	-0.00017

The friction sleeve net area ratio presented above is determined at the maximum applied pressure during the measurement.



Applied pressure (P _w) [MPa]	Measured friction sleeve net area ratio (bf) 1 (bf,1)	Measured friction sleeve net area ratio (bf) 2 (bf,2)	Measured friction sleeve net area ratio (bf) 3 (bf,3)	Measured average Friction sleeve net area ratio (bf)
2.000	-0.002	-0.001	-0.001	-0.001
4.000	-0.001	-0.001	-0.001	-0.001
6.000	0.000	0.000	0.000	0.000
8.000	0.000	0.000	0.000	0.000
10.000	0.000	0.000	0.000	0.000
8.000	0.000	0.000	0.000	0.000
6.000	0.000	0.000	0.000	0.000
4.000	-0.001	-0.001	-0.001	-0.001
2.000	-0.002	-0.002	-0.001	-0.002

Symbols and Definitions

Appendix Applicable to
Certificate Number
FCN24032916

Symbols and Definitions (general)

af	Cone net area ratio, defined as the factor between the applied pressure to the instrument and the indicated cone resistance.
af,x	Measured cone net area ratio at measurement x.
bf	Friction sleeve net area ratio, defined as the factor between the applied pressure to the instrument and the indicated sleeve friction.
bf,x	The measured friction sleeve net area ratio at measurement x.

Symbols and Definitions (quantity specific: Q may be substituted for P, as appropriate)

Q _w	Applied reference quantity value.
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Quantities

P	Pressure
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Calibration Certificate

Applicant Fugro GeoServices Ltd.
Fugro House, Hithercroft Road
OX10 9RB, Wallingford
United Kingdom

Certificate Number
FCN24032918

Instrument Cone Penetrometer
Manufacturer Fugro
Type CP10-CF100PB10SN2-P1E1M1-V1
Serial Number 1706-2790

Calibration method The instrument was calibrated according to Fugro procedures using a comparison technique against a reference standard.

Environmental Conditions
Temperature during calibration 20.5 ± 3 °C
Atmospheric pressure during calibration 1000 ± 100 mbar

Result The condition of the cone penetrometer meets the requirements of ISO 22476-1:2012 Section 4.1 through 4.7. The calibration results are reported on the next page(s).

The calibration results indicate that the cone penetrometer meets the requirements for use in Application Class 1 as defined in ISO 22476-1:2012 Section 5.2.

Uncertainty The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, which provides a confidence level of approximately 95%. The standard uncertainty has been determined in accordance with EA-4/02.

Traceability Fugro reference standards are periodically recertified and are traceable to the International System of Units (SI). Fugro's calibration system meets or exceeds the requirements of ISO 9001:2008, ISO 10012:2003 and ISO/IEC 17025:2017.

Calibration period 04-Mar-2024 through 07-Mar-2024

Calibrate before 04-Mar-2025

Calibrated Sensor	Manufacturer / Type	Calibrated Range	Maximum Rating	Procedure
Cone [Force]	Fugro Loadcell	0 to 100 kN	0 to 100 kN	EUAF-FNLM- CAL-PR-003
Cone+Fric. [Force]	Fugro Loadcell	0 to 100 kN	0 to 100 kN	EUAF-FNLM- CAL-PR-003
Pore 2 [Pressure]	Keller PA-8/100bar (8467.8)	0 to 10 MPa	0 to 15 MPa	EUAF-FNLM- CAL-PR-004
Slope [Inclination]	ADXL	0 to 15 Deg	0 to 20 Deg	EUAF-FNLM- CAL-PR-005

Calibrated Sensor	Before adjustment		After adjustment		Drift	
	Sensitivity	Zero Load	Sensitivity	Zero Load	Sensitivity	Zero Load
Cone [Force]	25.1 $\mu\text{V/V/kN}$	11.0 $\mu\text{V/V}$	25.2 $\mu\text{V/V/kN}$	14.9 $\mu\text{V/V}$	0.20 %	0.15 %
Cone+Fric. [Force]	25.0 $\mu\text{V/V/kN}$	7.20 $\mu\text{V/V}$	25.0 $\mu\text{V/V/kN}$	10.1 $\mu\text{V/V}$	0.31 %	0.12 %
Pore 2 [Pressure]	3.20 mV/V/MPa	2.07 mV/V	3.20 mV/V/MPa	2.08 mV/V	-0.04 %	0.01 %

Nootdorp, 08-Mar-2024

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Ruud Schrijvers
Deputy Manager Transducer Workshop

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Cone Calibration Result [Force]

Instrument	
Manufacturer	Fugro
Type	CP10-CF100PB10SN2-P 1E1M1-V1
Serial Number	1706-2790
Electronics	9038
Node Type	7001
Hardware Version	6.00
Software Version	8.01

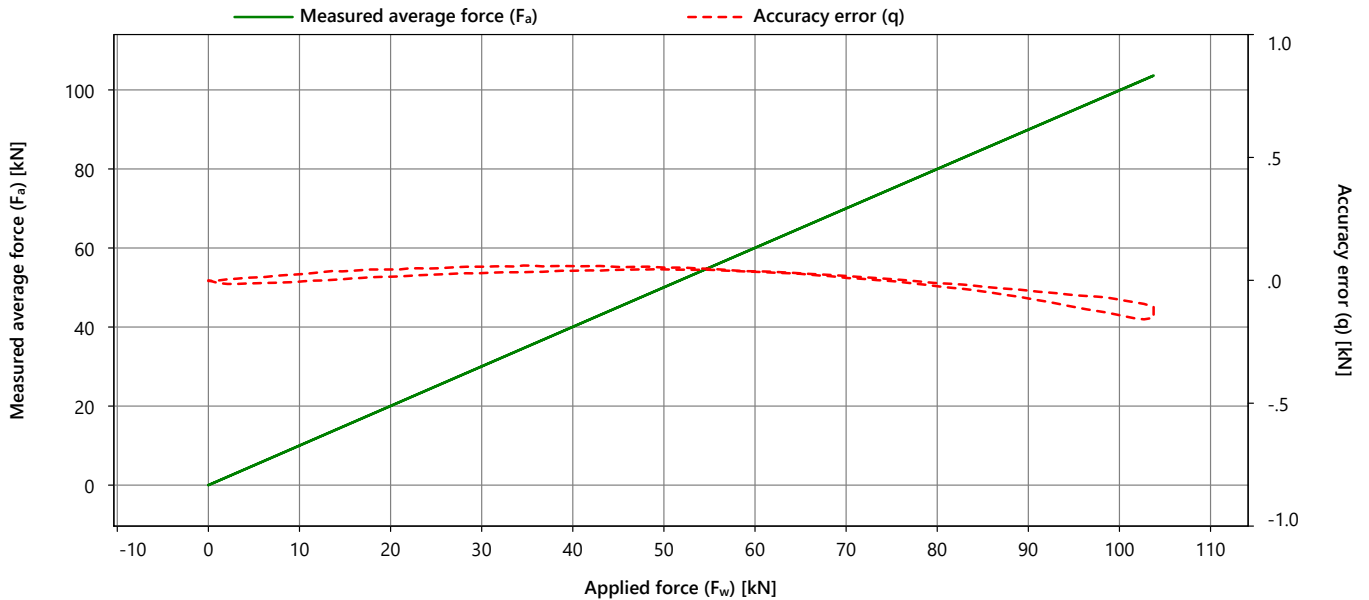
Reference	
Manufacturer	Zwick/Roell
Serial Number	6034-0002
Uncertainty	0.003•F _w +0.015 [kN]

Certificate Number
FCN24032918

Calibration Details	
Calibration Date	04 Mar 2024 09:04:48
Procedure	EUAF-FNLM- CAL-PR-003
Software Version	4.2.0.55751

Sensor	
Channel	Cone [Force]
Manufacturer	Fugro Loadcell
Calibrated Range	0 to 100 kN
Maximum Rating	0 to 100 kN

Characteristics	Unit	Value
Max accuracy error (q)	[kN]	0.142
Max repeatability error (b)	[kN]	0.009
Max reversibility error (v)	[kN]	0.029
Zero load error (F _{c0})	[kN]	0.003
Zero load offset (F ₀)	[kN]	-0.003
Resolution	[kN]	3.7E-05
Noise RMS	[kN]	0.002



Applied force (F _w) [kN]	Measured force 1 (F _{a,1}) [kN]	Measured force 2 (F _{a,2}) [kN]	Measured force 3 (F _{a,3}) [kN]	Measured average force (F _a) [kN]	Accuracy error (q) [kN]	Repeatability error (b) [kN]	Reversibility error (v) [kN]	Expanded Uncertainty (U) [kN]
0.000	0.002	-0.002	-0.001	0.000	0.000	0.004		0.017
20.000	20.017	20.012	20.015	20.015	0.015	0.005	0.029	0.085
40.000	40.041	40.038	40.036	40.039	0.039	0.005	0.019	0.140
60.000	60.037	60.036	60.030	60.035	0.035	0.007	0.002	0.200
80.000	79.980	79.975	79.973	79.976	-0.024	0.007	0.013	0.262
100.000	99.859	99.858	99.858	99.858	-0.142	0.001		0.323
80.000	79.992	79.990	79.983	79.989	-0.011	0.009	0.013	0.262
60.000	60.039	60.037	60.035	60.037	0.037	0.004	0.002	0.200
40.000	40.059	40.058	40.056	40.058	0.058	0.003	0.019	0.140
20.000	20.046	20.042	20.044	20.044	0.044	0.004	0.029	0.085
0.000	-0.002	-0.004	-0.003	-0.003	-0.003	0.002		0.017

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Cone+Fric. Calibration Result [Force]

Instrument	
Manufacturer	Fugro
Type	CP10-CF100PB10SN2-P 1E1M1-V1
Serial Number	1706-2790
Electronics	9038
Node Type	7001
Hardware Version	6.00
Software Version	8.01

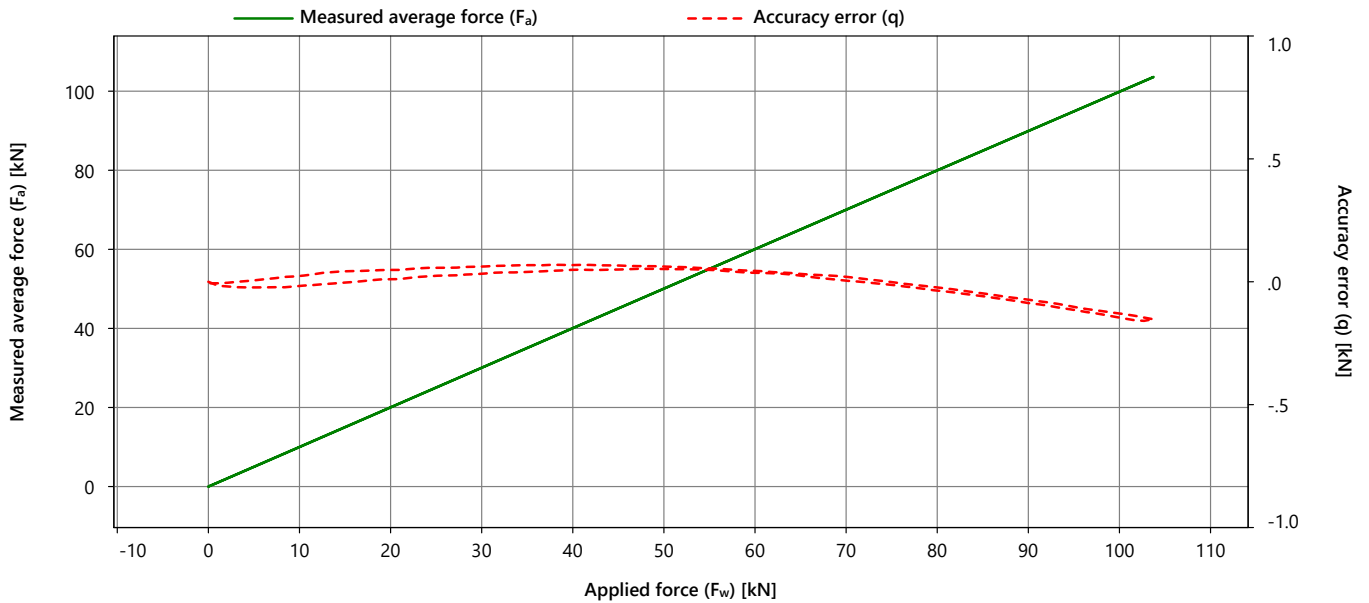
Reference	
Manufacturer	Zwick/Roell
Serial Number	6034-0002
Uncertainty	0.003•F _w +0.015 [kN]

Certificate Number
FCN24032918

Calibration Details	
Calibration Date	04 Mar 2024 09:04:48
Procedure	EUAF-FNLM- CAL-PR-003
Software Version	4.2.0.55751

Sensor	
Channel	Cone+Fric. [Force]
Manufacturer	Fugro Loadcell
Calibrated Range	0 to 100 kN
Maximum Rating	0 to 100 kN

Characteristics	Unit	Value
Max accuracy error (q)	[kN]	0.146
Max repeatability error (b)	[kN]	0.014
Max reversibility error (v)	[kN]	0.038
Zero load error (F _{c0})	[kN]	0.006
Zero load offset (F ₀)	[kN]	0.002
Resolution	[kN]	3.72E-05
Noise RMS	[kN]	0.002
Tip-Sleeve Interaction %	[%]	0.057



Applied force (F _w) [kN]	Measured force 1 (F _{a,1}) [kN]	Measured force 2 (F _{a,2}) [kN]	Measured force 3 (F _{a,3}) [kN]	Measured average force (F _a) [kN]	Accuracy error (q) [kN]	Repeatability error (b) [kN]	Reversibility error (v) [kN]	Expanded Uncertainty (U) [kN]
0.000	0.002	-0.001	-0.001	0.000	0.000	0.003		0.018
20.000	20.012	20.012	20.007	20.010	0.010	0.005	0.038	0.091
40.000	40.053	40.047	40.047	40.049	0.049	0.006	0.019	0.141
60.000	60.040	60.038	60.032	60.036	0.036	0.008	0.008	0.200
80.000	79.970	79.962	79.960	79.964	-0.036	0.010	0.013	0.262
100.000	99.861	99.853	99.849	99.854	-0.146	0.012		0.323
80.000	79.982	79.977	79.971	79.977	-0.023	0.011	0.013	0.262
60.000	60.051	60.046	60.037	60.044	0.044	0.014	0.008	0.201
40.000	40.072	40.068	40.064	40.068	0.068	0.008	0.019	0.141
20.000	20.051	20.048	20.045	20.048	0.048	0.006	0.038	0.091
0.000	-0.007	-0.006	-0.006	-0.006	-0.006	0.001		0.018

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Pore 2 Calibration Result [Pressure]

Instrument	
Manufacturer	Fugro
Type	CP10-CF100PB10SN2-P 1E1M1-V1
Serial Number	1706-2790
Electronics	9038
Node Type	7001
Hardware Version	6.00
Software Version	8.01

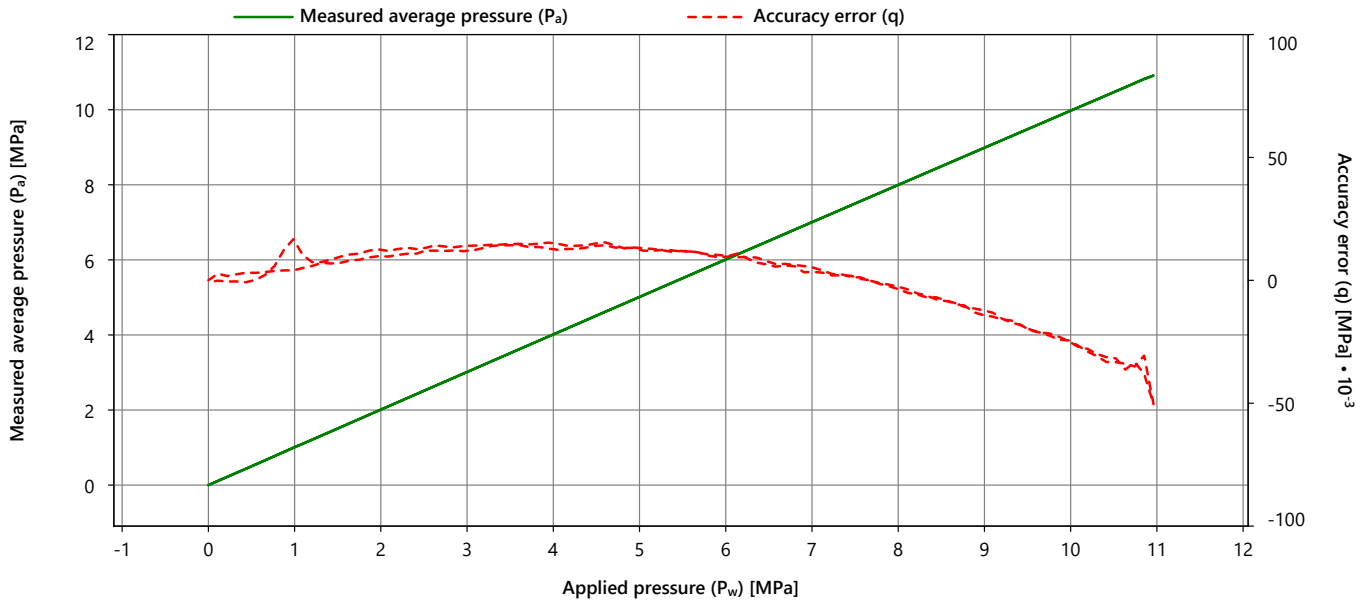
Reference	
Manufacturer	Keller PA-33X
Serial Number	3257-0002
Uncertainty	0.0005•P _w +0.002 [MPa]

Certificate Number
FCN24032918

Calibration Details	
Calibration Date	07 Mar 2024 08:15:09
Procedure	EUAF-FNLM- CAL-PR-004
Software Version	4.2.0.55751

Sensor	
Channel	Pore 2 [Pressure]
Manufacturer	Keller PA-8/100bar (8467.8)
Calibrated Range	0 to 10 MPa
Maximum Rating	0 to 15 MPa

Characteristics	Unit	Value
Max accuracy error (q)	[MPa]	0.025
Max repeatability error (b)	[MPa]	0.004
Max reversibility error (v)	[MPa]	0.003
Zero load error (P _{c0})	[MPa]	0.001
Zero load offset (P ₀)	[MPa]	0.004
Resolution	[MPa]	2.33E-06
Noise RMS	[MPa]	0.000



Applied pressure (P _w)	Measured pressure 1 (P _{a,1})	Measured pressure 2 (P _{a,2})	Measured pressure 3 (P _{a,3})	Measured average pressure (P _a)	Accuracy error (q)	Repeatability error (b)	Reversibility error (v)	Expanded Uncertainty (U)
[MPa]	[MPa]	[MPa]	[MPa]	[MPa]	[MPa]	[MPa]	[MPa]	[MPa]
0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.003
2.000	2.009	2.011	2.009	2.010	0.010	0.003	0.003	0.007
4.000	4.011	4.014	4.012	4.012	0.012	0.004	0.003	0.008
6.000	6.011	6.008	6.010	6.010	0.010	0.003	0.000	0.007
8.000	7.997	7.996	7.997	7.996	-0.004	0.000	0.001	0.007
10.000	9.974	9.976	9.976	9.975	-0.025	0.003		0.008
8.000	7.998	7.998	7.997	7.997	-0.003	0.001	0.001	0.007
6.000	6.009	6.009	6.010	6.010	0.010	0.001	0.000	0.006
4.000	4.015	4.015	4.015	4.015	0.015	0.000	0.003	0.006
2.000	2.012	2.013	2.012	2.012	0.012	0.002	0.003	0.006
0.000	-0.001	-0.001	-0.001	-0.001	-0.001	0.000		0.003

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Slope Calibration Result [Inclination]

Instrument	
Manufacturer	Fugro
Type	CP10-CF100PB10SN2-P 1E1M1-V1
Serial Number	1706-2790
Electronics	9038
Node Type	7001
Hardware Version	6.00
Software Version	8.01

Reference	
Manufacturer	Hoek-O-Mat
Serial Number	2109-0001
Uncertainty	0.6 [Deg]

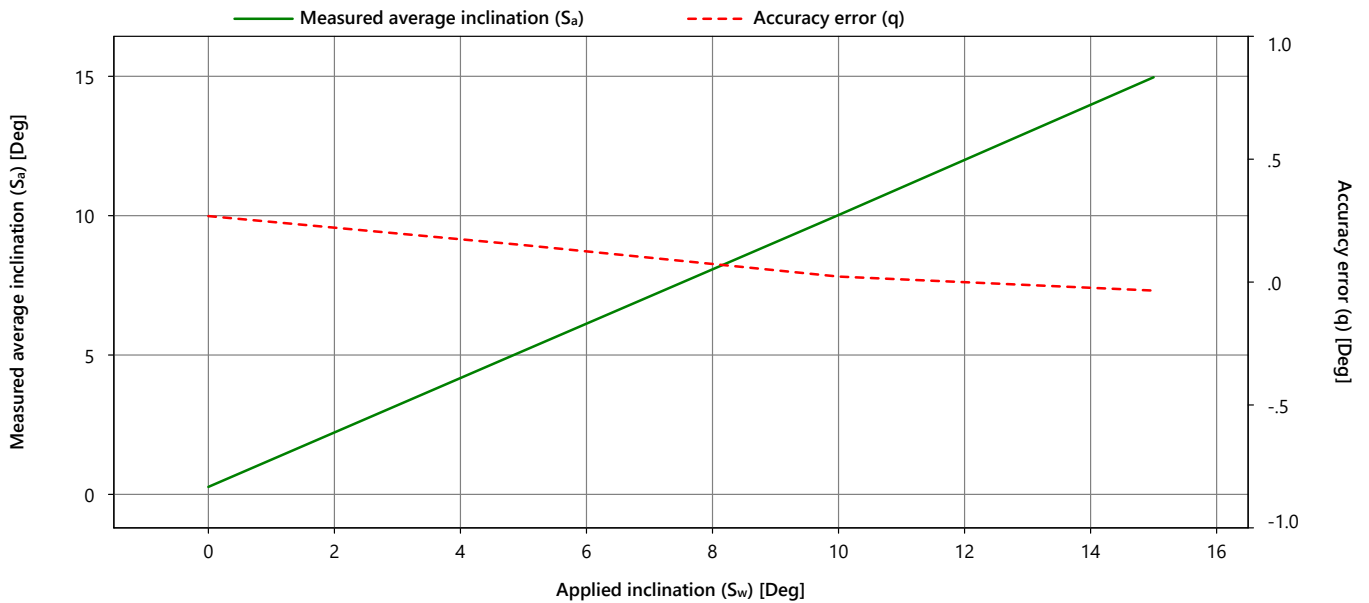
Certificate Number
FCN24032918

Calibration Details	
Calibration Date	04 Mar 2024 09:08:47
Procedure	EUAF-FNLM- CAL-PR-005
Software Version	4.2.0.55751

Sensor	
Channel	Slope [Inclination]
Manufacturer	ADXL
Calibrated Range	0 to 15 Deg
Maximum Rating	0 to 20 Deg

Characteristics	Unit	Value
Max accuracy error (q)	[Deg]	0.3
Max repeatability error (b)	[Deg]	0.4
Zero load error (S_{c0})	[Deg]	0.0
Zero load offset (S_0)	[Deg]	0.0
Resolution	[Deg]	1.28E-05
Noise RMS	[Deg]	0.0

Inclination is defined as the angular deviation of the cone penetrometer from the vertical.



Applied inclination (S_w) [Deg]	Measured inclination 1 ($S_{a,1}$) [Deg]	Measured inclination 2 ($S_{a,2}$) [Deg]	Measured inclination 3 ($S_{a,3}$) [Deg]	Measured average inclination (S_a) [Deg]	Accuracy error (q) [Deg]	Repeatability error (b) [Deg]	Expanded Uncertainty (U) [Deg]
0.0	0.0	0.3	0.4	0.3	0.3	0.4	0.9
5.0	5.0	5.2	5.2	5.2	0.2	0.2	0.7
10.0	10.0	10.0	10.0	10.0	0.0	0.0	0.7
15.0	15.1	14.9	14.9	15.0	0.0	0.2	0.8

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Symbols, Definitions and References

Certificate Number
FCN24032918

Symbols and Definitions (general)

b	Repeatability error, defined as the maximum difference between the measurements of the instrument at the applied value.
Noise RMS	Signal noise, defined as the quadratic mean when the sensor is not subjected to load.
q	Accuracy error, defined as the difference between the average indicated value by the instrument and the applied value.
Resolution	Smallest change in a quantity being measured that causes a perceptible change in the corresponding indication.
U	The stated uncertainty is that of the average indicated quantity, and includes the entire calibration method, including the reference and calibrated sensor, but excludes the difference between average indicated value by the instrument and the applied value.
v	Reversibility error, defined as the difference between the average indicated value by the instrument at a certain applied value when it was increased and when it was decreased.

Symbols and Definitions (quantity specific: Q may be substituted for F, P or S, as appropriate)

Q₀	Zero load offset, instrument output where the specified measured quantity value is zero.
Q_a	Average indicated quantity value by the instrument.
Q_{a,x}	Quantity value indicated by the instrument at measurement x.
Q_{c0}	Zero load error, defined as the difference between the average indicated value by the instrument before and after the load cycle has been applied.
Q_w	Applied reference quantity value.

Quantities

F	Force
P	Pressure
S	Inclination

References

International Organization for Standardization, 2012. *ISO 22476-1:2012 Geotechnical investigation and testing, Field testing, Electrical cone and piezocone penetration test*. Geneva: ISO.

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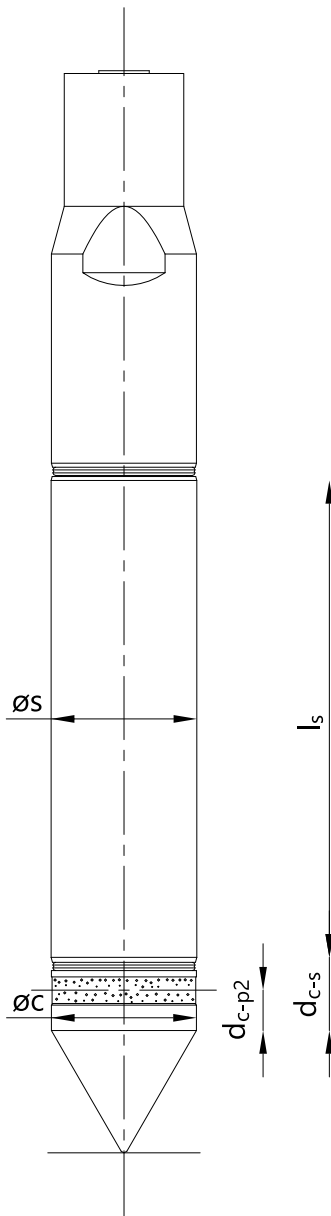


Typical Dimensions

Instrument

Manufacturer	Fugro
Type	CP10-CF100PB10SN2-P1E1M1-V1
Serial Number	1706-2790

Appendix Applicable to
Certificate Number
FCN24032918



Typical Dimensions

A_c	Cross-sectional projected area of the cone	0.001 m ²
A_s	Surface area of the friction sleeve	0.015 m ²
a_f	Cone net area ratio	0.75
b_f	Friction sleeve net area ratio	0
$\varnothing c$	Diameter of the cylindrical part of the cone	35.8 mm
$\varnothing s$	Diameter of the friction sleeve	36.1 mm
l_s	Length of the friction sleeve	132.7 mm
d_{c-s}	Cone - friction sleeve distance	13.5 mm
d_{c-p2}	Cone - pore 2 distance	5 mm

Diagram is not to scale

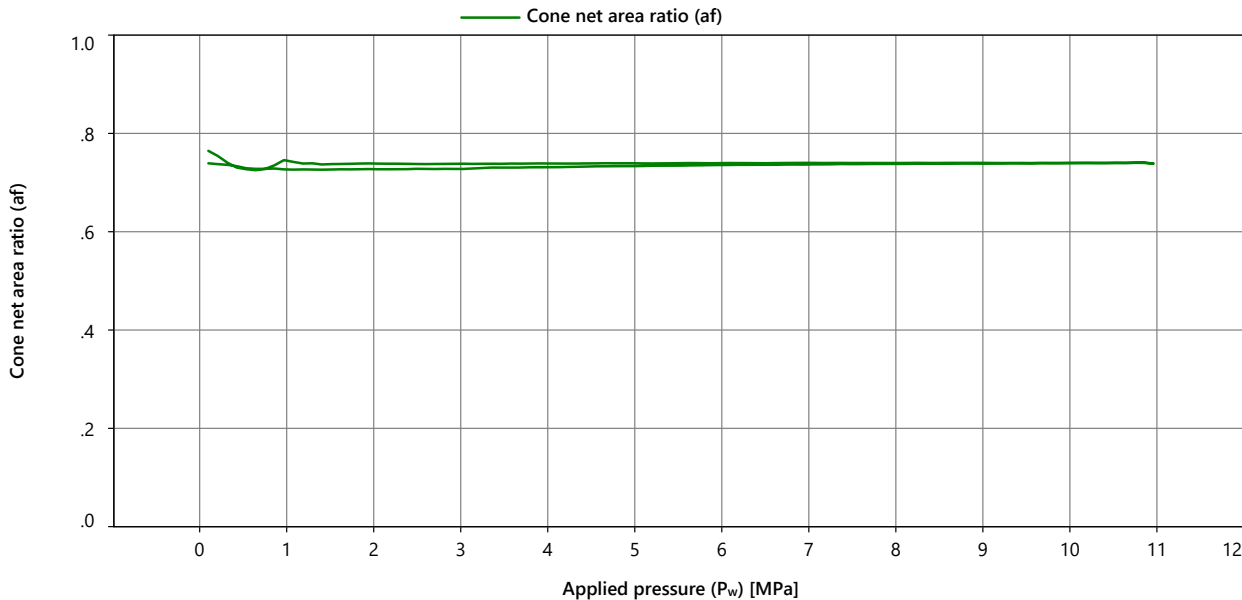
Cone Net Area Ratio Result

Instrument		Reference	
Manufacturer	Fugro	Manufacturer	Keller PA-33X
Type	CP10-CF100PB10SN2-P 1E1M1-V1	Serial Number	3257-0002
Serial Number	1706-2790	Uncertainty	0.0005•P _w +0.002 [MPa]
Electronics	9038	Measurement Details	
Node Type	7001	Measurement Date	07 Mar 2024 08:15:09
Hardware Version	6.00	Procedure	EUAF-FNLM- CAL-PR-003
Software Version	8.01	Software Version	4.2.0.55751

Appendix Applicable to
Certificate Number
FCN24032918

Characteristics	Unit	Value
Cone net area ratio (af)	[-]	0.74

The cone net area ratio presented above is determined at the maximum applied pressure during the measurement.



Applied pressure (P _w) [MPa]	Measured cone net area ratio 1 (af,1)	Measured cone net area ratio 2 (af,2)	Measured cone net area ratio 3 (af,3)	Measured average cone net area ratio (af)
2.000	0.727	0.727	0.728	0.727
4.000	0.731	0.731	0.732	0.731
6.000	0.736	0.735	0.736	0.736
8.000	0.738	0.738	0.738	0.738
10.000	0.740	0.740	0.740	0.740
8.000	0.740	0.740	0.740	0.740
6.000	0.740	0.739	0.740	0.740
4.000	0.739	0.739	0.738	0.739
2.000	0.739	0.739	0.738	0.739

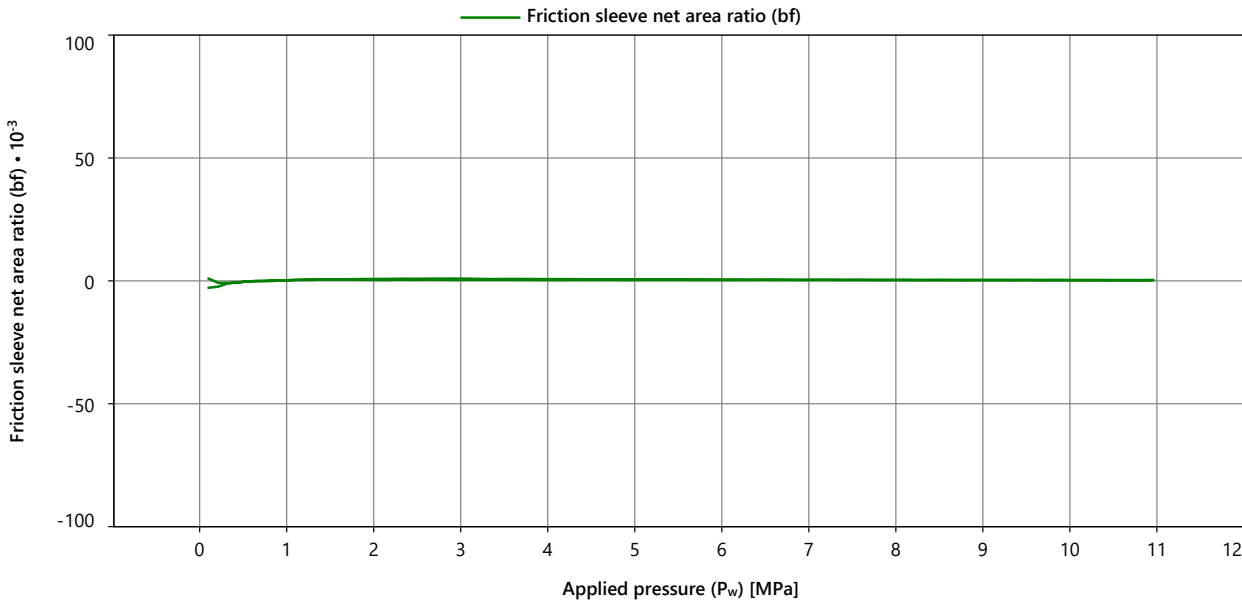
Friction Sleeve Net Area Ratio Result

Instrument		Reference	
Manufacturer	Fugro	Manufacturer	Keller PA-33X
Type	CP10-CF100PB10SN2-P 1E1M1-V1	Serial Number	3257-0002
Serial Number	1706-2790	Uncertainty	0.0005•P _w +0.002 [MPa]
Electronics	9038	Measurement Details	
Node Type	7001	Measurement Date	07 Mar 2024 08:15:09
Hardware Version	6.00	Procedure	EUAF-FNLM- CAL-PR-003
Software Version	8.01	Software Version	4.2.0.55751

Appendix Applicable to
Certificate Number
FCN24032918

Characteristics	Unit	Value
Friction sleeve net area ratio (bf)	[-]	0.00032

The friction sleeve net area ratio presented above is determined at the maximum applied pressure during the measurement.



Applied pressure (P _w) [MPa]	Measured friction sleeve net area ratio (bf) 1 (bf,1)	Measured friction sleeve net area ratio (bf) 2 (bf,2)	Measured friction sleeve net area ratio (bf) 3 (bf,3)	Measured average Friction sleeve net area ratio (bf)
2.000	0.001	0.001	0.001	0.001
4.000	0.001	0.001	0.001	0.001
6.000	0.001	0.001	0.000	0.001
8.000	0.000	0.000	0.000	0.000
10.000	0.000	0.000	0.000	0.000
8.000	0.000	0.000	0.000	0.000
6.000	0.000	0.000	0.000	0.000
4.000	0.000	0.000	0.000	0.000
2.000	0.000	0.000	0.000	0.000

Symbols and Definitions

Appendix Applicable to
Certificate Number
FCN24032918

Symbols and Definitions (general)

af	Cone net area ratio, defined as the factor between the applied pressure to the instrument and the indicated cone resistance.
af,x	Measured cone net area ratio at measurement x.
bf	Friction sleeve net area ratio, defined as the factor between the applied pressure to the instrument and the indicated sleeve friction.
bf,x	The measured friction sleeve net area ratio at measurement x.

Symbols and Definitions (quantity specific: Q may be substituted for P, as appropriate)

Q _w	Applied reference quantity value.
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Quantities

P	Pressure
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Calibration Certificate

Applicant Fugro GeoServices Ltd.
Fugro House, Hithercroft Road
OX10 9RB, Wallingford
United Kingdom

Certificate Number
FCN24033175

Instrument Cone Penetrometer
Manufacturer Fugro
Type CP15-CF200PB10SN2-P1E1M4-V1
Serial Number 1715-0056

Calibration method The instrument was calibrated according to Fugro procedures using a comparison technique against a reference standard.

Environmental Conditions
Temperature during calibration 20.5 ± 3 °C
Atmospheric pressure during calibration 1000 ± 100 mbar

Result The condition of the cone penetrometer meets the requirements of ISO 22476-1:2012 Section 4.1 through 4.7. The calibration results are reported on the next page(s).

The calibration results indicate that the cone penetrometer meets the requirements for use in Application Class 1 as defined in ISO 22476-1:2012 Section 5.2.

Uncertainty The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, which provides a confidence level of approximately 95%. The standard uncertainty has been determined in accordance with EA-4/02.

Traceability Fugro reference standards are periodically recertified and are traceable to the International System of Units (SI). Fugro's calibration system meets or exceeds the requirements of ISO 9001:2008, ISO 10012:2003 and ISO/IEC 17025:2017.

Calibration period 26-Mar-2024 through 27-Mar-2024

Calibrate before 26-Mar-2025

Calibrated Sensor	Manufacturer / Type	Calibrated Range	Maximum Rating	Procedure
Cone [Force]	Fugro Loadcell	0 to 200 kN	0 to 200 kN	EUAF-FNLM- CAL-PR-003
Cone+Fric. [Force]	Fugro Loadcell	0 to 200 kN	0 to 200 kN	EUAF-FNLM- CAL-PR-003
Pore 2 [Pressure]	Keller PA-6L/100bar (81188)	0 to 10 MPa	0 to 20 MPa	EUAF-FNLM- CAL-PR-004
Slope [Inclination]	ADXL	0 to 15 Deg	0 to 20 Deg	EUAF-FNLM- CAL-PR-005

Calibrated Sensor	Before adjustment		After adjustment		Drift	
	Sensitivity	Zero Load	Sensitivity	Zero Load	Sensitivity	Zero Load
Cone [Force]	10.7 $\mu\text{V/V/kN}$	3.39 $\mu\text{V/V}$	10.7 $\mu\text{V/V/kN}$	2.42 $\mu\text{V/V}$	-0.01 %	-0.05 %
Cone+Fric. [Force]	10.7 $\mu\text{V/V/kN}$	3.88 $\mu\text{V/V}$	10.7 $\mu\text{V/V/kN}$	0.457 $\mu\text{V/V}$	-0.08 %	-0.16 %
Pore 2 [Pressure]	2.97 mV/V/MPa	610 $\mu\text{V/V}$	2.96 mV/V/MPa	587 $\mu\text{V/V}$	-0.05 %	-0.08 %

Nootdorp, 28-Mar-2024

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Ruud Schrijvers
Deputy Manager Transducer Workshop

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Cone Calibration Result [Force]

Instrument	
Manufacturer	Fugro
Type	CP15-CF200PB10SN2-P 1E1M4-V1
Serial Number	1715-0056
Electronics	234
Node Type	7001
Hardware Version	5.01
Software Version	8.01

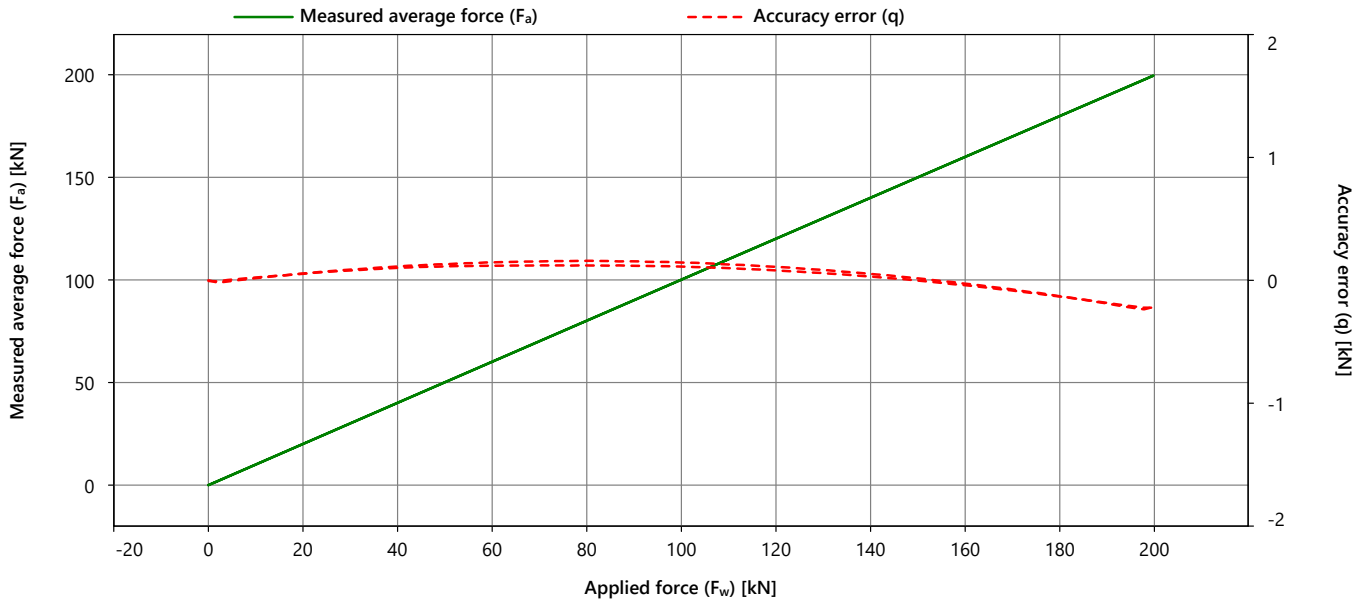
Reference	
Manufacturer	Zwick/Roell
Serial Number	6034-0003
Uncertainty	0.003•F _w +0.015 [kN]

Certificate Number
FCN24033175

Calibration Details	
Calibration Date	26 Mar 2024 11:11:54
Procedure	EUAF-FNLM- CAL-PR-003
Software Version	4.2.0.55751

Sensor	
Channel	Cone [Force]
Manufacturer	Fugro Loadcell
Calibrated Range	0 to 200 kN
Maximum Rating	0 to 200 kN

Characteristics	Unit	Value
Max accuracy error (q)	[kN]	0.214
Max repeatability error (b)	[kN]	0.024
Max reversibility error (v)	[kN]	0.039
Zero load error (F _{c0})	[kN]	0.006
Zero load offset (F ₀)	[kN]	-0.016
Resolution	[kN]	8.68E-05
Noise RMS	[kN]	0.001



Applied force (F _w) [kN]	Measured force 1 (F _{a,1}) [kN]	Measured force 2 (F _{a,2}) [kN]	Measured force 3 (F _{a,3}) [kN]	Measured average force (F _a) [kN]	Accuracy error (q) [kN]	Repeatability error (b) [kN]	Reversibility error (v) [kN]	Expanded Uncertainty (U) [kN]
0.000	0.003	0.001	-0.004	0.000	0.000	0.008		0.020
40.000	40.116	40.113	40.108	40.113	0.113	0.008	-0.011	0.140
80.000	80.160	80.161	80.157	80.159	0.159	0.004	-0.039	0.265
120.000	120.112	120.111	120.105	120.110	0.110	0.007	-0.029	0.386
160.000	159.975	159.976	159.968	159.973	-0.027	0.007	-0.012	0.508
200.000	199.799	199.775	199.784	199.786	-0.214	0.024		0.631
160.000	159.964	159.961	159.957	159.961	-0.039	0.006	-0.012	0.508
120.000	120.087	120.079	120.076	120.081	0.081	0.010	-0.029	0.386
80.000	80.125	80.122	80.115	80.121	0.121	0.009	-0.039	0.266
40.000	40.108	40.099	40.097	40.101	0.101	0.011	-0.011	0.140
0.000	-0.003	-0.007	-0.007	-0.006	-0.006	0.004		0.018

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Cone+Fric. Calibration Result [Force]

Instrument	
Manufacturer	Fugro
Type	CP15-CF200PB10SN2-P 1E1M4-V1
Serial Number	1715-0056
Electronics	234
Node Type	7001
Hardware Version	5.01
Software Version	8.01

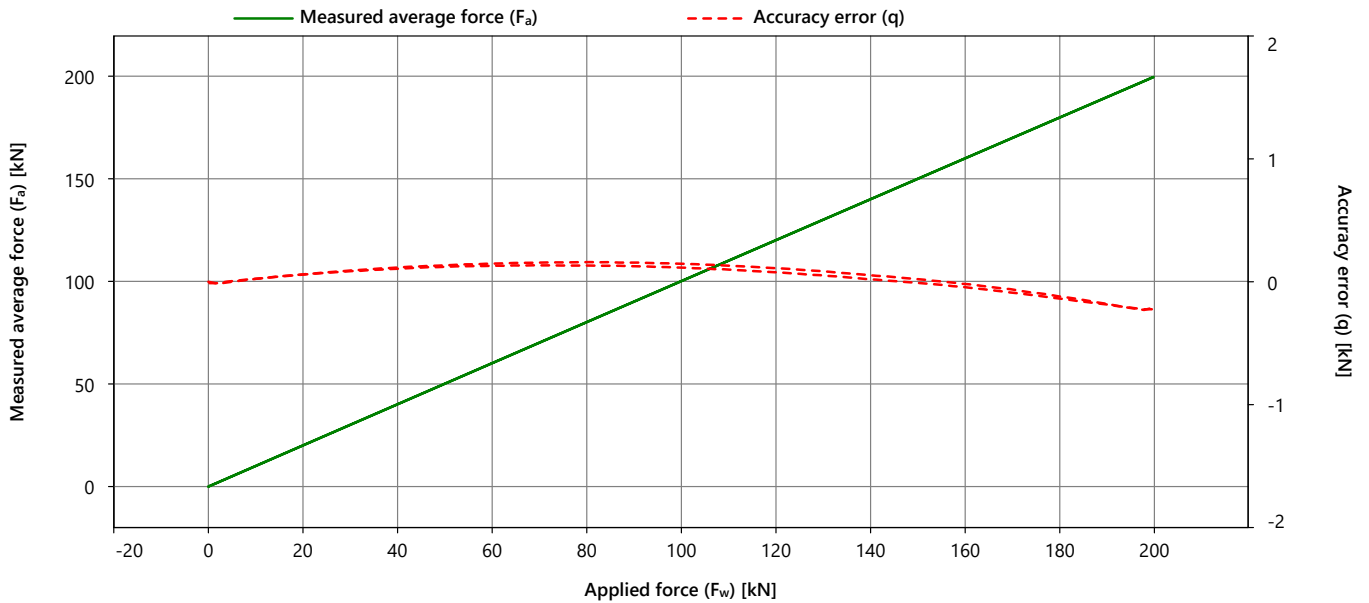
Reference	
Manufacturer	Zwick/Roell
Serial Number	6034-0003
Uncertainty	0.003•F _w +0.015 [kN]

Certificate Number
FCN24033175

Calibration Details	
Calibration Date	26 Mar 2024 11:11:54
Procedure	EUAF-FNLM- CAL-PR-003
Software Version	4.2.0.55751

Sensor	
Channel	Cone+Fric. [Force]
Manufacturer	Fugro Loadcell
Calibrated Range	0 to 200 kN
Maximum Rating	0 to 200 kN

Characteristics	Unit	Value
Max accuracy error (q)	[kN]	0.208
Max repeatability error (b)	[kN]	0.023
Max reversibility error (v)	[kN]	0.033
Zero load error (F _{c0})	[kN]	0.011
Zero load offset (F ₀)	[kN]	-0.014
Resolution	[kN]	8.71E-05
Noise RMS	[kN]	0.001
Tip-Sleeve Interaction %	[%]	0.015



Applied force (F _w) [kN]	Measured force 1 (F _{a,1}) [kN]	Measured force 2 (F _{a,2}) [kN]	Measured force 3 (F _{a,3}) [kN]	Measured average force (F _a) [kN]	Accuracy error (q) [kN]	Repeatability error (b) [kN]	Reversibility error (v) [kN]	Expanded Uncertainty (U) [kN]
0.000	0.008	-0.001	-0.007	0.000	0.000	0.016		0.033
40.000	40.121	40.115	40.111	40.116	0.116	0.010	-0.010	0.140
80.000	80.164	80.159	80.157	80.160	0.160	0.007	-0.028	0.264
120.000	120.116	120.108	120.106	120.110	0.110	0.010	-0.033	0.387
160.000	159.985	159.984	159.978	159.982	-0.018	0.007	-0.026	0.509
200.000	199.803	199.780	199.793	199.792	-0.208	0.023		0.631
160.000	159.960	159.954	159.955	159.956	-0.044	0.005	-0.026	0.509
120.000	120.083	120.077	120.072	120.077	0.077	0.011	-0.033	0.387
80.000	80.136	80.131	80.127	80.132	0.132	0.008	-0.028	0.264
40.000	40.115	40.101	40.101	40.105	0.105	0.014	-0.010	0.141
0.000	-0.007	-0.014	-0.013	-0.011	-0.011	0.007		0.024

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Pore 2 Calibration Result [Pressure]

Instrument	
Manufacturer	Fugro
Type	CP15-CF200PB10SN2-P 1E1M4-V1
Serial Number	1715-0056
Electronics	234
Node Type	7001
Hardware Version	5.01
Software Version	8.01

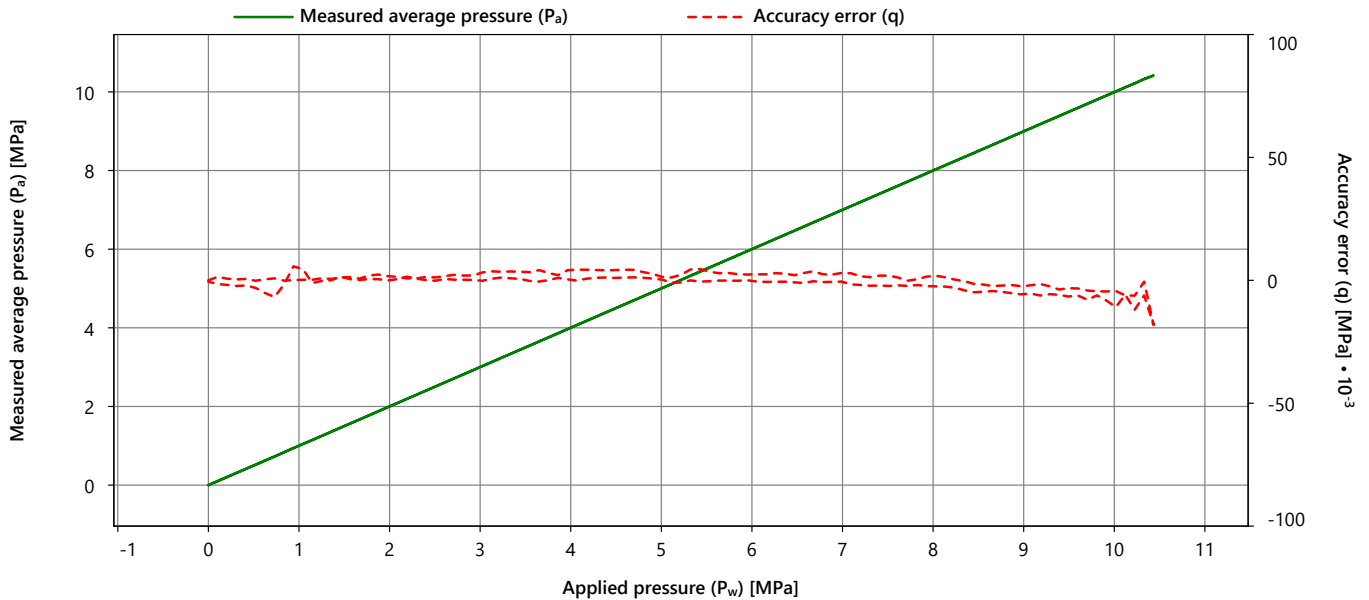
Reference	
Manufacturer	Keller PA-33X
Serial Number	3257-0002
Uncertainty	0.0005•P _w +0.002 [MPa]

Certificate Number
FCN24033175

Calibration Details	
Calibration Date	27 Mar 2024 06:36:29
Procedure	EUAF-FNLM- CAL-PR-004
Software Version	4.2.0.55751

Sensor	
Channel	Pore 2 [Pressure]
Manufacturer	Keller PA-6L/100bar (81188)
Calibrated Range	0 to 10 MPa
Maximum Rating	0 to 20 MPa

Characteristics	Unit	Value
Max accuracy error (q)	[MPa]	0.004
Max repeatability error (b)	[MPa]	0.003
Max reversibility error (v)	[MPa]	0.004
Zero load error (P _{c0})	[MPa]	0.001
Zero load offset (P ₀)	[MPa]	0.004
Resolution	[MPa]	2.51E-06
Noise RMS	[MPa]	0.000



Applied pressure (P _w)	Measured pressure 1 (P _{a,1})	Measured pressure 2 (P _{a,2})	Measured pressure 3 (P _{a,3})	Measured average pressure (P _a)	Accuracy error (q)	Repeatability error (b)	Reversibility error (v)	Expanded Uncertainty (U)
[MPa]	[MPa]	[MPa]	[MPa]	[MPa]	[MPa]	[MPa]	[MPa]	[MPa]
0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.003
2.000	2.001	2.000	2.004	2.002	0.002	0.003	-0.002	0.007
4.000	4.005	4.004	4.004	4.004	0.004	0.001	-0.004	0.008
6.000	6.002	6.003	6.002	6.002	0.002	0.001	-0.003	0.006
8.000	8.002	8.001	8.002	8.002	0.002	0.001	-0.004	0.009
10.000	9.995	9.996	9.996	9.996	-0.004	0.002		0.008
8.000	7.997	7.999	7.996	7.997	-0.003	0.002	-0.004	0.009
6.000	6.000	6.000	5.999	6.000	0.000	0.001	-0.003	0.006
4.000	4.001	3.999	4.000	4.000	0.000	0.002	-0.004	0.008
2.000	2.000	2.000	2.000	2.000	0.000	0.000	-0.002	0.004
0.000	-0.001	0.000	-0.001	-0.001	-0.001	0.000		0.003

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Slope Calibration Result [Inclination]

Instrument	
Manufacturer	Fugro
Type	CP15-CF200PB10SN2-P 1E1M4-V1
Serial Number	1715-0056
Electronics	234
Node Type	7001
Hardware Version	5.01
Software Version	8.01

Reference	
Manufacturer	Hoek-O-Mat
Serial Number	2109-0002
Uncertainty	0.6 [Deg]

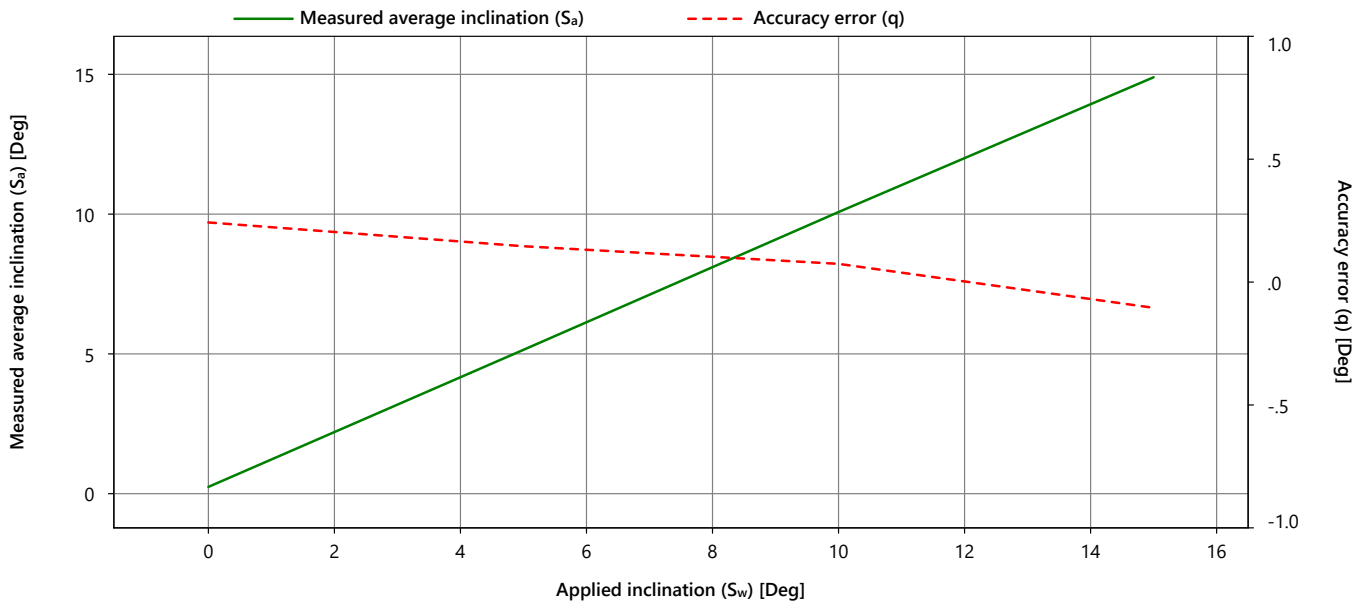
Certificate Number
FCN24033175

Calibration Details	
Calibration Date	26 Mar 2024 11:16:34
Procedure	EUAF-FNLM- CAL-PR-005
Software Version	4.2.0.55751

Sensor	
Channel	Slope [Inclination]
Manufacturer	ADXL
Calibrated Range	0 to 15 Deg
Maximum Rating	0 to 20 Deg

Characteristics	Unit	Value
Max accuracy error (q)	[Deg]	0.2
Max repeatability error (b)	[Deg]	0.3
Zero load error (S_{c0})	[Deg]	0.0
Zero load offset (S_0)	[Deg]	0.1
Resolution	[Deg]	1.28E-05
Noise RMS	[Deg]	0.0

Inclination is defined as the angular deviation of the cone penetrometer from the vertical.



Applied inclination (S_w) [Deg]	Measured inclination 1 ($S_{a,1}$) [Deg]	Measured inclination 2 ($S_{a,2}$) [Deg]	Measured inclination 3 ($S_{a,3}$) [Deg]	Measured average inclination (S_a) [Deg]	Accuracy error (q) [Deg]	Repeatability error (b) [Deg]	Expanded Uncertainty (U) [Deg]
0.0	0.2	0.4	0.2	0.2	0.2	0.2	0.7
5.0	5.0	5.2	5.2	5.1	0.1	0.3	0.8
10.0	10.0	10.1	10.1	10.1	0.1	0.1	0.7
15.0	15.0	14.9	14.8	14.9	-0.1	0.1	0.7

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Symbols, Definitions and References

Certificate Number
FCN24033175

Symbols and Definitions (general)

b	Repeatability error, defined as the maximum difference between the measurements of the instrument at the applied value.
Noise RMS	Signal noise, defined as the quadratic mean when the sensor is not subjected to load.
q	Accuracy error, defined as the difference between the average indicated value by the instrument and the applied value.
Resolution	Smallest change in a quantity being measured that causes a perceptible change in the corresponding indication.
U	The stated uncertainty is that of the average indicated quantity, and includes the entire calibration method, including the reference and calibrated sensor, but excludes the difference between average indicated value by the instrument and the applied value.
v	Reversibility error, defined as the difference between the average indicated value by the instrument at a certain applied value when it was increased and when it was decreased.

Symbols and Definitions (quantity specific: Q may be substituted for F, P or S, as appropriate)

Q₀	Zero load offset, instrument output where the specified measured quantity value is zero.
Q_a	Average indicated quantity value by the instrument.
Q_{a,x}	Quantity value indicated by the instrument at measurement x.
Q_{c0}	Zero load error, defined as the difference between the average indicated value by the instrument before and after the load cycle has been applied.
Q_w	Applied reference quantity value.

Quantities

F	Force
P	Pressure
S	Inclination

References

International Organization for Standardization, 2012. *ISO 22476-1:2012 Geotechnical investigation and testing, Field testing, Electrical cone and piezocone penetration test*. Geneva: ISO.

European Co-operation For Accreditation, 2013. *Evaluation of the uncertainty of measurement in calibration*. European Co-operation For Accreditation, Publication; EA-4/02 M:2013.

International Organization for Standardization, 2005. *ISO 17025:2005 General requirements for the competence of testing and calibration laboratories*. Geneva: ISO.

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International Organization for Standardization, 2008. *ISO 9001:2008 Quality management systems - Requirements*. Geneva: ISO.

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Typical Dimensions

Instrument

Manufacturer	Fugro
Type	CP15-CF200PB10SN2-P1E1M4-V1
Serial Number	1715-0056

Appendix Applicable to
Certificate Number
FCN24033175

Typical Dimensions

Cross-sectional projected area of the cone	0.0015 m ²
Surface area of the friction sleeve	0.023 m ²
Cone net area ratio	0.76
Friction sleeve net area ratio	0
Diameter of the cylindrical part of the cone	43.85 mm
Diameter of the friction sleeve	44.1 mm
Length of the friction sleeve	162.75 mm
Cone - friction sleeve distance	15.75 mm
Cone - pore 2 distance	3 mm

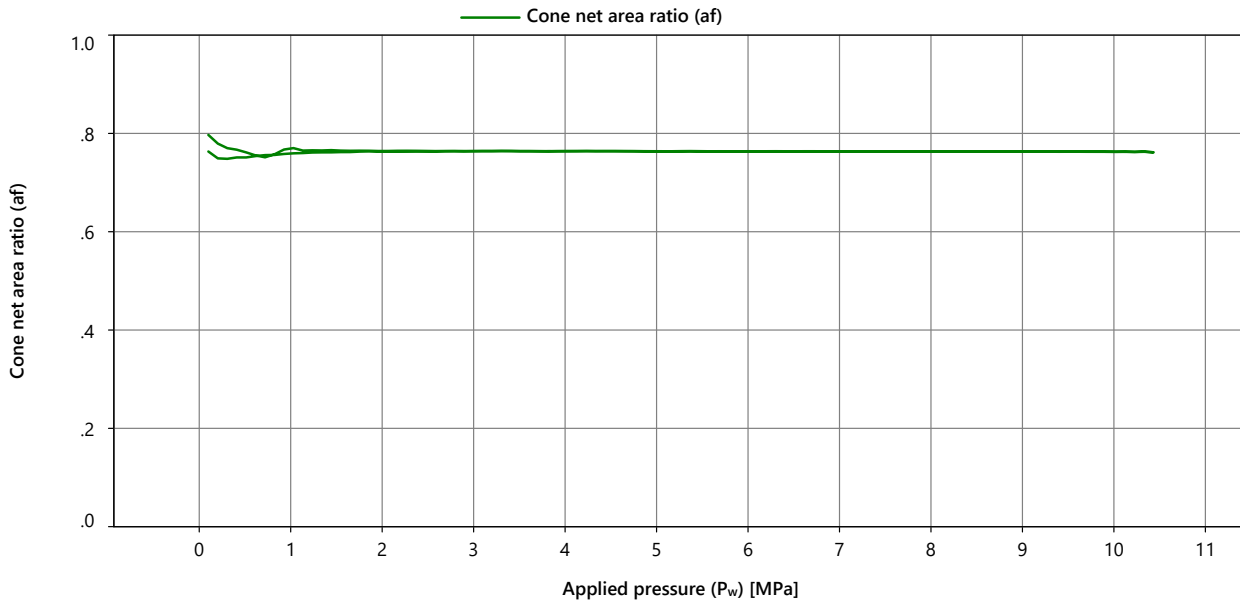
Cone Net Area Ratio Result

Instrument		Reference	
Manufacturer	Fugro	Manufacturer	Keller PA-33X
Type	CP15-CF200PB10SN2-P 1E1M4-V1	Serial Number	3257-0002
Serial Number	1715-0056	Uncertainty	0.0005•P _w +0.002 [MPa]
Electronics	234	Measurement Details	
Node Type	7001	Measurement Date	27 Mar 2024 06:36:29
Hardware Version	5.01	Procedure	EUAF-FNLM- CAL-PR-003
Software Version	8.01	Software Version	4.2.0.55751

Appendix Applicable to
Certificate Number
FCN24033175

Characteristics	Unit	Value
Cone net area ratio (af)	[-]	0.76

The cone net area ratio presented above is determined at the maximum applied pressure during the measurement.



Applied pressure (P _w) [MPa]	Measured cone net area ratio 1 (af,1)	Measured cone net area ratio 2 (af,2)	Measured cone net area ratio 3 (af,3)	Measured average cone net area ratio (af)
2.000	0.762	0.762	0.765	0.763
4.000	0.764	0.764	0.765	0.764
6.000	0.763	0.764	0.764	0.764
8.000	0.763	0.763	0.764	0.763
10.000	0.762	0.763	0.763	0.763
8.000	0.763	0.763	0.764	0.763
6.000	0.763	0.764	0.764	0.764
4.000	0.763	0.764	0.764	0.764
2.000	0.764	0.764	0.765	0.764

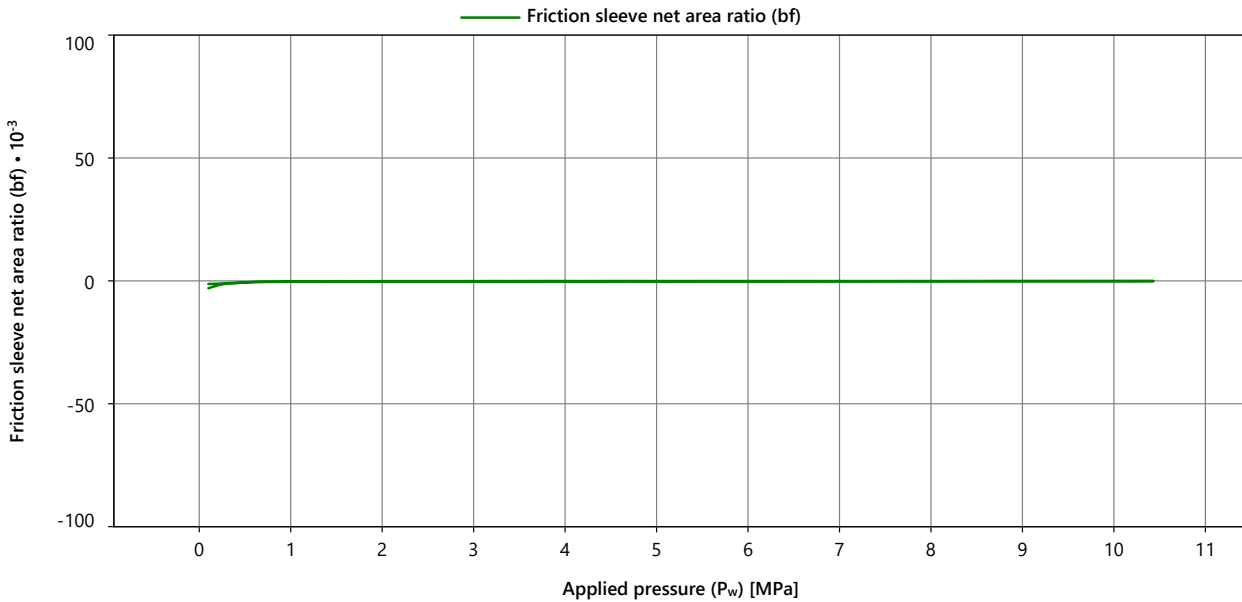
Friction Sleeve Net Area Ratio Result

Instrument		Reference	
Manufacturer	Fugro	Manufacturer	Keller PA-33X
Type	CP15-CF200PB10SN2-P 1E1M4-V1	Serial Number	3257-0002
Serial Number	1715-0056	Uncertainty	0.0005•P _w +0.002 [MPa]
Electronics	234	Measurement Details	
Node Type	7001	Measurement Date	27 Mar 2024 06:36:29
Hardware Version	5.01	Procedure	EUAF-FNLM- CAL-PR-003
Software Version	8.01	Software Version	4.2.0.55751

**Appendix Applicable to
Certificate Number
FCN24033175**

Characteristics	Unit	Value
Friction sleeve net area ratio (bf)	[-]	-0.00008

The friction sleeve net area ratio presented above is determined at the maximum applied pressure during the measurement.



Applied pressure (P _w) [MPa]	Measured friction sleeve net area ratio (bf) 1 (bf,1)	Measured friction sleeve net area ratio (bf) 2 (bf,2)	Measured friction sleeve net area ratio (bf) 3 (bf,3)	Measured average Friction sleeve net area ratio (bf)
2.000	0.000	0.000	0.000	0.000
4.000	0.000	0.000	0.000	0.000
6.000	0.000	0.000	0.000	0.000
8.000	0.000	0.000	0.000	0.000
10.000	0.000	0.000	0.000	0.000
8.000	0.000	0.000	0.000	0.000
6.000	0.000	0.000	0.000	0.000
4.000	0.000	0.000	0.000	0.000
2.000	0.000	0.000	0.000	0.000

Symbols and Definitions

Appendix Applicable to
Certificate Number
FCN24033175

Symbols and Definitions (general)

af	Cone net area ratio, defined as the factor between the applied pressure to the instrument and the indicated cone resistance.
af,x	Measured cone net area ratio at measurement x.
bf	Friction sleeve net area ratio, defined as the factor between the applied pressure to the instrument and the indicated sleeve friction.
bf,x	The measured friction sleeve net area ratio at measurement x.

Symbols and Definitions (quantity specific: Q may be substituted for P, as appropriate)

Q _w	Applied reference quantity value.
----------------	-----------------------------------

Quantities

P	Pressure
---	----------

Calibration Certificate

Applicant Fugro GeoServices Ltd.
Fugro House, Hithercroft Road
OX10 9RB, Wallingford
United Kingdom

Certificate Number
FCN24033179

Instrument Cone Penetrometer
Manufacturer Fugro
Type CP15-CF200PB10SN2-P1E1M4-V1
Serial Number 1715-0057

Calibration method The instrument was calibrated according to Fugro procedures using a comparison technique against a reference standard.

Environmental Conditions
Temperature during calibration 20.5 ± 3 °C
Atmospheric pressure during calibration 1000 ± 100 mbar

Result The condition of the cone penetrometer meets the requirements of ISO 22476-1:2012 Section 4.1 through 4.7. The calibration results are reported on the next page(s).

The calibration results indicate that the cone penetrometer meets the requirements for use in Application Class 1 as defined in ISO 22476-1:2012 Section 5.2.

Uncertainty The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, which provides a confidence level of approximately 95%. The standard uncertainty has been determined in accordance with EA-4/02.

Traceability Fugro reference standards are periodically recertified and are traceable to the International System of Units (SI). Fugro's calibration system meets or exceeds the requirements of ISO 9001:2008, ISO 10012:2003 and ISO/IEC 17025:2017.

Calibration date 27-Mar-2024

Calibrate before 27-Mar-2025

Calibrated Sensor	Manufacturer / Type	Calibrated Range	Maximum Rating	Procedure
Cone [Force]	Fugro Loadcell	0 to 200 kN	0 to 200 kN	EUAF-FNLM- CAL-PR-003
Cone+Fric. [Force]	Fugro Loadcell	0 to 200 kN	0 to 200 kN	EUAF-FNLM- CAL-PR-003
Pore 2 [Pressure]	Keller PA-6L/100bar (81188)	0 to 10 MPa	0 to 20 MPa	EUAF-FNLM- CAL-PR-004
Slope [Inclination]	ADXL	0 to 15 Deg	0 to 20 Deg	EUAF-FNLM- CAL-PR-005

Calibrated Sensor	Before adjustment		After adjustment		Drift	
	Sensitivity	Zero Load	Sensitivity	Zero Load	Sensitivity	Zero Load
Cone [Force]	10.8 $\mu\text{V/V/kN}$	-0.460 $\mu\text{V/V}$	10.8 $\mu\text{V/V/kN}$	1.95 $\mu\text{V/V}$	-0.03 %	0.11 %
Cone+Fric. [Force]	10.7 $\mu\text{V/V/kN}$	1.47 $\mu\text{V/V}$	10.7 $\mu\text{V/V/kN}$	4.72 $\mu\text{V/V}$	-0.11 %	0.15 %
Pore 2 [Pressure]	3.07 mV/V/MPa	1.08 mV/V	3.07 mV/V/MPa	1.05 mV/V	-0.08 %	-0.08 %

Nootdorp, 28-Mar-2024

This certificate is issued provided that Fugro assumes no liability.

Ruud Schrijvers
Deputy Manager Transducer Workshop

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Cone Calibration Result [Force]

Instrument	
Manufacturer	Fugro
Type	CP15-CF200PB10SN2-P 1E1M4-V1
Serial Number	1715-0057
Electronics	128
Node Type	7001
Hardware Version	5.01
Software Version	8.01

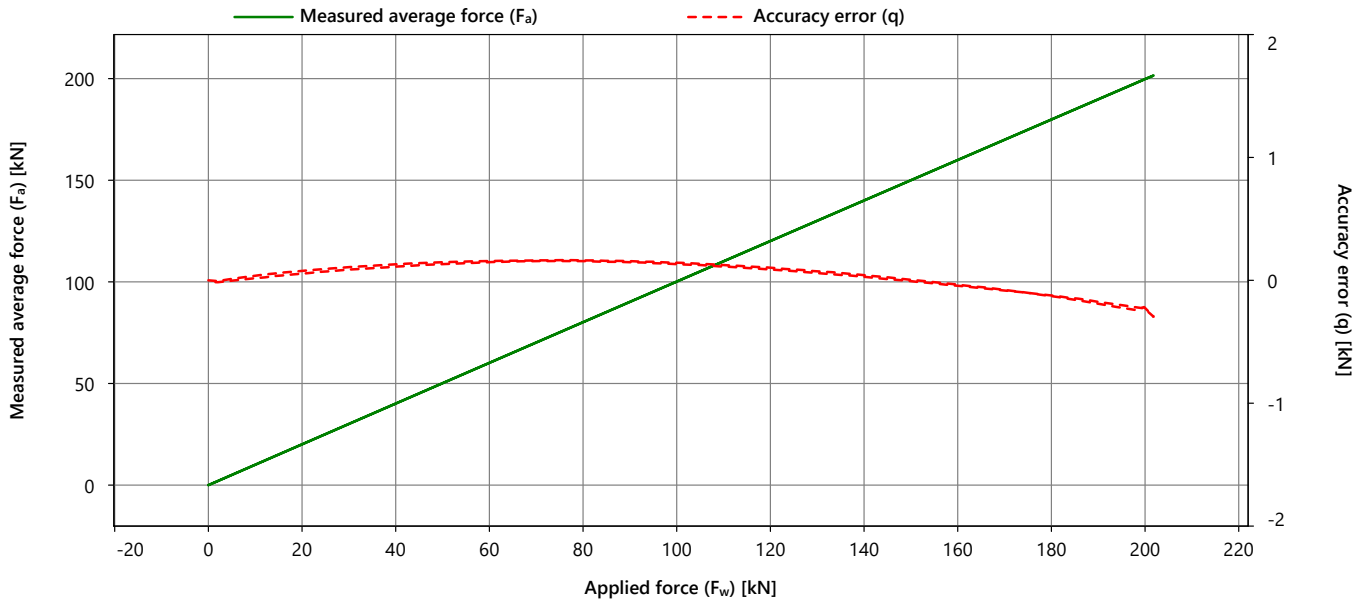
Reference	
Manufacturer	Zwick/Roell
Serial Number	6034-0003
Uncertainty	0.003•F _w +0.015 [kN]

Certificate Number
FCN24033179

Calibration Details	
Calibration Date	27 Mar 2024 06:06:34
Procedure	EUAF-FNLM- CAL-PR-003
Software Version	4.2.0.55751

Sensor	
Channel	Cone [Force]
Manufacturer	Fugro Loadcell
Calibrated Range	0 to 200 kN
Maximum Rating	0 to 200 kN

Characteristics	Unit	Value
Max accuracy error (q)	[kN]	0.214
Max repeatability error (b)	[kN]	0.026
Max reversibility error (v)	[kN]	0.019
Zero load error (F _{c0})	[kN]	0.013
Zero load offset (F ₀)	[kN]	-0.002
Resolution	[kN]	8.65E-05
Noise RMS	[kN]	0.001



Applied force (F _w)	Measured force 1 (F _{a,1})	Measured force 2 (F _{a,2})	Measured force 3 (F _{a,3})	Measured average force (F _a)	Accuracy error (q)	Repeatability error (b)	Reversibility error (v)	Expanded Uncertainty (U)
[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
0.000	0.003	0.000	-0.003	0.000	0.000	0.006		0.026
40.000	40.132	40.132	40.127	40.130	0.130	0.005	-0.019	0.141
80.000	80.161	80.162	80.162	80.162	0.162	0.001	-0.005	0.262
120.000	120.101	120.101	120.107	120.103	0.103	0.007	-0.015	0.385
160.000	159.964	159.963	159.967	159.965	-0.035	0.005	-0.009	0.508
200.000	199.793	199.770	199.795	199.786	-0.214	0.026		0.631
160.000	159.956	159.955	159.957	159.956	-0.044	0.001	-0.009	0.508
120.000	120.087	120.088	120.090	120.088	0.088	0.003	-0.015	0.385
80.000	80.157	80.156	80.157	80.157	0.157	0.002	-0.005	0.262
40.000	40.115	40.112	40.107	40.111	0.111	0.008	-0.019	0.141
0.000	-0.009	-0.013	-0.017	-0.013	-0.013	0.008		0.027

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Cone+Fric. Calibration Result [Force]

Instrument	
Manufacturer	Fugro
Type	CP15-CF200PB10SN2-P 1E1M4-V1
Serial Number	1715-0057
Electronics	128
Node Type	7001
Hardware Version	5.01
Software Version	8.01

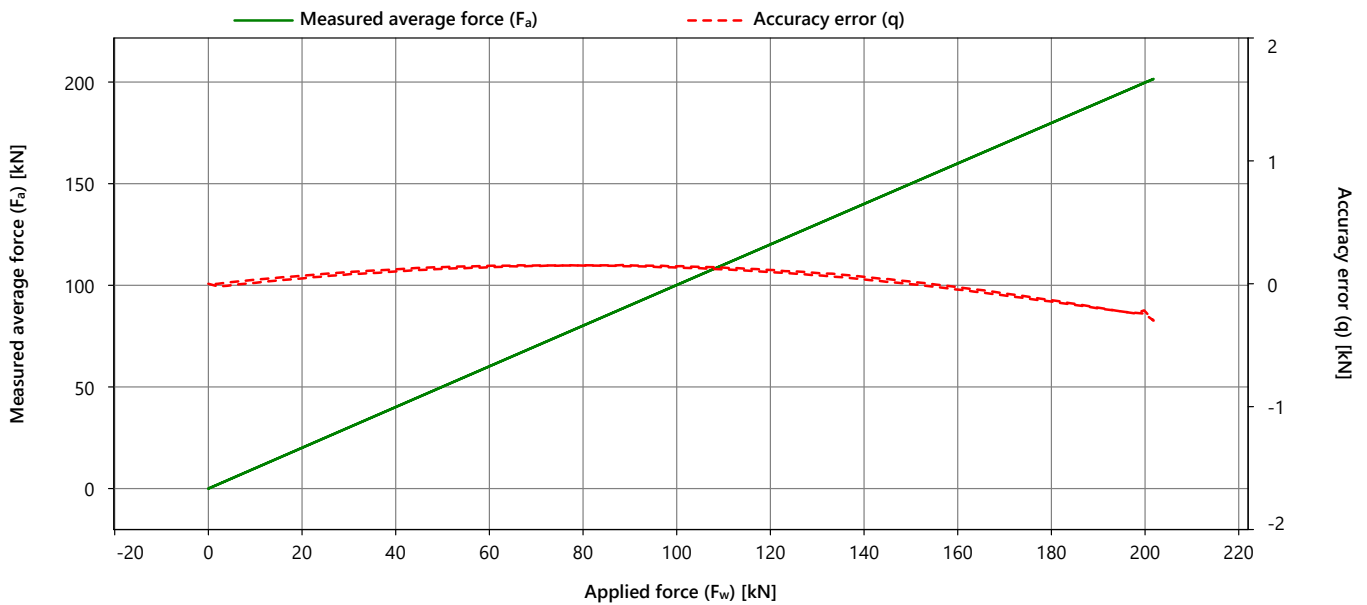
Reference	
Manufacturer	Zwick/Roell
Serial Number	6034-0003
Uncertainty	0.003•F _w +0.015 [kN]

Certificate Number
FCN24033179

Calibration Details	
Calibration Date	27 Mar 2024 06:06:34
Procedure	EUAF-FNLM- CAL-PR-003
Software Version	4.2.0.55751

Sensor	
Channel	Cone+Fric. [Force]
Manufacturer	Fugro Loadcell
Calibrated Range	0 to 200 kN
Maximum Rating	0 to 200 kN

Characteristics	Unit	Value
Max accuracy error (q)	[kN]	0.213
Max repeatability error (b)	[kN]	0.028
Max reversibility error (v)	[kN]	0.019
Zero load error (F _{c0})	[kN]	0.005
Zero load offset (F ₀)	[kN]	-0.001
Resolution	[kN]	8.7E-05
Noise RMS	[kN]	0.002
Tip-Sleeve Interaction %	[%]	0.050



Applied force (F _w) [kN]	Measured force 1 (F _{a,1}) [kN]	Measured force 2 (F _{a,2}) [kN]	Measured force 3 (F _{a,3}) [kN]	Measured average force (F _a) [kN]	Accuracy error (q) [kN]	Repeatability error (b) [kN]	Reversibility error (v) [kN]	Expanded Uncertainty (U) [kN]
0.000	0.004	0.001	-0.005	0.000	0.000	0.009		0.021
40.000	40.105	40.101	40.093	40.100	0.100	0.012	0.018	0.141
80.000	80.154	80.151	80.146	80.150	0.150	0.008	-0.001	0.262
120.000	120.119	120.111	120.109	120.113	0.113	0.010	-0.019	0.385
160.000	159.976	159.971	159.969	159.972	-0.028	0.007	-0.019	0.508
200.000	199.800	199.772	199.790	199.787	-0.213	0.028		0.631
160.000	159.958	159.956	159.946	159.953	-0.047	0.012	-0.019	0.508
120.000	120.097	120.095	120.091	120.094	0.094	0.007	-0.019	0.385
80.000	80.153	80.147	80.147	80.149	0.149	0.006	-0.001	0.262
40.000	40.122	40.119	40.111	40.117	0.117	0.011	0.018	0.141
0.000	-0.001	-0.005	-0.010	-0.005	-0.005	0.009		0.021

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Pore 2 Calibration Result [Pressure]

Instrument	
Manufacturer	Fugro
Type	CP15-CF200PB10SN2-P 1E1M4-V1
Serial Number	1715-0057
Electronics	128
Node Type	7001
Hardware Version	5.01
Software Version	8.01

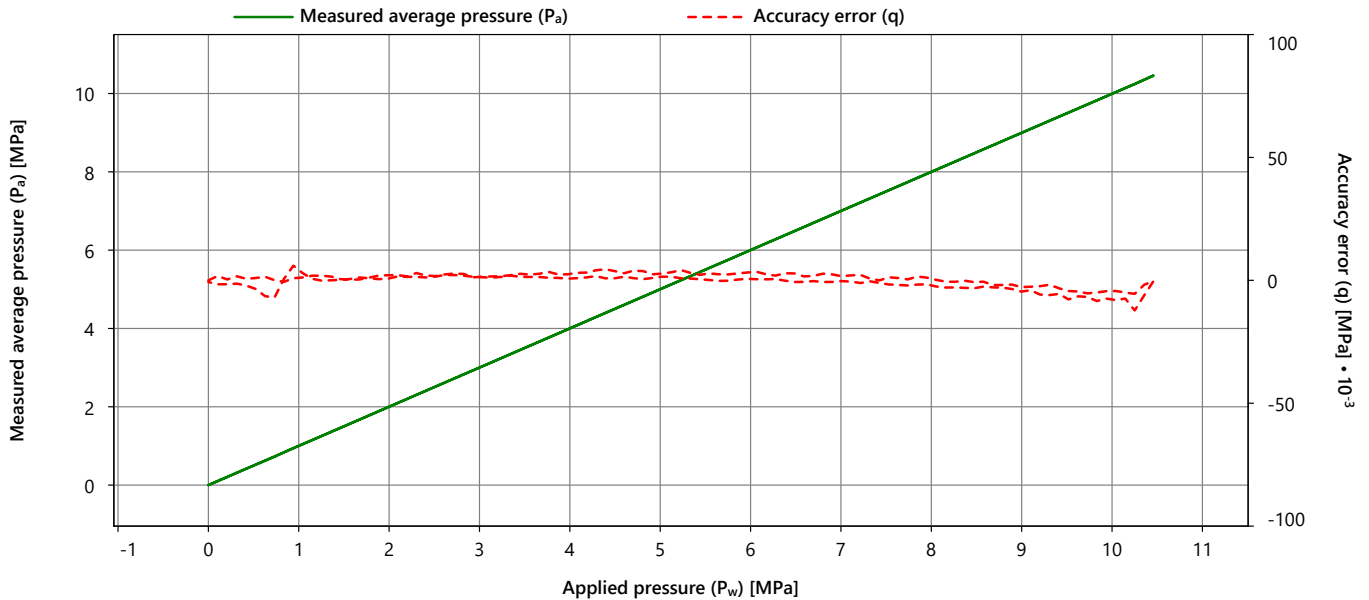
Reference	
Manufacturer	Keller PA-33X
Serial Number	3257-0002
Uncertainty	0.0005•P _w +0.002 [MPa]

Certificate Number
FCN24033179

Calibration Details	
Calibration Date	27 Mar 2024 06:48:15
Procedure	EUAF-FNLM- CAL-PR-004
Software Version	4.2.0.55751

Sensor	
Channel	Pore 2 [Pressure]
Manufacturer	Keller PA-6L/100bar (81188)
Calibrated Range	0 to 10 MPa
Maximum Rating	0 to 20 MPa

Characteristics	Unit	Value
Max accuracy error (q)	[MPa]	0.004
Max repeatability error (b)	[MPa]	0.003
Max reversibility error (v)	[MPa]	0.003
Zero load error (P _{c0})	[MPa]	0.001
Zero load offset (P ₀)	[MPa]	0.002
Resolution	[MPa]	2.43E-06
Noise RMS	[MPa]	0.000



Applied pressure (P _w) [MPa]	Measured pressure 1 (P _{a,1}) [MPa]	Measured pressure 2 (P _{a,2}) [MPa]	Measured pressure 3 (P _{a,3}) [MPa]	Measured average pressure (P _a) [MPa]	Accuracy error (q) [MPa]	Repeatability error (b) [MPa]	Reversibility error (v) [MPa]	Expanded Uncertainty (U) [MPa]
0.000	0.000	0.000	0.000	0.000	0.000	0.001		0.003
2.000	2.001	2.001	2.004	2.002	0.002	0.003	-0.001	0.005
4.000	4.001	4.003	4.003	4.003	0.003	0.002	-0.002	0.006
6.000	6.004	6.002	6.004	6.004	0.004	0.002	-0.003	0.007
8.000	8.001	8.001	8.000	8.001	0.001	0.002	-0.003	0.007
10.000	9.996	9.996	9.995	9.996	-0.004	0.002		0.008
8.000	7.998	7.998	7.997	7.998	-0.002	0.001	-0.003	0.007
6.000	6.000	6.001	6.001	6.001	0.001	0.001	-0.003	0.007
4.000	4.001	4.001	4.000	4.001	0.001	0.001	-0.002	0.005
2.000	2.003	2.000	2.000	2.001	0.001	0.003	-0.001	0.006
0.000	0.000	-0.001	-0.001	-0.001	-0.001	0.001		0.003

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Slope Calibration Result [Inclination]

Instrument	
Manufacturer	Fugro
Type	CP15-CF200PB10SN2-P 1E1M4-V1
Serial Number	1715-0057
Electronics	128
Node Type	7001
Hardware Version	5.01
Software Version	8.01

Reference	
Manufacturer	Hoek-O-Mat
Serial Number	2109-0002
Uncertainty	0.6 [Deg]

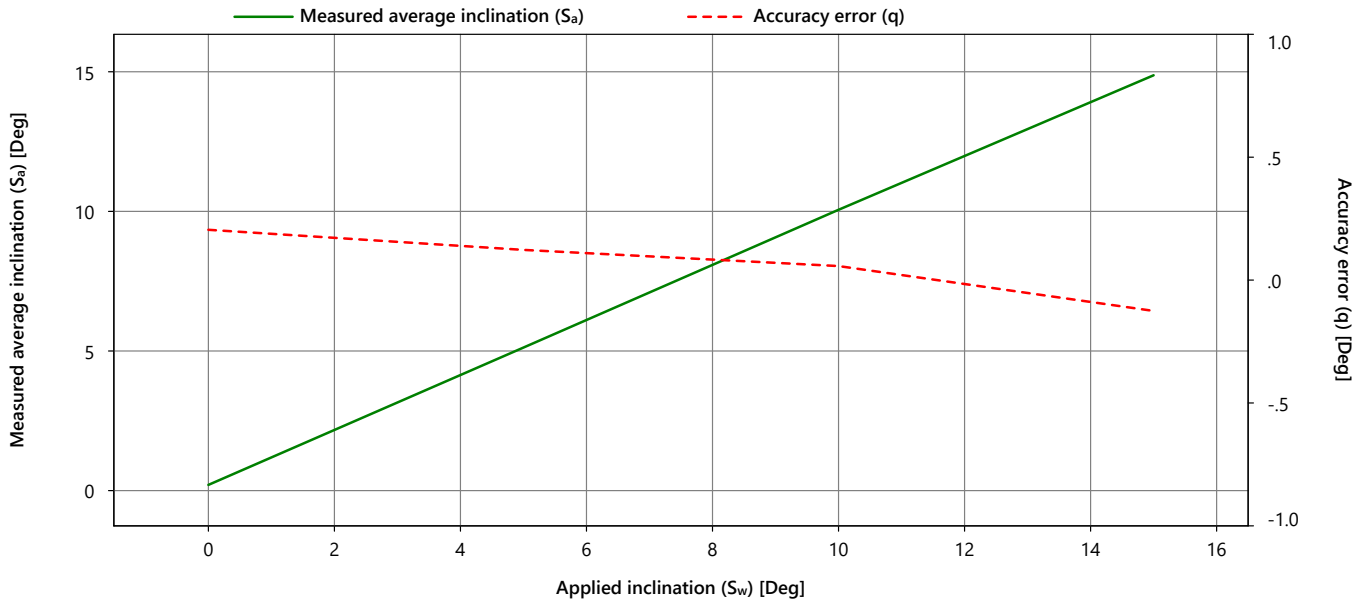
Certificate Number
FCN24033179

Calibration Details	
Calibration Date	27 Mar 2024 06:11:35
Procedure	EUAF-FNLM- CAL-PR-005
Software Version	4.2.0.55751

Sensor	
Channel	Slope [Inclination]
Manufacturer	ADXL
Calibrated Range	0 to 15 Deg
Maximum Rating	0 to 20 Deg

Characteristics	Unit	Value
Max accuracy error (q)	[Deg]	0.2
Max repeatability error (b)	[Deg]	0.2
Zero load error (S_{c0})	[Deg]	0.0
Zero load offset (S_0)	[Deg]	0.1
Resolution	[Deg]	1.32E-05
Noise RMS	[Deg]	0.0

Inclination is defined as the angular deviation of the cone penetrometer from the vertical.



Applied inclination (S_w) [Deg]	Measured inclination 1 ($S_{a,1}$) [Deg]	Measured inclination 2 ($S_{a,2}$) [Deg]	Measured inclination 3 ($S_{a,3}$) [Deg]	Measured average inclination (S_a) [Deg]	Accuracy error (q) [Deg]	Repeatability error (b) [Deg]	Expanded Uncertainty (U) [Deg]
0.0	0.1	0.3	0.2	0.2	0.2	0.2	0.7
5.0	5.0	5.2	5.2	5.1	0.1	0.1	0.7
10.0	10.0	10.1	10.1	10.1	0.1	0.1	0.7
15.0	14.9	14.9	14.8	14.9	-0.1	0.1	0.7

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Symbols, Definitions and References

Certificate Number
FCN24033179

Symbols and Definitions (general)

b	Repeatability error, defined as the maximum difference between the measurements of the instrument at the applied value.
Noise RMS	Signal noise, defined as the quadratic mean when the sensor is not subjected to load.
q	Accuracy error, defined as the difference between the average indicated value by the instrument and the applied value.
Resolution	Smallest change in a quantity being measured that causes a perceptible change in the corresponding indication.
U	The stated uncertainty is that of the average indicated quantity, and includes the entire calibration method, including the reference and calibrated sensor, but excludes the difference between average indicated value by the instrument and the applied value.
v	Reversibility error, defined as the difference between the average indicated value by the instrument at a certain applied value when it was increased and when it was decreased.

Symbols and Definitions (quantity specific: Q may be substituted for F, P or S, as appropriate)

Q₀	Zero load offset, instrument output where the specified measured quantity value is zero.
Q_a	Average indicated quantity value by the instrument.
Q_{a,x}	Quantity value indicated by the instrument at measurement x.
Q_{c0}	Zero load error, defined as the difference between the average indicated value by the instrument before and after the load cycle has been applied.
Q_w	Applied reference quantity value.

Quantities

F	Force
P	Pressure
S	Inclination

References

International Organization for Standardization, 2012. *ISO 22476-1:2012 Geotechnical investigation and testing, Field testing, Electrical cone and piezocone penetration test*. Geneva: ISO.

European Co-operation For Accreditation, 2013. *Evaluation of the uncertainty of measurement in calibration*. European Co-operation For Accreditation, Publication; EA-4/02 M:2013.

International Organization for Standardization, 2005. *ISO 17025:2005 General requirements for the competence of testing and calibration laboratories*. Geneva: ISO.

International Organization for Standardization, 2003. *ISO 10012:2003 Measurement management systems - requirements for measurement processes and measuring equipment*. Geneva: ISO.

International Organization for Standardization, 2008. *ISO 9001:2008 Quality management systems - Requirements*. Geneva: ISO.

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Typical Dimensions

Instrument

Manufacturer	Fugro
Type	CP15-CF200PB10SN2-P1E1M4-V1
Serial Number	1715-0057

Appendix Applicable to
Certificate Number
FCN24033179

Typical Dimensions

Cross-sectional projected area of the cone	0.0015 m ²
Surface area of the friction sleeve	0.023 m ²
Cone net area ratio	0.76
Friction sleeve net area ratio	0
Diameter of the cylindrical part of the cone	43.85 mm
Diameter of the friction sleeve	44.1 mm
Length of the friction sleeve	162.75 mm
Cone - friction sleeve distance	15.75 mm
Cone - pore 2 distance	3 mm

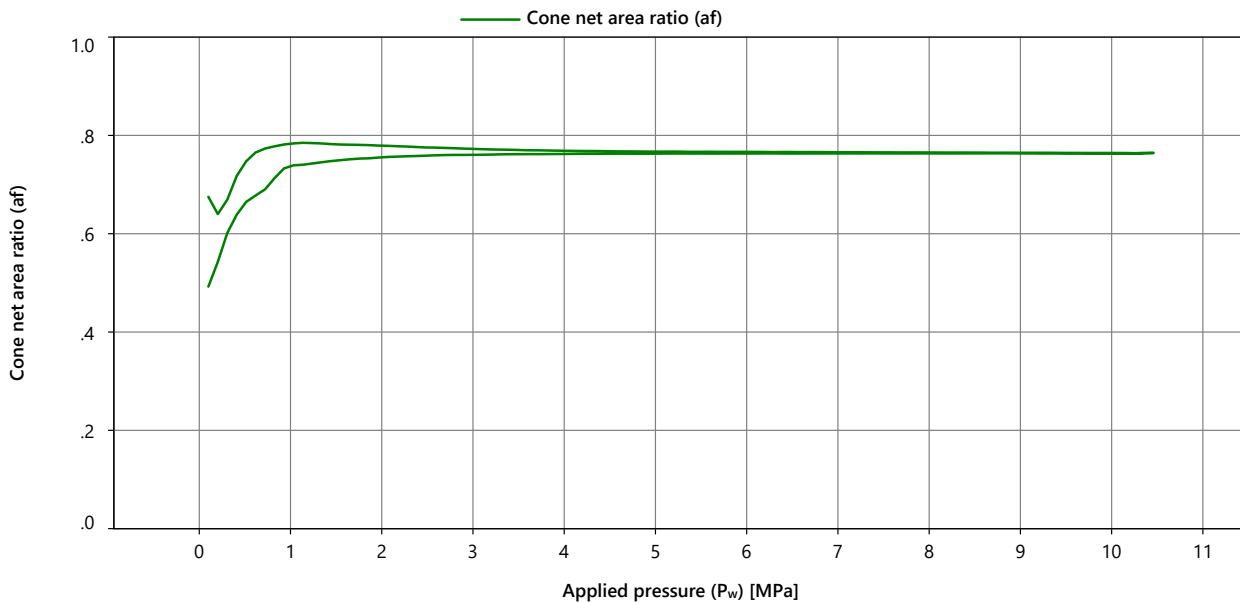
Cone Net Area Ratio Result

Instrument		Reference	
Manufacturer	Fugro	Manufacturer	Keller PA-33X
Type	CP15-CF200PB10SN2-P 1E1M4-V1	Serial Number	3257-0002
Serial Number	1715-0057	Uncertainty	0.0005•P _w +0.002 [MPa]
Electronics	128	Measurement Details	
Node Type	7001	Measurement Date	27 Mar 2024 06:48:15
Hardware Version	5.01	Procedure	EUAF-FNLM- CAL-PR-003
Software Version	8.01	Software Version	4.2.0.55751

Appendix Applicable to
Certificate Number
FCN24033179

Characteristics	Unit	Value
Cone net area ratio (af)	[-]	0.76

The cone net area ratio presented above is determined at the maximum applied pressure during the measurement.



Applied pressure (P _w) [MPa]	Measured cone net area ratio 1 (af,1)	Measured cone net area ratio 2 (af,2)	Measured cone net area ratio 3 (af,3)	Measured average cone net area ratio (af)
2.000	0.776	0.779	0.783	0.779
4.000	0.767	0.769	0.770	0.769
6.000	0.766	0.766	0.767	0.767
8.000	0.764	0.766	0.766	0.765
10.000	0.764	0.764	0.765	0.764
8.000	0.763	0.763	0.764	0.763
6.000	0.762	0.763	0.764	0.763
4.000	0.761	0.763	0.763	0.762
2.000	0.754	0.755	0.757	0.755

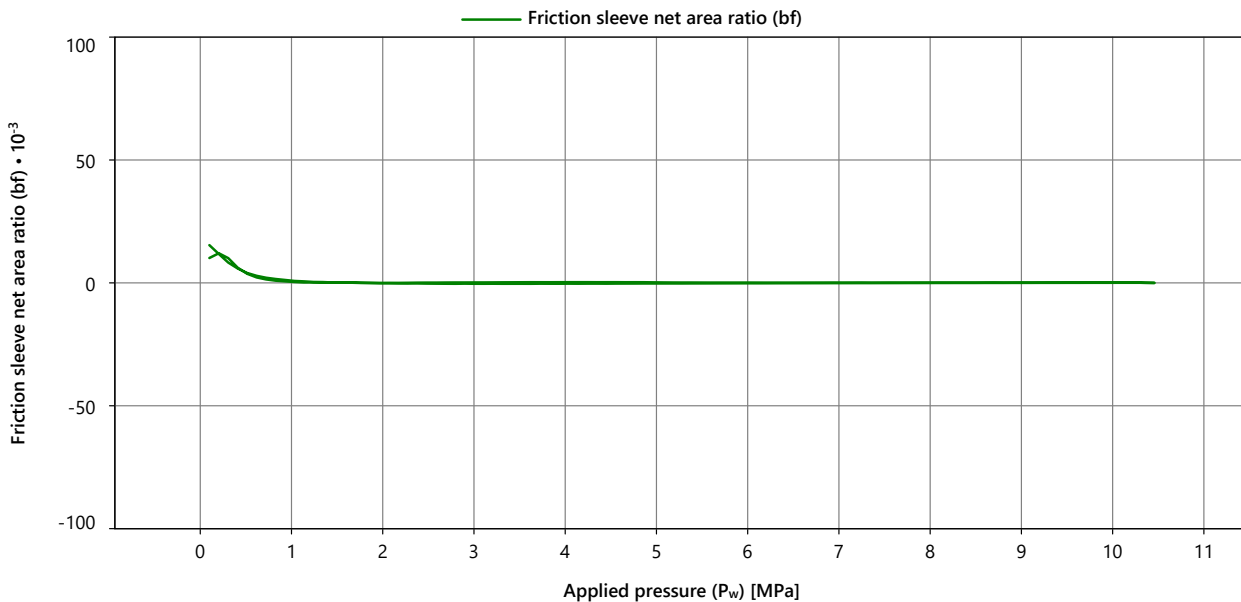
Friction Sleeve Net Area Ratio Result

Instrument		Reference	
Manufacturer	Fugro	Manufacturer	Keller PA-33X
Type	CP15-CF200PB10SN2-P 1E1M4-V1	Serial Number	3257-0002
Serial Number	1715-0057	Uncertainty	0.0005•P _w +0.002 [MPa]
Electronics	128	Measurement Details	
Node Type	7001	Measurement Date	27 Mar 2024 06:48:15
Hardware Version	5.01	Procedure	EUAF-FNLM- CAL-PR-003
Software Version	8.01	Software Version	4.2.0.55751

Appendix Applicable to
Certificate Number
FCN24033179

Characteristics	Unit	Value
Friction sleeve net area ratio (bf)	[-]	-0.00002

The friction sleeve net area ratio presented above is determined at the maximum applied pressure during the measurement.



Applied pressure (P _w) [MPa]	Measured friction sleeve net area ratio (bf) 1 (bf,1)	Measured friction sleeve net area ratio (bf) 2 (bf,2)	Measured friction sleeve net area ratio (bf) 3 (bf,3)	Measured average Friction sleeve net area ratio (bf)
2.000	0.000	0.000	0.000	0.000
4.000	0.000	0.000	0.000	0.000
6.000	0.000	0.000	0.000	0.000
8.000	0.000	0.000	0.000	0.000
10.000	0.000	0.000	0.000	0.000
8.000	0.000	0.000	0.000	0.000
6.000	0.000	0.000	0.000	0.000
4.000	0.000	-0.001	0.000	0.000
2.000	0.000	0.000	0.000	0.000

Symbols and Definitions

Appendix Applicable to
Certificate Number
FCN24033179

Symbols and Definitions (general)

af	Cone net area ratio, defined as the factor between the applied pressure to the instrument and the indicated cone resistance.
af,x	Measured cone net area ratio at measurement x.
bf	Friction sleeve net area ratio, defined as the factor between the applied pressure to the instrument and the indicated sleeve friction.
bf,x	The measured friction sleeve net area ratio at measurement x.

Symbols and Definitions (quantity specific: Q may be substituted for P, as appropriate)

Q _w	Applied reference quantity value.
----------------	-----------------------------------

Quantities

P	Pressure
---	----------

D.2 Laboratory Equipment Calibration

List of Plates

Laboratory Equipment Calibration

32 Plates

CERTIFICATE OF CALIBRATION



DATE OF ISSUE: 14/Mar/2024

CERTIFICATE NUMBER: C32N000989

ISSUED BY NORTHERN BALANCE LTD



Page 1 of 2 Pages

Approved Signatory: J. Sherwood-Smith

Signature:

Northern Balance Ltd

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Team Valley Trading Estate

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Tel: 0191 488 2881

Fax: 0191 488 2998

Email: enquiries@northernbalance.co.uk

Customer

Fugro GeoServices Limited

Armstrong House, Unit 43

No.1 Industrial Estate, Medomsley Road

Consett

Co. Durham

DH8 6TW

Site

Fugro GeoServices Limited

Armstrong House, Unit 43

No.1 Industrial Estate, Medomsley Road

Consett

Co. Durham

DH8 6TW

Contact: H Belton

Balance Make

Adam

Model

CKT32

Serial Number

AE921104

Range 1

32 000g

Resolution

1g

Range 2

Resolution

Range 3

Resolution

Range 4

Resolution

Location: OED / Sheer Boxes

Customer Ref: Bal 19

Comments:

Weight Sets Used: N13748 N13576

The weighing equipment described above has been calibrated using weights traceable to National Standards and in accordance with the following procedures (where relevant). The results were recorded.

LINEARITY

A series of test loads using standard weight, distributed evenly over the normal weighing range were added to the centre of the load receptor. The reading at each load was recorded.

ECCENTRICITY

A load was placed in the centre of the load receptor and the reading recorded. The load was then placed at each pan support in turn and again in the centre, the readings were recorded.

REPEATABILITY

The load was applied to the centre of the load receptor and the reading recorded. The load was removed and the reading recorded. This was carried out a minimum of three times.

Results are reported in terms of conventional mass which is the value of the result of weighing in air in accordance with International Document OIML D28.

For a weight taken at 20°C, the conventional mass is the mass of a reference weight of density of 8000kg/m³ which it balances in air of a density 1.2kg/m³.

This certificate provides traceability of measurement to the SI system of units and/or units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes.

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CERTIFICATE OF CALIBRATION

CERTIFICATE NUMBER

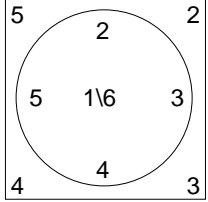
C32N000989

Page 2 of 2 Pages

Balance Make: **Adam**
 Model: **CKT32**
 Serial No: **AE921104**
 Location: **OED / Sheer Boxes**
 Range Calibrated: **32 000g x 1g**
 Type of Calibration: **Definitive**

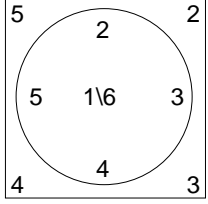
Date of Calibration: **12/Mar/2024**
 Test Engineer: **James Twidale**
 Environmental Measurements:
 Temp: **N/A** Rel Humidity: **N/A**
 Air Pressure: **N/A** Air Density: **N/A**

As Found

Eccentricity Test		Load Applied: 12 000g
Ref	Indicated Reading (g)	
1	12 001	
2	12 003	
3	12 003	
4	12 000	
5	12 000	
6	12 001	

Linearity Test		
Applied Load (g)	Indicated Reading (g)	Difference (g)
200	200	0
15 000	15 002	2
30 000	30 002	2

Definitive

Eccentricity Test		Load Applied: 12 000g
Ref	Indicated Reading (g)	
1	12 000	
2	12 001	
3	12 002	
4	12 000	
5	11 999	
6	12 000	

Linearity Test		
Applied Load (g)	Indicated Reading (g)	Difference (g)
0	0	0
10	10	0
100	100	0
1 000	1 000	0
5 000	5 000	0
10 000	10 001	1
20 000	20 000	0
32 000	32 001	1

Repeatability Test	
Zero Offset Load: 0g	Nominal Load: 30000g
Unloaded Reading (g)	Loaded Reading (g)
0	30 002
0	30 000
0	30 000
0	30 001
0	29 999

CERTIFICATE OF CALIBRATION



DATE OF ISSUE: 19/Mar/2024

CERTIFICATE NUMBER: C36N000399

ISSUED BY NORTHERN BALANCE LTD



Page 1 of 2 Pages

Approved Signatory: J. Sherwood-Smith

Signature:

Northern Balance Ltd

3 Bamburgh Court

First Avenue

Team Valley Trading Estate

Gateshead

NE11 0TX

Tel: 0191 488 2881

Fax: 0191 488 2998

Email: enquiries@northernbalance.co.uk

Customer

Fugro GeoServices Limited

Armstrong House, Unit 43

No.1 Industrial Estate, Medomsley Road

Consett

Co. Durham

DH8 6TW

Contact: H Belton

Site

Fugro GeoServices Limited

Armstrong House, Unit 43

No.1 Industrial Estate, Medomsley Road

Consett

Co. Durham

DH8 6TW

Balance Make

OHAUS

Model

AX5202

Serial Number

C341941640

Range 1

5 200g

Resolution

0.01g

Range 2

Resolution

Range 3

Resolution

Range 4

Resolution

Location: Oed Shear Box

Customer Ref: N/A

Comments: No as found readings as it is a new equipment.

Weight Sets Used: N13736

The weighing equipment described above has been calibrated using weights traceable to National Standards and in accordance with the following procedures (where relevant). The results were recorded.

LINEARITY

A series of test loads using standard weight, distributed evenly over the normal weighing range were added to the centre of the load receptor. The reading at each load was recorded.

ECCENTRICITY

A load was placed in the centre of the load receptor and the reading recorded. The load was then placed at each pan support in turn and again in the centre, the readings were recorded.

REPEATABILITY

The load was applied to the centre of the load receptor and the reading recorded. The load was removed and the reading recorded. This was carried out a minimum of three times.

Results are reported in terms of conventional mass which is the value of the result of weighing in air in accordance with International Document OIML D28.

For a weight taken at 20°C, the conventional mass is the mass of a reference weight of density of 8000kg/m³ which it balances in air of a density 1.2kg/m³.

This certificate provides traceability of measurement to the SI system of units and/or units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes.

This certificate may not be reproduced other than in full, except with the prior written approval of Northern Balance Ltd.

CERTIFICATE OF CALIBRATION

CERTIFICATE NUMBER

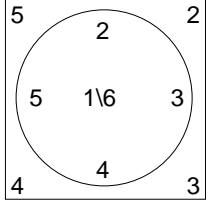
C36N000399

Page 2 of 2 Pages

Balance Make: **OHAUS**
Model: **AX5202**
Serial No: **C341941640**
Location: **Oed Shear Box**
Range Calibrated: **5 200g x 0.01g**
Type of Calibration: **Definitive**

Date of Calibration: **11/Mar/2024**
Test Engineer: **Gary Thompson**
Environmental Measurements:
Temp: **N/A** Rel Humidity: **N/A**
Air Pressure: **N/A** Air Density: **N/A**

Definitive

Eccentricity Test		Load Applied: 1 800.00g
Ref	Indicated Reading (g)	
1	1 800.00	
2	1 800.00	
3	1 800.00	
4	1 800.00	
5	1 800.00	
6	1 800.00	

Linearity Test		
Applied Load (g)	Indicated Reading (g)	Difference (g)
0.00	0.00	0.00
10.00	10.00	0.00
100.00	100.00	0.00
1 000.00	1 000.00	0.00
2 000.00	2 000.00	0.00
3 000.00	3 000.00	0.00
4 000.00	4 000.00	0.00
4 999.99	5 000.00	0.01

Repeatability Test	
Zero Offset Load: 0g	Nominal Load: 5000g
Unloaded Reading (g)	Loaded Reading (g)
0.00	5 000.00
0.00	5 000.00
0.00	5 000.00
0.00	5 000.00
0.00	5 000.00

EQUIPMENT CHECK RECORD - CALIPERS

Item Description	Calipers	Company Identification No	DC131-C
Measurement Range (mm)	150	Manufacturer's Serial No	LIN97950744
Check Interval	12 months	Reference Equipment	GB16707
Temperature (Initial/Final) (°C)	20.1 20.2	Resolution (mm)	0.01
Thermometer Reference	TDT7/C	Accuracy Required (mm)	0.05
Method or Procedure	LCM Section 6		

Equipment Utilised					
Type	Gauge Blocks	ID	GB16707	Calibrations Due	07/07/2025
Type		ID		Calibrations Due	

Test Length (mm)	Determination			Mean Value (mm)	Test Length (mm)	Determination			Mean Value (mm)
	1 (mm)	2 (mm)	3 (mm)			1 (mm)	2 (mm)	3 (mm)	
0	0.00	0.00	0.00	0.00	120	119.98	119.98	119.99	119.98
15	14.97	14.97	14.98	14.97	135	135	135	135.01	135.00
30	29.97	29.97	29.98	29.97	150	150	150	150.01	150.00
45	44.98	44.98	44.99	44.98	Internal Measurement				
60	59.97	59.97	59.98	59.97	50	49.97	49.98	49.97	49.97
75	74.97	74.97	74.98	74.97	Depth Measurement				
90	89.97	89.97	89.98	89.97	50	49.99	49.97	49.98	49.98
105	104.99	104.99	105.00	104.99					
Parallelism Check									
	1	2	Average	Difference	Uncertainty of Measurement				
Tip	10.00	10.00	10	0	0.01293				
Foot	10.00	10.00	10						

Remarks		Accepted/Rejected	Accepted
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Date of last check	N/A	* Comment
Date of this check	06/03/2024	
Interval compliance (*)		
Date of next check	07/03/2025	

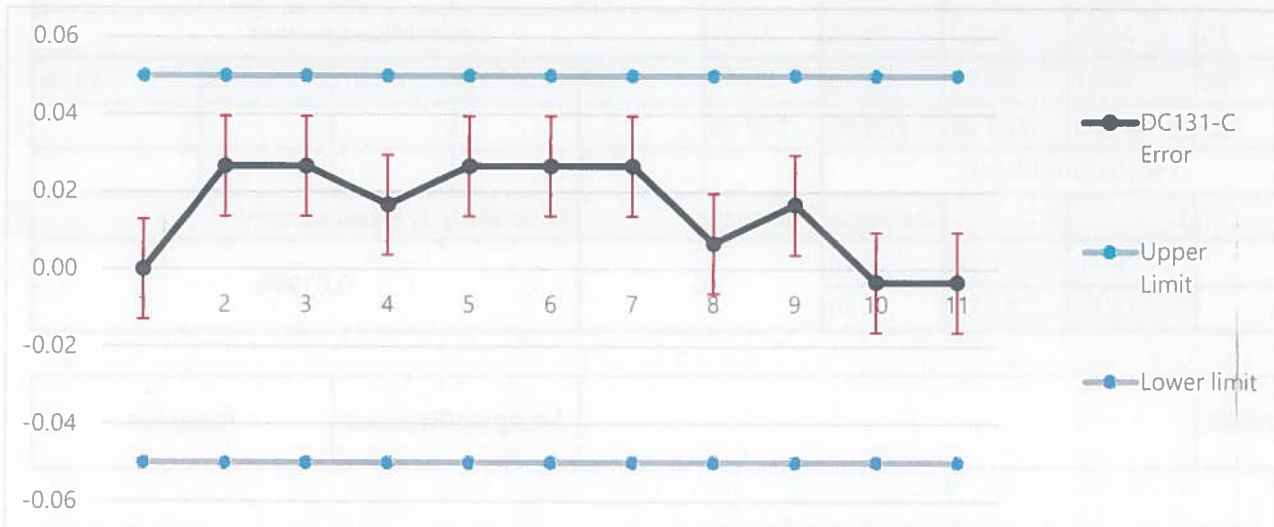
Calibration Laboratory	(✓)	Operator	AB	Date	06/03/2024
		Input By	AB	Date	06/03/2024
Consett	(✓)	Approved By	ABE	Date	8/3/24

EQUIPMENT CHECK RECORD - CALIPERS

Repeatability	
Expected Value	Actual Value
45	44.980
45	44.980
45	44.990
Repeatability (Standard Deviation)	0.005773503

Uncertainty					
Source	Uncertainty	PDF	Divisor	Ci	Standard Uncertainty
Ref Equipment	0.00066	Normal (k=2)	2	1	0.000330
Resolution	0.00500	Rectangular	1.732051	1	0.002887
Repeatability	0.00577	Normal	1	1	0.005774
Thermal Expansion	0.00017	Rectangular	1.732051	1	0.000100
Drift	0.00024	Rectangular	1.732051	1	0.000139

Combined Uncertainty	0.00647
Expanded Uncertainty (k=2)	0.01293 mm



The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%.

Calibration Laboratory	(✓)	Operator	AB	Date	06/03/2024
		Input By	AB	Date	06/03/2024
Consett	(✓)	Approved By	ABE	Date	8/3/24

EQUIPMENT CHECK RECORD - CALIPERS

Item Description	Calipers	Company Identification No	DC132-C
Measurement Range (mm)	300	Manufacturer's Serial No	LIN96413192
Check Interval	12 months	Reference Equipment	GB16707
Temperature (Initial/Final) (°C)	20.1 20.3	Resolution (mm)	0.01
Thermometer Reference	TDT7/C	Accuracy Required (mm)	0.05
Method or Procedure	LCM Section 6		

Equipment Utilised					
Type	Gauge Blocks	ID	GB16707	Calibrations Due	07/07/2025
Type		ID		Calibrations Due	

Test Length (mm)	Determination			Mean Value (mm)	Test Length (mm)	Determination			Mean Value (mm)
	1 (mm)	2 (mm)	3 (mm)			1 (mm)	2 (mm)	3 (mm)	
0	0.00	0.00	0.00	0.00	240	240.03	240.02	240.03	240.03
30	30.00	30.01	30.00	30.00	270	270.03	270.02	270.03	270.03
60	60.00	60.01	60.00	60.00	300	300.03	300.02	300.03	300.03
90	90.01	90.02	90.01	90.01	Internal Measurement				
120	120.02	120.03	120.02	120.02	50	49.98	49.99	49.99	49.99
150	150.02	150.03	150.02	150.02	Depth Measurement				
180	180.00	180.01	180.00	180.00	50	50.04	50.03	50.01	50.03
210	210.02	210.02	210.02	210.02					
Parallelism Check									
	1	2	Average	Difference	Uncertainty of Measurement				
Tip	10.00	10.00	10	0.01	0.01295				
Foot	10.01	10.01	10.01						

Remarks		Accepted/Rejected	Accepted
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Date of last check	N/A	* Comment
Date of this check	06/03/2024	
Interval compliance (*)		
Date of next check	07/03/2025	

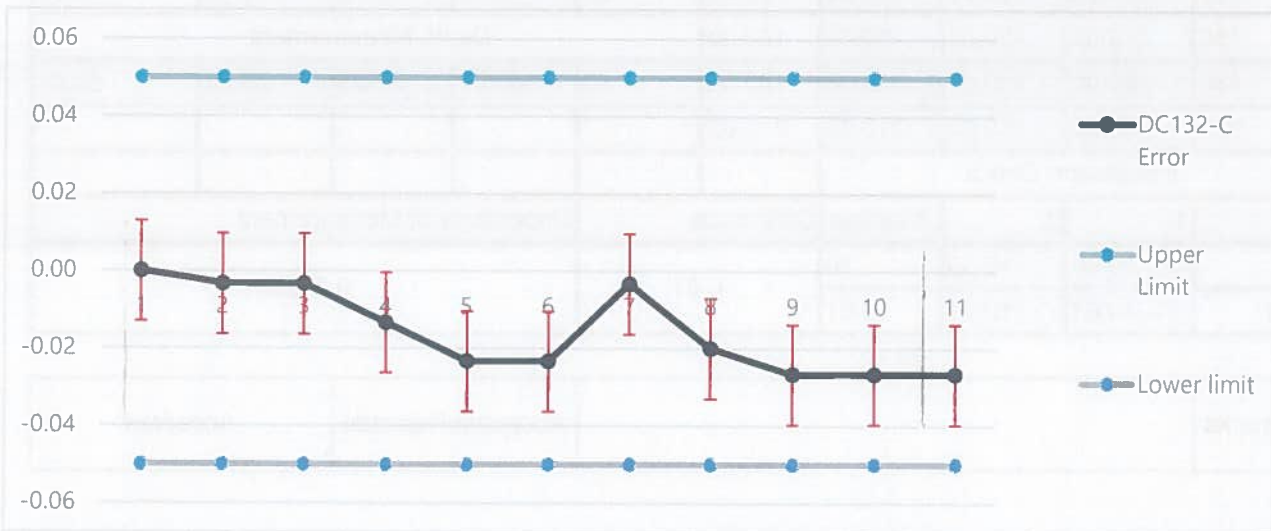
Calibration Laboratory	(✓)	Operator	AB	Date	06/03/2024
		Input By	AB	Date	06/03/2024
Consett	(✓)	Approved By	ARL	Date	8/3/24

EQUIPMENT CHECK RECORD - CALIPERS

Repeatability	
Expected Value	Actual Value
120	120.020
120	120.030
120	120.020
Repeatability (Standard Deviation)	0.005773503

Uncertainty					
Source	Uncertainty	PDF	Divisor	Ci	Standard Uncertainty
Ref Equipment	0.00066	Normal (k=2)	2	1	0.000330
Resolution	0.00500	Rectangular	1.732051	1	0.002887
Repeatability	0.00577	Normal	1	1	0.005774
Thermal Expansion	0.00069	Rectangular	1.732051	1	0.000398
Drift	0.00024	Rectangular	1.732051	1	0.000139

Combined Uncertainty	0.00648	
Expanded Uncertainty (k=2)	0.01295	mm



The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%.

Calibration Laboratory	(✓)	Operator	AB	Date	06/03/2024
		Input By	AB	Date	06/03/2024
Consett	(✓)	Approved By	<i>ABE</i>	Date	8/3/24

EQUIPMENT CHECK RECORD - POCKET PENTROMETER

Item Description	Pocket Pen	Company Identification No	PP0250	
Measurement Range (kg/cm ²)	4.5	Manufacturer's Serial No	N/A	
Test Type	Pocket Pen	Temperature (Initial/Final) (°C)	19.6	19.8
Check Interval	Yearly	Thermometer Reference	TDT6/C	
Method or Procedure	LCM Sec 50			

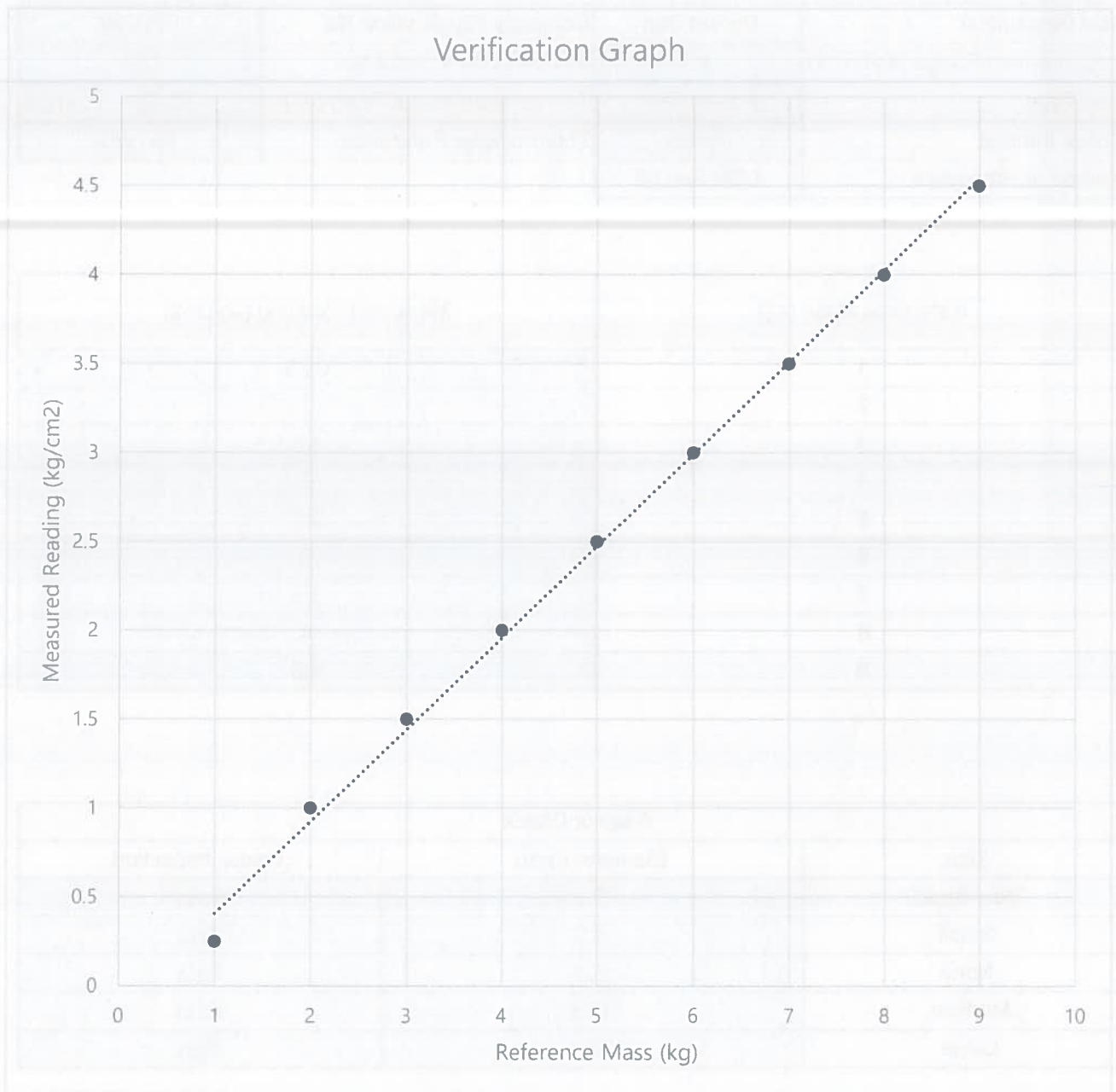
Reference Mass (kg)	Measured Reading (kg/cm ²)
1	0.25
2	1
3	1.5
4	2
5	2.5
6	3
7	3.5
8	4
9	4.5

Adaptor Check		
Size	Diameter (mm)	Visual Inspection
Very Small	3.2	Pass
Small	4.5	Pass
None	6.4	Pass
Medium	13.5	Pass
Large	25.4	Pass

Date of last check	N/A	* Comment
Date of this check	12/03/2024	
Interval compliance (*)		
Date of next check	12/03/2025	

Calibration Laboratory		Operator	AB	Date	12/03/2024
		Input By	AB	Date	12/03/2024
Consett	(✓)	Approved By	ABE	Date	14/3/24

EQUIPMENT CHECK RECORD - POCKET PENTROMETER



Date of last check	N/A	* Comment
Date of this check	12/03/2024	
Interval compliance (*)		
Date of next check	12/03/2025	

Calibration Laboratory		Operator	AB	Date	12/03/2024
		Input By	AB	Date	12/03/2024
Consett	(✓)	Approved By	ABE	Date	14/3/24

EQUIPMENT CHECK RECORD - TORVANE

Item Description	TorVane	Company Identification No	TV-0196
Measurement Range (Nm)	1	Manufacturer's Serial No	N/A
Check Interval	Yearly	Reference Standard	TW2/C
Ambient Temperature <i>(corrected)</i>	20.1°C	Acceptability Criterion	N/A
Thermometer Reference	TDT7/C	Method or Procedure	LCM Sec 33

Applied Torque (Nm)	Determination (Nm)			Average
	1	2	3	
0	0	0	0	0.000
0.1	0.05	0.05	0.05	0.050
0.2	0.15	0.15	0.175	0.158
0.3	0.3	0.275	0.275	0.283
0.4	0.4	0.4	0.4	0.400
0.5	0.5	0.5	0.5	0.500
0.6	0.6	0.575	0.6	0.592
0.7	0.7	0.675	0.7	0.692
0.8	0.8	0.8	0.8	0.800
0.9	0.9	0.9	0.9	0.900
1	1	1	1	1.000

Remarks	Accepted	(✓)
	Rejected	

Data Storage		Equipment Utilised	Calibration File
Disc Directory		Vane Torque Head	Site File
File Identifier		Torque Wrench	Site File

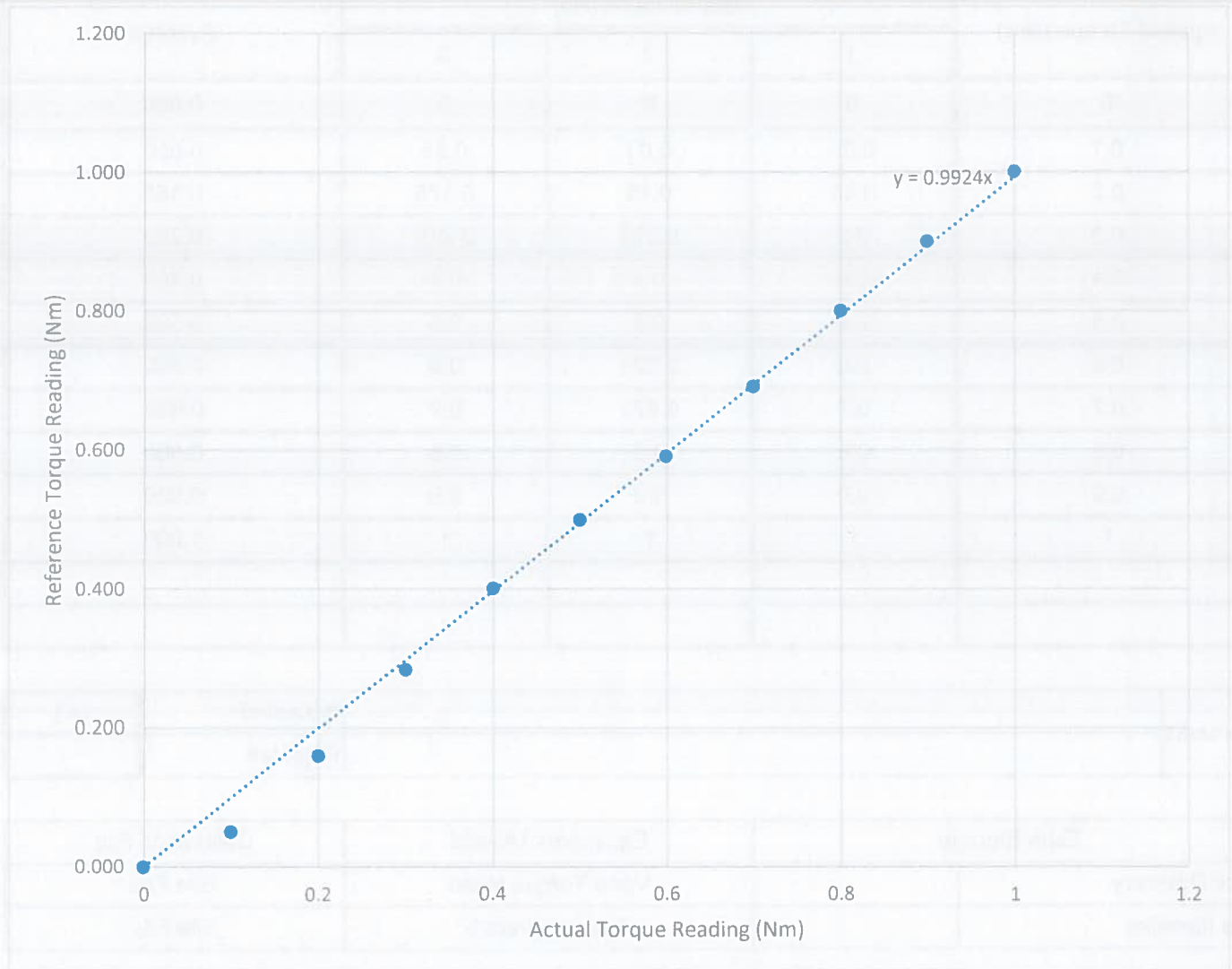
Date of last check	N/A	* Comment
Date of this check	12/03/2024	
Interval compliance (*)		
Date of next check	12/03/2025	

Calibration Laboratory		Operator	AB	Date	12/03/2024
		Input By	AB	Date	12/03/2024
Consett	(✓)	Approved By	ABC	Date	14/3/24



EQUIPMENT CHECK RECORD - TORVANE

Item Description	TorVane	Company Identification No	TV-0196
Measurement Range (Nm)	1	Manufacturer's Serial No	N/A
Check Interval	Yearly	Reference Standard	TW2/C
Ambient Temperature <i>(corrected)</i>	20.1°C	Acceptability Criterion	N/A
Thermometer Reference	TDT7/C	Method or Procedure	LCM Sec 33



Correction Factor	0.9898
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Calibration Laboratory		Operator	AB	Date	12/03/2024
		Input By	AB	Date	12/03/2024
Consett	(✓)	Approved By	ABE	Date	14/3/24

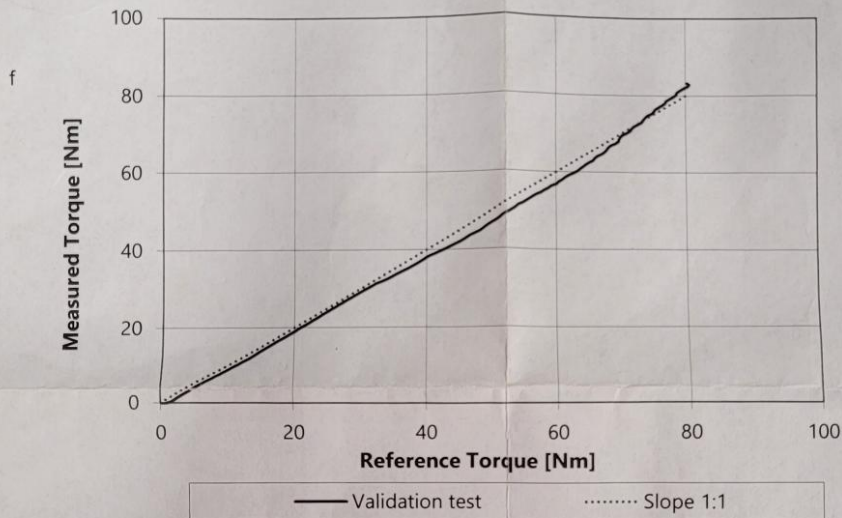


VERIFICATION CERTIFICATE - TORVANE

Equipment: **Torvane**
Equipment ID: TV-0322
Serial number: 1956-0322
Procedure: NL-EQP-PR-001

Certificate No: 715736
Expiry date: 15/02/2025

Verification graph



Regression data:

Std. deviation [kPa]	Slope [-]	Intercept [kPa]
1.37	1.01	-1.85

Blades dimensions:

Adaptor [s_u factor]	Width [mm]	Height [mm]
Small [reading x 27.3]	19.05	3.50
None [reading x 10.9]	25.53	5.20
Large [reading x 2.2]	47.66	5.60

Verification date: 16/02/2023

Tested by: Mo Mouaouya

Approved by: Gerry Sinjorgo

Signature approver:

EQUIPMENT CHECK RECORD - FALL CONE

Item Description	Fall Cone	Company Identification No	FC13-C
Check Interval	1 Year	Manufacturer's Serial No	1834
Ambient Temperature (<i>corrected</i>)	20.5°C	Acceptability Criterion	$\theta \pm 0.2^\circ$
Thermometer Reference	TDT7/C		Ra < 0.8 μm
Method or Procedure	LCM Sec 20		m \pm 1%

Equipment Utilised					
Type	Balance	ID	Balance 20	Calibration Due	26/04/2024
Type	Calipers	ID	DRV2/C	Calibration Due	22/11/2024

Cone Tips

Cone ID	Cone Diameter (D mm)	Cone Length (L mm)	Cone Angle (θ°) $2 * (\tan^{-1}(D/2)/L)$	Mass of Cone and Shaft (m g)	Surface Roughness ($R_a \mu\text{m}$)
FC13-1	23.67	20.54	59.90	10.08	0.372
FC13-2	26	22.48	60.08	60.34	0.115
FC13-3	11.96	22.27	30.06	100.6	0.367
FC13-4	11.91	22.35	29.84	400.47	0.763

Sample Cup

Cup ID	Diameter (mm)	D > 50mm	Depth (mm)	I > 25mm
FC13-CUP	66.33	Accepted	29.87	Accepted

Remarks	Accepted/Rejected	Accepted

Date of last check	N/A	* Comment
Date of this check	05/03/2024	
Interval compliance (*)		
Date of next check	05/03/2025	

Calibration Laboratory		Operator	AB	Date	05/03/2024
		Input By	AB	Date	05/03/2024
Consett	(✓)	Approved By	ABE	Date	4/3/24

EQUIPMENT CHECK RECORD - LAB VANE RODS

Item Description	Lab Vane Rods	Company Identification No	LVR1, LVR2, LVR3
Measurement Range	SEE BELOW	Manufacturer's Serial No	N/A
Check Interval	Yearly	Maintenance Record Ref	N/A
Ambient Temperature (°C)	20.4	Reference Standard	DRV2/C
Thermometer Reference	TDT7/C	Acceptability Criterion	Area Ratio < 15%
Method or Procedure	LCM Section 48		

Vane Rod Label	Rod Diameter		Width (mm)		Length (mm)		Thickness (mm)		Area Ratio
LVR1	2.99	2.99	12.65	12.66	12.51	12.59	0.72	0.76	14.89
LVR2	2.98	2.99	12.69	12.64	12.67	12.75	0.72	0.67	13.97
LVR3	2.99	3.00	25.38	25.45	25.39	25.43	0.68	0.70	6.91

$$\text{Area Ratio (\%)} = \left\{ \left(\frac{8T(D)}{\pi D^2} \right) \right\} * 100$$
 where
 D is the overall blade width in mm
 T is the thickness of the vane blades in mm

Remarks		Accepted/Rejected	Accepted
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Data Storage		Equipment Utilised	Calibration File
Disc Directory	N/A	Reference Verniers	Reference Standards
File Identifier	N/A	Reference Micrometer	Reference Standards

Date of last check	N/A	* Comment
Date of this check	05/03/2024	
Interval compliance (*)		
Date of next check	05/03/2025	

Calibration Laboratory	(✓)	Operator	AB	Date	05/03/2024
		Input By	AB	Date	05/03/2025
Consett	✓	Approved By	ABC	Date	14/3/24

EQUIPMENT CHECK RECORD - LAB VANE SPRINGS

Item Description	Vane Springs	Company Identification No	A303
Measurement Range (Nm)	1.5	Manufacturer's Serial No	A303
Check Interval	Yearly	Reference Standard	TW2/C
Ambient Temperature (<i>corrected</i>)	20.1°C	Acceptability Criterion (%)	2
Thermometer Reference	TDT2/C	Method or Procedure	

Applied Rotation	Measured Torque (N mm)			Average	Accepted/Rejected
	1	2	3		
Spring 1					
75	112	110	111	111.00	Accepted
150	170	170	170	170.00	Accepted
225	226	226	226	226.00	Accepted
300	282	282	282	282.00	Accepted
Spring 2					
75	170	170	170	170.00	Accepted
150	282	282	282	282.00	Accepted
225	395	395	395	395.00	Accepted
300	508	508	508	508.00	Accepted
Spring 3					
75	226	225	225	225.33	Accepted
150	339	340	340	339.67	Accepted
225	452	451	452	451.67	Accepted
300	564	565	565	564.67	Accepted
Spring 4					
75	452	451	452	451.67	Accepted
150	677	678	678	677.67	Accepted
225	904	905	904	904.33	Accepted
300	1130	1130	1130	1130.00	Accepted

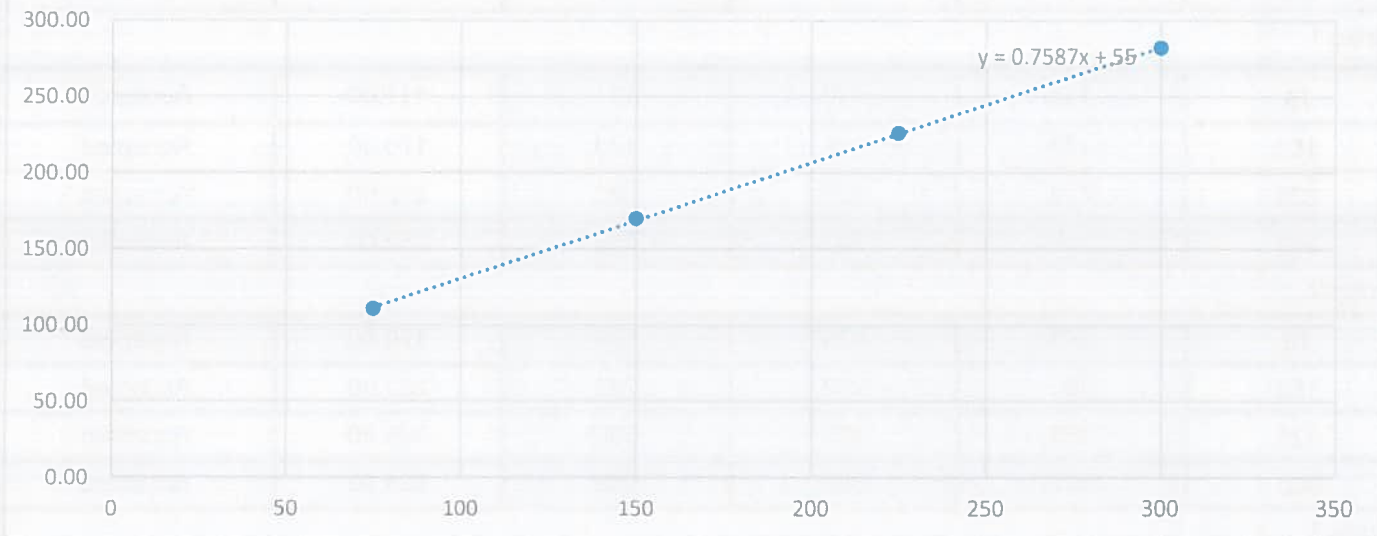
Date of last check	N/A	* Comment
Date of this check	05/03/2024	
Interval compliance (*)		
Date of next check	05/03/2025	

Calibration Laboratory	(✓)	Operator	AB	Date	05/03/2024
		Input By	AB	Date	05/03/2024
Consett	(✓)	Approved By	ABC	Date	5/3/24

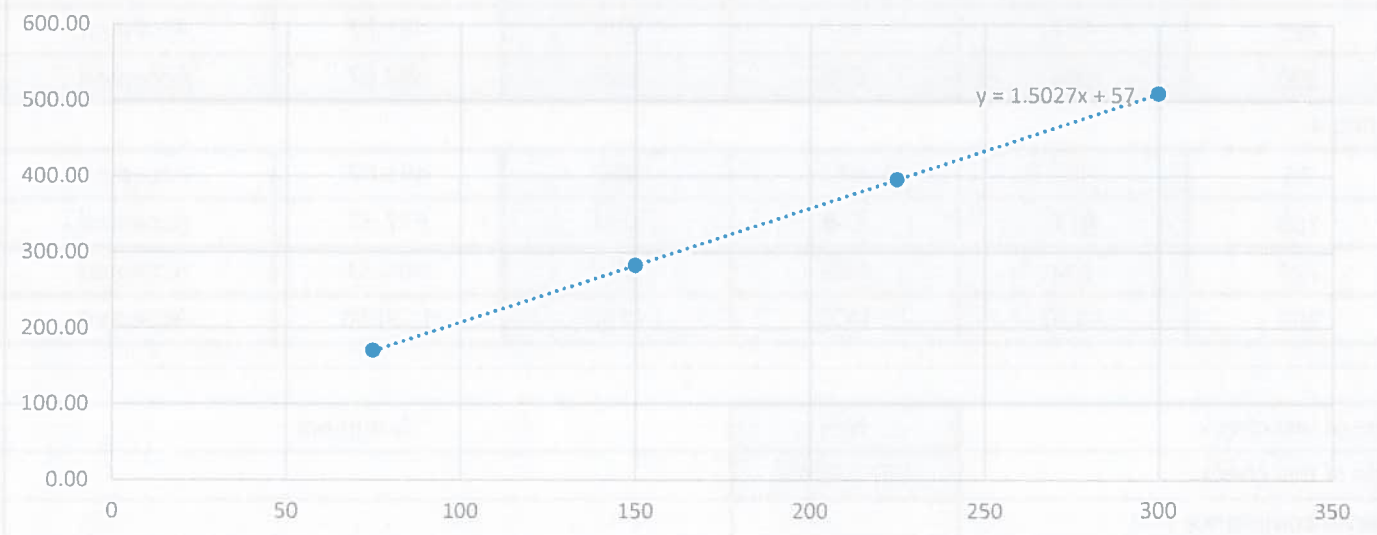
EQUIPMENT CHECK RECORD - LAB VANE SPRINGS

Item Description	Vane Springs	Company Identification No	A303
Measurement Range (Nm)	1.5	Manufacturer's Serial No	A303
Check Interval	Yearly	Reference Standard	TW2/C
Ambient Temperature (corrected)	20.1°C	Acceptability Criterion (%)	2
Thermometer Reference	TDT2/C	Method or Procedure	

Spring 1



Spring 2

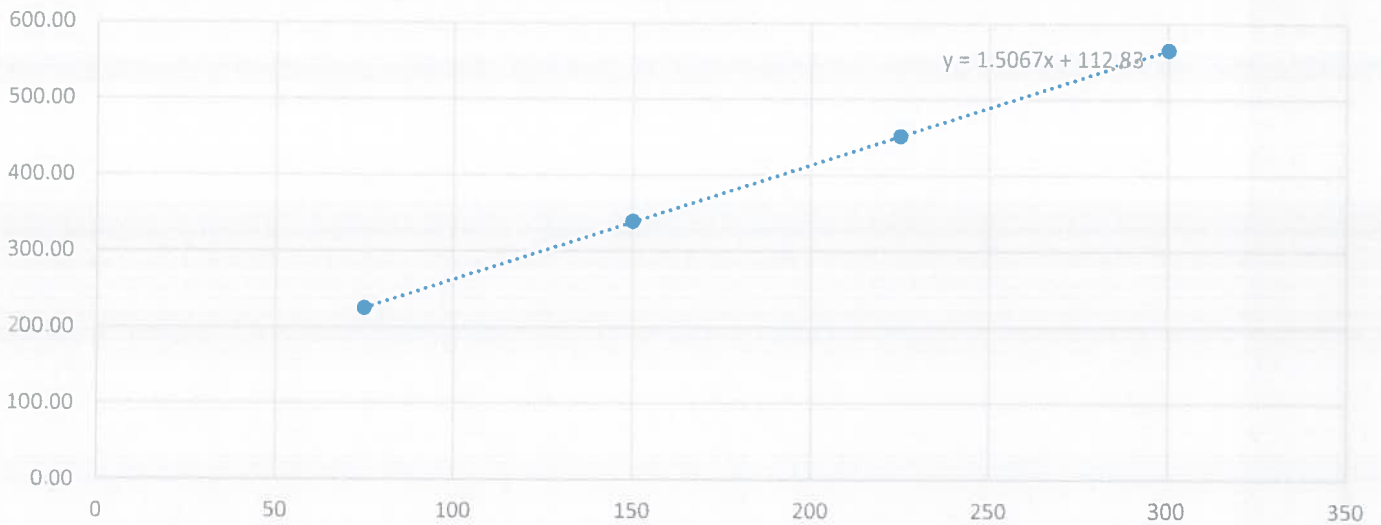


Calibration Laboratory	(✓)	Operator	AB	Date	05/03/2024
		Input By	AB	Date	05/03/2024
Consett	(✓)	Approved By	<i>ABE</i>	Date	03/24

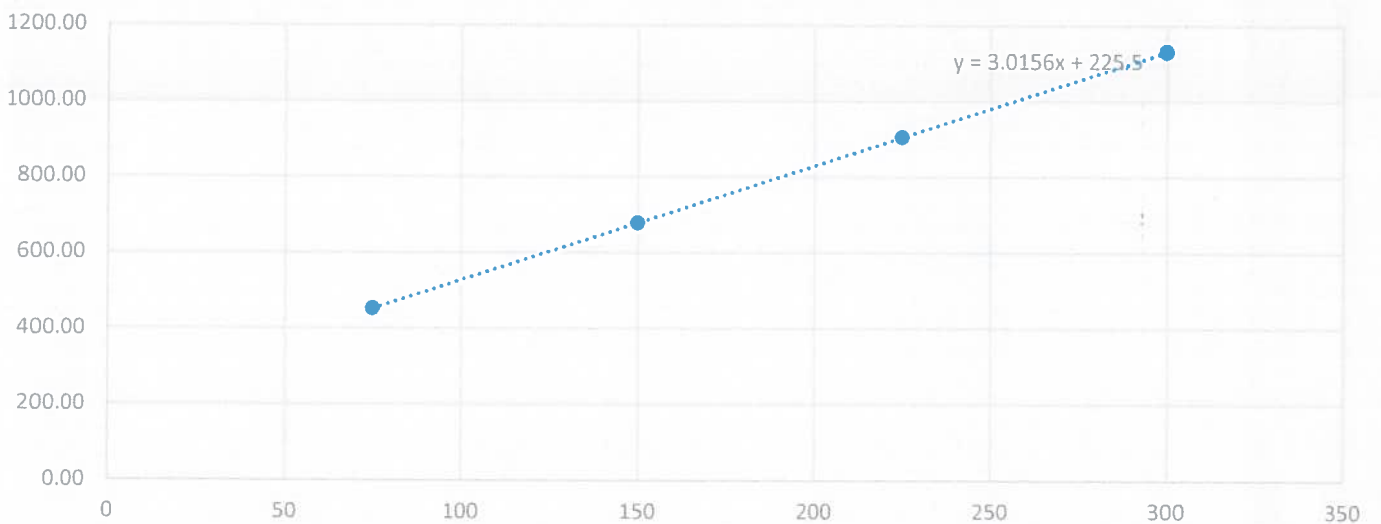
EQUIPMENT CHECK RECORD - LAB VANE SPRINGS

Item Description	Vane Springs	Company Identification No	A303
Measurement Range (Nm)	1.5	Manufacturer's Serial No	A303
Check Interval	Yearly	Reference Standard	TW2/C
Ambient Temperature (corrected)	20.1°C	Acceptability Criterion (%)	2
Thermometer Reference	TDT2/C	Method or Procedure	

Spring 3



Spring 4



Calibration Laboratory	(✓)	Operator	AB	Date	05/03/2024
		Input By	AB	Date	05/03/2024
Consett	(✓)	Approved By	<i>ABE</i>	Date	6/3/24



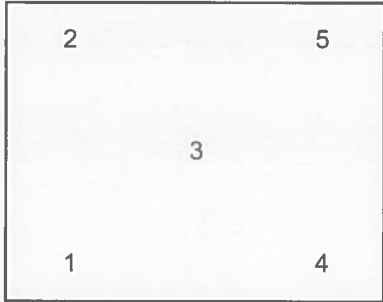
EQUIPMENT CHECK RECORD - OVEN PROFILE

Item Description	Oven Profile	Company Identification No	OVEND13-C
Measurement Range (°C)	105-110	Manufacturer's Serial No	20200000017729
Check Interval	New/On Overhaul	Acceptability Criterion	See Range Below
Ambient Temperature (corrected)	N/A	Method or Procedure	LCM Section 13

Equipment Utilised					
Type	Thermometer	ID	TC-08	Calibration Due	29/11/2025
Type		ID		Calibration Due	

Level	Profile Position 1 °C	Profile Position 2 °C	Profile Position 3 °C	Profile Position 4 °C	Profile Position 5 °C
1	107.69	107.23	107.11	106.39	106.84
2	107.73	107.53	107.19	107.35	107.04
3	107.55	107.46	107.3	107.55	106.84

Profile Variation					
Levels			Positions		
Elevation			Plan		
1	0.5	0.04	-0.08	-0.8	-0.35
2	0.54	0.34	0	0.16	-0.15
3	0.36	0.27	0.11	0.36	-0.35



file Mid-Point Range Record

Remarks	Upper range (°C) : 109.46	Accepted/Rejected	Accepted
	Lower range (°C) : 105.8		

Date of last check	N/A	* Comment
Date of this check	05/03/2024	
Interval compliance (*)	N/A	
Date of next check	05/03/2025	

Calibration Laboratory		Operator	AB	Date	05/03/2024
		Input By	AB	Date	05/03/2024
Consett	(✓)	Approved By	HB	Date	5/3/24



EQUIPMENT CHECK RECORD - OVEN PROFILE

Item Description	Oven Profile	Company Identification No	OVENN13-C
Measurement Range (°C)	105-110	Manufacturer's Serial No	20200000017727
Check Interval	New/On Overhaul	Acceptability Criterion	See Range Below
Ambient Temperature (corrected)	N/A	Method or Procedure	LCM Section 13

Equipment Utilised					
Type	Thermometer	ID	TC-08	Calibration Due	29/11/2025
Type		ID		Calibration Due	

Level	Profile Position 1 °C	Profile Position 2 °C	Profile Position 3 °C	Profile Position 4 °C	Profile Position 5 °C
1	108.63	108.25	108.03	107.8	107.04
2	107.41	108.24	107.91	106.95	107.21
3	107.97	108	107.61	107.62	106.81

Profile Variation

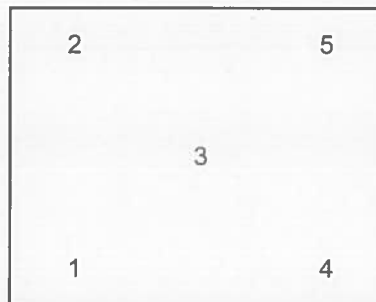
Levels

Positions

Elevation

Plan

1	0.72	0.34	0.12	-0.11	-0.87
2	-0.5	0.33	0	-0.96	-0.7
3	0.06	0.09	-0.3	-0.29	-1.1



file Mid-Point Range Record

Remarks	Upper range (°C) : 109.28	Accepted/Rejected	Accepted
	Lower range (°C) : 106.1		

Date of last check	N/A	* Comment
Date of this check	05/03/2024	
Interval compliance (*)	N/A	
Date of next check	05/03/2025	

Calibration Laboratory		Operator	AB	Date	05/03/2024
		Input By	AB	Date	05/03/2024
Consett	(✓)	Approved By	HB	Date	5/3/24



EQUIPMENT CHECK RECORD - TIMER

Item Description	Timer	Company Identification No	SW13-C
Measurement Range	0-1h	Manufacturer's Serial No	8111814
Check Interval	Yearly	Maintenance Record Ref	N/A
Ambient Temperature	19.5°C	Reference Standard	BT Clock
Thermometer Reference	TDT7/C	Acceptability Criterion	5m ± 1 s
Method or Procedure	LCM Section 10		

Nominal Elapsed Time			Ref Standard Time			Item Time			Time Difference		
h	m	s	h	m	s	h	m	s	h	m	s
00	00	00	00	00	00	00	00	00	x	x	00
00	00	10	00	00	10	00	00	10	x	x	00
00	00	20	00	00	20	00	00	20	x	x	00
00	00	30	00	00	30	00	00	30	x	x	00
00	00	40	00	00	40	00	00	40	x	x	00
00	00	50	00	00	50	00	00	50	x	x	00
00	01	00	00	01	00	00	01	00	x	x	00
00	02	00	00	02	00	00	02	00	x	x	00
00	05	00	00	05	00	00	05	00	x	x	00
00	10	00	00	10	00	00	10	00	x	x	00
00	15	00	00	15	00	00	15	00	x	x	00
00	30	00	00	30	00	00	30	00	x	x	00
01	00	00	01	00	00	01	00	00	x	x	00

Remarks		Accepted	(✓)
		Rejected	

Data Storage		Equipment Utilised	Calibration File
Disc Directory	N/A	BT speaking clock	CF/REF
File Identifier	N/A		

Date of last check	NEW	* Comment
Date of this check	07/03/2024	
Interval compliance (*)		
Date of next check	07/03/2025	

Calibration Laboratory		Operator	AB	Date	07/03/2024
		Input By	AB	Date	07/03/2024
Consett	(✓)	Approved By	ABE	Date	14/3/24



EQUIPMENT CHECK RECORD - LOAD CELL CALIBRATION (kN)

Item Description	Load Cell		Company Identification No	LC513-C
Measurement Range (kN)	5		Manufacturer's Serial No	70516
Test Type	Triaxial Compression		Resolution (kN)	0.001
Check Interval	Yearly		Accuracy Required	N
Temperature (Initial/Final) (°C)	18.2	18.3	20 to 100% Accuracy (%)	1
Thermometer Reference	TDT7/C		Method or Procedure	LCM Sec 37

Equipment Utilised					
Type	Reference Load Cell	ID	LC REF 05	Calibration Due	10/01/2026
Type	Reference Load Cell	ID	LC REF 05	Calibration Due	10/01/2026

Applied Load (kN)	Determination			Reversibility	Mean (kN)	Upper Limit	Lower Limit	Accepted/Rejected
	1 (kN)	2 (kN)	3 (kN)	1 (kN)				
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Accepted
0.01	0.010	0.010	0.010	0.010	0.010	0.010	0.010	Accepted
0.02	0.020	0.020	0.020	0.020	0.020	0.020	0.020	Accepted
0.03	0.030	0.030	0.030	0.030	0.030	0.030	0.030	Accepted
0.04	0.040	0.040	0.040	0.040	0.040	0.040	0.040	Accepted
0.05	0.050	0.050	0.050	0.050	0.050	0.050	0.050	Accepted
0.1	0.100	0.100	0.100	0.100	0.100	0.100	0.100	Accepted
0.2	0.200	0.200	0.200	0.200	0.200	0.201	0.199	Accepted
0.3	0.301	0.301	0.300	0.300	0.301	0.302	0.298	Accepted
0.4	0.401	0.401	0.400	0.403	0.401	0.403	0.397	Accepted
0.5	0.502	0.502	0.503	0.505	0.502	0.504	0.496	Accepted
0.75	0.755	0.756	0.755	0.756	0.755	0.756	0.744	Accepted
1	1.004	1.004	1.004	1.004	1.004	1.009	0.991	Accepted
1	1.004	1.004	1.004	1.004	1.004	1.009	0.991	Accepted
2	2.003	2.002	2.003	2.002	2.003	2.018	1.982	Accepted
3	3.001	3.000	3.001	3.000	3.001	3.027	2.973	Accepted
4	4.001	4.000	4.001	4.000	4.001	4.036	3.964	Accepted
5	4.998	4.998	4.998	4.998	4.998	5.044	4.956	Accepted

Reversibility	Accepted
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Agreeability	Accepted
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Remarks	Accepted/Rejected	Accepted
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Date of last check	N/A	* Comment
Date of this check	08/03/2024	
Interval compliance (*)		
Date of next check	08/03/2025	

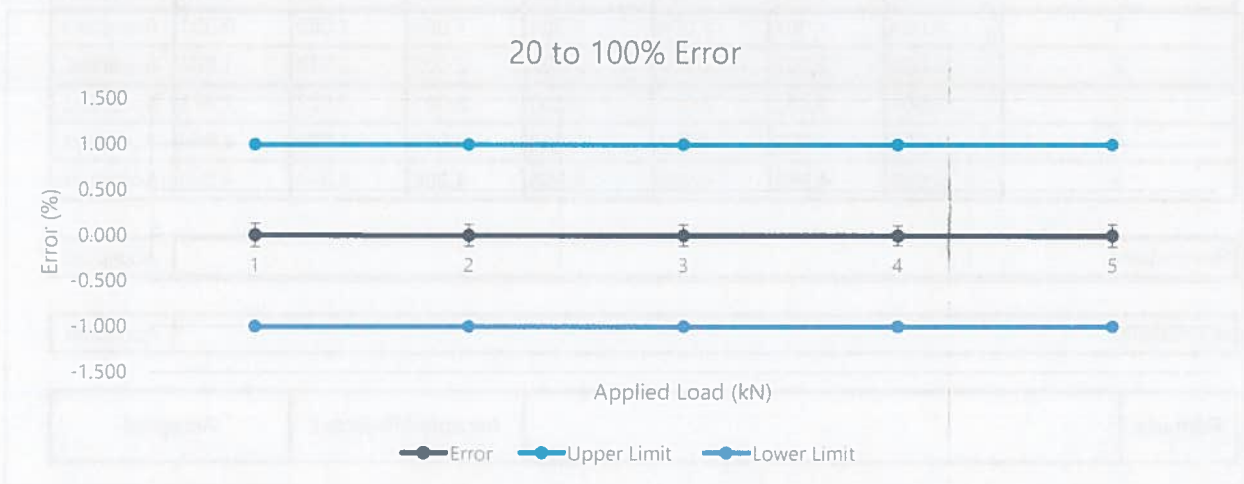
Calibration Laboratory		Operator	AB	Date	08/03/2024
		Input By	AB	Date	08/03/2024
Consent	✓	Approved By	ATSE	Date	11/3/24

EQUIPMENT CHECK RECORD - LOAD CELL CALIBRATION (kN)

Uncertainty

Load	Reference Equipment	Resolution	Repeatability	Drift	Combined Uncertainty	Expanded Uncertainty	Units
0.01	0.000295	0.000289	0.000000	0.000000	0.000413	0.000825	kN
0.02	0.000295	0.000289	0.000000	0.000000	0.000413	0.000825	kN
0.03	0.000295	0.000289	0.000000	0.000000	0.000413	0.000825	kN
0.04	0.000295	0.000289	0.000000	0.000000	0.000413	0.000825	kN
0.05	0.000295	0.000289	0.000000	0.000000	0.000413	0.000825	kN
0.1	0.000305	0.000289	0.000000	0.000000	0.000420	0.000840	kN
0.2	0.000305	0.000289	0.000000	0.000000	0.000420	0.000840	kN
0.3	0.000380	0.000289	0.000471	0.000000	0.000671	0.001342	kN
0.4	0.000380	0.000289	0.000471	0.000000	0.000671	0.001342	kN
0.5	0.000380	0.000289	0.000471	0.000000	0.000671	0.001342	kN
0.75	0.000575	0.000289	0.000471	0.000000	0.000798	0.001595	kN
1	0.000575	0.000289	0.000000	0.000000	0.000643	0.001287	kN
1	0.000575	0.000289	0.000000	0.000000	0.000643	0.001287	kN
2	0.001040	0.000289	0.000471	0.000000	0.001178	0.002356	kN
3	0.001530	0.000289	0.000471	0.000577	0.001726	0.003452	kN
4	0.002020	0.000289	0.000471	0.000577	0.002172	0.004345	kN
5	0.002515	0.000289	0.000000	0.001732	0.003067	0.006135	kN

PDF	Normal (k=2)	Rectangular	Normal (k=1)	Rectangular
Divisor	2	1.732051	1	1.732051
Ci	1	1	1	1



The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%.

Calibration Laboratory		Operator	AB	Date	08/03/2024
		Input By	AB	Date	08/03/2024
Consett	✓	Approved By	ABE	Date	11/3/24

EQUIPMENT CHECK RECORD - LOAD CELL CALIBRATION (kN)

Item Description	Load Cell		Company Identification No	LC2513-C
Measurement Range (kN)	25		Manufacturer's Serial No	71781
Test Type	Triaxial Compression		Resolution (kN)	0.001
Check Interval	Yearly		Accuracy Required	N 1
Temperature (Initial/Final) (°C)	18.2	18.3	20 to 100% Accuracy (%)	1
Thermometer Reference	TDT7/C		Method or Procedure	LCM Sec 37

Equipment Utilised					
Type	Reference Load Cell	ID	LC REF 05	Calibration Due	10/01/2026
Type	Reference Load Cell	ID	LC REF 50	Calibration Due	09/01/2026

Applied Load (kN)	Determination			Reversibility	Mean (kN)	Upper Limit	Lower Limit	Accepted/Rejected
	1 (kN)	2 (kN)	3 (kN)	1 (kN)				
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Accepted
0.05	0.050	0.050	0.050	0.050	0.050	0.050	0.050	Accepted
0.1	0.100	0.100	0.100	0.100	0.100	0.100	0.100	Accepted
0.15	0.150	0.150	0.150	0.150	0.150	0.151	0.149	Accepted
0.2	0.200	0.200	0.200	0.200	0.200	0.201	0.199	Accepted
0.25	0.250	0.250	0.251	0.249	0.250	0.251	0.249	Accepted
0.5	0.501	0.500	0.500	0.501	0.500	0.504	0.496	Accepted
1	1.001	1.002	1.001	1.001	1.001	1.008	0.992	Accepted
1.5	1.502	1.502	1.501	1.499	1.502	1.513	1.487	Accepted
2	2.001	2.002	2.003	1.998	2.002	2.017	1.983	Accepted
2.5	2.501	2.502	2.503	2.499	2.502	2.522	2.478	Accepted
3.75	3.751	3.751	3.752	3.748	3.751	3.783	3.717	Accepted
5	4.985	4.987	4.987	4.985	4.986	5.044	4.956	Accepted
5	4.991	4.991	4.991	4.991	4.991	5.046	4.954	Accepted
10	10.024	10.020	10.020	10.020	10.021	10.094	9.906	Accepted
15	15.040	15.041	15.041	15.041	15.041	15.144	14.856	Accepted
20	20.041	20.045	20.045	20.045	20.044	20.191	19.809	Accepted
25	25.045	25.047	25.047	25.047	25.046	25.239	24.761	Accepted

Reversibility	Accepted
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Agreeability	Accepted
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Remarks	Accepted/Rejected	Accepted
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Date of last check	N/A	* Comment
Date of this check	08/03/2024	
Interval compliance (*)		
Date of next check	08/03/2025	

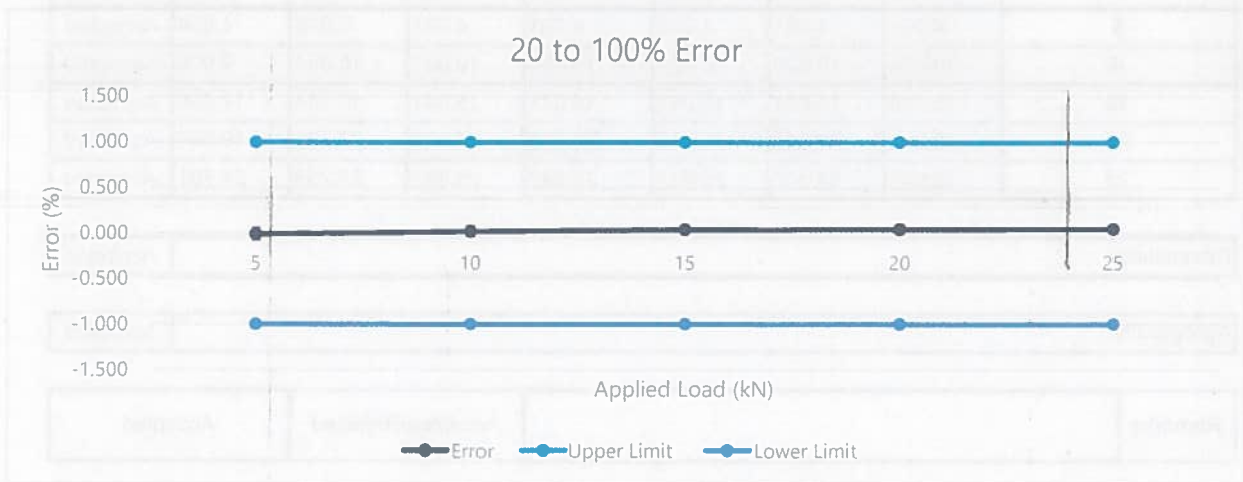
Calibration Laboratory		Operator	AB	Date	08/03/2024
		Input By	AB	Date	08/03/2024
Consett	✓	Approved By	ABE	Date	11/3/24

EQUIPMENT CHECK RECORD - LOAD CELL CALIBRATION (kN)

Uncertainty

Load	Reference Equipment	Resolution	Repeatability	Drift	Combined Uncertainty	Expanded Uncertainty	Units
0.05	0.000295	0.000289	0.000000	0.000000	0.000413	0.000825	kN
0.1	0.000305	0.000289	0.000000	0.000000	0.000420	0.000840	kN
0.15	0.000305	0.000289	0.000000	0.000000	0.000420	0.000840	kN
0.2	0.000305	0.000289	0.000000	0.000000	0.000420	0.000840	kN
0.25	0.000305	0.000289	0.000471	0.000000	0.000631	0.001263	kN
0.5	0.000380	0.000289	0.000471	0.000000	0.000671	0.001342	kN
1	0.000575	0.000289	0.000471	0.000000	0.000798	0.001595	kN
1.5	0.000805	0.000289	0.000471	0.000577	0.001134	0.002269	kN
2	0.001040	0.000289	0.000816	0.000000	0.001353	0.002707	kN
2.5	0.001285	0.000289	0.000816	0.000577	0.001654	0.003307	kN
3.75	0.002020	0.000289	0.000471	0.000577	0.002172	0.004345	kN
5	0.002515	0.000289	0.000850	0.001732	0.003183	0.006366	kN
5	0.000255	0.000289	0.000000	0.001732	0.001774	0.003549	kN
10	0.000505	0.000289	0.001886	0.002309	0.003038	0.006075	kN
15	0.001000	0.000289	0.000471	0.002887	0.003105	0.006209	kN
20	0.001500	0.000289	0.001886	0.004041	0.004714	0.009428	kN
25	0.002000	0.000289	0.000943	0.005196	0.005654	0.011309	kN

PDF	Normal (k=2)	Rectangular	Normal (k=1)	Rectangular
Divisor	2	1.732051	1	1.732051
Ci	1	1	1	1



The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%.

Calibration Laboratory		Operator	AB	Date	08/03/2024
		Input By	AB	Date	08/03/2024
Consett	✓	Approved By	ADK	Date	11/3/24

EQUIPMENT CHECK RECORD - MECHANICAL MACHINE SPEEDS

Item Description	Rate of Displacement	Company Identification No	TRI-SCAN 50
Measurement Range	Various	Manufacturer's Serial No	N/A
Check Interval	Yearly	Maintenance Record Ref	N/A
Ambient Temperature <i>(corrected)</i>	17.5	Reference Standard	GB 16707
Thermometer Reference	TDT7/C		BT CLOCK
Method or Procedure	LCM Section 29	Acceptability Criterion	± 10%

Stud Setting: 1 mm/min		Stud Setting: 2.25 mm/min		Stud Setting: 0.5 mm/min	
Elapsed Time (m:s)	Platen Movement (mm)	Elapsed Time (m:s)	Platen Movement (mm)	Elapsed Time (m:s)	Platen Movement (mm)
01:00	1	01:00	2.25	01:00	0.5
02:00	2	02:00	5	02:00	1
03:00	3	03:00	7.75	03:00	1.5
04:00	4	04:00	10.5	04:00	2
05:00	5	05:00	13.25	05:00	2.5
06:00	6	06:00	16	06:00	3
07:00	7	07:00	18.75	07:00	3.5
08:00	8	08:00	21.5	08:00	4
09:00	9	09:00	24.25	09:00	4.5
10:00	10	10:00	27	10:00	5
11:00	11	11:00	29.75	11:00	5.5
12:00	12	12:00	32.5	12:00	6
13:00	13	13:00	35.25	13:00	6.5
14:00	14	14:00	38	14:00	7
15:00	15	15:00	40.75	15:00	7.5
16:00	16			16:00	8
17:00	17			17:00	8.5
18:00	18			18:00	9
19:00	19			19:00	9.5
20:00	20			20:00	10

Remarks	Accepted	<input checked="" type="checkbox"/>
	Rejected	<input type="checkbox"/>

Data Storage	Equipment Utilised	Calibration File
Disc Directory	Stopwatch/Timer & Gauge Blocks	CF/REF
File Identifier		CF/16, CF13

Date of last check	N/A	* Comment
Date of this check	08/03/2024	
Interval compliance (*)		
Date of next check	08/03/2025	

Calibration Laboratory		Operator	AB	Date	08/03/2024
		Input By	AB	Date	08/03/2024
Consett	<input checked="" type="checkbox"/>	Approved By	ABE	Date	14/3/24



EQUIPMENT CHECK RECORD - LVDT CALIBRATION

Item Description	LVDT		Company Identification No	VD13-C
Measurement Range (mm)	50		Manufacturer's Serial No	11931
Test Type	Triaxial		Reference Equipment	GB16707
Check Interval	1 Year		Resolution (mm)	0.001
Temperature (Initial/Final) (°C)	18.2	18.3	Accuracy Required (mm)	0.1
Thermometer Reference	TDT7/C		Method or Procedure	LCM Section 35

Equipment Utilised					
Type	Gauge Blocks	ID	GB16707	Calibration Due	07/07/2025
Type		ID		Calibration Due	

Gauge Height (mm)	Determination			Mean (Divs)	Upper Limit	Lower Limit	Accepted/Rejected
	1 (Div)	2 (Div)	3 (Div)				
0	0.000	0.000	0.000	0.000	0.079	-0.079	Accepted
5	5.005	5.025	5.025	5.018	5.079	4.921	Accepted
10	10.004	10.019	10.024	10.016	10.079	9.921	Accepted
15	15.014	15.029	15.034	15.026	15.079	14.921	Accepted
20	20.011	20.031	20.029	20.024	20.079	19.921	Accepted
25	25.024	25.039	25.036	25.033	25.079	24.921	Accepted
30	30.033	30.038	30.033	30.035	30.079	29.921	Accepted
35	35.056	35.056	35.053	35.055	35.079	34.921	Accepted
40	40.040	40.045	40.045	40.043	40.079	39.921	Accepted
45	45.053	45.055	45.048	45.052	45.079	44.921	Accepted
50	50.025	50.030	50.017	50.024	50.079	49.921	Accepted

Remarks		Accepted/Rejected	Accepted
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Date of last check	N/A	* Comment
Date of this check	08/03/2024	
Interval compliance (*)		
Date of next check	08/03/2025	

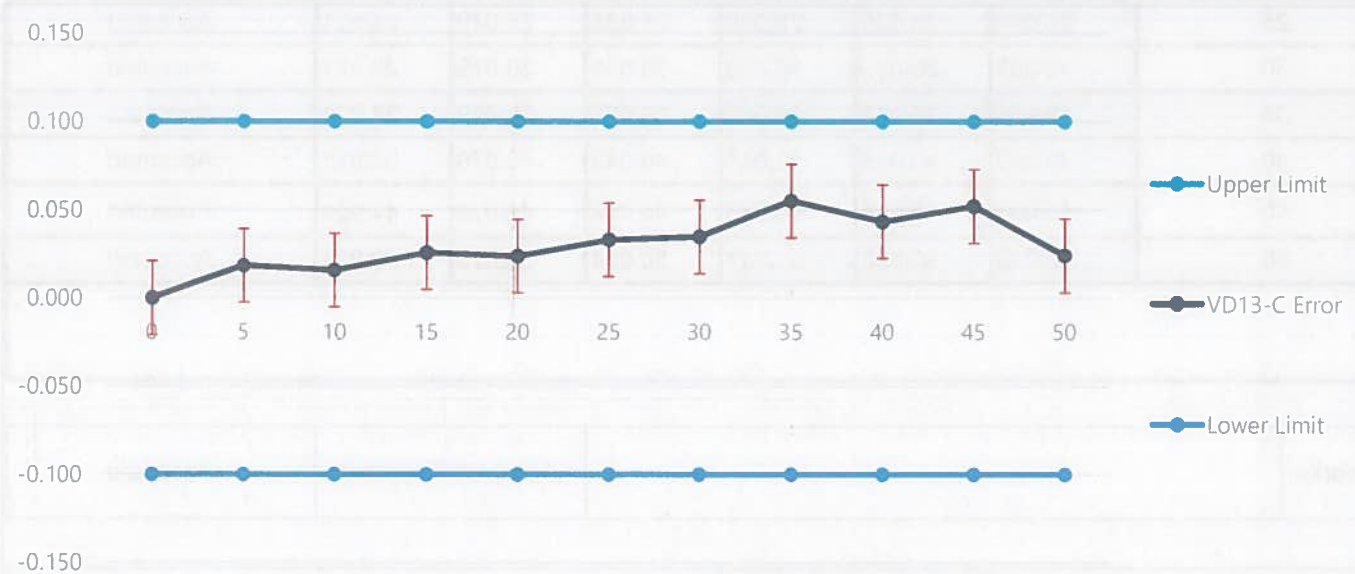
Calibration Laboratory	(✓)	Operator	AB	Date	08/03/2024
		Input By	AB	Date	08/03/2024
Consett	(✓)	Approved By	JIS	Date	8/3/24

EQUIPMENT CHECK RECORD - LVDT CALIBRATION

Repeatability	
Expected Value	Actual Value
15	15.014
15	15.029
15	15.034
Repeatability (Standard Deviation)	0.01040833

Uncertainty					
Source	Uncertainty	PDF	Divisor	Ci	Standard Uncertainty
Ref Equipment	0.00066	Normal	2	1	0.000330
Resolution	0.00050	Rectangular	1.732051	1	0.000289
Repeatability	0.01041	Normal (1)	1	1	0.010408
Thermal Expansion	0.00006	Rectangular	1.732051	1	0.000033
Drift	0.00024	Rectangular	1.732051	1	0.000139

Combined Uncertainty	0.010419	
Expanded Uncertainty (k=2)	0.020837	mm



The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%.

Calibration Laboratory	(✓)	Operator	AB	Date	08/03/2024
		Input By	AB	Date	08/03/2024
Consett	(✓)	Approved By	<i>AB</i>	Date	8/3/24

EQUIPMENT CHECK RECORD - PRESSURE GAUGE

Item Description	Pressure Gauge	Company Identification No	PT13-C	
Measurement Range (kPa)	2000	Manufacturer's Serial No	119587	
Test Type	UUT	Maintenance Record Ref	N/A	
Check Interval	6 months	Reference Standard	DTG1/C	
Temperature (Initial/Final) (°C)	19.2	19.2	Accuracy Required (kPa)	10
Thermometer Reference	TDT7/C	Method or Procedure	LCM Sec 39	

Equipment Utilised					
Type	Reference Gauge	ID	DTG1/C	Calibration Due	26/05/2024
Type		ID			

Applied Pressure kPa	Determination (kPa)			Mean (kPa)	Upper Limit	Lower Limit	Accepted/Rejected
	1	2	3				
0	1	1	1	1.0	7.7	-5.7	Accepted
200	201	201	202	201.3	208.0	194.6	Accepted
400	401	401	402	401.3	408.0	394.6	Accepted
600	601	601	602	601.3	608.0	594.6	Accepted
800	802	802	801	801.7	808.4	795.0	Accepted
1000	1002	1003	1002	1002.3	1009.0	995.6	Accepted
1200	1201	1202	1202	1201.7	1208.4	1195.0	Accepted
1400	1401	1402	1402	1401.7	1408.4	1395.0	Accepted
1600	1602	1603	1602	1602.3	1609.0	1595.6	Accepted
1800	1801	1802	1802	1801.7	1808.4	1795.0	Accepted
2000	2001	2002	2003	2002.0	2008.7	1995.3	Accepted

Remarks		Accepted/Rejected	Accepted
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Date of last check	N/A	* Comment
Date of this check	12/03/2024	
Interval compliance (*)		
Date of next check	12/03/2025	

Calibration Laboratory		Operator	AB	Date	12/03/2024
		Input By	AB	Date	12/03/2024
Consett	✓	Approved By	ABE	Date	14/3/24

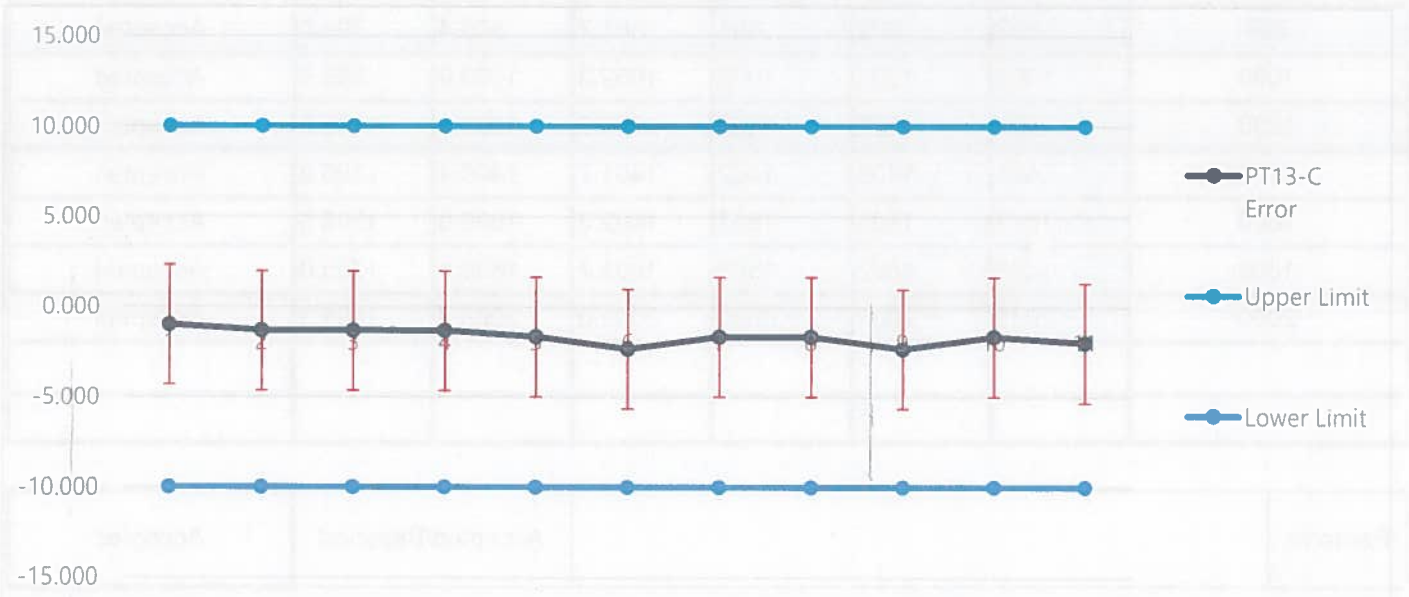


EQUIPMENT CHECK RECORD - PRESSURE GAUGE

Repeatability	
Expected Value	Actual Value
2000	2001.000
2000	2002.000
2000	2003.000
Repeatability (Standard Deviation)	1

Uncertainty					
Source	Uncertainty	PDF	Divisor	Ci	Standard Uncertainty
Ref Equipment	2.30000	Normal (k=2)	2	1	1.150000
Resolution	0.50000	Rectangular	1.732051	1	0.288675
Repeatability	1.00000	Normal	1	1	1.000000
Drift	1.00000	Rectangular	1.732051	1	0.577350

Combined Uncertainty	1.655043	
Expanded Uncertainty (k=2)	3.310086	kPa



The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%.

Calibration Laboratory		Operator	AB	Date	12/03/2024
		Input By	AB	Date	12/03/2024
Consett	✓	Approved By	ABX	Date	12/3/24



Hire Contract

Account No: FUGR	Delivery Address		
FUGRO GEOSERVICES LTD BICKLAND INDUSTRIAL PARK FALMOUTH CORNWALL TR11 4TA	WALLINGFORD DEPOT FUGRO HOUSE HITHERCROFT ROAD WALLINGFORD OXFORDSHIRE OX10 9RB	Contract No.	3374
		Delivery Date	04 Apr 2024
		Customer Ref.	135119/SB
	NICK ROBERTS 07794 194266	Ordered By	NICK ROBERTS

Hire Items Type **WEEK**

Item Number	Description	Quantity	
373899	GMI PS200 MULTI GAS DETECTOR	1	
BCGMI200	BATTERY CHARGER, LEAD & COMMS CLIP	1	
399393	GMI PS200 MULTI GAS DETECTOR	1	
BCGMI200	BATTERY CHARGER, LEAD & COMMS CLIP	1	
Transport Charges			
CARRIER		1.00	16.00

Any damages or loss of parts will be chargeable
Should the equipment come back in a soiled state a cleaning charge may be applied

For Lord Technical's full Terms and Conditions please visit www.surveyingstuff.com

Confirmation

Signed:	Date:	
.....	
Print Name:		
.....		

D.3 Positioning Survey Equipment Calibration

List of Plates

Positioning Survey Equipment Calibration

271 Plates

EXCALIBUR_240149
FINAL FIX REPORT



Project ID	Excalibur_240149
Starfix Version	v2022.1110.9 (build 0)
Client	Fugro Geoservices Inc
Primary Vessel	Excalibur
Location Description	UK

Session Name	20240527-144145-v1		
Start Time	27 May 2024, 15:42:25+01:00	End Time	27 May 2024, 15:50:44+01:00

Position Source:	SPK1 - Starfix.G4 Plus-10003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7096'N	±0.02m
Longitude - ETRS89	07°30.1690'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,415.37m E	±0.02m
Northing	6,197,278.83m N	±0.02m
Convergence	-1.24002°	
Heading ° True	204.92° T	±0.05°
Heading ° Grid	206.16° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7099'N	±0.02m
Longitude - ITRF2014	07°30.1695'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

Seabed Depth :	0.0m
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The final position was computed from session "20240527-144145-v1" by averaging 500 observations from a total of 500 observations between 27/05/2024 15:42:25 (UTC+01:00) and 27/05/2024 15:50:44 (UTC+01:00).

Position from	Waypoint: BH080
Excalibur at Moonpool_1	2.00m Geodetic @ 53.12° T

Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	406,415.37m E, 6,197,278.83m N, 8.04m MSS	0.00m	0.00m	0.00m
Secondary	406,415.37m E, 6,197,278.85m N, 8.08m MSS	-0.01m	0.01m	0.04m
Tertiary	406,415.47m E, 6,197,278.81m N, 7.92m MSS	0.10m	-0.02m	-0.12m
Quaternary	406,415.49m E, 6,197,278.83m N, 8.11m MSS	0.11m	-0.01m	0.07m
Quinary	406,415.46m E, 6,197,278.81m N, 7.91m MSS	0.09m	-0.02m	-0.13m


Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North Marine)


Leumman Dos Santos
 Client Representative
 Fugro Geoservices Inc

Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	406,415.37	6,197,278.83	8.04	55°54.7096'N	07°30.1690'E
Crane 1	406,429.92	6,197,293.01	8.04	55°54.7174'N	07°30.1826'E
Crane 2	406,434.05	6,197,270.45	8.04	55°54.7053'N	07°30.1870'E
Leg 1	406,429.71	6,197,260.72	8.04	55°54.7000'N	07°30.1831'E
Leg 2	406,404.69	6,197,273.04	8.04	55°54.7063'N	07°30.1588'E
Leg 3	406,437.70	6,197,276.82	8.04	55°54.7087'N	07°30.1904'E
Leg 4	406,412.66	6,197,289.04	8.04	55°54.7150'N	07°30.1661'E
Leg 5	406,440.53	6,197,282.66	8.04	55°54.7119'N	07°30.1930'E
Leg 6	406,415.52	6,197,294.94	8.04	55°54.7182'N	07°30.1688'E
Leg 7	406,450.67	6,197,303.15	8.04	55°54.7231'N	07°30.2023'E
Leg 8	406,425.51	6,197,315.49	8.04	55°54.7294'N	07°30.1779'E
Moonpool_1	406,415.37	6,197,278.83	8.04	55°54.7096'N	07°30.1690'E
Moonpool_2	406,420.06	6,197,282.84	8.01	55°54.7118'N	07°30.1734'E
SPK1_Primary	406,423.83	6,197,265.05	19.77	55°54.7022'N	07°30.1774'E
SPK1_Secondary	406,412.35	6,197,270.61	20.05	55°54.7051'N	07°30.1662'E
SPK2_Primary	406,419.53	6,197,297.80	14.87	55°54.7198'N	07°30.1726'E
SPK2_Secondary	406,420.51	6,197,293.92	15.01	55°54.7177'N	07°30.1736'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Secondary)

Position Source:	SPK1 - Starfix.G4-10001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7096'N	±0.02m
Longitude - ETRS89	07°30.1690'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,415.37m E	±0.02m
Northing	6,197,278.85m N	±0.02m
Convergence	-1.24002°	
Heading ° True	204.92° T	±0.05°
Heading ° Grid	206.16° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7099'N	±0.02m
Longitude - ITRF2014	07°30.1695'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240527-144145-v1" by averaging 500 observations from a total of 500 observations between 27/05/2024 15:42:25 (UTC+01:00) and 27/05/2024 15:50:44 (UTC+01:00).

Position from	Waypoint: BH080
Excalibur at Moonpool_1	2.00m Geodetic @ 53.48° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Tertiary)

Position Source:	SPK2 - Starfix.G4 Plus-20003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7095'N	±0.01m
Longitude - ETRS89	07°30.1691'E	±0.03m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,415.47m E	±0.03m
Northing	6,197,278.81m N	±0.01m
Convergence	-1.24002°	
Heading ° True	204.92° T	±0.05°
Heading ° Grid	206.16° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7099'N	±0.01m
Longitude - ITRF2014	07°30.1696'E	±0.03m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240527-144145-v1" by averaging 498 observations from a total of 498 observations between 27/05/2024 15:42:25 (UTC+01:00) and 27/05/2024 15:50:44 (UTC+01:00).

Position from	Waypoint: BH080
Excalibur at Moonpool_1	1.94m Geodetic @ 50.78° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quaternary)

Position Source:	SPK1 - Starfix.XP2-10002
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7095'N	±0.02m
Longitude - ETRS89	07°30.1691'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,415.49m E	±0.02m
Northing	6,197,278.83m N	±0.02m
Convergence	-1.24002°	
Heading ° True	204.92° T	±0.05°
Heading ° Grid	206.16° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7099'N	±0.02m
Longitude - ITRF2014	07°30.1696'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240527-144145-v1" by averaging 500 observations from a total of 500 observations between 27/05/2024 15:42:25 (UTC+01:00) and 27/05/2024 15:50:44 (UTC+01:00).

Position from	Waypoint: BH080
Excalibur at Moonpool_1	1.92m Geodetic @ 50.99° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quinary)

Position Source:	SPK2 - Starfix.G4-20001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7095'N	±0.01m
Longitude - ETRS89	07°30.1690'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,415.46m E	±0.02m
Northing	6,197,278.81m N	±0.01m
Convergence	-1.24002°	
Heading ° True	204.92° T	±0.05°
Heading ° Grid	206.16° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7099'N	±0.01m
Longitude - ITRF2014	07°30.1696'E	±0.02m

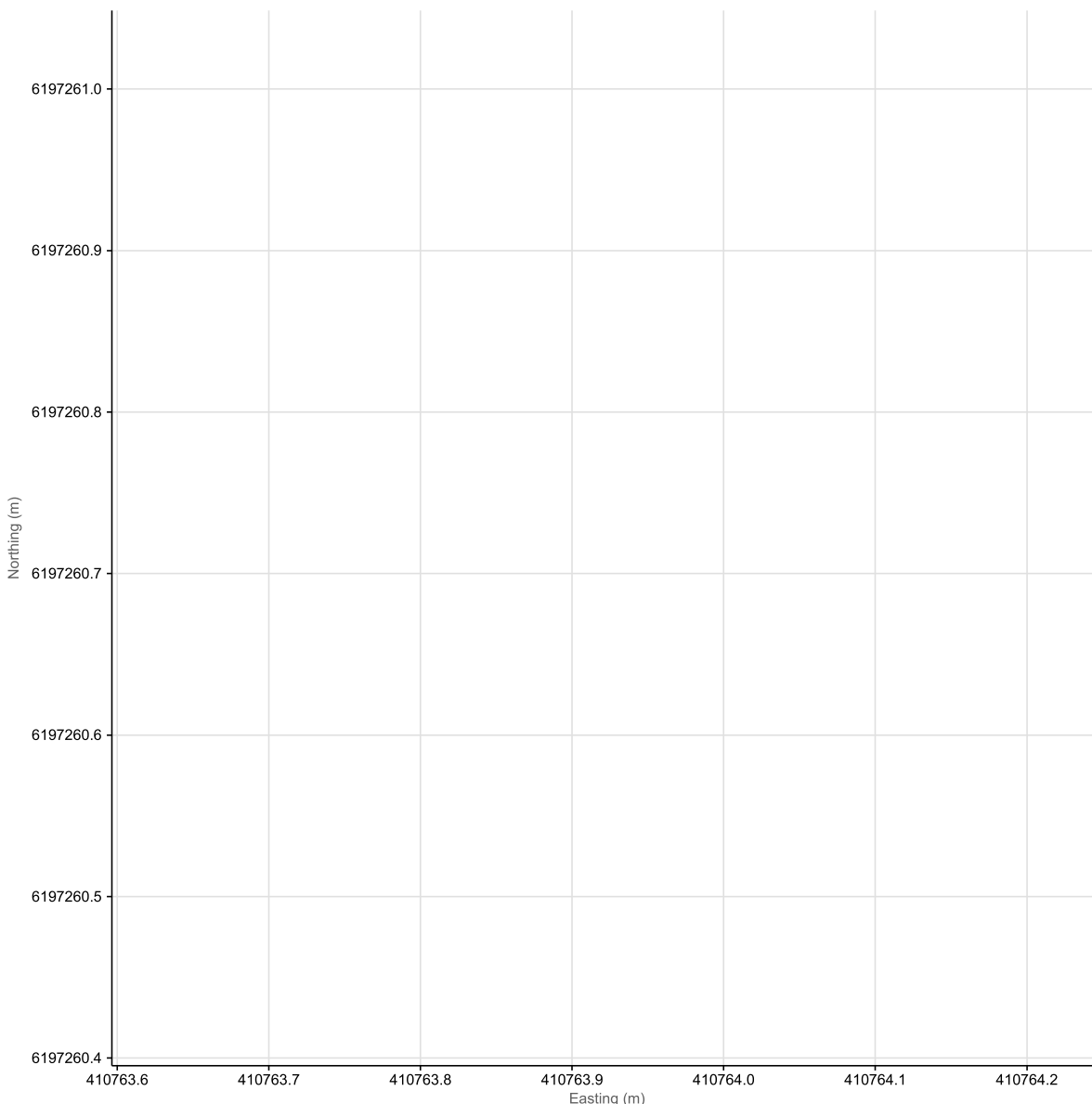
Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240527-144145-v1" by averaging 498 observations from a total of 498 observations between 27/05/2024 15:42:25 (UTC+01:00) and 27/05/2024 15:50:44 (UTC+01:00).

Position from	Waypoint: BH080
Excalibur at Moonpool_1	1.94m Geodetic @ 51.04° T



Scatter Plot-ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	406,415.37m E, 6,197,278.83m N, 8.04m MSS	0.00m	0.00m	0.00m
Secondary	406,415.37m E, 6,197,278.85m N, 8.08m MSS	-0.01m	0.01m	0.04m
Tertiary	406,415.47m E, 6,197,278.81m N, 7.92m MSS	0.10m	-0.02m	-0.12m
Quaternary	406,415.49m E, 6,197,278.83m N, 8.11m MSS	0.11m	-0.01m	0.07m
Quinary	406,415.46m E, 6,197,278.81m N, 7.91m MSS	0.09m	-0.02m	-0.13m

EXCALIBUR_240149
FINAL FIX REPORT



Antenna Positions

Primary

	Antenna Position for SPK1 - Starfix.G4 Plus-10003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7022'N	±0.02m
Longitude - ETRS89	07°30.1774'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,423.83m E	±0.01m
Northing	6,197,265.05m N	±0.02m
Raw Rig Heading ° True	204.92° T	±0.05°
Raw Rig Heading ° Grid	206.16° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7025'N	±0.02m
Longitude - ITRF2014	07°30.1779'E	±0.01m

Secondary

	Antenna Position for SPK1 - Starfix.G4-10001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7022'N	±0.01m
Longitude - ETRS89	07°30.1773'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,423.82m E	±0.01m
Northing	6,197,265.06m N	±0.01m
Raw Rig Heading ° True	204.92° T	±0.05°
Raw Rig Heading ° Grid	206.16° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7026'N	±0.01m
Longitude - ITRF2014	07°30.1779'E	±0.01m

Tertiary

	Antenna Position for SPK2 - Starfix.G4 Plus-20003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7198'N	±0.01m
Longitude - ETRS89	07°30.1726'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,419.63m E	±0.02m
Northing	6,197,297.77m N	±0.01m
Raw Rig Heading ° True	204.92° T	±0.05°
Raw Rig Heading ° Grid	206.16° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7201'N	±0.01m
Longitude - ITRF2014	07°30.1732'E	±0.02m

Quaternary

	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	

EXCALIBUR_240149
FINAL FIX REPORT

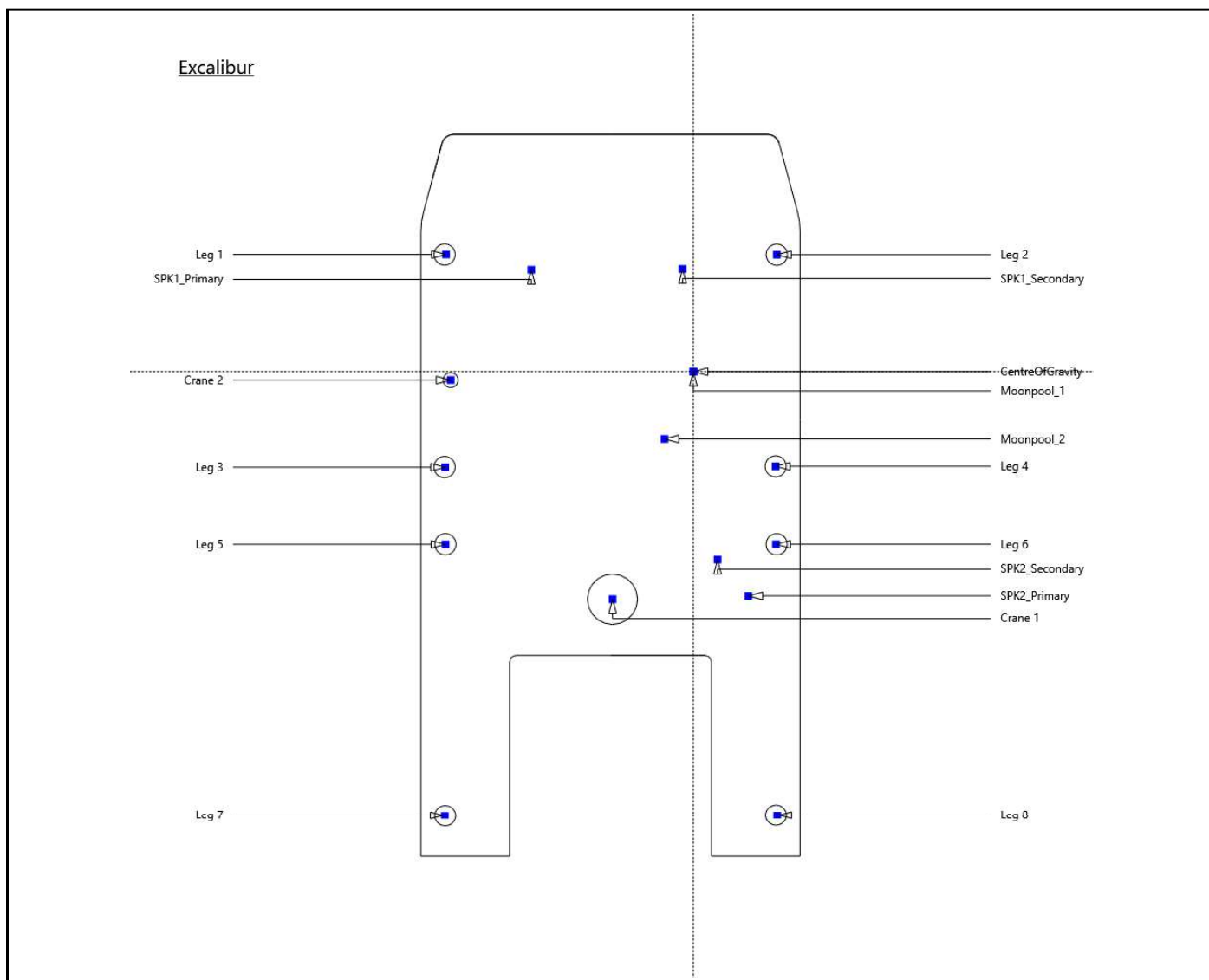


	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7022'N	±0.02m
Longitude - ETRS89	07°30.1775'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,423.94m E	±0.01m
Northing	6,197,265.04m N	±0.02m
Raw Rig Heading ° True	204.92° T	±0.05°
Raw Rig Heading ° Grid	206.16° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7025'N	±0.02m
Longitude - ITRF2014	07°30.1780'E	±0.01m

Quinary

	Antenna Position for SPK2 - Starfix.G4-20001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7198'N	±0.01m
Longitude - ETRS89	07°30.1726'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,419.62m E	±0.01m
Northing	6,197,297.77m N	±0.01m
Raw Rig Heading ° True	204.92° T	±0.05°
Raw Rig Heading ° Grid	206.16° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7201'N	±0.01m
Longitude - ITRF2014	07°30.1732'E	±0.01m

Vessel Outline and Offsets





Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m
SPK2_Secondary		2.04m	-15.81m	6.97m

EXCALIBUR_240149

FINAL FIX REPORT



Project ID	Excalibur_240149
Starfix Version	v2022.1110.9 (build 0)
Client	Fugro Geoservices Inc
Primary Vessel	Excalibur
Location Description	UK

Session Name	20240525-150132-v1		
Start Time	25 May 2024, 16:01:42+01:00	End Time	25 May 2024, 16:10:01+01:00

Position Source:	SPK1 - Starfix.G4 Plus-10003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7493'N	±0.01m
Longitude - ETRS89	07°34.3419'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,763.83m E	±0.01m
Northing	6,197,260.70m N	±0.01m
Convergence	-1.18242°	
Heading ° True	269.33° T	±0.02°
Heading ° Grid	270.51° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7497'N	±0.01m
Longitude - ITRF2014	07°34.3424'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

Seabed Depth :	0.0m
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The final position was computed from session "20240525-150132-v1" by averaging 500 observations from a total of 500 observations between 25/05/2024 16:01:42 (UTC+01:00) and 25/05/2024 16:10:01 (UTC+01:00).

Position from	Waypoint: BH081
Excalibur at Moonpool_1	3.90m Geodetic @ 258.50° T

Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	410,763.83m E, 6,197,260.70m N, 7.63m MSS	0.00m	0.00m	0.00m
Secondary	410,763.84m E, 6,197,260.71m N, 7.56m MSS	0.01m	0.01m	-0.07m
Tertiary	410,763.85m E, 6,197,260.73m N, 7.71m MSS	0.01m	0.03m	0.08m
Quaternary	410,763.83m E, 6,197,260.67m N, 7.71m MSS	0.00m	-0.02m	0.08m
Quinary	410,763.79m E, 6,197,260.72m N, 7.65m MSS	-0.04m	0.02m	0.02m

Jamie Davison
Site Manager/Supervisor
FGBNM (Fugro Great Britain North Marine)

Rob Harwood
Client Representative
Fugro Geoservices Inc



Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	410,763.83	6,197,260.70	7.63	55°54.7493'N	07°34.3419'E
Crane 1	410,782.91	6,197,253.72	7.63	55°54.7458'N	07°34.3603'E
Crane 2	410,764.36	6,197,240.24	7.63	55°54.7383'N	07°34.3428'E
Leg 1	410,753.71	6,197,239.93	7.63	55°54.7380'N	07°34.3326'E
Leg 2	410,753.98	6,197,267.82	7.63	55°54.7531'N	07°34.3323'E
Leg 3	410,771.68	6,197,239.70	7.63	55°54.7381'N	07°34.3498'E
Leg 4	410,771.85	6,197,267.56	7.63	55°54.7531'N	07°34.3494'E
Leg 5	410,778.17	6,197,239.68	7.63	55°54.7382'N	07°34.3560'E
Leg 6	410,778.41	6,197,267.54	7.63	55°54.7532'N	07°34.3557'E
Leg 7	410,801.03	6,197,239.41	7.63	55°54.7383'N	07°34.3780'E
Leg 8	410,801.26	6,197,267.43	7.63	55°54.7534'N	07°34.3777'E
Moonpool_1	410,763.83	6,197,260.70	7.63	55°54.7493'N	07°34.3419'E
Moonpool_2	410,769.47	6,197,258.21	7.60	55°54.7480'N	07°34.3473'E
SPK1_Primary	410,755.06	6,197,247.11	19.36	55°54.7419'N	07°34.3337'E
SPK1_Secondary	410,755.11	6,197,259.87	19.64	55°54.7488'N	07°34.3335'E
SPK2_Primary	410,782.73	6,197,265.16	14.46	55°54.7519'N	07°34.3599'E
SPK2_Secondary	410,779.66	6,197,262.60	14.60	55°54.7505'N	07°34.3570'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Secondary)

Position Source:	SPK1 - Starfix.G4-10001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7493'N	±0.01m
Longitude - ETRS89	07°34.3419'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,763.84m E	±0.01m
Northing	6,197,260.71m N	±0.01m
Convergence	-1.18242°	
Heading ° True	269.33° T	±0.02°
Heading ° Grid	270.51° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7497'N	±0.01m
Longitude - ITRF2014	07°34.3424'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240525-150132-v1" by averaging 500 observations from a total of 500 observations between 25/05/2024 16:01:42 (UTC+01:00) and 25/05/2024 16:10:01 (UTC+01:00).

Position from	Waypoint: BH081
Excalibur at Moonpool_1	3.91m Geodetic @ 258.32° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Tertiary)

Position Source:	SPK2 - Starfix.G4 Plus-20003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7493'N	±0.02m
Longitude - ETRS89	07°34.3419'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,763.85m E	±0.02m
Northing	6,197,260.73m N	±0.02m
Convergence	-1.18242°	
Heading ° True	269.33° T	±0.02°
Heading ° Grid	270.51° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7497'N	±0.02m
Longitude - ITRF2014	07°34.3424'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240525-150132-v1" by averaging 500 observations from a total of 500 observations between 25/05/2024 16:01:42 (UTC+01:00) and 25/05/2024 16:10:01 (UTC+01:00).

Position from	Waypoint: BH081
Excalibur at Moonpool_1	3.92m Geodetic @ 258.06° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quaternary)

Position Source:	SPK1 - Starfix.XP2-10002
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7493'N	±0.01m
Longitude - ETRS89	07°34.3419'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,763.83m E	±0.02m
Northing	6,197,260.67m N	±0.01m
Convergence	-1.18242°	
Heading ° True	269.33° T	±0.02°
Heading ° Grid	270.51° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7496'N	±0.01m
Longitude - ITRF2014	07°34.3424'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240525-150132-v1" by averaging 500 observations from a total of 500 observations between 25/05/2024 16:01:42 (UTC+01:00) and 25/05/2024 16:10:01 (UTC+01:00).

Position from	Waypoint: BH081
Excalibur at Moonpool_1	3.89m Geodetic @ 258.83° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quinary)

Position Source:	SPK2 - Starfix.G4-20001
Heading Source:	SPK1 - GNSS Heading-10004

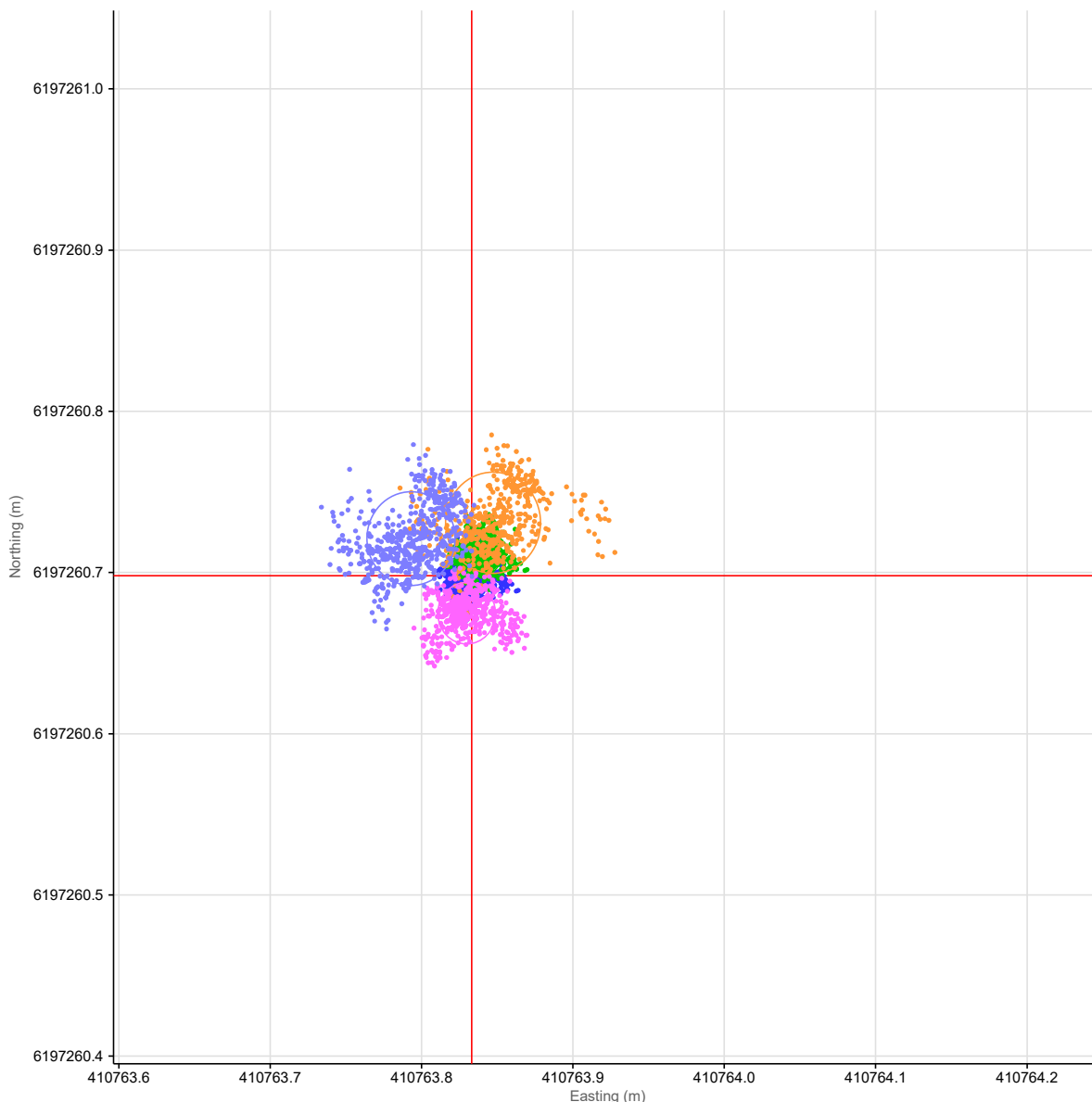
	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7493'N	±0.02m
Longitude - ETRS89	07°34.3418'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,763.79m E	±0.02m
Northing	6,197,260.72m N	±0.02m
Convergence	-1.18242°	
Heading ° True	269.33° T	±0.02°
Heading ° Grid	270.51° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7497'N	±0.02m
Longitude - ITRF2014	07°34.3424'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240525-150132-v1" by averaging 500 observations from a total of 500 observations between 25/05/2024 16:01:42 (UTC+01:00) and 25/05/2024 16:10:01 (UTC+01:00).

Position from	Waypoint: BH081
Excalibur at Moonpool_1	3.86m Geodetic @ 258.05° T

Scatter Plot-ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	410,763.83m E, 6,197,260.70m N, 7.63m MSS	0.00m	0.00m	0.00m
Secondary	410,763.84m E, 6,197,260.71m N, 7.56m MSS	0.01m	0.01m	-0.07m
Tertiary	410,763.85m E, 6,197,260.73m N, 7.71m MSS	0.01m	0.03m	0.08m
Quaternary	410,763.83m E, 6,197,260.67m N, 7.71m MSS	0.00m	-0.02m	0.08m
Quinary	410,763.79m E, 6,197,260.72m N, 7.65m MSS	-0.04m	0.02m	0.02m



Antenna Positions

Primary

	Antenna Position for SPK1 - Starfix.G4 Plus-10003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7419'N	±0.01m
Longitude - ETRS89	07°34.3337'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,755.06m E	±0.01m
Northing	6,197,247.11m N	±0.01m
Raw Rig Heading ° True	269.33° T	±0.02°
Raw Rig Heading ° Grid	270.51° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7422'N	±0.01m
Longitude - ITRF2014	07°34.3343'E	±0.01m

Secondary

	Antenna Position for SPK1 - Starfix.G4-10001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7419'N	±0.01m
Longitude - ETRS89	07°34.3337'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,755.07m E	±0.01m
Northing	6,197,247.12m N	±0.01m
Raw Rig Heading ° True	269.33° T	±0.02°
Raw Rig Heading ° Grid	270.51° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7422'N	±0.01m
Longitude - ITRF2014	07°34.3343'E	±0.01m

Tertiary

	Antenna Position for SPK2 - Starfix.G4 Plus-20003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7520'N	±0.02m
Longitude - ETRS89	07°34.3599'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,782.74m E	±0.02m
Northing	6,197,265.19m N	±0.02m
Raw Rig Heading ° True	269.33° T	±0.02°
Raw Rig Heading ° Grid	270.51° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7523'N	±0.02m
Longitude - ITRF2014	07°34.3605'E	±0.02m

Quaternary

	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	

EXCALIBUR_240149
FINAL FIX REPORT

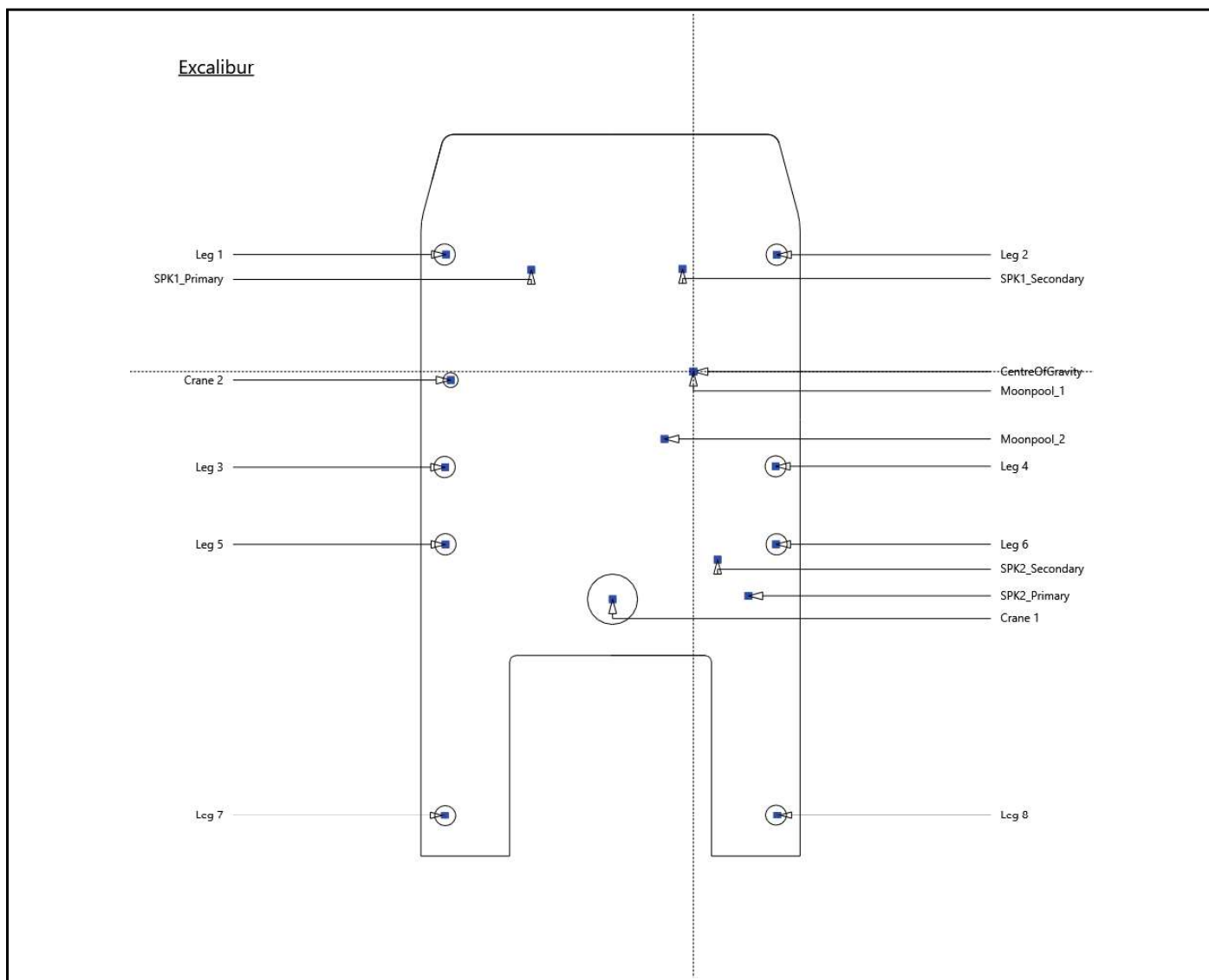


	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7419'N	±0.01m
Longitude - ETRS89	07°34.3337'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,755.06m E	±0.01m
Northing	6,197,247.09m N	±0.01m
Raw Rig Heading ° True	269.33° T	±0.02°
Raw Rig Heading ° Grid	270.51° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7422'N	±0.01m
Longitude - ITRF2014	07°34.3342'E	±0.01m

Quinary

	Antenna Position for SPK2 - Starfix.G4-20001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7520'N	±0.02m
Longitude - ETRS89	07°34.3599'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,782.69m E	±0.02m
Northing	6,197,265.18m N	±0.02m
Raw Rig Heading ° True	269.33° T	±0.02°
Raw Rig Heading ° Grid	270.51° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7523'N	±0.02m
Longitude - ITRF2014	07°34.3604'E	±0.02m

Vessel Outline and Offsets





Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m
SPK2_Secondary		2.04m	-15.81m	6.97m

EXCALIBUR_240149
FINAL FIX REPORT



Project ID	Excalibur_240149
Starfix Version	v2022.1110.9 (build 0)
Client	Fugro Geoservices Inc
Primary Vessel	Excalibur
Location Description	UK

Session Name	20240524-060105-v1		
Start Time	24 May 2024, 07:01:33+01:00	End Time	24 May 2024, 07:09:53+01:00

Position Source:	SPK1 - Starfix.G4 Plus-10003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7468'N	±0.01m
Longitude - ETRS89	07°34.3397'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,761.52m E	±0.02m
Northing	6,197,256.09m N	±0.01m
Convergence	-1.18245°	
Heading ° True	262.27° T	±0.04°
Heading ° Grid	263.46° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7471'N	±0.01m
Longitude - ITRF2014	07°34.3403'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

Seabed Depth :	0.0m
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The final position was computed from session "20240524-060105-v1" by averaging 500 observations from a total of 500 observations between 24/05/2024 07:01:34 (UTC+01:00) and 24/05/2024 07:09:53 (UTC+01:00).

Position from	Waypoint: BH081-CPT
Excalibur at Moonpool_1	4.19m Geodetic @ 337.60° T

Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	410,761.52m E, 6,197,256.09m N, 7.13m MSS	0.00m	0.00m	0.00m
Secondary	410,761.54m E, 6,197,256.10m N, 7.03m MSS	0.02m	0.00m	-0.10m
Tertiary	410,761.54m E, 6,197,256.06m N, 7.04m MSS	0.02m	-0.03m	-0.10m
Quaternary	410,761.56m E, 6,197,256.11m N, 7.08m MSS	0.04m	0.02m	-0.06m
Quinary	410,761.56m E, 6,197,256.06m N, 6.81m MSS	0.04m	-0.03m	-0.33m

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc



Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	410,761.52	6,197,256.09	7.13	55°54.7468'N	07°34.3397'E
Crane 1	410,781.30	6,197,251.51	7.14	55°54.7446'N	07°34.3588'E
Crane 2	410,764.55	6,197,235.85	7.13	55°54.7359'N	07°34.3431'E
Leg 1	410,754.02	6,197,234.24	7.13	55°54.7350'N	07°34.3330'E
Leg 2	410,750.86	6,197,261.95	7.13	55°54.7499'N	07°34.3294'E
Leg 3	410,771.89	6,197,236.22	7.13	55°54.7362'N	07°34.3501'E
Leg 4	410,768.63	6,197,263.89	7.13	55°54.7511'N	07°34.3464'E
Leg 5	410,778.33	6,197,236.99	7.14	55°54.7367'N	07°34.3563'E
Leg 6	410,775.14	6,197,264.67	7.13	55°54.7516'N	07°34.3526'E
Leg 7	410,801.05	6,197,239.54	7.14	55°54.7383'N	07°34.3780'E
Leg 8	410,797.84	6,197,267.37	7.14	55°54.7533'N	07°34.3744'E
Moonpool_1	410,761.52	6,197,256.09	7.13	55°54.7468'N	07°34.3397'E
Moonpool_2	410,767.42	6,197,254.31	7.10	55°54.7459'N	07°34.3454'E
SPK1_Primary	410,754.48	6,197,241.53	18.86	55°54.7389'N	07°34.3333'E
SPK1_Secondary	410,752.96	6,197,254.19	19.14	55°54.7457'N	07°34.3316'E
SPK2_Primary	410,779.72	6,197,262.84	13.97	55°54.7507'N	07°34.3571'E
SPK2_Secondary	410,776.99	6,197,259.92	14.10	55°54.7491'N	07°34.3545'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

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Final Position for Moonpool_1 (Secondary)

Position Source:	SPK1 - Starfix.G4-10001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7468'N	±0.01m
Longitude - ETRS89	07°34.3398'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,761.54m E	±0.02m
Northing	6,197,256.10m N	±0.01m
Convergence	-1.18245°	
Heading ° True	262.27° T	±0.04°
Heading ° Grid	263.46° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7471'N	±0.01m
Longitude - ITRF2014	07°34.3403'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240524-060105-v1" by averaging 500 observations from a total of 500 observations between 24/05/2024 07:01:34 (UTC+01:00) and 24/05/2024 07:09:53 (UTC+01:00).

Position from	Waypoint: BH081-CPT
Excalibur at Moonpool_1	4.20m Geodetic @ 337.34° T

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Final Position for Moonpool_1 (Tertiary)

Position Source:	SPK2 - Starfix.G4 Plus-20003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7468'N	±0.03m
Longitude - ETRS89	07°34.3398'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,761.54m E	±0.02m
Northing	6,197,256.06m N	±0.03m
Convergence	-1.18245°	
Heading ° True	262.27° T	±0.04°
Heading ° Grid	263.46° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7471'N	±0.03m
Longitude - ITRF2014	07°34.3403'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240524-060105-v1" by averaging 499 observations from a total of 499 observations between 24/05/2024 07:01:34 (UTC+01:00) and 24/05/2024 07:09:53 (UTC+01:00).

Position from	Waypoint: BH081-CPT
Excalibur at Moonpool_1	4.23m Geodetic @ 337.54° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quaternary)

Position Source:	SPK1 - Starfix.XP2-10002
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7468'N	±0.03m
Longitude - ETRS89	07°34.3398'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,761.56m E	±0.02m
Northing	6,197,256.11m N	±0.03m
Convergence	-1.18245°	
Heading ° True	262.27° T	±0.04°
Heading ° Grid	263.46° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7472'N	±0.03m
Longitude - ITRF2014	07°34.3403'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240524-060105-v1" by averaging 500 observations from a total of 500 observations between 24/05/2024 07:01:34 (UTC+01:00) and 24/05/2024 07:09:53 (UTC+01:00).

Position from	Waypoint: BH081-CPT
Excalibur at Moonpool_1	4.20m Geodetic @ 336.95° T

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Final Position for Moonpool_1 (Quinary)

Position Source:	SPK2 - Starfix.G4-20001
Heading Source:	SPK1 - GNSS Heading-10004

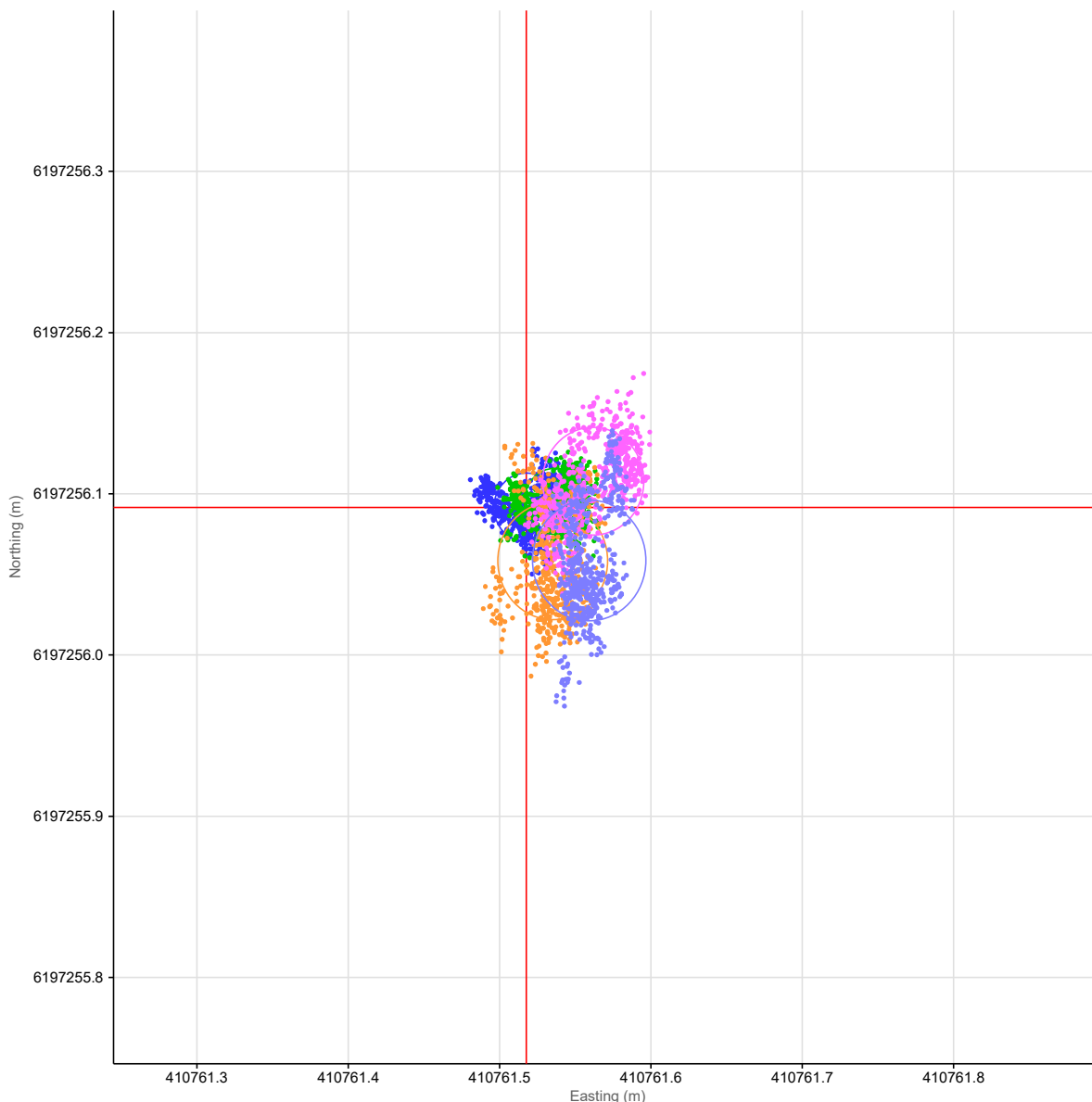
	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7468'N	±0.04m
Longitude - ETRS89	07°34.3398'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,761.56m E	±0.01m
Northing	6,197,256.06m N	±0.04m
Convergence	-1.18245°	
Heading ° True	262.27° T	±0.04°
Heading ° Grid	263.46° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7471'N	±0.04m
Longitude - ITRF2014	07°34.3403'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240524-060105-v1" by averaging 499 observations from a total of 499 observations between 24/05/2024 07:01:34 (UTC+01:00) and 24/05/2024 07:09:53 (UTC+01:00).

Position from	Waypoint: BH081-CPT
Excalibur at Moonpool_1	4.24m Geodetic @ 337.23° T

Scatter Plot-ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	410,761.52m E, 6,197,256.09m N, 7.13m MSS	0.00m	0.00m	0.00m
Secondary	410,761.54m E, 6,197,256.10m N, 7.03m MSS	0.02m	0.00m	-0.10m
Tertiary	410,761.54m E, 6,197,256.06m N, 7.04m MSS	0.02m	-0.03m	-0.10m
Quaternary	410,761.56m E, 6,197,256.11m N, 7.08m MSS	0.04m	0.02m	-0.06m
Quinary	410,761.56m E, 6,197,256.06m N, 6.81m MSS	0.04m	-0.03m	-0.33m



Antenna Positions

Primary

	Antenna Position for SPK1 - Starfix.G4 Plus-10003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7389'N	±0.01m
Longitude - ETRS89	07°34.3333'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,754.48m E	±0.01m
Northing	6,197,241.53m N	±0.01m
Raw Rig Heading ° True	262.27° T	±0.04°
Raw Rig Heading ° Grid	263.46° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7392'N	±0.01m
Longitude - ITRF2014	07°34.3338'E	±0.01m

Secondary

	Antenna Position for SPK1 - Starfix.G4-10001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7389'N	±0.01m
Longitude - ETRS89	07°34.3333'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,754.50m E	±0.01m
Northing	6,197,241.53m N	±0.01m
Raw Rig Heading ° True	262.27° T	±0.04°
Raw Rig Heading ° Grid	263.46° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7392'N	±0.01m
Longitude - ITRF2014	07°34.3338'E	±0.01m

Tertiary

	Antenna Position for SPK2 - Starfix.G4 Plus-20003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7506'N	±0.04m
Longitude - ETRS89	07°34.3571'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,779.74m E	±0.01m
Northing	6,197,262.81m N	±0.04m
Raw Rig Heading ° True	262.27° T	±0.04°
Raw Rig Heading ° Grid	263.46° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7510'N	±0.04m
Longitude - ITRF2014	07°34.3576'E	±0.01m

Quaternary

	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	

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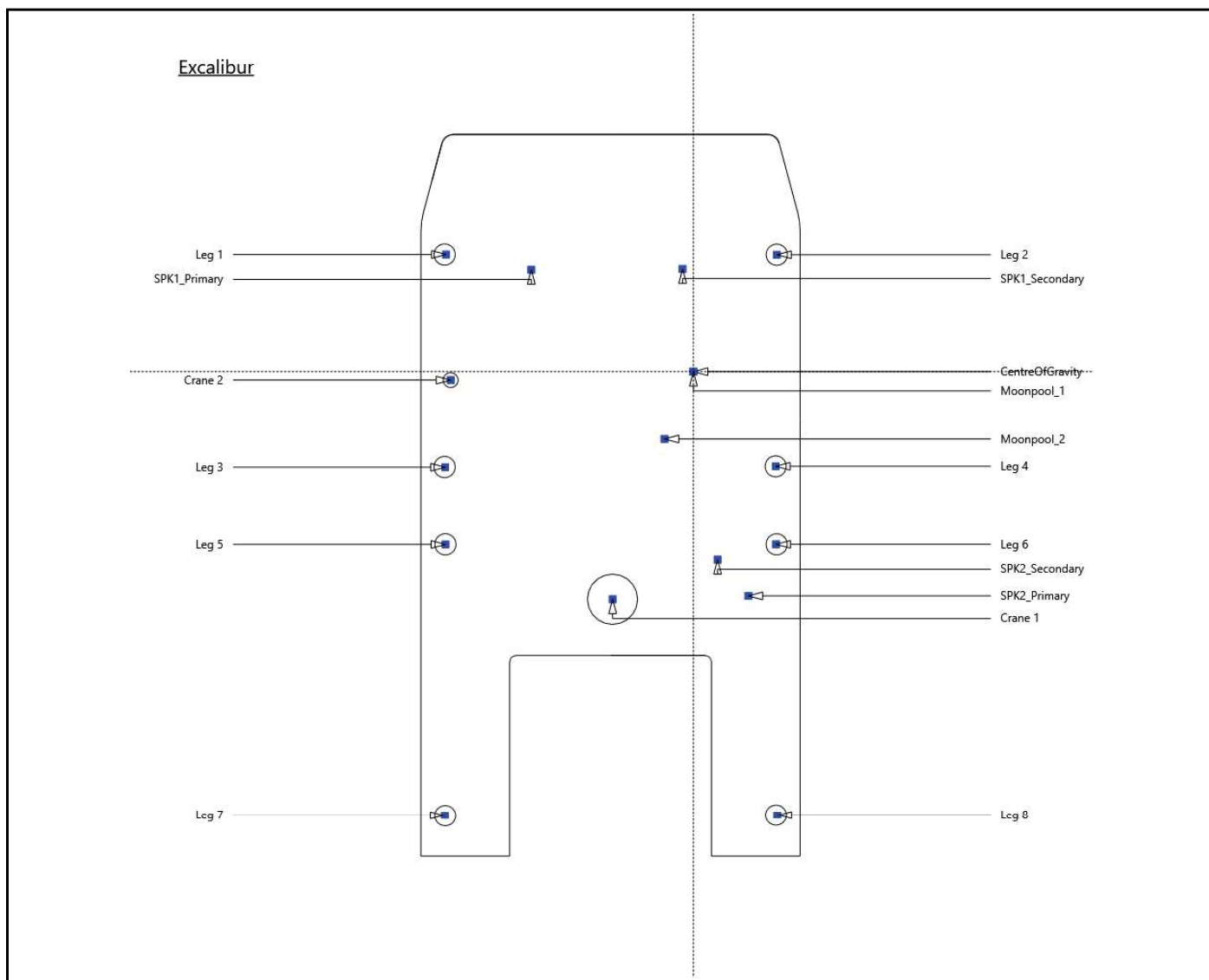


	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7389'N	±0.03m
Longitude - ETRS89	07°34.3333'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,754.53m E	±0.02m
Northing	6,197,241.55m N	±0.03m
Raw Rig Heading ° True	262.27° T	±0.04°
Raw Rig Heading ° Grid	263.46° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7392'N	±0.03m
Longitude - ITRF2014	07°34.3338'E	±0.02m

Quinary

	Antenna Position for SPK2 - Starfix.G4-20001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°54.7506'N	±0.04m
Longitude - ETRS89	07°34.3571'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,779.76m E	±0.01m
Northing	6,197,262.81m N	±0.04m
Raw Rig Heading ° True	262.27° T	±0.04°
Raw Rig Heading ° Grid	263.46° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°54.7510'N	±0.04m
Longitude - ITRF2014	07°34.3576'E	±0.01m

Vessel Outline and Offsets





Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m
SPK2_Secondary		2.04m	-15.81m	6.97m

EXCALIBUR_240149

FINAL FIX REPORT



Project ID: Excalibur_240149
Starfix Version: v2022.1110.9 (build 0)
Client: Fugro Geoservices Inc
Client Rep: OCR
Fugro Personnel: James Hills
Primary Vessel: Excalibur
Location: UK
Comment:

Session Name: 20240618-201739-v2
Start Time: 18 Jun 2024, 21:18:09+01:00
End Time: 18 Jun 2024, 21:20:08+01:00 (Session Length 0.033 hrs - No. Obs. 120)

Position Fix Summary for Excalibur at BH093

Moonpool_1 position computed from SPK1 - Starfix.G4 Plus-10003 (Primary)

Geodetic Datum	European Terrestrial Reference System 1989	International Terrestrial Reference Frame 2014
Latitude	55°53.3852'N	55°53.3855'N
Longitude	07°32.4550'E	07°32.4556'E
Grid System	UTM zone 32N CM 9° E	
Easting	408,744.98m E	
Northing	6,194,771.71m N	
Height	9.04m MSS (DTU21 MSS height)	
Heading	205.07°True (206.28°Grid)	

Position for Moonpool_1 is 3.43m @ 58.988°True (60.197°Grid) FROM the waypoint.

Moonpool_1 from CRP:	Starboard = 0.00m	Forward = 0.00m	Up = 0.00m
SPK1_Primary from CRP:	Starboard = -13.67m	Forward = 8.65m	Up = 11.73m
Heading correction applied (C-O):	0.00°		
Convergence:	-1.20803°		

Waypoint

European Terrestrial Reference System 1989		UTM zone 32N CM 9° E	
Latitude: 55°53.3843'N	Longitude: 07°32.4522'E	Easting: 408,742.00m E	Northing: 6,194,770.00m N
Intended Vessel Heading	0.000°True		

Positioning System Comparison

Sensor	Mean Position			Delta Easting	Delta Northing	Delta Height
	UTM zone 32N CM 9° E					
Primary	408,744.98m E	6,194,771.71m N	9.04m MSS	0.00m	0.00m	0.00m
Secondary	408,744.94m E	6,194,771.66m N	8.85m MSS	-0.04m	-0.05m	-0.19m
Tertiary	408,744.98m E	6,194,771.70m N	8.99m MSS	0.00m	0.00m	-0.05m
Quaternary	408,744.97m E	6,194,771.68m N	9.09m MSS	-0.01m	-0.03m	0.04m
Quinary	408,744.95m E	6,194,771.64m N	8.93m MSS	-0.02m	-0.07m	-0.11m

James Hills
 Party Chief
 FGBNM (Fugro Great Britain North Marine)

OCR
 Client Representative
 Fugro Geoservices Inc

EXCALIBUR_240149
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Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	408,744.98	6,194,771.71	9.04	55°53.3852'N	07°32.4550'E
Crane 1	408,759.56	6,194,785.85	9.04	55°53.3930'N	07°32.4687'E
Crane 2	408,763.63	6,194,763.29	9.04	55°53.3809'N	07°32.4731'E
Leg 1	408,759.28	6,194,753.56	9.04	55°53.3756'N	07°32.4691'E
Leg 2	408,734.28	6,194,765.93	9.04	55°53.3820'N	07°32.4449'E
Leg 3	408,767.30	6,194,769.65	9.04	55°53.3844'N	07°32.4765'E
Leg 4	408,742.28	6,194,781.91	9.04	55°53.3907'N	07°32.4522'E
Leg 5	408,770.14	6,194,775.48	9.04	55°53.3875'N	07°32.4791'E
Leg 6	408,745.16	6,194,787.81	9.04	55°53.3939'N	07°32.4549'E
Leg 7	408,780.32	6,194,795.95	9.04	55°53.3987'N	07°32.4884'E
Leg 8	408,755.19	6,194,808.34	9.04	55°53.4051'N	07°32.4641'E
Moonpool_1	408,744.98	6,194,771.71	9.04	55°53.3852'N	07°32.4550'E
Moonpool_2	408,749.67	6,194,775.70	9.01	55°53.3874'N	07°32.4595'E
SPK1_Primary	408,753.40	6,194,757.90	20.77	55°53.3779'N	07°32.4634'E
SPK1_Secondary	408,741.93	6,194,763.49	21.05	55°53.3808'N	07°32.4523'E
SPK2_Primary	408,749.18	6,194,790.66	15.87	55°53.3955'N	07°32.4587'E
SPK2_Secondary	408,750.15	6,194,786.78	16.01	55°53.3934'N	07°32.4597'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

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Summary of Excalibur Positions

	Primary	SD	Secondary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK2 - Starfix.G4 Plus-20003	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	120 of 120 used		120 of 120 used	

Heading (Corrected)	205.07°True (C-O: 0.00°)	±0.03°	205.07°True (C-O: 0.00°)	±0.03°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°53.3852'N	±0.01m	55°53.3852'N	±0.01m
Longitude	07°32.4550'E	±0.01m	07°32.4550'E	±0.02m
Height	49.77m Ell.	±0.01m	49.58m Ell.	±0.03m
Grid System	UTM zone 32N CM 9° E			
Easting	408,744.98m E	±0.01m	408,744.94m E	±0.02m
Northing	6,194,771.71m N	±0.01m	6,194,771.66m N	±0.01m
Height	9.04m MSS	±0.13m	8.85m MSS	±0.13m
Delta Easting	0.00m		-0.04m	
Delta Northing	0.00m		-0.05m	
Delta Height	0.00m		-0.19m	

Position of Moonpool_1 from waypoint				
Range	3.43m		3.37m	
Bearing	58.99°True		59.36°True	



Summary of Excalibur Positions

	Primary	SD	Tertiary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK1 - Starfix.G4-10001	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	120 of 120 used		120 of 120 used	

Heading (Corrected)	205.07°True (C-O: 0.00°)	±0.03°	205.07°True (C-O: 0.00°)	±0.03°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°53.3852'N	±0.01m	55°53.3852'N	±0.01m
Longitude	07°32.4550'E	±0.01m	07°32.4550'E	±0.01m
Height	49.77m Ell.	±0.01m	49.72m Ell.	±0.01m
Grid System	UTM zone 32N CM 9° E			
Easting	408,744.98m E	±0.01m	408,744.98m E	±0.01m
Northing	6,194,771.71m N	±0.01m	6,194,771.70m N	±0.01m
Height	9.04m MSS	±0.13m	8.99m MSS	±0.13m
Delta Easting	0.00m		0.00m	
Delta Northing	0.00m		0.00m	
Delta Height	0.00m		-0.05m	

Position of Moonpool_1 from waypoint				
Range	3.43m		3.43m	
Bearing	58.99°True		59.02°True	

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FINAL FIX REPORT



Summary of Excalibur Positions

	Primary	SD	Quaternary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK1 - Starfix.XP2-10002	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	120 of 120 used		120 of 120 used	

Heading (Corrected)	205.07°True (C-O: 0.00°)	±0.03°	205.07°True (C-O: 0.00°)	±0.03°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°53.3852'N	±0.01m	55°53.3852'N	±0.01m
Longitude	07°32.4550'E	±0.01m	07°32.4550'E	±0.01m
Height	49.77m Ell.	±0.01m	49.81m Ell.	±0.01m
Grid System	UTM zone 32N CM 9° E			
Easting	408,744.98m E	±0.01m	408,744.97m E	±0.01m
Northing	6,194,771.71m N	±0.01m	6,194,771.68m N	±0.01m
Height	9.04m MSS	±0.13m	9.09m MSS	±0.13m
Delta Easting	0.00m		-0.01m	
Delta Northing	0.00m		-0.03m	
Delta Height	0.00m		0.04m	

Position of Moonpool_1 from waypoint				
Range	3.43m		3.41m	
Bearing	58.99°True		59.29°True	

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FINAL FIX REPORT



Summary of Excalibur Positions

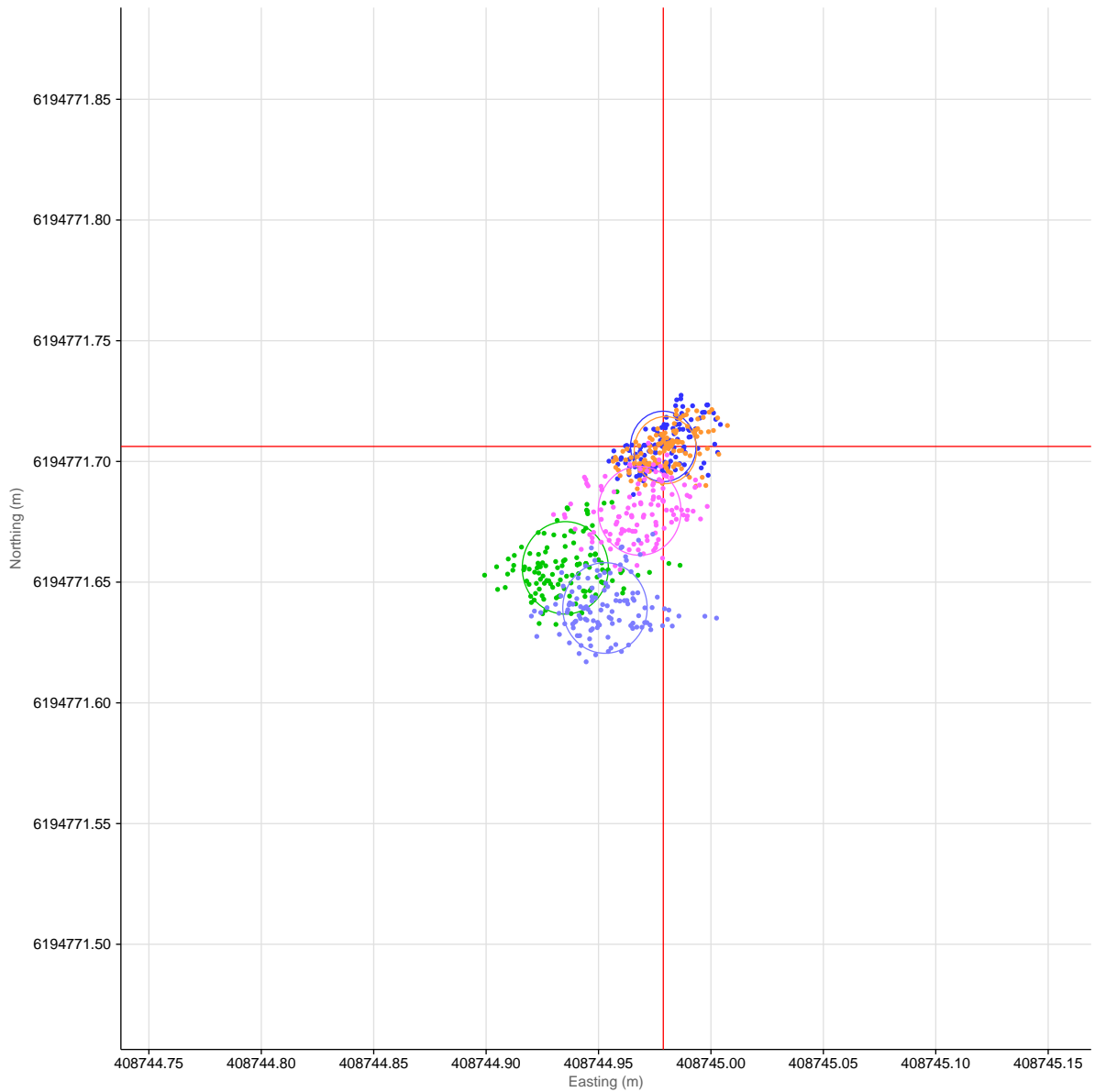
	Primary	SD	Quinary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK2 - Starfix.G4-20001	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	120 of 120 used		120 of 120 used	

Heading (Corrected)	205.07°True (C-O: 0.00°)	±0.03°	205.07°True (C-O: 0.00°)	±0.03°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°53.3852'N	±0.01m	55°53.3852'N	±0.01m
Longitude	07°32.4550'E	±0.01m	07°32.4550'E	±0.02m
Height	49.77m Ell.	±0.01m	49.66m Ell.	±0.03m
Grid System	UTM zone 32N CM 9° E			
Easting	408,744.98m E	±0.01m	408,744.95m E	±0.02m
Northing	6,194,771.71m N	±0.01m	6,194,771.64m N	±0.01m
Height	9.04m MSS	±0.13m	8.93m MSS	±0.14m
Delta Easting	0.00m		-0.02m	
Delta Northing	0.00m		-0.07m	
Delta Height	0.00m		-0.11m	

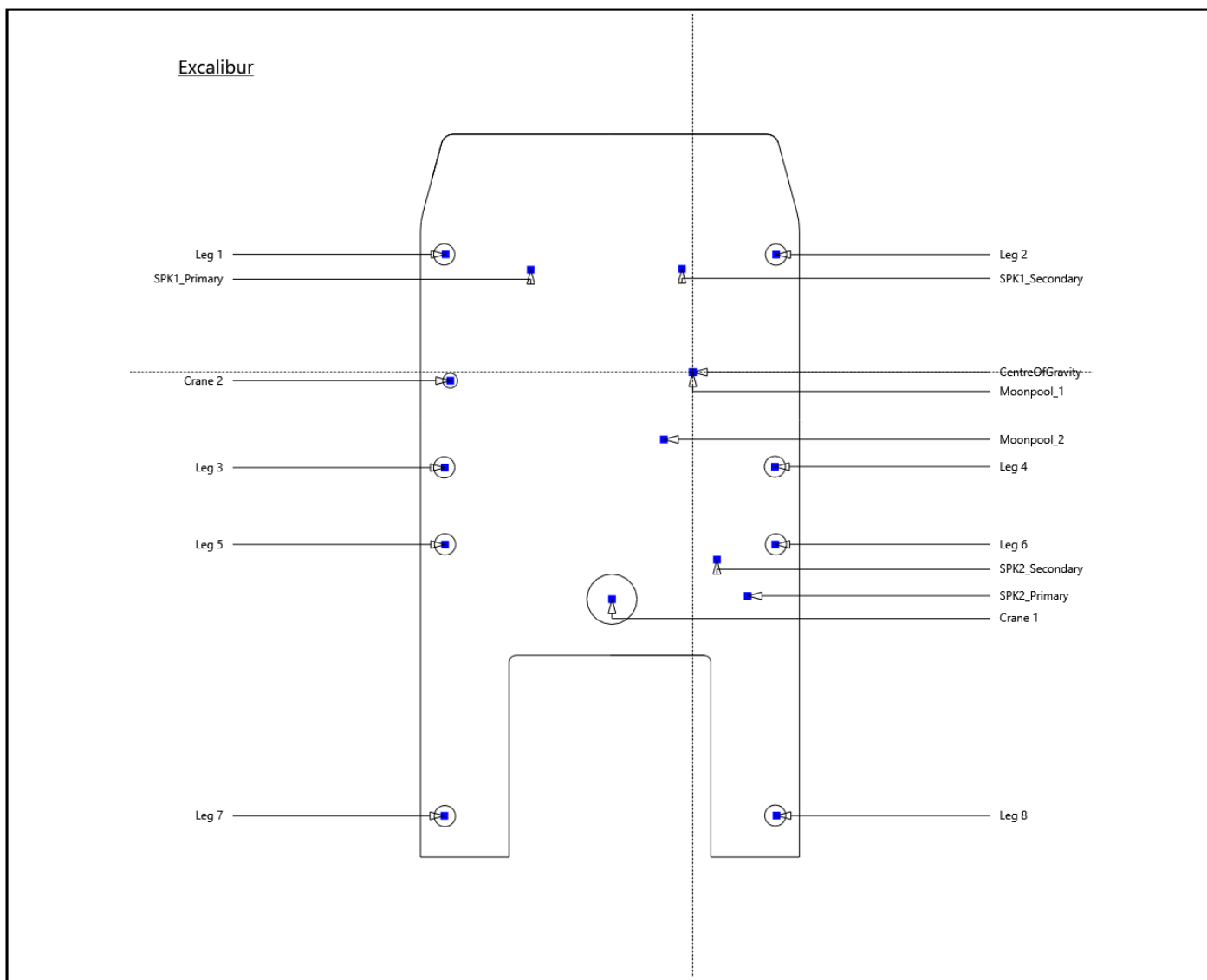
Position of Moonpool_1 from waypoint				
Range	3.43m		3.38m	
Bearing	58.99°True		59.75°True	

Scatter Plot



Sensor Group	Excalibur Mean Position at Moonpool_1 ETRS89 / UTM zone 32N [ETRF2000- ITRF2014][2023],DTU21 MSS height [DTU21 MSS]	Delta Easting	Delta Northing	Delta Height
Primary	408,744.98m E, 6,194,771.71m N, 9.04m MSS	0.00m	0.00m	0.00m
Secondary	408,744.94m E, 6,194,771.66m N, 8.85m MSS	-0.04m	-0.05m	-0.19m
Tertiary	408,744.98m E, 6,194,771.70m N, 8.99m MSS	0.00m	0.00m	-0.05m
Quaternary	408,744.97m E, 6,194,771.68m N, 9.09m MSS	-0.01m	-0.03m	0.04m
Quinary	408,744.95m E, 6,194,771.64m N, 8.93m MSS	-0.02m	-0.07m	-0.11m

Excalibur Outline and Offsets



Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m

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SPK2_Secondary		2.04m	-15.81m	6.97m
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EXCALIBUR_240149

FINAL FIX REPORT



Project ID: Excalibur_240149
Starfix Version: v2022.1110.9 (build 0)
Client: Fugro Geoservices Inc
Client Rep: OCR
Fugro Personnel:
Primary Vessel: Excalibur
Location: UK
Comment:

Session Name: BH101-v3
Start Time: 21 Jun 2024, 01:45:03+01:00
End Time: 21 Jun 2024, 01:55:09+01:00 (Session Length 0.168 hrs - No. Obs. 607)

Position Fix Summary for Excalibur at BH101

Moonpool_1 position computed from SPK1 - Starfix.G4 Plus-10003 (Primary)

Geodetic Datum	European Terrestrial Reference System 1989	International Terrestrial Reference Frame 2014
Latitude	55°52.0403'N	55°52.0406'N
Longitude	07°38.9403'E	07°38.9408'E
Grid System	UTM zone 32N CM 9° E	
Easting	415,455.88m E	
Northing	6,192,139.90m N	
Height	7.57m MSS (DTU21 MSS height)	
Heading	138.53°True (139.65°Grid)	

Position for Moonpool_1 is 2.88m @ 90.785°True (91.903°Grid) FROM the waypoint.

Moonpool_1 from CRP:	Starboard = 0.00m	Forward = 0.00m	Up = 0.00m
SPK1_Primary from CRP:	Starboard = -13.67m	Forward = 8.65m	Up = 11.73m
Heading correction applied (C-O):	0.00°		
Convergence:	-1.11813°		

Waypoint

European Terrestrial Reference System 1989		UTM zone 32N CM 9° E	
Latitude: 55°52.0403'N	Longitude: 07°38.9375'E	Easting: 415,453.00m E	Northing: 6,192,140.00m N
Intended Vessel Heading	0.000°True		

Positioning System Comparison

Sensor	Mean Position			Delta Easting	Delta Northing	Delta Height
	UTM zone 32N CM 9° E					
Primary	415,455.88m E,	6,192,139.90m N,	7.57m MSS	0.00m	0.00m	0.00m
Secondary	415,456.02m E,	6,192,139.76m N,	7.43m MSS	0.14m	-0.14m	-0.13m
Tertiary	415,455.88m E,	6,192,139.90m N,	7.57m MSS	0.00m	0.00m	0.00m
Quaternary	415,455.87m E,	6,192,139.89m N,	7.64m MSS	-0.01m	-0.01m	0.07m
Quinary	415,456.03m E,	6,192,139.72m N,	7.27m MSS	0.16m	-0.18m	-0.30m

David Lloyd

Party Chief

FGBNM (Fugro Great Britain North Marine)



Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	415,455.88	6,192,139.90	7.57	55°52.0403'N	07°38.9403'E
Crane 1	415,448.68	6,192,158.89	7.57	55°52.0504'N	07°38.9330'E
Crane 2	415,471.01	6,192,153.69	7.57	55°52.0479'N	07°38.9545'E
Leg 1	415,478.20	6,192,145.83	7.57	55°52.0437'N	07°38.9616'E
Leg 2	415,456.94	6,192,127.79	7.57	55°52.0337'N	07°38.9415'E
Leg 3	415,466.62	6,192,159.58	7.57	55°52.0510'N	07°38.9502'E
Leg 4	415,445.44	6,192,141.48	7.57	55°52.0410'N	07°38.9303'E
Leg 5	415,462.40	6,192,164.50	7.57	55°52.0536'N	07°38.9461'E
Leg 6	415,441.17	6,192,146.45	7.57	55°52.0436'N	07°38.9261'E
Leg 7	415,447.64	6,192,181.96	7.57	55°52.0628'N	07°38.9316'E
Leg 8	415,426.30	6,192,163.81	7.57	55°52.0528'N	07°38.9115'E
Moonpool_1	415,455.88	6,192,139.90	7.57	55°52.0403'N	07°38.9403'E
Moonpool_2	415,454.07	6,192,145.80	7.54	55°52.0434'N	07°38.9384'E
SPK1_Primary	415,471.89	6,192,142.16	19.30	55°52.0416'N	07°38.9556'E
SPK1_Secondary	415,462.22	6,192,133.85	19.58	55°52.0371'N	07°38.9465'E
SPK2_Primary	415,440.14	6,192,151.28	14.40	55°52.0462'N	07°38.9250'E
SPK2_Secondary	415,444.09	6,192,150.63	14.54	55°52.0459'N	07°38.9288'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

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Summary of Excalibur Positions

	Primary	SD	Secondary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK2 - Starfix.G4 Plus-20003	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	607 of 607 used		606 of 606 used	

Heading (Corrected)	138.53°True (C-O: 0.00°)	±0.04°	138.53°True (C-O: 0.00°)	±0.04°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°52.0403'N	±0.01m	55°52.0402'N	±0.02m
Longitude	07°38.9403'E	±0.01m	07°38.9404'E	±0.02m
Height	48.28m Ell.	±0.02m	48.14m Ell.	±0.04m
Grid System	UTM zone 32N CM 9° E			
Easting	415,455.88m E	±0.01m	415,456.02m E	±0.02m
Northing	6,192,139.90m N	±0.01m	6,192,139.76m N	±0.02m
Height	7.57m MSS	±0.13m	7.43m MSS	±0.14m
Delta Easting	0.00m		0.14m	
Delta Northing	0.00m		-0.14m	
Delta Height	0.00m		-0.13m	

Position of Moonpool_1 from waypoint				
Range	2.88m		3.03m	
Bearing	90.78°True		93.42°True	



Summary of Excalibur Positions

	Primary	SD	Tertiary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK1 - Starfix.G4-10001	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	607 of 607 used		607 of 607 used	

Heading (Corrected)	138.53°True (C-O: 0.00°)	±0.04°	138.53°True (C-O: 0.00°)	±0.04°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°52.0403'N	±0.01m	55°52.0403'N	±0.01m
Longitude	07°38.9403'E	±0.01m	07°38.9403'E	±0.01m
Height	48.28m Ell.	±0.02m	48.28m Ell.	±0.02m
Grid System	UTM zone 32N CM 9° E			
Easting	415,455.88m E	±0.01m	415,455.88m E	±0.01m
Northing	6,192,139.90m N	±0.01m	6,192,139.90m N	±0.01m
Height	7.57m MSS	±0.13m	7.57m MSS	±0.13m
Delta Easting	0.00m		0.00m	
Delta Northing	0.00m		0.00m	
Delta Height	0.00m		0.00m	

Position of Moonpool_1 from waypoint				
Range	2.88m		2.88m	
Bearing	90.78°True		90.86°True	



Summary of Excalibur Positions

	Primary	SD	Quaternary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK1 - Starfix.XP2-10002	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	607 of 607 used		607 of 607 used	

Heading (Corrected)	138.53°True (C-O: 0.00°)	±0.04°	138.53°True (C-O: 0.00°)	±0.04°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°52.0403'N	±0.01m	55°52.0403'N	±0.02m
Longitude	07°38.9403'E	±0.01m	07°38.9403'E	±0.01m
Height	48.28m Ell.	±0.02m	48.35m Ell.	±0.02m
Grid System	UTM zone 32N CM 9° E			
Easting	415,455.88m E	±0.01m	415,455.87m E	±0.01m
Northing	6,192,139.90m N	±0.01m	6,192,139.89m N	±0.02m
Height	7.57m MSS	±0.13m	7.64m MSS	±0.13m
Delta Easting	0.00m		-0.01m	
Delta Northing	0.00m		-0.01m	
Delta Height	0.00m		0.07m	

Position of Moonpool_1 from waypoint				
Range	2.88m		2.88m	
Bearing	90.78°True		91.06°True	



Summary of Excalibur Positions

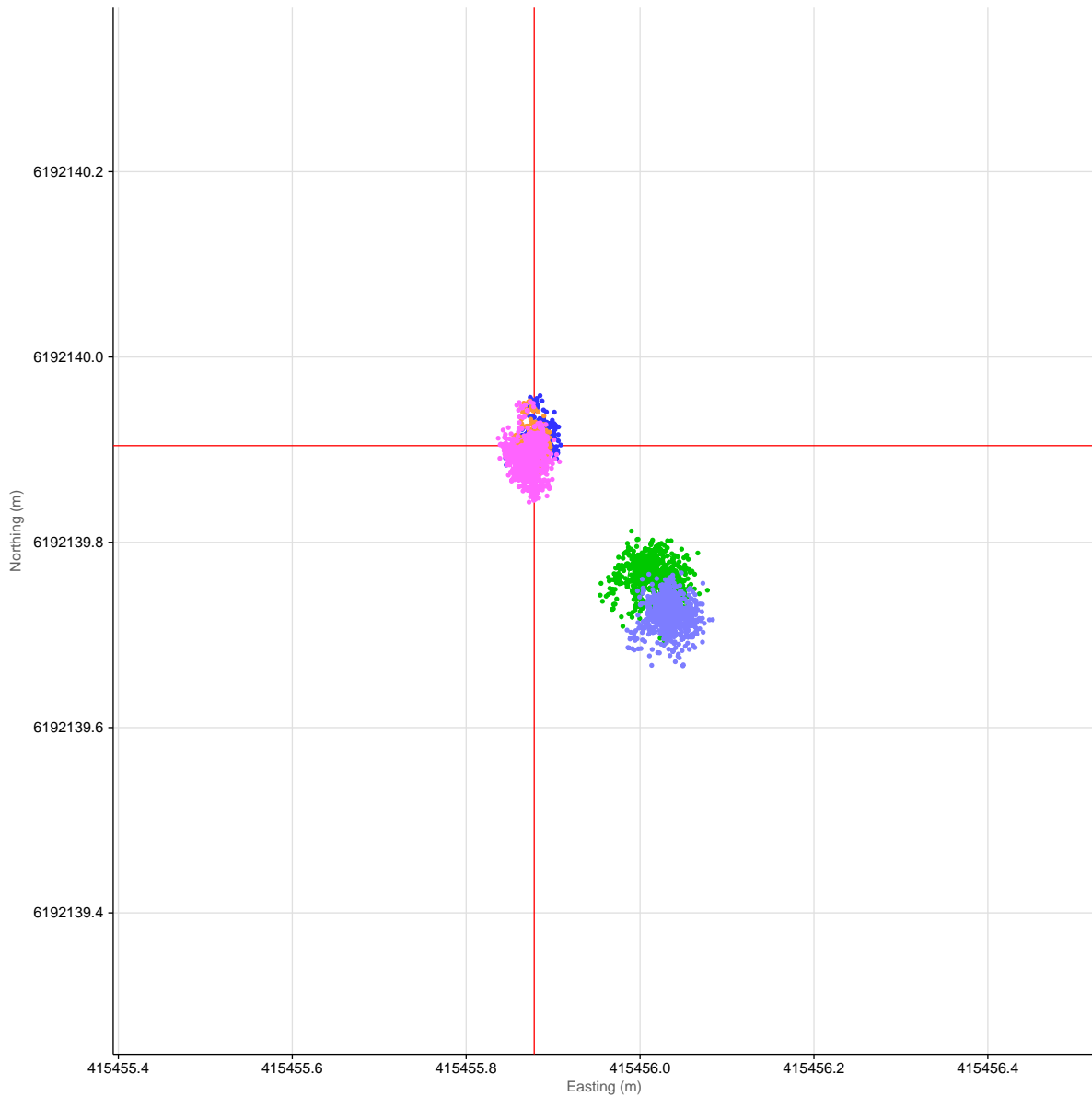
	Primary	SD	Quinary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK2 - Starfix.G4-20001	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	607 of 607 used		606 of 606 used	

Heading (Corrected)	138.53°True (C-O: 0.00°)	±0.04°	138.53°True (C-O: 0.00°)	±0.04°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°52.0403'N	±0.01m	55°52.0402'N	±0.02m
Longitude	07°38.9403'E	±0.01m	07°38.9404'E	±0.02m
Height	48.28m Ell.	±0.02m	47.98m Ell.	±0.05m
Grid System	UTM zone 32N CM 9° E			
Easting	415,455.88m E	±0.01m	415,456.03m E	±0.02m
Northing	6,192,139.90m N	±0.01m	6,192,139.72m N	±0.02m
Height	7.57m MSS	±0.13m	7.27m MSS	±0.14m
Delta Easting	0.00m		0.16m	
Delta Northing	0.00m		-0.18m	
Delta Height	0.00m		-0.30m	

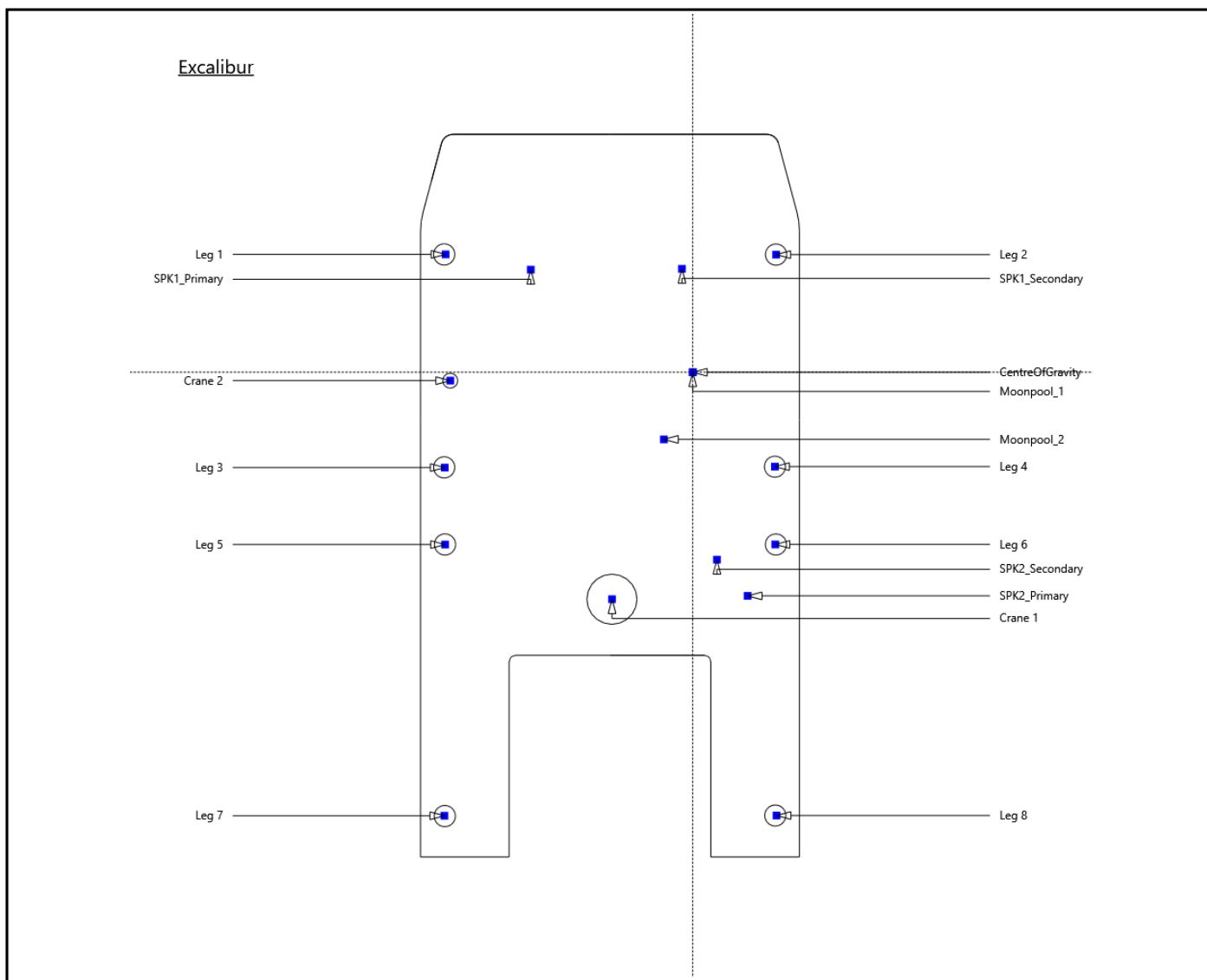
Position of Moonpool_1 from waypoint				
Range	2.88m		3.05m	
Bearing	90.78°True		94.11°True	

Scatter Plot



Sensor Group	Excalibur Mean Position at Moonpool_1 ETRS89 / UTM zone 32N [ETRF2000- ITRF2014][2023],DTU21 MSS height [DTU21 MSS]	Delta Easting	Delta Northing	Delta Height
Primary	415,455.88m E, 6,192,139.90m N, 7.57m MSS	0.00m	0.00m	0.00m
Secondary	415,456.02m E, 6,192,139.76m N, 7.43m MSS	0.14m	-0.14m	-0.13m
Tertiary	415,455.88m E, 6,192,139.90m N, 7.57m MSS	0.00m	0.00m	0.00m
Quaternary	415,455.87m E, 6,192,139.89m N, 7.64m MSS	-0.01m	-0.01m	0.07m
Quinary	415,456.03m E, 6,192,139.72m N, 7.27m MSS	0.16m	-0.18m	-0.30m

Excalibur Outline and Offsets



Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m

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SPK2_Secondary		2.04m	-15.81m	6.97m
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EXCALIBUR_240149
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Project ID	Excalibur_240149
Starfix Version	v2022.1110.9 (build 0)
Client	Fugro Geoservices Inc
Primary Vessel	Excalibur
Location Description	UK

Session Name	20240508-164457-v1	
Start Time	08 May 2024, 17:45:11+01:00	End Time 08 May 2024, 17:53:31+01:00

Position Source:	SPK1 - Starfix.G4 Plus-10003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°52.0400'N	±0.01m
Longitude - ETRS89	07°38.9366'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,452.07m E	±0.02m
Northing	6,192,139.49m N	±0.01m
Convergence	-1.11839°	
Heading ° True	245.53° T	±0.04°
Heading ° Grid	246.65° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°52.0403'N	±0.01m
Longitude - ITRF2014	07°38.9372'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

Seabed Depth :	0.0m
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The final position was computed from session "20240508-164457-v1" by averaging 500 observations from a total of 500 observations between 08/05/2024 17:45:12 (UTC+01:00) and 08/05/2024 17:53:31 (UTC+01:00).

Position from	Waypoint: BH101-CPT
Excalibur at Moonpool_1	1.06m Geodetic @ 60.00° T

Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	415,452.07m E, 6,192,139.49m N, 7.95m MSS	0.00m	0.00m	0.00m
Secondary	415,452.07m E, 6,192,139.50m N, 7.94m MSS	-0.01m	0.01m	0.00m
Tertiary	415,452.04m E, 6,192,139.48m N, 7.78m MSS	-0.03m	-0.01m	-0.17m
Quaternary	415,452.09m E, 6,192,139.55m N, 7.85m MSS	0.02m	0.06m	-0.10m
Quinary	415,451.98m E, 6,192,139.48m N, 7.64m MSS	-0.09m	-0.01m	-0.30m

Jamie Davison
Site Manager/Supervisor
FGBNM (Fugro Great Britain North Marine)

Client Representative
Fugro Geoservices Inc



Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	415,452.07	6,192,139.49	7.95	55°52.0400'N	07°38.9366'E
Crane 1	415,472.34	6,192,140.82	7.95	55°52.0409'N	07°38.9560'E
Crane 2	415,460.83	6,192,120.99	7.95	55°52.0301'N	07°38.9454'E
Leg 1	415,451.21	6,192,116.40	7.95	55°52.0275'N	07°38.9363'E
Leg 2	415,440.18	6,192,142.02	7.95	55°52.0412'N	07°38.9252'E
Leg 3	415,467.74	6,192,123.46	7.95	55°52.0315'N	07°38.9520'E
Leg 4	415,456.63	6,192,149.01	7.95	55°52.0452'N	07°38.9408'E
Leg 5	415,473.69	6,192,126.06	7.95	55°52.0330'N	07°38.9576'E
Leg 6	415,462.64	6,192,151.64	7.95	55°52.0467'N	07°38.9465'E
Leg 7	415,494.70	6,192,135.07	7.95	55°52.0381'N	07°38.9776'E
Leg 8	415,483.58	6,192,160.79	7.95	55°52.0518'N	07°38.9664'E
Moonpool_1	415,452.07	6,192,139.49	7.95	55°52.0400'N	07°38.9366'E
Moonpool_2	415,458.23	6,192,139.49	7.92	55°52.0401'N	07°38.9426'E
SPK1_Primary	415,449.55	6,192,123.51	19.68	55°52.0314'N	07°38.9345'E
SPK1_Secondary	415,444.43	6,192,135.20	19.96	55°52.0376'N	07°38.9294'E
SPK2_Primary	415,467.55	6,192,151.21	14.78	55°52.0465'N	07°38.9513'E
SPK2_Secondary	415,465.77	6,192,147.62	14.92	55°52.0445'N	07°38.9496'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

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FINAL FIX REPORT



Final Position for Moonpool_1 (Secondary)

Position Source:	SPK1 - Starfix.G4-10001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°52.0400'N	±0.01m
Longitude - ETRS89	07°38.9366'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,452.07m E	±0.02m
Northing	6,192,139.50m N	±0.01m
Convergence	-1.11839°	
Heading ° True	245.53° T	±0.04°
Heading ° Grid	246.65° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°52.0403'N	±0.01m
Longitude - ITRF2014	07°38.9372'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240508-164457-v1" by averaging 500 observations from a total of 500 observations between 08/05/2024 17:45:12 (UTC+01:00) and 08/05/2024 17:53:31 (UTC+01:00).

Position from	Waypoint: BH101-CPT
Excalibur at Moonpool_1	1.06m Geodetic @ 60.52° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Tertiary)

Position Source:	SPK2 - Starfix.G4 Plus-20003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°52.0400'N	±0.04m
Longitude - ETRS89	07°38.9366'E	±0.03m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,452.04m E	±0.03m
Northing	6,192,139.48m N	±0.04m
Convergence	-1.11839°	
Heading ° True	245.53° T	±0.04°
Heading ° Grid	246.65° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°52.0403'N	±0.04m
Longitude - ITRF2014	07°38.9371'E	±0.03m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240508-164457-v1" by averaging 500 observations from a total of 500 observations between 08/05/2024 17:45:12 (UTC+01:00) and 08/05/2024 17:53:31 (UTC+01:00).

Position from	Waypoint: BH101-CPT
Excalibur at Moonpool_1	1.09m Geodetic @ 60.43° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quaternary)

Position Source:	SPK1 - Starfix.XP2-10002
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°52.0400'N	±0.02m
Longitude - ETRS89	07°38.9367'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,452.09m E	±0.02m
Northing	6,192,139.55m N	±0.02m
Convergence	-1.11839°	
Heading ° True	245.53° T	±0.04°
Heading ° Grid	246.65° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°52.0404'N	±0.02m
Longitude - ITRF2014	07°38.9372'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240508-164457-v1" by averaging 500 observations from a total of 500 observations between 08/05/2024 17:45:12 (UTC+01:00) and 08/05/2024 17:53:31 (UTC+01:00).

Position from	Waypoint: BH101-CPT
Excalibur at Moonpool_1	1.02m Geodetic @ 62.43° T

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FINAL FIX REPORT



Final Position for Moonpool_1 (Quinary)

Position Source:	SPK2 - Starfix.G4-20001
Heading Source:	SPK1 - GNSS Heading-10004

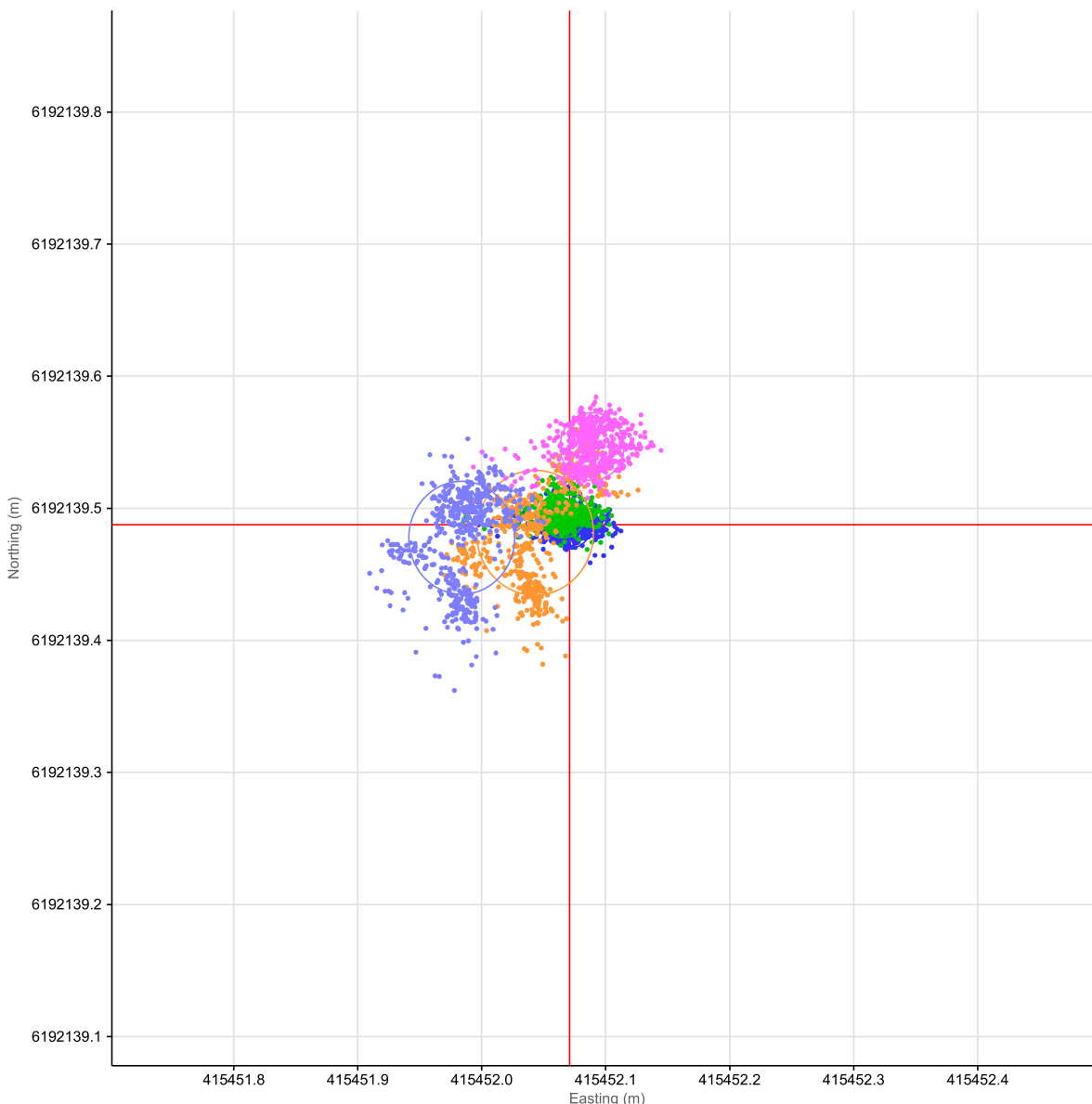
	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°52.0400'N	±0.04m
Longitude - ETRS89	07°38.9366'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,451.98m E	±0.02m
Northing	6,192,139.48m N	±0.04m
Convergence	-1.11839°	
Heading ° True	245.53° T	±0.04°
Heading ° Grid	246.65° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°52.0403'N	±0.04m
Longitude - ITRF2014	07°38.9371'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240508-164457-v1" by averaging 500 observations from a total of 500 observations between 08/05/2024 17:45:12 (UTC+01:00) and 08/05/2024 17:53:31 (UTC+01:00).

Position from	Waypoint: BH101-CPT
Excalibur at Moonpool_1	1.14m Geodetic @ 61.68° T

Scatter Plot-ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	415,452.07m E, 6,192,139.49m N, 7.95m MSS	0.00m	0.00m	0.00m
Secondary	415,452.07m E, 6,192,139.50m N, 7.94m MSS	-0.01m	0.01m	0.00m
Tertiary	415,452.04m E, 6,192,139.48m N, 7.78m MSS	-0.03m	-0.01m	-0.17m
Quaternary	415,452.09m E, 6,192,139.55m N, 7.85m MSS	0.02m	0.06m	-0.10m
Quinary	415,451.98m E, 6,192,139.48m N, 7.64m MSS	-0.09m	-0.01m	-0.30m



Antenna Positions

Primary

	Antenna Position for SPK1 - Starfix.G4 Plus-10003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°52.0314'N	±0.01m
Longitude - ETRS89	07°38.9345'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,449.55m E	±0.01m
Northing	6,192,123.51m N	±0.01m
Raw Rig Heading ° True	245.53° T	±0.04°
Raw Rig Heading ° Grid	246.65° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°52.0317'N	±0.01m
Longitude - ITRF2014	07°38.9351'E	±0.01m

Secondary

	Antenna Position for SPK1 - Starfix.G4-10001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°52.0314'N	±0.01m
Longitude - ETRS89	07°38.9345'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,449.54m E	±0.01m
Northing	6,192,123.52m N	±0.01m
Raw Rig Heading ° True	245.53° T	±0.04°
Raw Rig Heading ° Grid	246.65° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°52.0317'N	±0.01m
Longitude - ITRF2014	07°38.9350'E	±0.01m

Tertiary

	Antenna Position for SPK2 - Starfix.G4 Plus-20003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°52.0465'N	±0.03m
Longitude - ETRS89	07°38.9512'E	±0.03m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,467.52m E	±0.03m
Northing	6,192,151.20m N	±0.03m
Raw Rig Heading ° True	245.53° T	±0.04°
Raw Rig Heading ° Grid	246.65° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°52.0468'N	±0.03m
Longitude - ITRF2014	07°38.9518'E	±0.03m

Quaternary

	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	

EXCALIBUR_240149
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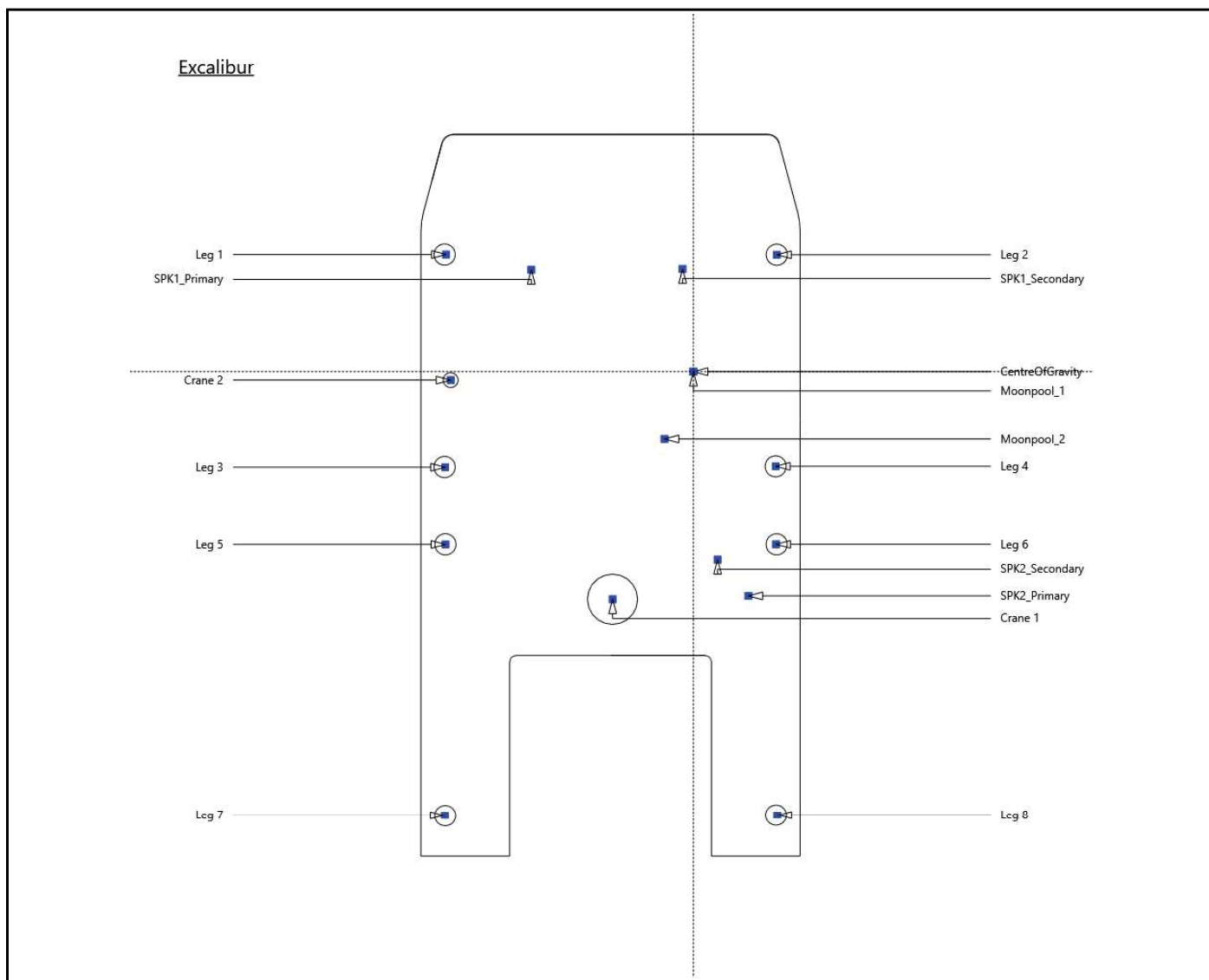


	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°52.0314'N	±0.02m
Longitude - ETRS89	07°38.9345'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,449.57m E	±0.02m
Northing	6,192,123.57m N	±0.02m
Raw Rig Heading ° True	245.53° T	±0.04°
Raw Rig Heading ° Grid	246.65° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°52.0317'N	±0.02m
Longitude - ITRF2014	07°38.9351'E	±0.02m

Quinary

	Antenna Position for SPK2 - Starfix.G4-20001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°52.0465'N	±0.03m
Longitude - ETRS89	07°38.9512'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,467.46m E	±0.02m
Northing	6,192,151.20m N	±0.03m
Raw Rig Heading ° True	245.53° T	±0.04°
Raw Rig Heading ° Grid	246.65° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°52.0468'N	±0.03m
Longitude - ITRF2014	07°38.9517'E	±0.02m

Vessel Outline and Offsets





Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m
SPK2_Secondary		2.04m	-15.81m	6.97m

EXCALIBUR_240149
FINAL FIX REPORT



Project ID	Excalibur_240149
Starfix Version	v2022.1110.9 (build 0)
Client	Fugro Geoservices Inc
Primary Vessel	Excalibur
Location Description	UK

Session Name	20240519-104936-v1	
Start Time	19 May 2024, 11:49:46+01:00	End Time 19 May 2024, 11:58:08+01:00

Position Source:	SPK1 - Starfix.G4 Plus-10003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8547'N	±0.01m
Longitude - ETRS89	07°34.2693'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,539.13m E	±0.01m
Northing	6,190,038.81m N	±0.01m
Convergence	-1.18251°	
Heading ° True	94.59° T	±0.02°
Heading ° Grid	95.78° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8550'N	±0.01m
Longitude - ITRF2014	07°34.2699'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

Seabed Depth :	0.0m
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The final position was computed from session "20240519-104936-v1" by averaging 500 observations from a total of 500 observations between 19/05/2024 11:49:47 (UTC+01:00) and 19/05/2024 11:58:08 (UTC+01:00).

Position from	Waypoint: BH106
Excalibur at Moonpool_1	3.35m Geodetic @ 289.66° T

Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	410,539.13m E, 6,190,038.81m N, 8.04m MSS	0.00m	0.00m	0.00m
Secondary	410,539.08m E, 6,190,038.82m N, 8.00m MSS	-0.04m	0.01m	-0.04m
Tertiary	410,539.14m E, 6,190,038.78m N, 7.92m MSS	0.02m	-0.03m	-0.12m
Quaternary	410,539.15m E, 6,190,038.76m N, 8.04m MSS	0.02m	-0.05m	0.00m
Quinary	410,539.20m E, 6,190,038.75m N, 7.94m MSS	0.07m	-0.06m	-0.10m

Jamie Davison
Site Manager/Supervisor
FGBNM (Fugro Great Britain North Marine)

Rob Harwood
Client Representative
Fugro Geoservices Inc

Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	410,539.13	6,190,038.81	8.04	55°50.8547'N	07°34.2693'E
Crane 1	410,520.77	6,190,047.51	8.04	55°50.8591'N	07°34.2516'E
Crane 2	410,540.48	6,190,059.23	8.04	55°50.8657'N	07°34.2702'E
Leg 1	410,551.11	6,190,058.56	8.04	55°50.8654'N	07°34.2804'E
Leg 2	410,548.28	6,190,030.81	8.04	55°50.8505'N	07°34.2783'E
Leg 3	410,533.24	6,190,060.44	8.04	55°50.8663'N	07°34.2633'E
Leg 4	410,530.51	6,190,032.71	8.04	55°50.8513'N	07°34.2612'E
Leg 5	410,526.78	6,190,061.06	8.04	55°50.8665'N	07°34.2571'E
Leg 6	410,523.98	6,190,033.34	8.04	55°50.8515'N	07°34.2550'E
Leg 7	410,504.04	6,190,063.42	8.04	55°50.8675'N	07°34.2352'E
Leg 8	410,501.24	6,190,035.54	8.04	55°50.8525'N	07°34.2331'E
Moonpool_1	410,539.13	6,190,038.81	8.04	55°50.8547'N	07°34.2693'E
Moonpool_2	410,533.74	6,190,041.81	8.01	55°50.8562'N	07°34.2641'E
SPK1_Primary	410,549.10	6,190,051.54	19.77	55°50.8616'N	07°34.2787'E
SPK1_Secondary	410,547.89	6,190,038.84	20.05	55°50.8548'N	07°34.2777'E
SPK2_Primary	410,519.90	6,190,036.10	14.87	55°50.8530'N	07°34.2510'E
SPK2_Secondary	410,523.20	6,190,038.37	15.01	55°50.8542'N	07°34.2541'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Secondary)

Position Source:	SPK1 - Starfix.G4-10001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8547'N	±0.01m
Longitude - ETRS89	07°34.2693'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,539.08m E	±0.01m
Northing	6,190,038.82m N	±0.01m
Convergence	-1.18251°	
Heading ° True	94.59° T	±0.02°
Heading ° Grid	95.78° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8550'N	±0.01m
Longitude - ITRF2014	07°34.2698'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240519-104936-v1" by averaging 500 observations from a total of 500 observations between 19/05/2024 11:49:47 (UTC+01:00) and 19/05/2024 11:58:08 (UTC+01:00).

Position from	Waypoint: BH106
Excalibur at Moonpool_1	3.30m Geodetic @ 289.80° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Tertiary)

Position Source:	SPK2 - Starfix.G4 Plus-20003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8546'N	±0.02m
Longitude - ETRS89	07°34.2694'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,539.14m E	±0.02m
Northing	6,190,038.78m N	±0.02m
Convergence	-1.18251°	
Heading ° True	94.59° T	±0.02°
Heading ° Grid	95.78° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8550'N	±0.02m
Longitude - ITRF2014	07°34.2699'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240519-104936-v1" by averaging 502 observations from a total of 502 observations between 19/05/2024 11:49:47 (UTC+01:00) and 19/05/2024 11:58:08 (UTC+01:00).

Position from	Waypoint: BH106
Excalibur at Moonpool_1	3.37m Geodetic @ 290.06° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quaternary)

Position Source:	SPK1 - Starfix.XP2-10002
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8546'N	±0.02m
Longitude - ETRS89	07°34.2694'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,539.15m E	±0.01m
Northing	6,190,038.76m N	±0.02m
Convergence	-1.18251°	
Heading ° True	94.59° T	±0.02°
Heading ° Grid	95.78° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8550'N	±0.02m
Longitude - ITRF2014	07°34.2699'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240519-104936-v1" by averaging 497 observations from a total of 500 observations between 19/05/2024 11:49:47 (UTC+01:00) and 19/05/2024 11:58:08 (UTC+01:00).

Position from	Waypoint: BH106
Excalibur at Moonpool_1	3.38m Geodetic @ 290.25° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quinary)

Position Source:	SPK2 - Starfix.G4-20001
Heading Source:	SPK1 - GNSS Heading-10004

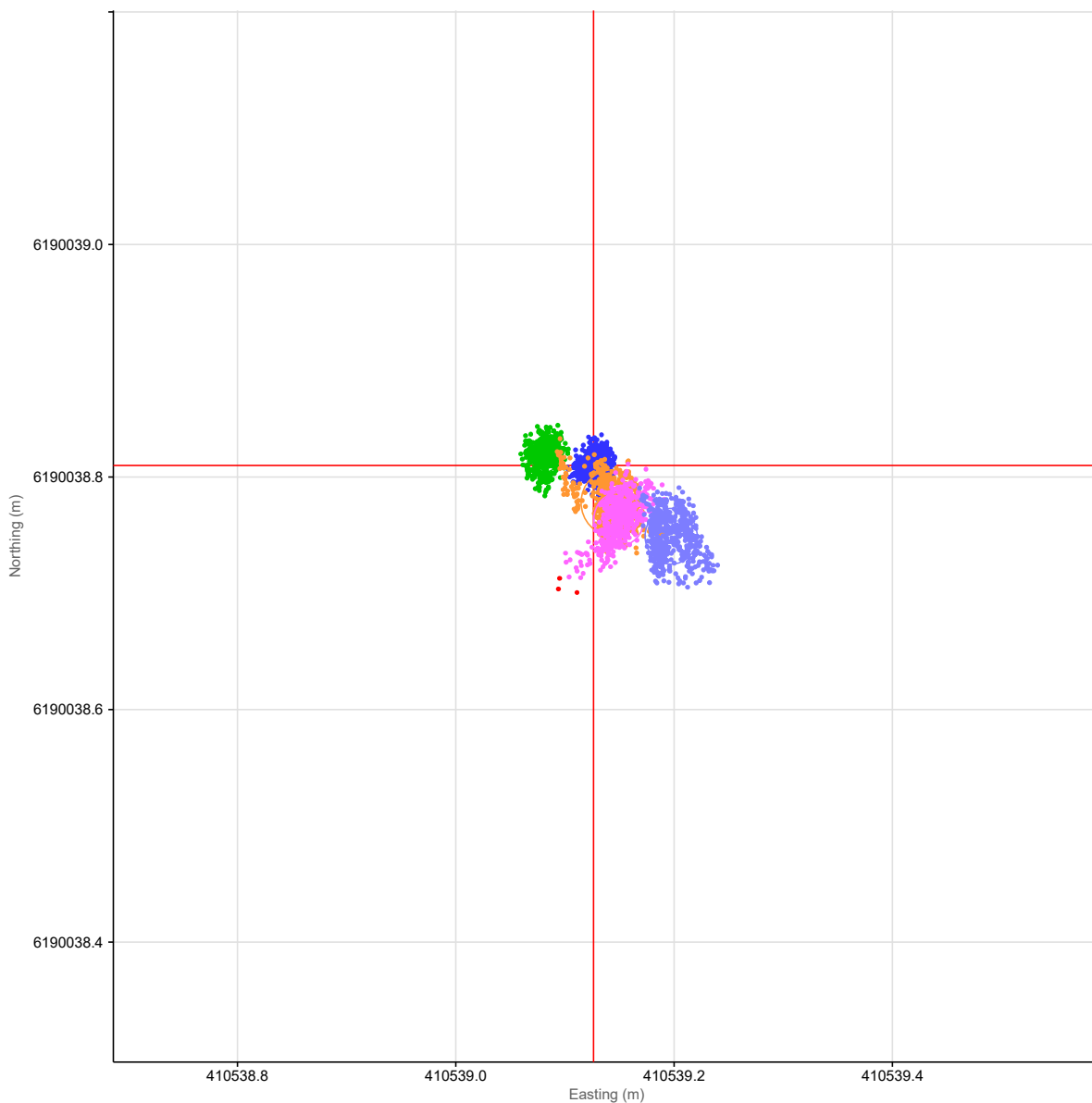
	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8546'N	±0.02m
Longitude - ETRS89	07°34.2694'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,539.20m E	±0.01m
Northing	6,190,038.75m N	±0.02m
Convergence	-1.18251°	
Heading ° True	94.59° T	±0.02°
Heading ° Grid	95.78° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8550'N	±0.02m
Longitude - ITRF2014	07°34.2699'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240519-104936-v1" by averaging 502 observations from a total of 502 observations between 19/05/2024 11:49:47 (UTC+01:00) and 19/05/2024 11:58:08 (UTC+01:00).

Position from	Waypoint: BH106
Excalibur at Moonpool_1	3.43m Geodetic @ 290.19° T

Scatter Plot-ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	410,539.13m E, 6,190,038.81m N, 8.04m MSS	0.00m	0.00m	0.00m
Secondary	410,539.08m E, 6,190,038.82m N, 8.00m MSS	-0.04m	0.01m	-0.04m
Tertiary	410,539.14m E, 6,190,038.78m N, 7.92m MSS	0.02m	-0.03m	-0.12m
Quaternary	410,539.15m E, 6,190,038.76m N, 8.04m MSS	0.02m	-0.05m	0.00m
Quinary	410,539.20m E, 6,190,038.75m N, 7.94m MSS	0.07m	-0.06m	-0.10m

Antenna Positions

Primary

	Antenna Position for SPK1 - Starfix.G4 Plus-10003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8616'N	±0.01m
Longitude - ETRS89	07°34.2787'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,549.10m E	±0.01m
Northing	6,190,051.54m N	±0.01m
Raw Rig Heading ° True	94.59° T	±0.02°
Raw Rig Heading ° Grid	95.78° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8620'N	±0.01m
Longitude - ITRF2014	07°34.2792'E	±0.01m

Secondary

	Antenna Position for SPK1 - Starfix.G4-10001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8616'N	±0.01m
Longitude - ETRS89	07°34.2786'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,549.06m E	±0.01m
Northing	6,190,051.54m N	±0.01m
Raw Rig Heading ° True	94.59° T	±0.02°
Raw Rig Heading ° Grid	95.78° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8620'N	±0.01m
Longitude - ITRF2014	07°34.2791'E	±0.01m

Tertiary

	Antenna Position for SPK2 - Starfix.G4 Plus-20003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8530'N	±0.02m
Longitude - ETRS89	07°34.2510'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,519.92m E	±0.02m
Northing	6,190,036.07m N	±0.02m
Raw Rig Heading ° True	94.59° T	±0.02°
Raw Rig Heading ° Grid	95.78° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8533'N	±0.02m
Longitude - ITRF2014	07°34.2515'E	±0.02m

Quaternary

	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	

EXCALIBUR_240149
FINAL FIX REPORT

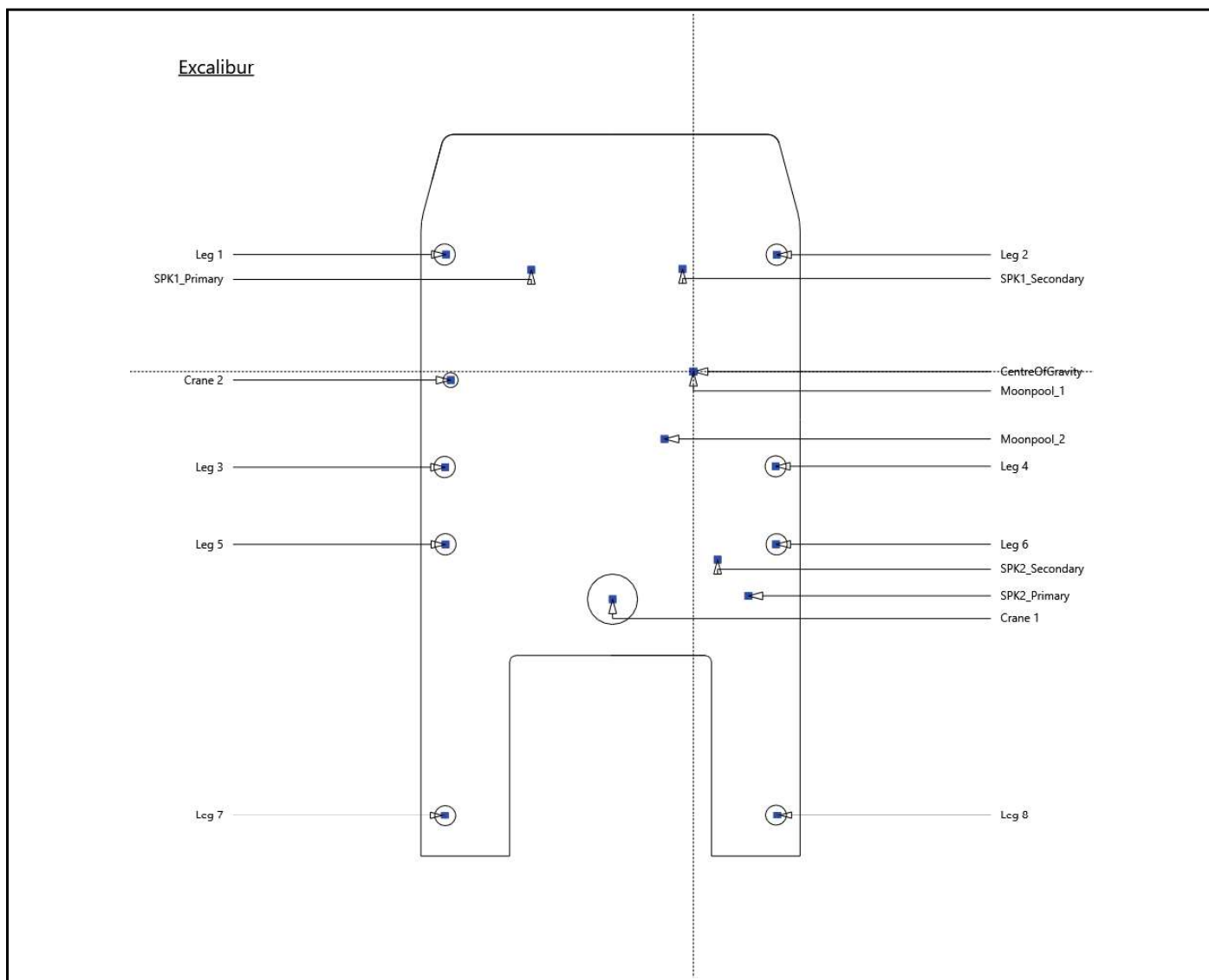


	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8616'N	±0.02m
Longitude - ETRS89	07°34.2787'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,549.13m E	±0.01m
Northing	6,190,051.49m N	±0.02m
Raw Rig Heading ° True	94.59° T	±0.02°
Raw Rig Heading ° Grid	95.78° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8619'N	±0.02m
Longitude - ITRF2014	07°34.2792'E	±0.01m

Quinary

	Antenna Position for SPK2 - Starfix.G4-20001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8530'N	±0.02m
Longitude - ETRS89	07°34.2511'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,519.97m E	±0.01m
Northing	6,190,036.04m N	±0.02m
Raw Rig Heading ° True	94.59° T	±0.02°
Raw Rig Heading ° Grid	95.78° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8533'N	±0.02m
Longitude - ITRF2014	07°34.2516'E	±0.02m

Vessel Outline and Offsets





Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m
SPK2_Secondary		2.04m	-15.81m	6.97m

EXCALIBUR_240149
FINAL FIX REPORT



Project ID	Excalibur_240149
Starfix Version	v2022.1110.9 (build 0)
Client	Fugro Geoservices Inc
Primary Vessel	Excalibur
Location Description	UK

Session Name	20240505-152653-v1	
Start Time	05 May 2024, 16:27:26+01:00	End Time 05 May 2024, 16:35:47+01:00

Position Source:	SPK1 - Starfix.G4 Plus-10003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0357'N	±0.01m
Longitude - ETRS89	07°40.5250'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,037.51m E	±0.01m
Northing	6,188,390.12m N	±0.01m
Convergence	-1.09604°	
Heading ° True	201.61° T	±0.03°
Heading ° Grid	202.71° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0361'N	±0.01m
Longitude - ITRF2014	07°40.5256'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

Seabed Depth :	0.0m
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The final position was computed from session "20240505-152653-v1" by averaging 500 observations from a total of 500 observations between 05/05/2024 16:27:27 (UTC+01:00) and 05/05/2024 16:35:47 (UTC+01:00).

Position from	Waypoint: BH110
Excalibur at Moonpool_1	3.51m Geodetic @ 266.90° T

Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	417,037.51m E, 6,188,390.12m N, 7.70m MSS	0.00m	0.00m	0.00m
Secondary	417,037.52m E, 6,188,390.12m N, 7.67m MSS	0.01m	-0.01m	-0.03m
Tertiary	417,037.54m E, 6,188,390.08m N, 7.58m MSS	0.03m	-0.04m	-0.12m
Quaternary	417,037.50m E, 6,188,390.12m N, 7.69m MSS	-0.01m	0.00m	-0.01m
Quinary	417,037.56m E, 6,188,390.07m N, 7.56m MSS	0.05m	-0.05m	-0.13m

Jamie Davison
Site Manager/Supervisor
FGBNM (Fugro Great Britain North Marine)

Rob Harwood
Client Representative
Fugro Geoservices Inc

Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	417,037.51	6,188,390.12	7.70	55°50.0357'N	07°40.5250'E
Crane 1	417,051.18	6,188,405.15	7.70	55°50.0440'N	07°40.5379'E
Crane 2	417,056.65	6,188,382.88	7.70	55°50.0320'N	07°40.5435'E
Leg 1	417,052.91	6,188,372.91	7.70	55°50.0266'N	07°40.5401'E
Leg 2	417,027.19	6,188,383.69	7.70	55°50.0322'N	07°40.5153'E
Leg 3	417,059.92	6,188,389.46	7.70	55°50.0356'N	07°40.5465'E
Leg 4	417,034.18	6,188,400.14	7.70	55°50.0411'N	07°40.5217'E
Leg 5	417,062.39	6,188,395.46	7.70	55°50.0389'N	07°40.5488'E
Leg 6	417,036.69	6,188,406.20	7.70	55°50.0444'N	07°40.5240'E
Leg 7	417,071.27	6,188,416.52	7.70	55°50.0503'N	07°40.5569'E
Leg 8	417,045.42	6,188,427.32	7.70	55°50.0559'N	07°40.5319'E
Moonpool_1	417,037.51	6,188,390.12	7.70	55°50.0357'N	07°40.5250'E
Moonpool_2	417,041.95	6,188,394.40	7.67	55°50.0381'N	07°40.5292'E
SPK1_Primary	417,046.78	6,188,376.87	19.43	55°50.0287'N	07°40.5342'E
SPK1_Secondary	417,034.99	6,188,381.73	19.71	55°50.0312'N	07°40.5228'E
SPK2_Primary	417,040.52	6,188,409.30	14.53	55°50.0461'N	07°40.5276'E
SPK2_Secondary	417,041.73	6,188,405.49	14.67	55°50.0441'N	07°40.5288'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Secondary)

Position Source:	SPK1 - Starfix.G4-10001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0357'N	±0.01m
Longitude - ETRS89	07°40.5251'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,037.52m E	±0.01m
Northing	6,188,390.12m N	±0.01m
Convergence	-1.09604°	
Heading ° True	201.61° T	±0.03°
Heading ° Grid	202.71° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0361'N	±0.01m
Longitude - ITRF2014	07°40.5256'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240505-152653-v1" by averaging 500 observations from a total of 500 observations between 05/05/2024 16:27:27 (UTC+01:00) and 05/05/2024 16:35:47 (UTC+01:00).

Position from	Waypoint: BH110
Excalibur at Moonpool_1	3.53m Geodetic @ 267.02° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Tertiary)

Position Source:	SPK2 - Starfix.G4 Plus-20003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0357'N	±0.03m
Longitude - ETRS89	07°40.5251'E	±0.03m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,037.54m E	±0.03m
Northing	6,188,390.08m N	±0.03m
Convergence	-1.09604°	
Heading ° True	201.61° T	±0.03°
Heading ° Grid	202.71° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0360'N	±0.03m
Longitude - ITRF2014	07°40.5256'E	±0.03m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240505-152653-v1" by averaging 501 observations from a total of 501 observations between 05/05/2024 16:27:27 (UTC+01:00) and 05/05/2024 16:35:47 (UTC+01:00).

Position from	Waypoint: BH110
Excalibur at Moonpool_1	3.54m Geodetic @ 267.63° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quaternary)

Position Source:	SPK1 - Starfix.XP2-10002
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0357'N	±0.01m
Longitude - ETRS89	07°40.5250'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,037.50m E	±0.01m
Northing	6,188,390.12m N	±0.01m
Convergence	-1.09604°	
Heading ° True	201.61° T	±0.03°
Heading ° Grid	202.71° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0361'N	±0.01m
Longitude - ITRF2014	07°40.5256'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240505-152653-v1" by averaging 500 observations from a total of 500 observations between 05/05/2024 16:27:27 (UTC+01:00) and 05/05/2024 16:35:47 (UTC+01:00).

Position from	Waypoint: BH110
Excalibur at Moonpool_1	3.51m Geodetic @ 266.90° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quinary)

Position Source:	SPK2 - Starfix.G4-20001
Heading Source:	SPK1 - GNSS Heading-10004

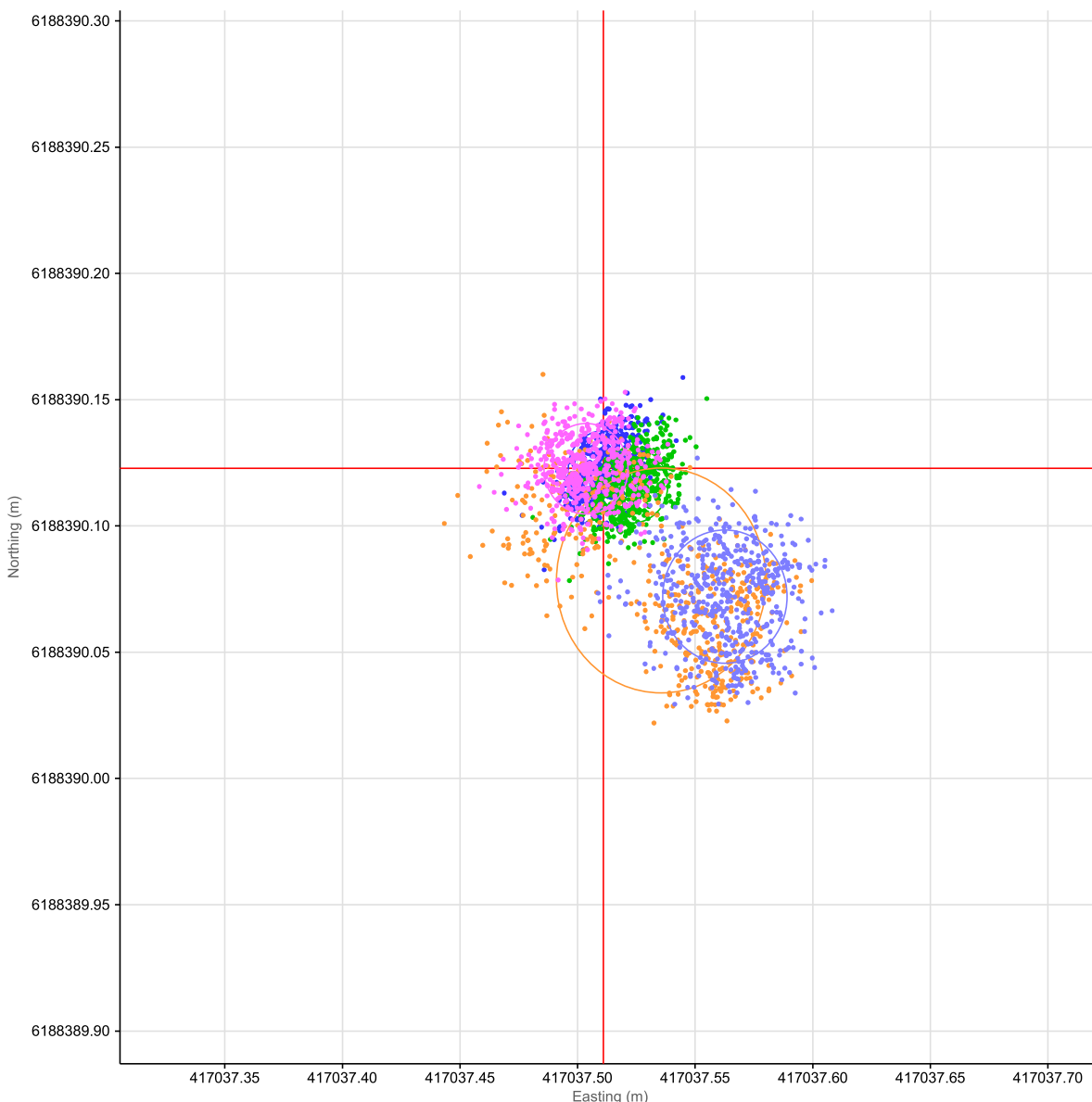
	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0357'N	±0.02m
Longitude - ETRS89	07°40.5251'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,037.56m E	±0.02m
Northing	6,188,390.07m N	±0.02m
Convergence	-1.09604°	
Heading ° True	201.61° T	±0.03°
Heading ° Grid	202.71° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0360'N	±0.02m
Longitude - ITRF2014	07°40.5256'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240505-152653-v1" by averaging 501 observations from a total of 501 observations between 05/05/2024 16:27:27 (UTC+01:00) and 05/05/2024 16:35:47 (UTC+01:00).

Position from	Waypoint: BH110
Excalibur at Moonpool_1	3.56m Geodetic @ 267.75° T

Scatter Plot-ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	417,037.51m E, 6,188,390.12m N, 7.70m MSS	0.00m	0.00m	0.00m
Secondary	417,037.52m E, 6,188,390.12m N, 7.67m MSS	0.01m	-0.01m	-0.03m
Tertiary	417,037.54m E, 6,188,390.08m N, 7.58m MSS	0.03m	-0.04m	-0.12m
Quaternary	417,037.50m E, 6,188,390.12m N, 7.69m MSS	-0.01m	0.00m	-0.01m
Quinary	417,037.56m E, 6,188,390.07m N, 7.56m MSS	0.05m	-0.05m	-0.13m



Antenna Positions

Primary

	Antenna Position for SPK1 - Starfix.G4 Plus-10003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0287'N	±0.01m
Longitude - ETRS89	07°40.5342'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,046.78m E	±0.01m
Northing	6,188,376.87m N	±0.01m
Raw Rig Heading ° True	201.61° T	±0.03°
Raw Rig Heading ° Grid	202.71° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0290'N	±0.01m
Longitude - ITRF2014	07°40.5347'E	±0.01m

Secondary

	Antenna Position for SPK1 - Starfix.G4-10001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0287'N	±0.01m
Longitude - ETRS89	07°40.5342'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,046.79m E	±0.01m
Northing	6,188,376.86m N	±0.01m
Raw Rig Heading ° True	201.61° T	±0.03°
Raw Rig Heading ° Grid	202.71° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0290'N	±0.01m
Longitude - ITRF2014	07°40.5347'E	±0.01m

Tertiary

	Antenna Position for SPK2 - Starfix.G4 Plus-20003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0461'N	±0.03m
Longitude - ETRS89	07°40.5276'E	±0.03m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,040.54m E	±0.03m
Northing	6,188,409.26m N	±0.03m
Raw Rig Heading ° True	201.61° T	±0.03°
Raw Rig Heading ° Grid	202.71° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0464'N	±0.03m
Longitude - ITRF2014	07°40.5281'E	±0.03m

Quaternary

	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	

EXCALIBUR_240149
FINAL FIX REPORT

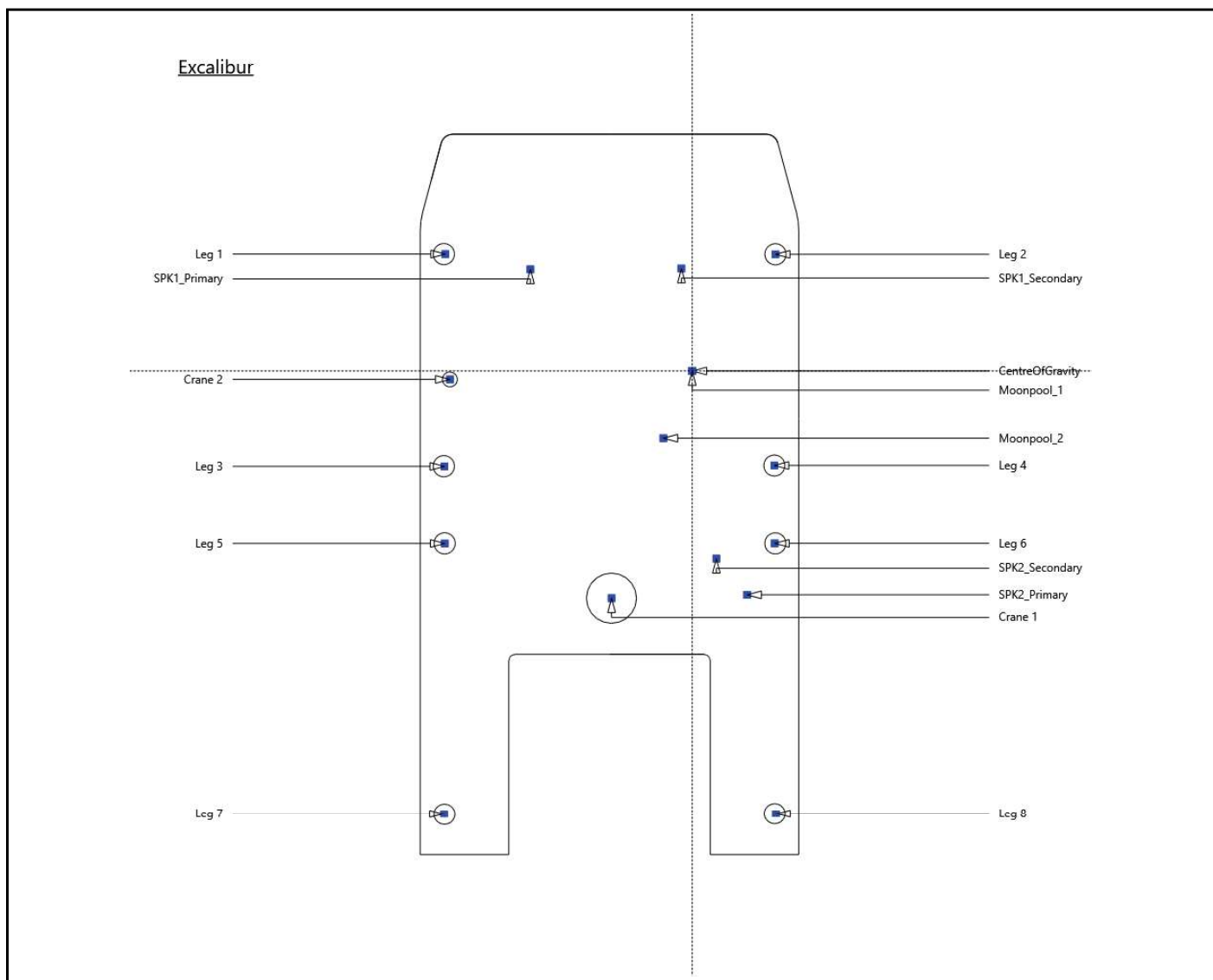


	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0287'N	±0.01m
Longitude - ETRS89	07°40.5342'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,046.77m E	±0.01m
Northing	6,188,376.87m N	±0.01m
Raw Rig Heading ° True	201.61° T	±0.03°
Raw Rig Heading ° Grid	202.71° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0290'N	±0.01m
Longitude - ITRF2014	07°40.5347'E	±0.01m

Quinary

	Antenna Position for SPK2 - Starfix.G4-20001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0461'N	±0.02m
Longitude - ETRS89	07°40.5276'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,040.57m E	±0.02m
Northing	6,188,409.25m N	±0.02m
Raw Rig Heading ° True	201.61° T	±0.03°
Raw Rig Heading ° Grid	202.71° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0464'N	±0.02m
Longitude - ITRF2014	07°40.5282'E	±0.02m

Vessel Outline and Offsets





Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m
SPK2_Secondary		2.04m	-15.81m	6.97m

EXCALIBUR_240149
FINAL FIX REPORT



Project ID:	Excalibur_240149
Starfix Version:	v2022.1110.9 (build 0)
Client:	Fugro Geoservices Inc
Client Rep:	OCR
Fugro Personnel:	James Hills
Primary Vessel:	Excalibur
Location:	UK
Comment:	

Session Name: 20240617-180350-v3
 Start Time: 17 Jun 2024, 19:05:07+01:00
 End Time: 17 Jun 2024, 19:07:07+01:00 (Session Length 0.033 hrs - No. Obs. 120)

Position Fix Summary for Excalibur at BH093

Moonpool_1 position computed from SPK1 - Starfix.G4 Plus-10003 (Primary)

Geodetic Datum	European Terrestrial Reference System 1989	International Terrestrial Reference Frame 2014
Latitude	55°53.3856'N	55°53.3860'N
Longitude	07°32.4522'E	07°32.4527'E
Grid System	UTM zone 32N CM 9° E	
Easting	408,741.99m E	
Northing	6,194,772.56m N	
Height	7.97m MSS (DTU21 MSS height)	
Heading	209.38°True (210.58°Grid)	

Position for Moonpool_1 is 2.56m @ 358.626°True (359.835°Grid) FROM the waypoint.

Moonpool_1 from CRP:	Starboard = 0.00m	Forward = 0.00m	Up = 0.00m
SPK1_Primary from CRP:	Starboard = -13.67m	Forward = 8.65m	Up = 11.73m
Heading correction applied (C-O):	0.00°		
Convergence:	-1.20808°		

Waypoint

European Terrestrial Reference System 1989		UTM zone 32N CM 9° E	
Latitude: 55°53.3843'N	Longitude: 07°32.4522'E	Easting: 408,742.00m E	Northing: 6,194,770.00m N
Intended Vessel Heading	0.000°True		

Positioning System Comparison

Sensor	Mean Position			Delta Easting	Delta Northing	Delta Height
	UTM zone 32N CM 9° E					
Primary	408,741.99m E,	6,194,772.56m N,	7.97m MSS	0.00m	0.00m	0.00m
Secondary	408,741.98m E,	6,194,772.56m N,	7.72m MSS	-0.01m	0.00m	-0.26m
Tertiary	408,742.02m E,	6,194,772.57m N,	7.98m MSS	0.03m	0.01m	0.00m
Quaternary	408,742.11m E,	6,194,772.50m N,	8.06m MSS	0.12m	-0.06m	0.08m
Quinary	408,742.02m E,	6,194,772.58m N,	7.72m MSS	0.02m	0.02m	-0.25m

James Hills
 Party Chief
 FGBNM (Fugro Great Britain North Marine)

OCR
 Client Representative
 Fugro Geoservices Inc

Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	408,741.99	6,194,772.56	7.97	55°53.3856'N	07°32.4522'E
Crane 1	408,757.59	6,194,785.57	7.97	55°53.3928'N	07°32.4669'E
Crane 2	408,759.96	6,194,762.77	7.97	55°53.3806'N	07°32.4696'E
Leg 1	408,754.89	6,194,753.40	7.97	55°53.3755'N	07°32.4649'E
Leg 2	408,730.89	6,194,767.61	7.97	55°53.3829'N	07°32.4416'E
Leg 3	408,764.09	6,194,768.84	7.97	55°53.3839'N	07°32.4734'E
Leg 4	408,740.07	6,194,782.94	7.97	55°53.3912'N	07°32.4501'E
Leg 5	408,767.37	6,194,774.44	7.97	55°53.3869'N	07°32.4765'E
Leg 6	408,743.38	6,194,788.61	7.97	55°53.3943'N	07°32.4532'E
Leg 7	408,779.05	6,194,794.09	7.97	55°53.3977'N	07°32.4873'E
Leg 8	408,754.92	6,194,808.33	7.97	55°53.4051'N	07°32.4638'E
Moonpool_1	408,741.99	6,194,772.56	7.97	55°53.3856'N	07°32.4522'E
Moonpool_2	408,746.97	6,194,776.19	7.94	55°53.3877'N	07°32.4569'E
SPK1_Primary	408,749.36	6,194,758.17	19.70	55°53.3780'N	07°32.4595'E
SPK1_Secondary	408,738.34	6,194,764.60	19.98	55°53.3813'N	07°32.4488'E
SPK2_Primary	408,747.60	6,194,791.15	14.80	55°53.3957'N	07°32.4572'E
SPK2_Secondary	408,748.28	6,194,787.21	14.94	55°53.3936'N	07°32.4579'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

EXCALIBUR_240149
FINAL FIX REPORT



Summary of Excalibur Positions

	Primary	SD	Secondary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK2 - Starfix.G4 Plus-20003	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	120 of 120 used		119 of 119 used	

Heading (Corrected)	209.38°True (C-O: 0.00°)	±0.03°	209.38°True (C-O: 0.00°)	±0.03°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°53.3856'N	±0.01m	55°53.3856'N	±0.03m
Longitude	07°32.4522'E	±0.01m	07°32.4521'E	±0.01m
Height	48.70m Ell.	±0.01m	48.44m Ell.	±0.03m
Grid System	UTM zone 32N CM 9° E			
Easting	408,741.99m E	±0.01m	408,741.98m E	±0.01m
Northing	6,194,772.56m N	±0.01m	6,194,772.56m N	±0.03m
Height	7.97m MSS	±0.13m	7.72m MSS	±0.13m
Delta Easting	0.00m		-0.01m	
Delta Northing	0.00m		0.00m	
Delta Height	0.00m		-0.26m	

Position of Moonpool_1 from waypoint				
Range	2.56m		2.56m	
Bearing	358.63°True		358.39°True	



Summary of Excalibur Positions

	Primary	SD	Tertiary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK1 - Starfix.G4-10001	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	120 of 120 used		120 of 120 used	

Heading (Corrected)	209.38°True (C-O: 0.00°)	±0.03°	209.38°True (C-O: 0.00°)	±0.03°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°53.3856'N	±0.01m	55°53.3857'N	±0.01m
Longitude	07°32.4522'E	±0.01m	07°32.4522'E	±0.01m
Height	48.70m Ell.	±0.01m	48.70m Ell.	±0.01m
Grid System	UTM zone 32N CM 9° E			
Easting	408,741.99m E	±0.01m	408,742.02m E	±0.01m
Northing	6,194,772.56m N	±0.01m	6,194,772.57m N	±0.01m
Height	7.97m MSS	±0.13m	7.98m MSS	±0.13m
Delta Easting	0.00m		0.03m	
Delta Northing	0.00m		0.01m	
Delta Height	0.00m		0.00m	

Position of Moonpool_1 from waypoint				
Range	2.56m		2.57m	
Bearing	358.63°True		359.29°True	

EXCALIBUR_240149
FINAL FIX REPORT



Summary of Excalibur Positions

	Primary	SD	Quaternary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK1 - Starfix.XP2-10002	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	120 of 120 used		120 of 120 used	

Heading (Corrected)	209.38°True (C-O: 0.00°)	±0.03°	209.38°True (C-O: 0.00°)	±0.03°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°53.3856'N	±0.01m	55°53.3856'N	±0.01m
Longitude	07°32.4522'E	±0.01m	07°32.4523'E	±0.01m
Height	48.70m Ell.	±0.01m	48.78m Ell.	±0.03m
Grid System	UTM zone 32N CM 9° E			
Easting	408,741.99m E	±0.01m	408,742.11m E	±0.01m
Northing	6,194,772.56m N	±0.01m	6,194,772.50m N	±0.01m
Height	7.97m MSS	±0.13m	8.06m MSS	±0.13m
Delta Easting	0.00m		0.12m	
Delta Northing	0.00m		-0.06m	
Delta Height	0.00m		0.08m	

Position of Moonpool_1 from waypoint				
Range	2.56m		2.50m	
Bearing	358.63°True		1.24°True	

EXCALIBUR_240149
FINAL FIX REPORT



Summary of Excalibur Positions

	Primary	SD	Quinary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK2 - Starfix.G4-20001	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	120 of 120 used		119 of 119 used	

Heading (Corrected)	209.38°True (C-O: 0.00°)	±0.03°	209.38°True (C-O: 0.00°)	±0.03°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°53.3856'N	±0.01m	55°53.3857'N	±0.02m
Longitude	07°32.4522'E	±0.01m	07°32.4522'E	±0.01m
Height	48.70m Ell.	±0.01m	48.45m Ell.	±0.01m
Grid System	UTM zone 32N CM 9° E			
Easting	408,741.99m E	±0.01m	408,742.02m E	±0.01m
Northing	6,194,772.56m N	±0.01m	6,194,772.58m N	±0.02m
Height	7.97m MSS	±0.13m	7.72m MSS	±0.13m
Delta Easting	0.00m		0.02m	
Delta Northing	0.00m		0.02m	
Delta Height	0.00m		-0.25m	

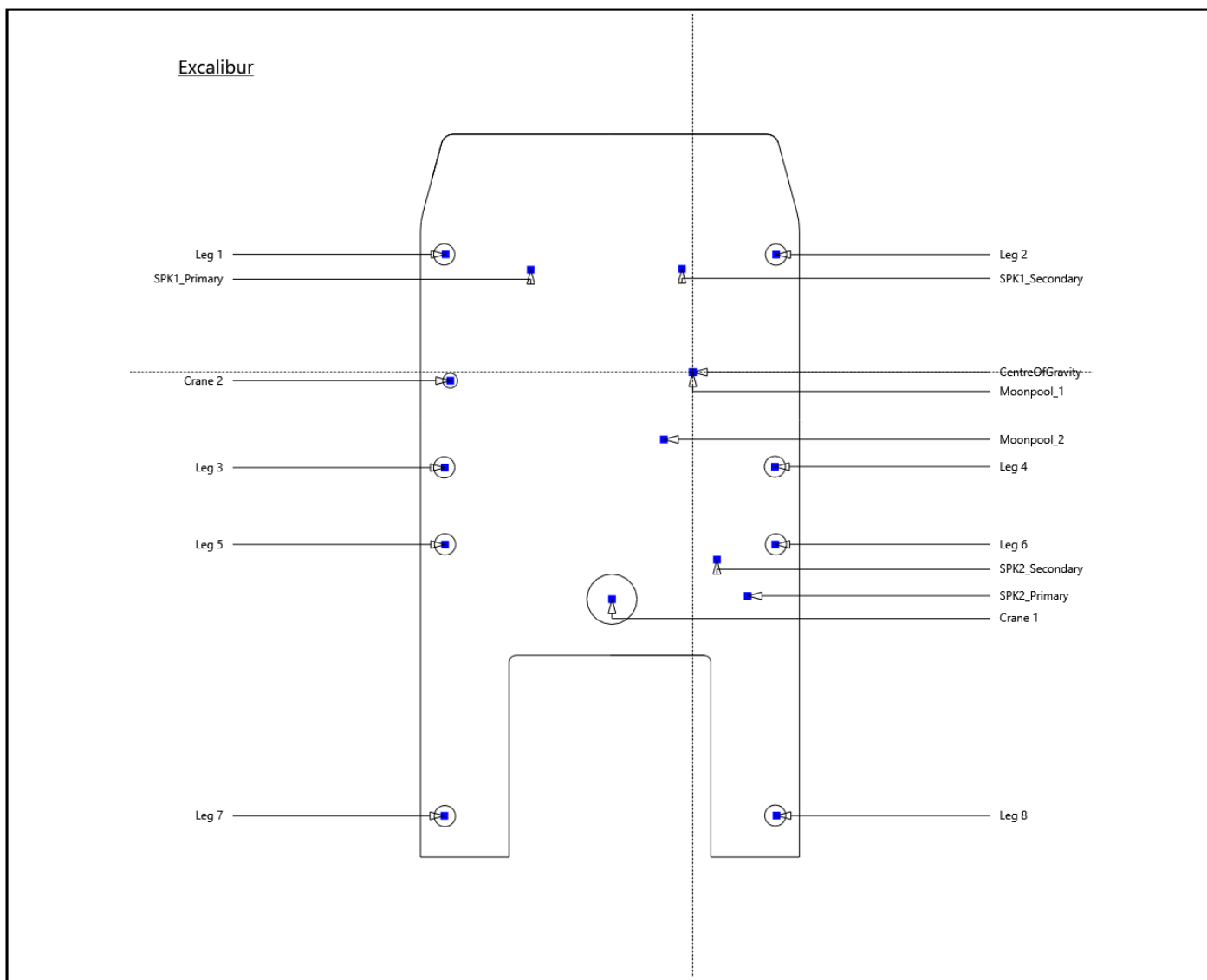
Position of Moonpool_1 from waypoint				
Range	2.56m		2.59m	
Bearing	358.63°True		359.15°True	

Scatter Plot



Sensor Group	Excalibur Mean Position at Moonpool_1 ETRS89 / UTM zone 32N [ETRF2000- ITRF2014][2023],DTU21 MSS height [DTU21 MSS]	Delta Easting	Delta Northing	Delta Height
Primary	408,741.99m E, 6,194,772.56m N, 7.97m MSS	0.00m	0.00m	0.00m
Secondary	408,741.98m E, 6,194,772.56m N, 7.72m MSS	-0.01m	0.00m	-0.26m
Tertiary	408,742.02m E, 6,194,772.57m N, 7.98m MSS	0.03m	0.01m	0.00m
Quaternary	408,742.11m E, 6,194,772.50m N, 8.06m MSS	0.12m	-0.06m	0.08m
Quinary	408,742.02m E, 6,194,772.58m N, 7.72m MSS	0.02m	0.02m	-0.25m

Excalibur Outline and Offsets



Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m

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SPK2_Secondary		2.04m	-15.81m	6.97m
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EXCALIBUR_240149

FINAL FIX REPORT



Project ID	Excalibur_240149
Starfix Version	v2022.1110.9 (build 0)
Client	Fugro Geoservices Inc
Primary Vessel	Excalibur
Location Description	UK

Session Name	20240518-144602-v1	
Start Time	18 May 2024, 15:46:26+01:00	End Time 18 May 2024, 15:54:46+01:00

Position Source:	SPK1 - Starfix.G4 Plus-10003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8563'N	±0.01m
Longitude - ETRS89	07°34.2653'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,535.02m E	±0.01m
Northing	6,190,041.99m N	±0.01m
Convergence	-1.18257°	
Heading ° True	107.58° T	±0.03°
Heading ° Grid	108.77° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8567'N	±0.01m
Longitude - ITRF2014	07°34.2659'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

Seabed Depth :	0.0m
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The final position was computed from session "20240518-144602-v1" by averaging 500 observations from a total of 500 observations between 18/05/2024 15:46:26 (UTC+01:00) and 18/05/2024 15:54:46 (UTC+01:00).

Position from	Waypoint: CPT106
Excalibur at Moonpool_1	2.22m Geodetic @ 152.52° T

Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	410,535.02m E, 6,190,041.99m N, 7.32m MSS	0.00m	0.00m	0.00m
Secondary	410,535.01m E, 6,190,041.99m N, 7.28m MSS	-0.01m	0.00m	-0.04m
Tertiary	410,534.99m E, 6,190,041.95m N, 7.20m MSS	-0.03m	-0.04m	-0.12m
Quaternary	410,535.02m E, 6,190,041.96m N, 7.30m MSS	0.00m	-0.03m	-0.02m
Quinary	410,534.97m E, 6,190,041.96m N, 7.21m MSS	-0.04m	-0.03m	-0.11m

Jamie Davison
Site Manager/Supervisor
FGBNM (Fugro Great Britain North Marine)

Rob Harwood
Client Representative
Fugro Geoservices Inc



Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	410,535.02	6,190,041.99	7.32	55°50.8563'N	07°34.2653'E
Crane 1	410,519.09	6,190,054.59	7.32	55°50.8629'N	07°34.2498'E
Crane 2	410,540.92	6,190,061.58	7.32	55°50.8670'N	07°34.2706'E
Leg 1	410,551.13	6,190,058.54	7.32	55°50.8654'N	07°34.2805'E
Leg 2	410,542.14	6,190,032.14	7.32	55°50.8511'N	07°34.2724'E
Leg 3	410,534.14	6,190,064.39	7.32	55°50.8684'N	07°34.2641'E
Leg 4	410,525.25	6,190,037.98	7.32	55°50.8541'N	07°34.2561'E
Leg 5	410,527.98	6,190,066.45	7.32	55°50.8694'N	07°34.2581'E
Leg 6	410,519.03	6,190,040.06	7.32	55°50.8551'N	07°34.2501'E
Leg 7	410,506.36	6,190,073.86	7.32	55°50.8732'N	07°34.2373'E
Leg 8	410,497.36	6,190,047.32	7.32	55°50.8588'N	07°34.2292'E
Moonpool_1	410,535.02	6,190,041.99	7.32	55°50.8563'N	07°34.2653'E
Moonpool_2	410,530.44	6,190,046.12	7.29	55°50.8585'N	07°34.2609'E
SPK1_Primary	410,547.60	6,190,052.15	19.05	55°50.8619'N	07°34.2772'E
SPK1_Secondary	410,543.56	6,190,040.05	19.33	55°50.8554'N	07°34.2736'E
SPK2_Primary	410,515.68	6,190,043.67	14.15	55°50.8570'N	07°34.2468'E
SPK2_Secondary	410,519.40	6,190,045.14	14.29	55°50.8579'N	07°34.2503'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

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Final Position for Moonpool_1 (Secondary)

Position Source:	SPK1 - Starfix.G4-10001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8563'N	±0.01m
Longitude - ETRS89	07°34.2653'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,535.01m E	±0.01m
Northing	6,190,041.99m N	±0.01m
Convergence	-1.18257°	
Heading ° True	107.58° T	±0.03°
Heading ° Grid	108.77° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8567'N	±0.01m
Longitude - ITRF2014	07°34.2659'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240518-144602-v1" by averaging 500 observations from a total of 500 observations between 18/05/2024 15:46:26 (UTC+01:00) and 18/05/2024 15:54:46 (UTC+01:00).

Position from	Waypoint: CPT106
Excalibur at Moonpool_1	2.22m Geodetic @ 152.36° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Tertiary)

Position Source:	SPK2 - Starfix.G4 Plus-20003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8563'N	±0.03m
Longitude - ETRS89	07°34.2653'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,534.99m E	±0.02m
Northing	6,190,041.95m N	±0.03m
Convergence	-1.18257°	
Heading ° True	107.58° T	±0.03°
Heading ° Grid	108.77° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8566'N	±0.03m
Longitude - ITRF2014	07°34.2658'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240518-144602-v1" by averaging 501 observations from a total of 501 observations between 18/05/2024 15:46:26 (UTC+01:00) and 18/05/2024 15:54:46 (UTC+01:00).

Position from	Waypoint: CPT106
Excalibur at Moonpool_1	2.20m Geodetic @ 151.36° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quaternary)

Position Source:	SPK1 - Starfix.XP2-10002
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8563'N	±0.02m
Longitude - ETRS89	07°34.2654'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,535.02m E	±0.01m
Northing	6,190,041.96m N	±0.02m
Convergence	-1.18257°	
Heading ° True	107.58° T	±0.03°
Heading ° Grid	108.77° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8566'N	±0.02m
Longitude - ITRF2014	07°34.2659'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240518-144602-v1" by averaging 500 observations from a total of 500 observations between 18/05/2024 15:46:26 (UTC+01:00) and 18/05/2024 15:54:46 (UTC+01:00).

Position from	Waypoint: CPT106
Excalibur at Moonpool_1	2.19m Geodetic @ 152.17° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quinary)

Position Source:	SPK2 - Starfix.G4-20001
Heading Source:	SPK1 - GNSS Heading-10004

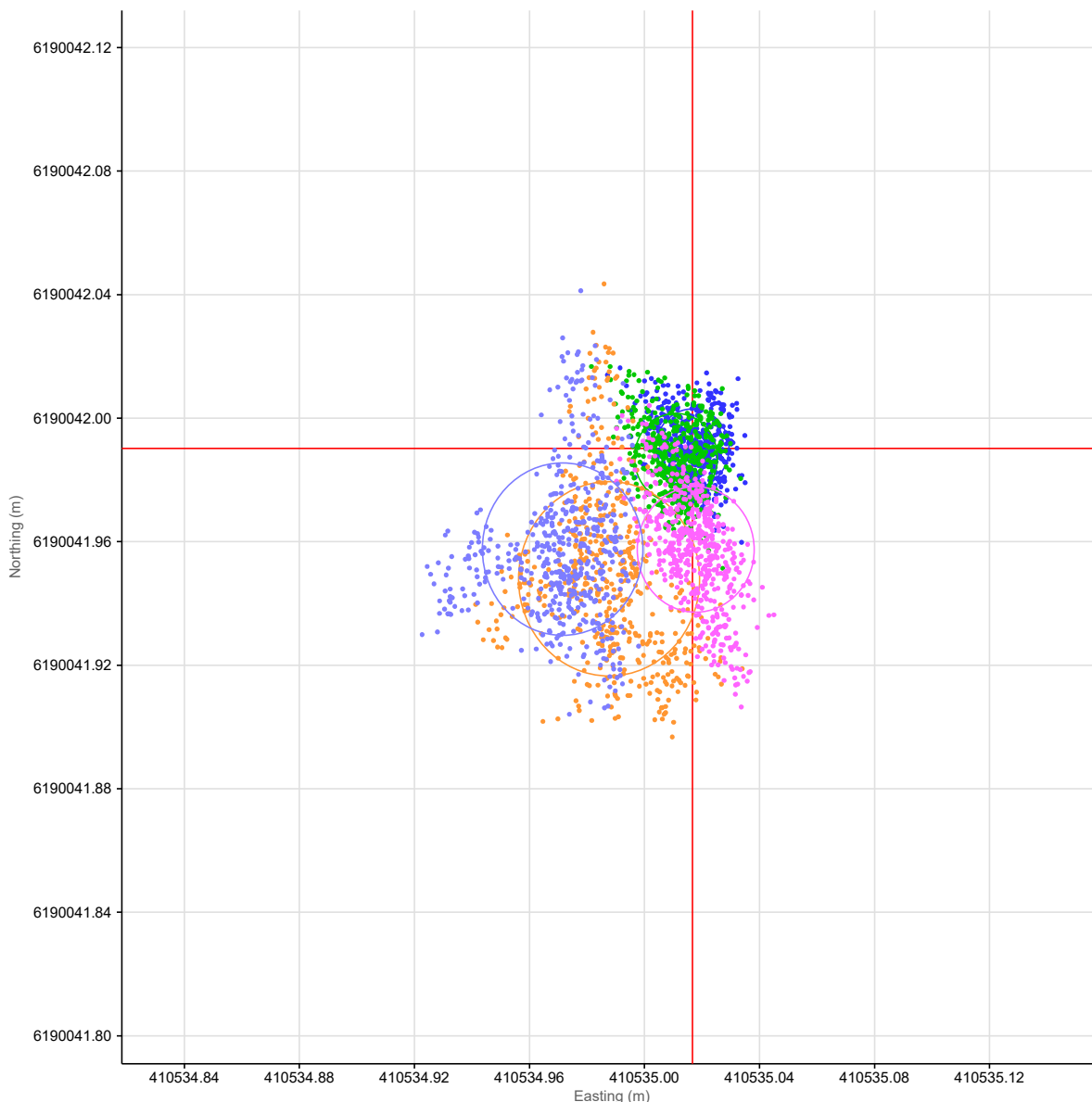
	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8563'N	±0.02m
Longitude - ETRS89	07°34.2653'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,534.97m E	±0.02m
Northing	6,190,041.96m N	±0.02m
Convergence	-1.18257°	
Heading ° True	107.58° T	±0.03°
Heading ° Grid	108.77° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8566'N	±0.02m
Longitude - ITRF2014	07°34.2658'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240518-144602-v1" by averaging 501 observations from a total of 501 observations between 18/05/2024 15:46:26 (UTC+01:00) and 18/05/2024 15:54:46 (UTC+01:00).

Position from	Waypoint: CPT106
Excalibur at Moonpool_1	2.21m Geodetic @ 151.10° T

Scatter Plot-ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	410,535.02m E, 6,190,041.99m N, 7.32m MSS	0.00m	0.00m	0.00m
Secondary	410,535.01m E, 6,190,041.99m N, 7.28m MSS	-0.01m	0.00m	-0.04m
Tertiary	410,534.99m E, 6,190,041.95m N, 7.20m MSS	-0.03m	-0.04m	-0.12m
Quaternary	410,535.02m E, 6,190,041.96m N, 7.30m MSS	0.00m	-0.03m	-0.02m
Quinary	410,534.97m E, 6,190,041.96m N, 7.21m MSS	-0.04m	-0.03m	-0.11m

Antenna Positions

Primary

	Antenna Position for SPK1 - Starfix.G4 Plus-10003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8619'N	±0.01m
Longitude - ETRS89	07°34.2772'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,547.60m E	±0.01m
Northing	6,190,052.15m N	±0.01m
Raw Rig Heading ° True	107.58° T	±0.03°
Raw Rig Heading ° Grid	108.77° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8623'N	±0.01m
Longitude - ITRF2014	07°34.2777'E	±0.01m

Secondary

	Antenna Position for SPK1 - Starfix.G4-10001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8619'N	±0.01m
Longitude - ETRS89	07°34.2772'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,547.59m E	±0.01m
Northing	6,190,052.14m N	±0.01m
Raw Rig Heading ° True	107.58° T	±0.03°
Raw Rig Heading ° Grid	108.77° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8623'N	±0.01m
Longitude - ITRF2014	07°34.2777'E	±0.01m

Tertiary

	Antenna Position for SPK2 - Starfix.G4 Plus-20003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8570'N	±0.02m
Longitude - ETRS89	07°34.2468'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,515.65m E	±0.02m
Northing	6,190,043.63m N	±0.02m
Raw Rig Heading ° True	107.58° T	±0.03°
Raw Rig Heading ° Grid	108.77° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8573'N	±0.02m
Longitude - ITRF2014	07°34.2473'E	±0.02m

Quaternary

	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	

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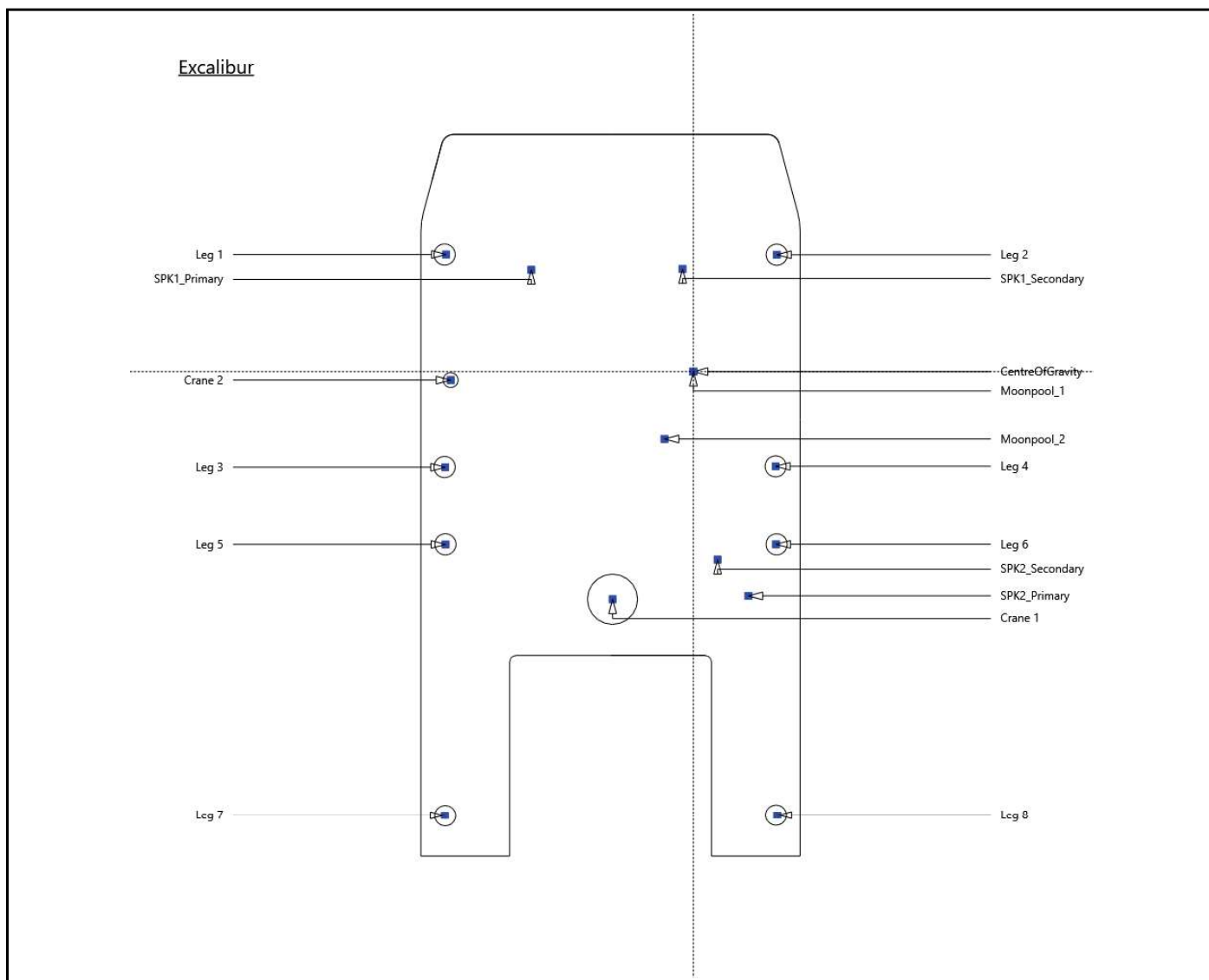


	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8619'N	±0.02m
Longitude - ETRS89	07°34.2772'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,547.60m E	±0.01m
Northing	6,190,052.12m N	±0.02m
Raw Rig Heading ° True	107.58° T	±0.03°
Raw Rig Heading ° Grid	108.77° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8623'N	±0.02m
Longitude - ITRF2014	07°34.2777'E	±0.01m

Quinary

	Antenna Position for SPK2 - Starfix.G4-20001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.8570'N	±0.02m
Longitude - ETRS89	07°34.2467'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	410,515.63m E	±0.02m
Northing	6,190,043.64m N	±0.02m
Raw Rig Heading ° True	107.58° T	±0.03°
Raw Rig Heading ° Grid	108.77° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.8573'N	±0.02m
Longitude - ITRF2014	07°34.2473'E	±0.02m

Vessel Outline and Offsets





Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m
SPK2_Secondary		2.04m	-15.81m	6.97m

EXCALIBUR_240149
FINAL FIX REPORT



Project ID	Excalibur_240149
Starfix Version	v2022.1110.9 (build 0)
Client	Fugro Geoservices Inc
Primary Vessel	Excalibur
Location Description	UK

Session Name	20240505-052811 CPT110-v1		
Start Time	05 May 2024, 06:28:58+01:00	End Time	05 May 2024, 06:37:18+01:00

Position Source:	SPK1 - Starfix.G4 Plus-10003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0368'N	±0.02m
Longitude - ETRS89	07°40.5207'E	±0.04m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,033.05m E	±0.04m
Northing	6,188,392.09m N	±0.02m
Convergence	-1.09610°	
Heading ° True	209.17° T	±0.14°
Heading ° Grid	210.27° G	±0.14°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0371'N	±0.02m
Longitude - ITRF2014	07°40.5213'E	±0.04m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

Seabed Depth :	0.0m
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The final position was computed from session "20240505-052811 CPT110-v1" by averaging 500 observations from a total of 500 observations between 05/05/2024 06:28:59 (UTC+01:00) and 05/05/2024 06:37:18 (UTC+01:00).

Position from	Waypoint: CPT110
Excalibur at Moonpool_1	2.30m Geodetic @ 154.42° T

Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	417,033.05m E, 6,188,392.09m N, 7.09m MSS	0.00m	0.00m	0.00m
Secondary	417,033.05m E, 6,188,392.09m N, 6.99m MSS	0.01m	0.00m	-0.10m
Tertiary	417,032.93m E, 6,188,392.09m N, 6.99m MSS	-0.12m	-0.01m	-0.10m
Quaternary	417,033.11m E, 6,188,392.11m N, 7.03m MSS	0.06m	0.03m	-0.06m
Quinary	417,032.96m E, 6,188,391.99m N, 7.14m MSS	-0.09m	-0.10m	0.05m


Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North Marine)


Rob Harwood
 Client Representative
 Fugro Geoservices Inc

Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	417,033.05	6,188,392.09	7.09	55°50.0368'N	07°40.5207'E
Crane 1	417,048.57	6,188,405.19	7.09	55°50.0440'N	07°40.5354'E
Crane 2	417,051.07	6,188,382.39	7.09	55°50.0317'N	07°40.5382'E
Leg 1	417,046.05	6,188,373.00	7.09	55°50.0266'N	07°40.5335'E
Leg 2	417,021.97	6,188,387.07	7.09	55°50.0339'N	07°40.5102'E
Leg 3	417,055.17	6,188,388.49	7.09	55°50.0350'N	07°40.5420'E
Leg 4	417,031.07	6,188,402.46	7.09	55°50.0423'N	07°40.5187'E
Leg 5	417,058.41	6,188,394.11	7.09	55°50.0381'N	07°40.5450'E
Leg 6	417,034.35	6,188,408.14	7.09	55°50.0454'N	07°40.5217'E
Leg 7	417,069.99	6,188,413.82	7.09	55°50.0489'N	07°40.5557'E
Leg 8	417,045.78	6,188,427.93	7.09	55°50.0562'N	07°40.5323'E
Moonpool_1	417,033.05	6,188,392.09	7.09	55°50.0368'N	07°40.5207'E
Moonpool_2	417,038.01	6,188,395.75	7.06	55°50.0388'N	07°40.5254'E
SPK1_Primary	417,040.49	6,188,377.73	18.82	55°50.0291'N	07°40.5281'E
SPK1_Secondary	417,029.44	6,188,384.10	19.10	55°50.0324'N	07°40.5174'E
SPK2_Primary	417,038.55	6,188,410.71	13.92	55°50.0469'N	07°40.5257'E
SPK2_Secondary	417,039.25	6,188,406.77	14.06	55°50.0447'N	07°40.5264'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Secondary)

Position Source:	SPK1 - Starfix.G4-10001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0368'N	±0.02m
Longitude - ETRS89	07°40.5207'E	±0.04m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,033.05m E	±0.04m
Northing	6,188,392.09m N	±0.02m
Convergence	-1.09610°	
Heading ° True	209.17° T	±0.14°
Heading ° Grid	210.27° G	±0.14°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0371'N	±0.02m
Longitude - ITRF2014	07°40.5213'E	±0.04m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240505-052811 CPT110-v1" by averaging 500 observations from a total of 500 observations between 05/05/2024 06:28:59 (UTC+01:00) and 05/05/2024 06:37:18 (UTC+01:00).

Position from	Waypoint: CPT110
Excalibur at Moonpool_1	2.30m Geodetic @ 154.58° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Tertiary)

Position Source:	SPK2 - Starfix.G4 Plus-20003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0368'N	±0.05m
Longitude - ETRS89	07°40.5206'E	±0.05m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,032.93m E	±0.05m
Northing	6,188,392.09m N	±0.05m
Convergence	-1.09610°	
Heading ° True	209.17° T	±0.14°
Heading ° Grid	210.27° G	±0.14°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0371'N	±0.05m
Longitude - ITRF2014	07°40.5212'E	±0.05m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240505-052811 CPT110-v1" by averaging 500 observations from a total of 500 observations between 05/05/2024 06:28:59 (UTC+01:00) and 05/05/2024 06:37:18 (UTC+01:00).

Position from	Waypoint: CPT110
Excalibur at Moonpool_1	2.35m Geodetic @ 151.69° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quaternary)

Position Source:	SPK1 - Starfix.XP2-10002
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0368'N	±0.02m
Longitude - ETRS89	07°40.5208'E	±0.04m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,033.11m E	±0.04m
Northing	6,188,392.11m N	±0.02m
Convergence	-1.09610°	
Heading ° True	209.17° T	±0.14°
Heading ° Grid	210.27° G	±0.14°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0371'N	±0.02m
Longitude - ITRF2014	07°40.5213'E	±0.04m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240505-052811 CPT110-v1" by averaging 500 observations from a total of 500 observations between 05/05/2024 06:28:59 (UTC+01:00) and 05/05/2024 06:37:18 (UTC+01:00).

Position from	Waypoint: CPT110
Excalibur at Moonpool_1	2.30m Geodetic @ 156.03° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quinary)

Position Source:	SPK2 - Starfix.G4-20001
Heading Source:	SPK1 - GNSS Heading-10004

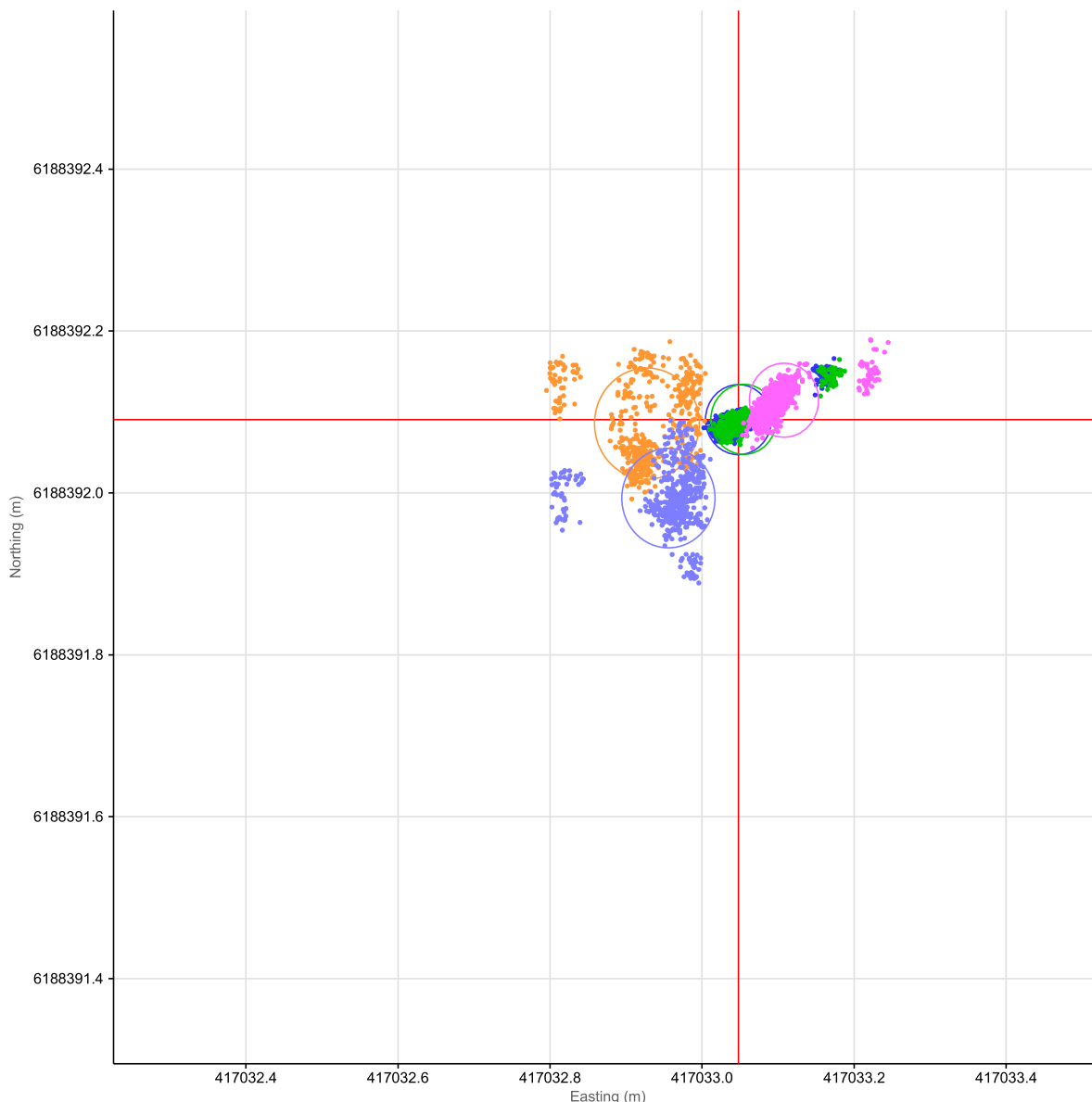
	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0367'N	±0.04m
Longitude - ETRS89	07°40.5207'E	±0.05m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,032.96m E	±0.05m
Northing	6,188,391.99m N	±0.04m
Convergence	-1.09610°	
Heading ° True	209.17° T	±0.14°
Heading ° Grid	210.27° G	±0.14°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0370'N	±0.04m
Longitude - ITRF2014	07°40.5212'E	±0.05m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240505-052811 CPT110-v1" by averaging 500 observations from a total of 500 observations between 05/05/2024 06:28:59 (UTC+01:00) and 05/05/2024 06:37:18 (UTC+01:00).

Position from	Waypoint: CPT110
Excalibur at Moonpool_1	2.25m Geodetic @ 151.26° T

Scatter Plot-ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	417,033.05m E, 6,188,392.09m N, 7.09m MSS	0.00m	0.00m	0.00m
Secondary	417,033.05m E, 6,188,392.09m N, 6.99m MSS	0.01m	0.00m	-0.10m
Tertiary	417,032.93m E, 6,188,392.09m N, 6.99m MSS	-0.12m	-0.01m	-0.10m
Quaternary	417,033.11m E, 6,188,392.11m N, 7.03m MSS	0.06m	0.03m	-0.06m
Quinary	417,032.96m E, 6,188,391.99m N, 7.14m MSS	-0.09m	-0.10m	0.05m

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Antenna Positions

Primary

	Antenna Position for SPK1 - Starfix.G4 Plus-10003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0291'N	±0.01m
Longitude - ETRS89	07°40.5281'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,040.49m E	±0.01m
Northing	6,188,377.73m N	±0.01m
Raw Rig Heading ° True	209.17° T	±0.14°
Raw Rig Heading ° Grid	210.27° G	±0.14°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0294'N	±0.01m
Longitude - ITRF2014	07°40.5287'E	±0.01m

Secondary

	Antenna Position for SPK1 - Starfix.G4-10001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0291'N	±0.01m
Longitude - ETRS89	07°40.5281'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,040.50m E	±0.01m
Northing	6,188,377.73m N	±0.01m
Raw Rig Heading ° True	209.17° T	±0.14°
Raw Rig Heading ° Grid	210.27° G	±0.14°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0294'N	±0.01m
Longitude - ITRF2014	07°40.5287'E	±0.01m

Tertiary

	Antenna Position for SPK2 - Starfix.G4 Plus-20003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0468'N	±0.05m
Longitude - ETRS89	07°40.5256'E	±0.03m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,038.43m E	±0.03m
Northing	6,188,410.70m N	±0.05m
Raw Rig Heading ° True	209.17° T	±0.14°
Raw Rig Heading ° Grid	210.27° G	±0.14°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0472'N	±0.05m
Longitude - ITRF2014	07°40.5261'E	±0.03m

Quaternary

	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	

EXCALIBUR_240149
FINAL FIX REPORT

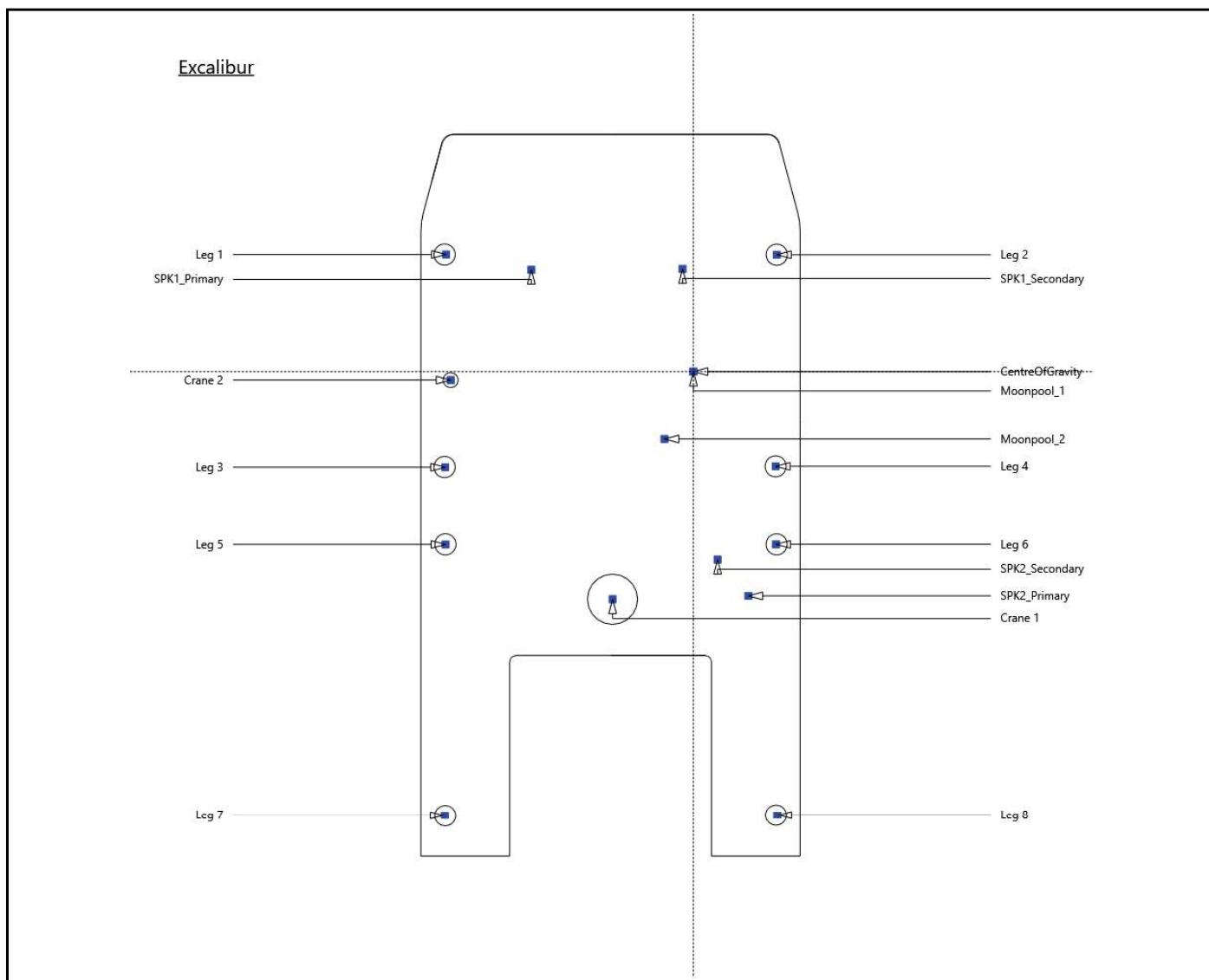


	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0291'N	±0.02m
Longitude - ETRS89	07°40.5282'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,040.55m E	±0.01m
Northing	6,188,377.76m N	±0.02m
Raw Rig Heading ° True	209.17° T	±0.14°
Raw Rig Heading ° Grid	210.27° G	±0.14°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0294'N	±0.02m
Longitude - ITRF2014	07°40.5287'E	±0.01m

Quinary

	Antenna Position for SPK2 - Starfix.G4-20001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.0468'N	±0.04m
Longitude - ETRS89	07°40.5256'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,038.46m E	±0.01m
Northing	6,188,410.61m N	±0.04m
Raw Rig Heading ° True	209.17° T	±0.14°
Raw Rig Heading ° Grid	210.27° G	±0.14°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.0471'N	±0.04m
Longitude - ITRF2014	07°40.5261'E	±0.01m

Vessel Outline and Offsets





Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m
SPK2_Secondary		2.04m	-15.81m	6.97m

EXCALIBUR_240149
FINAL FIX REPORT



Project ID	Excalibur_240149
Starfix Version	v2022.1110.9 (build 0)
Client	Fugro Geoservices Inc
Primary Vessel	Excalibur
Location Description	UK

Session Name	20240511-210639-v1	
Start Time	11 May 2024, 22:07:10+01:00	End Time 11 May 2024, 22:15:30+01:00

Position Source:	SPK1 - Starfix.G4 Plus-10003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.2795'N	±0.02m
Longitude - ETRS89	07°33.7659'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	409,953.19m E	±0.01m
Northing	6,187,128.31m N	±0.02m
Convergence	-1.18909°	
Heading ° True	135.59° T	±0.05°
Heading ° Grid	136.78° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.2799'N	±0.02m
Longitude - ITRF2014	07°33.7664'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

Seabed Depth :	0.0m
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The final position was computed from session "20240511-210639-v1" by averaging 500 observations from a total of 500 observations between 11/05/2024 22:07:11 (UTC+01:00) and 11/05/2024 22:15:30 (UTC+01:00).

Position from	Waypoint: CPT131
Excalibur at Moonpool_1	2.07m Geodetic @ 323.64° T

Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	409,953.19m E, 6,187,128.31m N, 6.88m MSS	0.00m	0.00m	0.00m
Secondary	409,953.19m E, 6,187,128.35m N, 6.90m MSS	0.00m	0.04m	0.02m
Tertiary	409,953.15m E, 6,187,128.38m N, 6.68m MSS	-0.04m	0.07m	-0.19m
Quaternary	409,953.17m E, 6,187,128.32m N, 6.95m MSS	-0.02m	0.01m	0.07m
Quinary	409,953.10m E, 6,187,128.40m N, 6.72m MSS	-0.09m	0.08m	-0.15m

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc



Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	409,953.19	6,187,128.31	6.88	55°49.2795'N	07°33.7659'E
Crane 1	409,945.05	6,187,146.92	6.88	55°49.2895'N	07°33.7578'E
Crane 2	409,967.61	6,187,142.83	6.88	55°49.2875'N	07°33.7794'E
Leg 1	409,975.19	6,187,135.35	6.88	55°49.2836'N	07°33.7868'E
Leg 2	409,954.85	6,187,116.26	6.88	55°49.2731'N	07°33.7678'E
Leg 3	409,962.93	6,187,148.50	6.88	55°49.2905'N	07°33.7749'E
Leg 4	409,942.68	6,187,129.36	6.88	55°49.2800'N	07°33.7558'E
Leg 5	409,958.47	6,187,153.20	6.88	55°49.2930'N	07°33.7705'E
Leg 6	409,938.17	6,187,134.12	6.88	55°49.2825'N	07°33.7514'E
Leg 7	409,942.86	6,187,169.91	6.88	55°49.3018'N	07°33.7552'E
Leg 8	409,922.45	6,187,150.70	6.88	55°49.2913'N	07°33.7361'E
Moonpool_1	409,953.19	6,187,128.31	6.88	55°49.2795'N	07°33.7659'E
Moonpool_2	409,951.09	6,187,134.11	6.85	55°49.2826'N	07°33.7638'E
SPK1_Primary	409,969.07	6,187,131.37	18.61	55°49.2814'N	07°33.7811'E
SPK1_Secondary	409,959.82	6,187,122.58	18.89	55°49.2765'N	07°33.7724'E
SPK2_Primary	409,936.91	6,187,138.88	13.71	55°49.2851'N	07°33.7501'E
SPK2_Secondary	409,940.88	6,187,138.43	13.85	55°49.2849'N	07°33.7539'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Secondary)

Position Source:	SPK1 - Starfix.G4-10001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.2796'N	±0.02m
Longitude - ETRS89	07°33.7659'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	409,953.19m E	±0.01m
Northing	6,187,128.35m N	±0.02m
Convergence	-1.18909°	
Heading ° True	135.59° T	±0.05°
Heading ° Grid	136.78° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.2799'N	±0.02m
Longitude - ITRF2014	07°33.7664'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240511-210639-v1" by averaging 500 observations from a total of 500 observations between 11/05/2024 22:07:11 (UTC+01:00) and 11/05/2024 22:15:30 (UTC+01:00).

Position from	Waypoint: CPT131
Excalibur at Moonpool_1	2.03m Geodetic @ 322.91° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Tertiary)

Position Source:	SPK2 - Starfix.G4 Plus-20003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.2796'N	±0.03m
Longitude - ETRS89	07°33.7659'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	409,953.15m E	±0.02m
Northing	6,187,128.38m N	±0.03m
Convergence	-1.18909°	
Heading ° True	135.59° T	±0.05°
Heading ° Grid	136.78° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.2799'N	±0.03m
Longitude - ITRF2014	07°33.7664'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240511-210639-v1" by averaging 498 observations from a total of 498 observations between 11/05/2024 22:07:11 (UTC+01:00) and 11/05/2024 22:15:30 (UTC+01:00).

Position from	Waypoint: CPT131
Excalibur at Moonpool_1	1.99m Geodetic @ 323.26° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quaternary)

Position Source:	SPK1 - Starfix.XP2-10002
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.2795'N	±0.03m
Longitude - ETRS89	07°33.7659'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	409,953.17m E	±0.01m
Northing	6,187,128.32m N	±0.03m
Convergence	-1.18909°	
Heading ° True	135.59° T	±0.05°
Heading ° Grid	136.78° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.2799'N	±0.03m
Longitude - ITRF2014	07°33.7664'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240511-210639-v1" by averaging 500 observations from a total of 500 observations between 11/05/2024 22:07:11 (UTC+01:00) and 11/05/2024 22:15:30 (UTC+01:00).

Position from	Waypoint: CPT131
Excalibur at Moonpool_1	2.04m Geodetic @ 323.95° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quinary)

Position Source:	SPK2 - Starfix.G4-20001
Heading Source:	SPK1 - GNSS Heading-10004

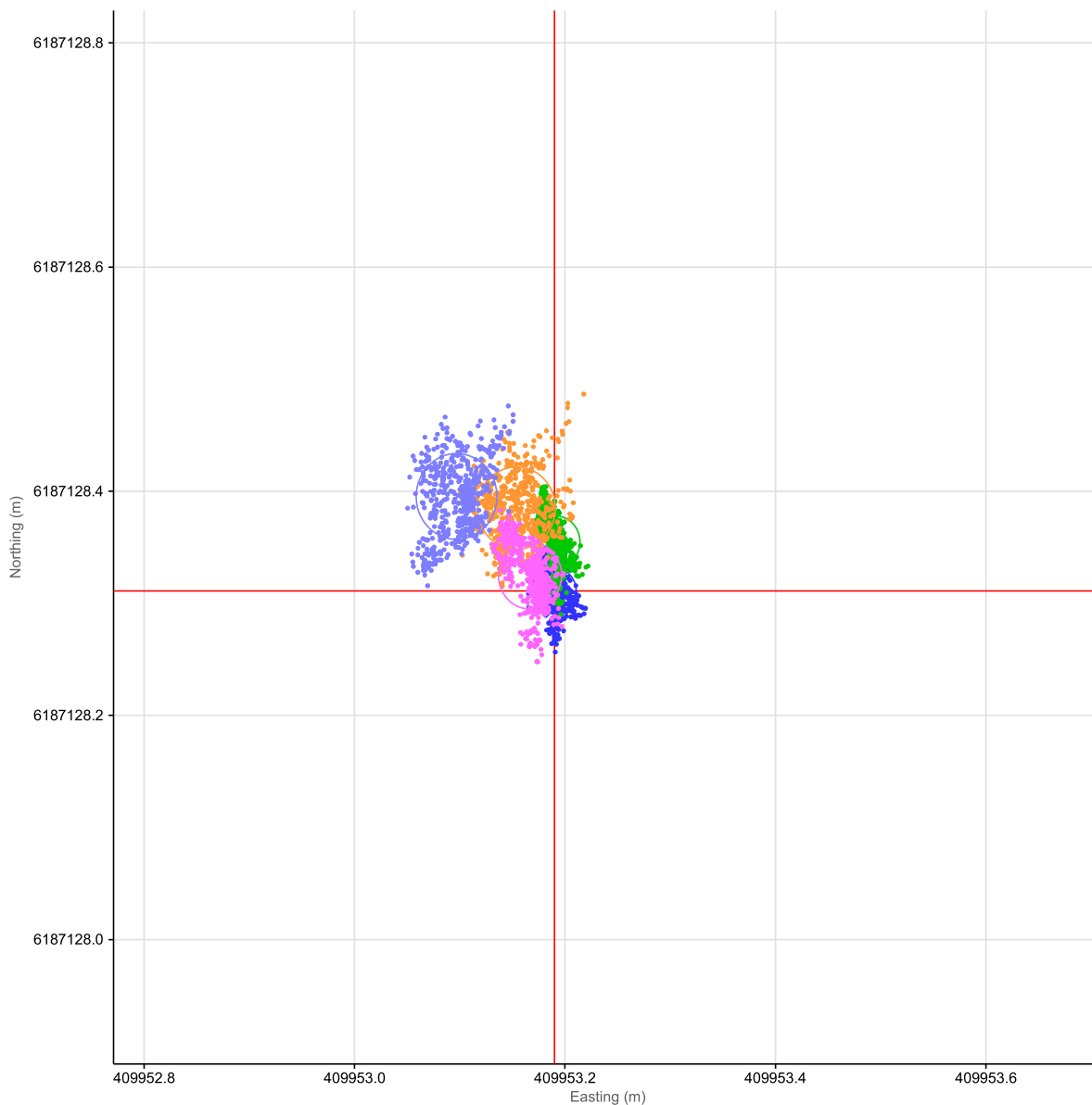
	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.2796'N	±0.03m
Longitude - ETRS89	07°33.7658'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	409,953.10m E	±0.02m
Northing	6,187,128.40m N	±0.03m
Convergence	-1.18909°	
Heading ° True	135.59° T	±0.05°
Heading ° Grid	136.78° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.2799'N	±0.03m
Longitude - ITRF2014	07°33.7664'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240511-210639-v1" by averaging 498 observations from a total of 498 observations between 11/05/2024 22:07:11 (UTC+01:00) and 11/05/2024 22:15:30 (UTC+01:00).

Position from	Waypoint: CPT131
Excalibur at Moonpool_1	1.94m Geodetic @ 324.46° T

Scatter Plot-ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	409,953.19m E, 6,187,128.31m N, 6.88m MSS	0.00m	0.00m	0.00m
Secondary	409,953.19m E, 6,187,128.35m N, 6.90m MSS	0.00m	0.04m	0.02m
Tertiary	409,953.15m E, 6,187,128.38m N, 6.68m MSS	-0.04m	0.07m	-0.19m
Quaternary	409,953.17m E, 6,187,128.32m N, 6.95m MSS	-0.02m	0.01m	0.07m
Quinary	409,953.10m E, 6,187,128.40m N, 6.72m MSS	-0.09m	0.08m	-0.15m



Antenna Positions

Primary

	Antenna Position for SPK1 - Starfix.G4 Plus-10003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.2814'N	±0.01m
Longitude - ETRS89	07°33.7811'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	409,969.07m E	±0.01m
Northing	6,187,131.37m N	±0.01m
Raw Rig Heading ° True	135.59° T	±0.05°
Raw Rig Heading ° Grid	136.78° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.2817'N	±0.01m
Longitude - ITRF2014	07°33.7816'E	±0.01m

Secondary

	Antenna Position for SPK1 - Starfix.G4-10001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.2814'N	±0.01m
Longitude - ETRS89	07°33.7811'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	409,969.07m E	±0.01m
Northing	6,187,131.41m N	±0.01m
Raw Rig Heading ° True	135.59° T	±0.05°
Raw Rig Heading ° Grid	136.78° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.2817'N	±0.01m
Longitude - ITRF2014	07°33.7816'E	±0.01m

Tertiary

	Antenna Position for SPK2 - Starfix.G4 Plus-20003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.2851'N	±0.02m
Longitude - ETRS89	07°33.7501'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	409,936.87m E	±0.02m
Northing	6,187,138.96m N	±0.02m
Raw Rig Heading ° True	135.59° T	±0.05°
Raw Rig Heading ° Grid	136.78° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.2854'N	±0.02m
Longitude - ITRF2014	07°33.7506'E	±0.02m

Quaternary

	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	

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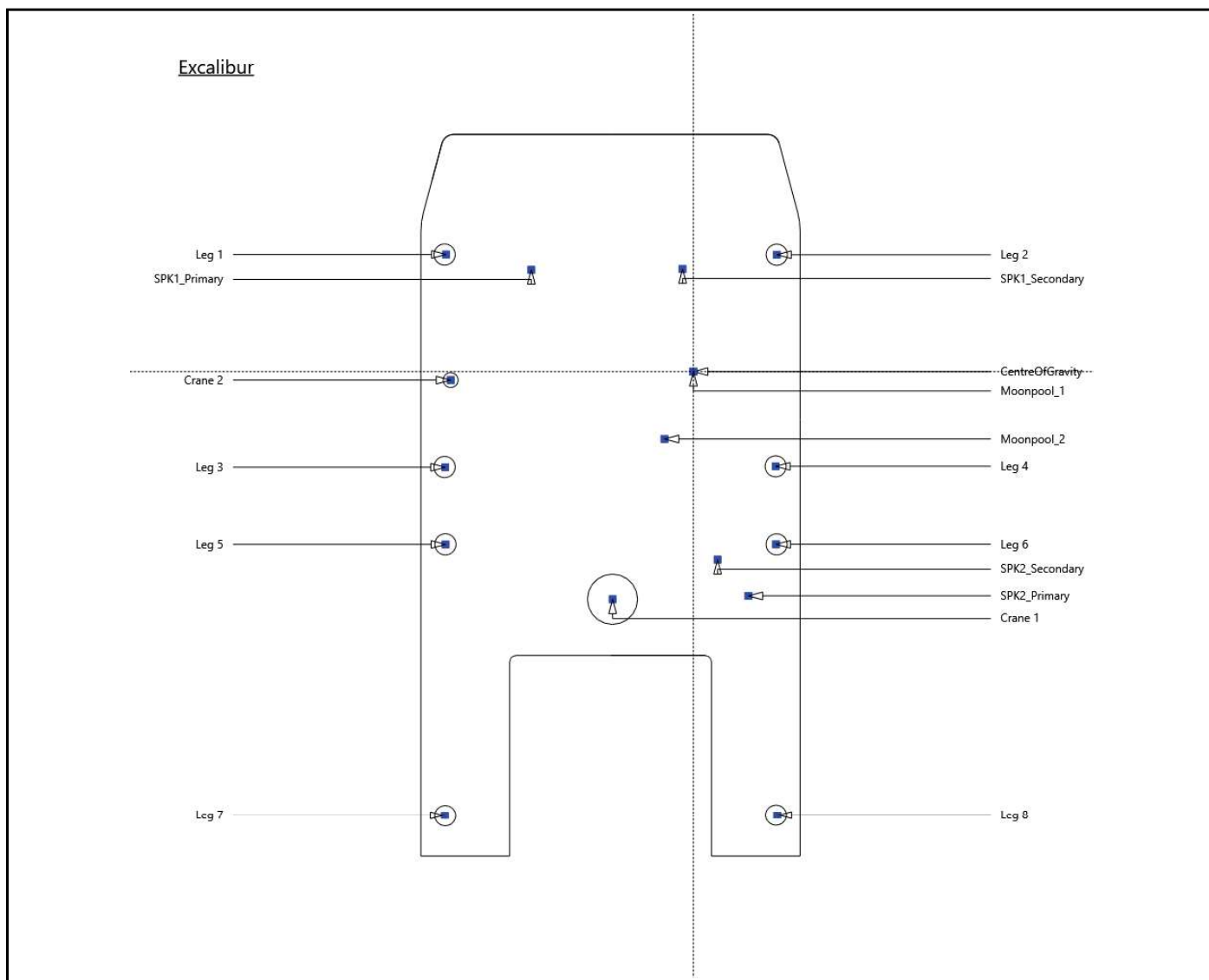


	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.2814'N	±0.02m
Longitude - ETRS89	07°33.7810'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	409,969.05m E	±0.01m
Northing	6,187,131.38m N	±0.02m
Raw Rig Heading ° True	135.59° T	±0.05°
Raw Rig Heading ° Grid	136.78° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.2817'N	±0.02m
Longitude - ITRF2014	07°33.7816'E	±0.02m

Quinary

	Antenna Position for SPK2 - Starfix.G4-20001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.2851'N	±0.03m
Longitude - ETRS89	07°33.7500'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	409,936.81m E	±0.02m
Northing	6,187,138.97m N	±0.03m
Raw Rig Heading ° True	135.59° T	±0.05°
Raw Rig Heading ° Grid	136.78° G	±0.05°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.2854'N	±0.03m
Longitude - ITRF2014	07°33.7506'E	±0.02m

Vessel Outline and Offsets





Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m
SPK2_Secondary		2.04m	-15.81m	6.97m

EXCALIBUR_240149
FINAL FIX REPORT



Project ID	Excalibur_240149
Starfix Version	v2022.1110.9 (build 0)
Client	Fugro Geoservices Inc
Primary Vessel	Excalibur
Location Description	UK

Session Name	20240515-155649-v1	
Start Time	15 May 2024, 16:57:59+01:00	End Time 15 May 2024, 17:06:18+01:00

Position Source:	SPK1 - Starfix.G4 Plus-10003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.5454'N	±0.01m
Longitude - ETRS89	07°32.8369'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,993.50m E	±0.01m
Northing	6,187,641.72m N	±0.01m
Convergence	-1.20196°	
Heading ° True	141.50° T	±0.02°
Heading ° Grid	142.70° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.5458'N	±0.01m
Longitude - ITRF2014	07°32.8374'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

Seabed Depth :	0.0m
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The final position was computed from session "20240515-155649-v1" by averaging 500 observations from a total of 500 observations between 15/05/2024 16:57:59 (UTC+01:00) and 15/05/2024 17:06:18 (UTC+01:00).

Position from	Waypoint: CPT157
Excalibur at Moonpool_1	1.79m Geodetic @ 162.76° T

Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	408,993.50m E, 6,187,641.72m N, 7.94m MSS	0.00m	0.00m	0.00m
Secondary	408,993.46m E, 6,187,641.71m N, 7.89m MSS	-0.04m	-0.01m	-0.05m
Tertiary	408,993.41m E, 6,187,641.76m N, 7.86m MSS	-0.10m	0.03m	-0.08m
Quaternary	408,993.42m E, 6,187,641.72m N, 8.05m MSS	-0.09m	-0.01m	0.11m
Quinary	408,993.43m E, 6,187,641.75m N, 7.82m MSS	-0.07m	0.03m	-0.12m

Jamie Davison
Site Manager/Supervisor
FGBNM (Fugro Great Britain North Marine)

Rob Harwood
Client Representative
Fugro Geoservices Inc



Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	408,993.50	6,187,641.72	7.94	55°49.5454'N	07°32.8369'E
Crane 1	408,987.32	6,187,661.07	7.94	55°49.5558'N	07°32.8306'E
Crane 2	409,009.34	6,187,654.68	7.94	55°49.5526'N	07°32.8518'E
Leg 1	409,016.11	6,187,646.46	7.94	55°49.5482'N	07°32.8584'E
Leg 2	408,993.92	6,187,629.57	7.94	55°49.5389'N	07°32.8375'E
Leg 3	409,005.28	6,187,660.80	7.94	55°49.5559'N	07°32.8478'E
Leg 4	408,983.16	6,187,643.85	7.94	55°49.5465'N	07°32.8269'E
Leg 5	409,001.32	6,187,665.94	7.94	55°49.5586'N	07°32.8439'E
Leg 6	408,979.17	6,187,649.05	7.94	55°49.5492'N	07°32.8230'E
Leg 7	408,987.51	6,187,684.16	7.94	55°49.5682'N	07°32.8303'E
Leg 8	408,965.24	6,187,667.16	7.94	55°49.5588'N	07°32.8093'E
Moonpool_1	408,993.50	6,187,641.72	7.94	55°49.5454'N	07°32.8369'E
Moonpool_2	408,992.02	6,187,647.70	7.91	55°49.5486'N	07°32.8353'E
SPK1_Primary	409,009.62	6,187,643.13	19.67	55°49.5464'N	07°32.8523'E
SPK1_Secondary	408,999.51	6,187,635.34	19.95	55°49.5421'N	07°32.8428'E
SPK2_Primary	408,978.40	6,187,653.92	14.77	55°49.5518'N	07°32.8222'E
SPK2_Secondary	408,982.30	6,187,653.06	14.91	55°49.5514'N	07°32.8259'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Secondary)

Position Source:	SPK1 - Starfix.G4-10001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.5454'N	±0.01m
Longitude - ETRS89	07°32.8369'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,993.46m E	±0.01m
Northing	6,187,641.71m N	±0.01m
Convergence	-1.20196°	
Heading ° True	141.50° T	±0.02°
Heading ° Grid	142.70° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.5458'N	±0.01m
Longitude - ITRF2014	07°32.8374'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240515-155649-v1" by averaging 500 observations from a total of 500 observations between 15/05/2024 16:57:59 (UTC+01:00) and 15/05/2024 17:06:18 (UTC+01:00).

Position from	Waypoint: CPT157
Excalibur at Moonpool_1	1.80m Geodetic @ 161.44° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Tertiary)

Position Source:	SPK2 - Starfix.G4 Plus-20003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.5455'N	±0.03m
Longitude - ETRS89	07°32.8368'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,993.41m E	±0.02m
Northing	6,187,641.76m N	±0.03m
Convergence	-1.20197°	
Heading ° True	141.50° T	±0.02°
Heading ° Grid	142.70° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.5458'N	±0.03m
Longitude - ITRF2014	07°32.8373'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240515-155649-v1" by averaging 500 observations from a total of 500 observations between 15/05/2024 16:57:59 (UTC+01:00) and 15/05/2024 17:06:18 (UTC+01:00).

Position from	Waypoint: CPT157
Excalibur at Moonpool_1	1.86m Geodetic @ 160.14° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quaternary)

Position Source:	SPK1 - Starfix.XP2-10002
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.5454'N	±0.02m
Longitude - ETRS89	07°32.8368'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,993.42m E	±0.02m
Northing	6,187,641.72m N	±0.02m
Convergence	-1.20197°	
Heading ° True	141.50° T	±0.02°
Heading ° Grid	142.70° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.5458'N	±0.02m
Longitude - ITRF2014	07°32.8373'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240515-155649-v1" by averaging 500 observations from a total of 500 observations between 15/05/2024 16:57:59 (UTC+01:00) and 15/05/2024 17:06:18 (UTC+01:00).

Position from	Waypoint: CPT157
Excalibur at Moonpool_1	1.82m Geodetic @ 160.12° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quinary)

Position Source:	SPK2 - Starfix.G4-20001
Heading Source:	SPK1 - GNSS Heading-10004

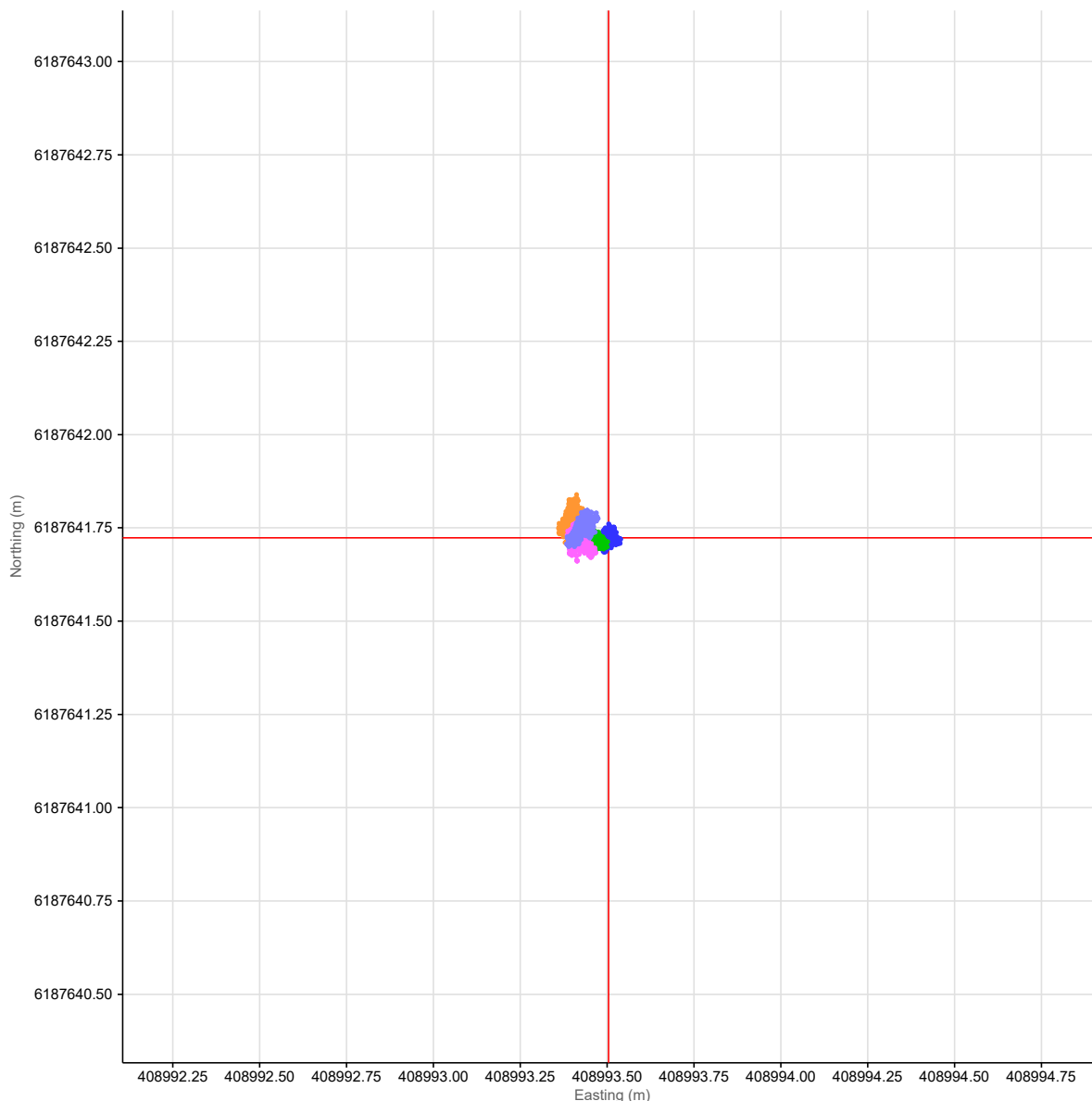
	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.5455'N	±0.02m
Longitude - ETRS89	07°32.8368'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,993.43m E	±0.02m
Northing	6,187,641.75m N	±0.02m
Convergence	-1.20196°	
Heading ° True	141.50° T	±0.02°
Heading ° Grid	142.70° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.5458'N	±0.02m
Longitude - ITRF2014	07°32.8373'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240515-155649-v1" by averaging 500 observations from a total of 500 observations between 15/05/2024 16:57:59 (UTC+01:00) and 15/05/2024 17:06:18 (UTC+01:00).

Position from	Waypoint: CPT157
Excalibur at Moonpool_1	1.84m Geodetic @ 160.86° T

Scatter Plot-ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	408,993.50m E, 6,187,641.72m N, 7.94m MSS	0.00m	0.00m	0.00m
Secondary	408,993.46m E, 6,187,641.71m N, 7.89m MSS	-0.04m	-0.01m	-0.05m
Tertiary	408,993.41m E, 6,187,641.76m N, 7.86m MSS	-0.10m	0.03m	-0.08m
Quaternary	408,993.42m E, 6,187,641.72m N, 8.05m MSS	-0.09m	-0.01m	0.11m
Quinary	408,993.43m E, 6,187,641.75m N, 7.82m MSS	-0.07m	0.03m	-0.12m

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Antenna Positions

Primary

	Antenna Position for SPK1 - Starfix.G4 Plus-10003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.5464'N	±0.01m
Longitude - ETRS89	07°32.8523'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	409,009.62m E	±0.01m
Northing	6,187,643.13m N	±0.01m
Raw Rig Heading ° True	141.50° T	±0.02°
Raw Rig Heading ° Grid	142.70° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.5467'N	±0.01m
Longitude - ITRF2014	07°32.8528'E	±0.01m

Secondary

	Antenna Position for SPK1 - Starfix.G4-10001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.5464'N	±0.01m
Longitude - ETRS89	07°32.8522'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	409,009.58m E	±0.01m
Northing	6,187,643.12m N	±0.01m
Raw Rig Heading ° True	141.50° T	±0.02°
Raw Rig Heading ° Grid	142.70° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.5467'N	±0.01m
Longitude - ITRF2014	07°32.8528'E	±0.01m

Tertiary

	Antenna Position for SPK2 - Starfix.G4 Plus-20003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.5519'N	±0.03m
Longitude - ETRS89	07°32.8221'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,978.30m E	±0.02m
Northing	6,187,653.95m N	±0.03m
Raw Rig Heading ° True	141.50° T	±0.02°
Raw Rig Heading ° Grid	142.70° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.5522'N	±0.03m
Longitude - ITRF2014	07°32.8226'E	±0.02m

Quaternary

	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	

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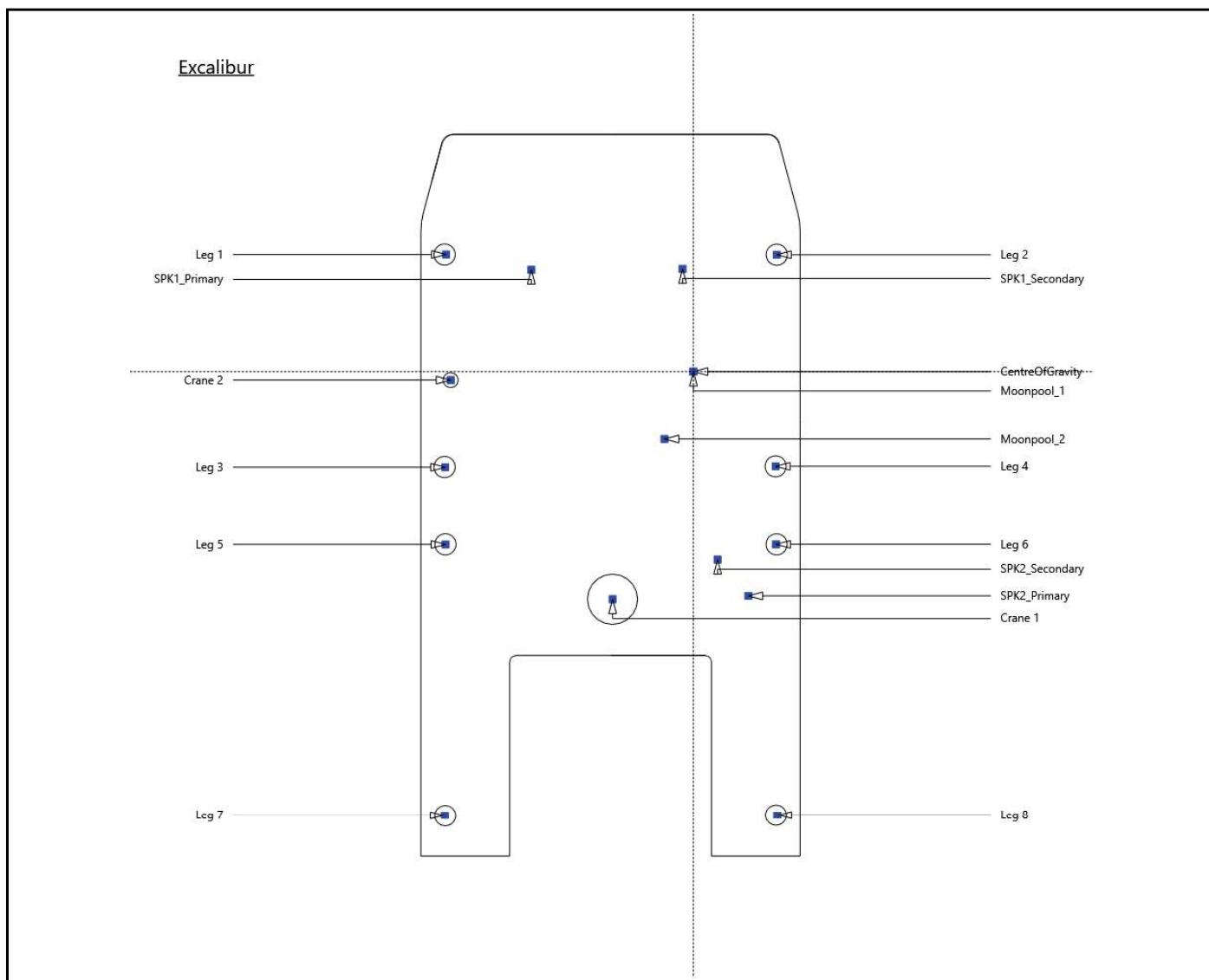


	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.5464'N	±0.02m
Longitude - ETRS89	07°32.8522'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	409,009.53m E	±0.02m
Northing	6,187,643.12m N	±0.02m
Raw Rig Heading ° True	141.50° T	±0.02°
Raw Rig Heading ° Grid	142.70° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.5467'N	±0.02m
Longitude - ITRF2014	07°32.8527'E	±0.02m

Quinary

	Antenna Position for SPK2 - Starfix.G4-20001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.5519'N	±0.02m
Longitude - ETRS89	07°32.8221'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,978.32m E	±0.02m
Northing	6,187,653.95m N	±0.02m
Raw Rig Heading ° True	141.50° T	±0.02°
Raw Rig Heading ° Grid	142.70° G	±0.02°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.5522'N	±0.02m
Longitude - ITRF2014	07°32.8226'E	±0.02m

Vessel Outline and Offsets





Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m
SPK2_Secondary		2.04m	-15.81m	6.97m

EXCALIBUR_240149

FINAL FIX REPORT



Project ID: Excalibur_240149
Starfix Version: v2022.1110.9 (build 0)
Client: Fugro Geoservices Inc
Client Rep: OCR
Fugro Personnel: David Lloyd
Primary Vessel: Excalibur
Location: UK
Comment:

Session Name: CPT182-v2
Start Time: 24 Jun 2024, 19:19:00+01:00
End Time: 24 Jun 2024, 19:29:07+01:00 (Session Length 0.169 hrs - No. Obs. 608)

Position Fix Summary for Excalibur at CPT182

Moonpool_1 position computed from SPK1 - Starfix.G4 Plus-10003 (Primary)

Geodetic Datum	European Terrestrial Reference System 1989	International Terrestrial Reference Frame 2014
Latitude	55°52.9247'N	55°52.9250'N
Longitude	07°33.1451'E	07°33.1456'E
Grid System	UTM zone 32N CM 9° E	
Easting	409,446.31m E	
Northing	6,193,902.38m N	
Height	7.30m MSS (DTU21 MSS height)	
Heading	282.13°True (283.33°Grid)	

Position for Moonpool_1 is 2.48m @ 342.632°True (343.831°Grid) FROM the waypoint.

Moonpool_1 from CRP:	Starboard = 0.00m	Forward = 0.00m	Up = 0.00m
SPK1_Primary from CRP:	Starboard = -13.67m	Forward = 8.65m	Up = 11.73m
Heading correction applied (C-O):	0.00°		
Convergence:	-1.19866°		

Waypoint

European Terrestrial Reference System 1989		UTM zone 32N CM 9° E	
Latitude: 55°52.9234'N	Longitude: 07°33.1458'E	Easting: 409,447.00m E	Northing: 6,193,900.00m N
Intended Vessel Heading	0.000°True		

Positioning System Comparison

Sensor	Mean Position			Delta Easting	Delta Northing	Delta Height
	UTM zone 32N CM 9° E					
Primary	409,446.31m E	6,193,902.38m N	7.30m MSS	0.00m	0.00m	0.00m
Secondary	409,446.30m E	6,193,902.43m N	7.14m MSS	-0.01m	0.04m	-0.16m
Tertiary	409,446.29m E	6,193,902.38m N	7.29m MSS	-0.02m	-0.01m	-0.01m
Quaternary	409,446.33m E	6,193,902.30m N	7.40m MSS	0.02m	-0.09m	0.10m
Quinary	409,446.26m E	6,193,902.49m N	7.23m MSS	-0.05m	0.11m	-0.07m

David Lloyd

Party Chief
 FGBNM (Fugro Great Britain North Marine)

Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	409,446.31	6,193,902.38	7.30	55°52.9247'N	07°33.1451'E
Crane 1	409,463.36	6,193,891.35	7.30	55°52.9189'N	07°33.1616'E
Crane 2	409,442.29	6,193,882.32	7.30	55°52.9138'N	07°33.1416'E
Leg 1	409,431.83	6,193,884.38	7.30	55°52.9148'N	07°33.1315'E
Leg 2	409,438.28	6,193,911.52	7.30	55°52.9295'N	07°33.1372'E
Leg 3	409,449.31	6,193,880.17	7.30	55°52.9127'N	07°33.1484'E
Leg 4	409,455.65	6,193,907.30	7.30	55°52.9274'N	07°33.1539'E
Leg 5	409,455.63	6,193,878.71	7.30	55°52.9120'N	07°33.1545'E
Leg 6	409,462.04	6,193,905.82	7.30	55°52.9267'N	07°33.1601'E
Leg 7	409,477.86	6,193,873.38	7.30	55°52.9094'N	07°33.1759'E
Leg 8	409,484.30	6,193,900.65	7.30	55°52.9241'N	07°33.1815'E
Moonpool_1	409,446.31	6,193,902.38	7.30	55°52.9247'N	07°33.1451'E
Moonpool_2	409,451.25	6,193,898.71	7.27	55°52.9227'N	07°33.1499'E
SPK1_Primary	409,434.74	6,193,891.08	19.03	55°52.9184'N	07°33.1342'E
SPK1_Secondary	409,437.62	6,193,903.51	19.31	55°52.9252'N	07°33.1367'E
SPK2_Primary	409,465.72	6,193,902.54	14.13	55°52.9250'N	07°33.1637'E
SPK2_Secondary	409,462.16	6,193,900.73	14.27	55°52.9239'N	07°33.1603'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

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Summary of Excalibur Positions

	Primary	SD	Secondary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK2 - Starfix.G4 Plus-20003	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	608 of 608 used		608 of 608 used	

Heading (Corrected)	282.13°True (C-O: 0.00°)	±0.03°	282.13°True (C-O: 0.00°)	±0.03°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°52.9247'N	±0.03m	55°52.9247'N	±0.04m
Longitude	07°33.1451'E	±0.02m	07°33.1450'E	±0.02m
Height	48.02m Ell.	±0.03m	47.86m Ell.	±0.08m
Grid System	UTM zone 32N CM 9° E			
Easting	409,446.31m E	±0.02m	409,446.30m E	±0.02m
Northing	6,193,902.38m N	±0.04m	6,193,902.43m N	±0.04m
Height	7.30m MSS	±0.13m	7.14m MSS	±0.16m
Delta Easting	0.00m		-0.01m	
Delta Northing	0.00m		0.04m	
Delta Height	0.00m		-0.16m	

Position of Moonpool_1 from waypoint				
Range	2.48m		2.53m	
Bearing	342.63°True		342.77°True	

Summary of Excalibur Positions

	Primary	SD	Tertiary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK1 - Starfix.G4-10001	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	608 of 608 used		608 of 608 used	

Heading (Corrected)	282.13°True (C-O: 0.00°)	±0.03°	282.13°True (C-O: 0.00°)	±0.03°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°52.9247'N	±0.03m	55°52.9247'N	±0.01m
Longitude	07°33.1451'E	±0.02m	07°33.1450'E	±0.01m
Height	48.02m Ell.	±0.03m	48.01m Ell.	±0.03m
Grid System	UTM zone 32N CM 9° E			
Easting	409,446.31m E	±0.02m	409,446.29m E	±0.01m
Northing	6,193,902.38m N	±0.04m	6,193,902.38m N	±0.01m
Height	7.30m MSS	±0.13m	7.29m MSS	±0.14m
Delta Easting	0.00m		-0.02m	
Delta Northing	0.00m		-0.01m	
Delta Height	0.00m		-0.01m	

Position of Moonpool_1 from waypoint				
Range	2.48m		2.48m	
Bearing	342.63°True		342.23°True	



Summary of Excalibur Positions

	Primary	SD	Quaternary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK1 - Starfix.XP2-10002	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	608 of 608 used		608 of 608 used	

Heading (Corrected)	282.13°True (C-O: 0.00°)	±0.03°	282.13°True (C-O: 0.00°)	±0.03°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°52.9247'N	±0.03m	55°52.9246'N	±0.02m
Longitude	07°33.1451'E	±0.02m	07°33.1451'E	±0.02m
Height	48.02m Ell.	±0.03m	48.12m Ell.	±0.04m
Grid System	UTM zone 32N CM 9° E			
Easting	409,446.31m E	±0.02m	409,446.33m E	±0.02m
Northing	6,193,902.38m N	±0.04m	6,193,902.30m N	±0.02m
Height	7.30m MSS	±0.13m	7.40m MSS	±0.14m
Delta Easting	0.00m		0.02m	
Delta Northing	0.00m		-0.09m	
Delta Height	0.00m		0.10m	

Position of Moonpool_1 from waypoint				
Range	2.48m		2.39m	
Bearing	342.63°True		342.51°True	

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FINAL FIX REPORT



Summary of Excalibur Positions

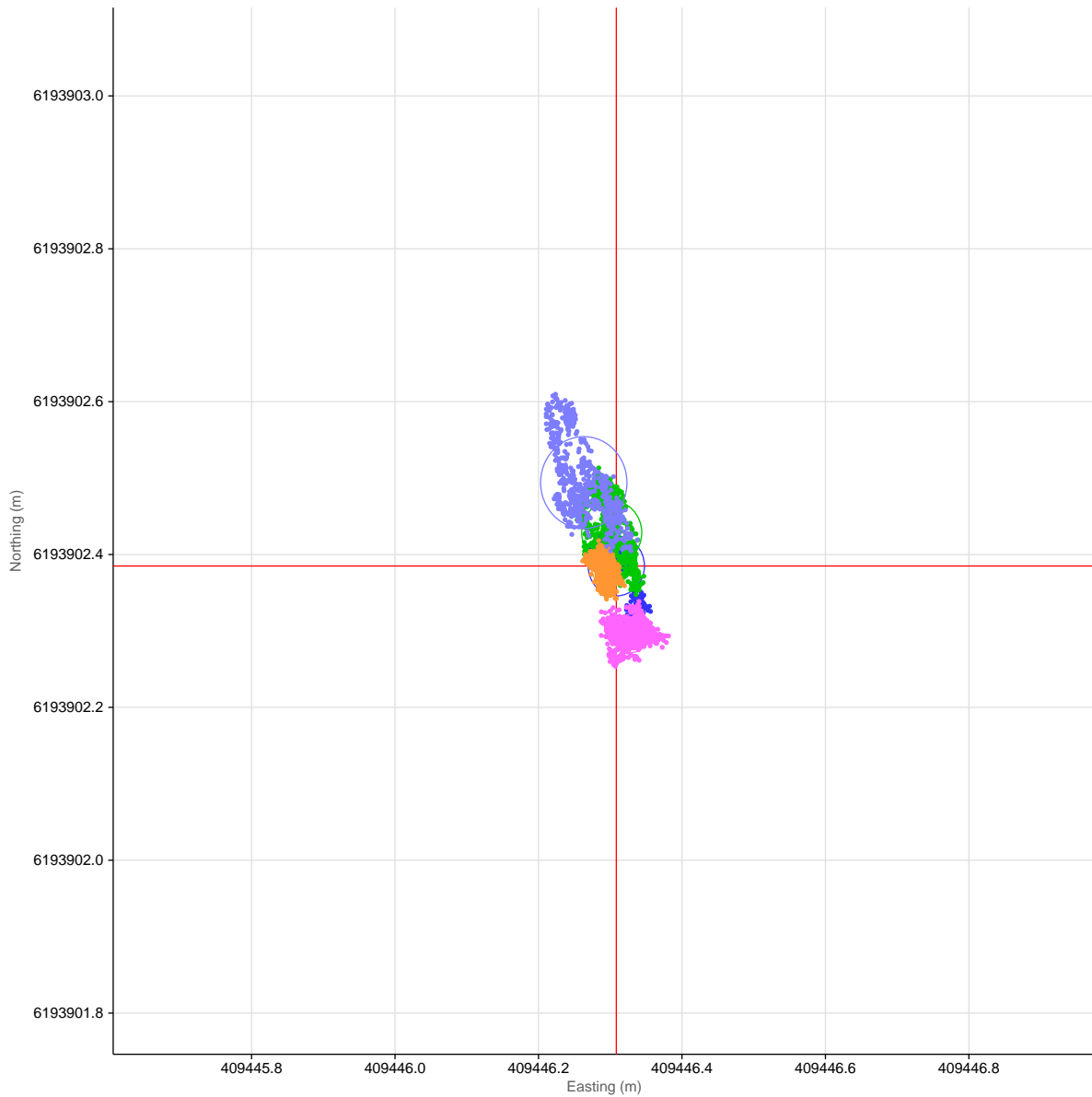
	Primary	SD	Quinary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK2 - Starfix.G4-20001	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	608 of 608 used		608 of 608 used	

Heading (Corrected)	282.13°True (C-O: 0.00°)	±0.03°	282.13°True (C-O: 0.00°)	±0.03°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°52.9247'N	±0.03m	55°52.9247'N	±0.05m
Longitude	07°33.1451'E	±0.02m	07°33.1450'E	±0.03m
Height	48.02m Ell.	±0.03m	47.95m Ell.	±0.18m
Grid System	UTM zone 32N CM 9° E			
Easting	409,446.31m E	±0.02m	409,446.26m E	±0.03m
Northing	6,193,902.38m N	±0.04m	6,193,902.49m N	±0.05m
Height	7.30m MSS	±0.13m	7.23m MSS	±0.22m
Delta Easting	0.00m		-0.05m	
Delta Northing	0.00m		0.11m	
Delta Height	0.00m		-0.07m	

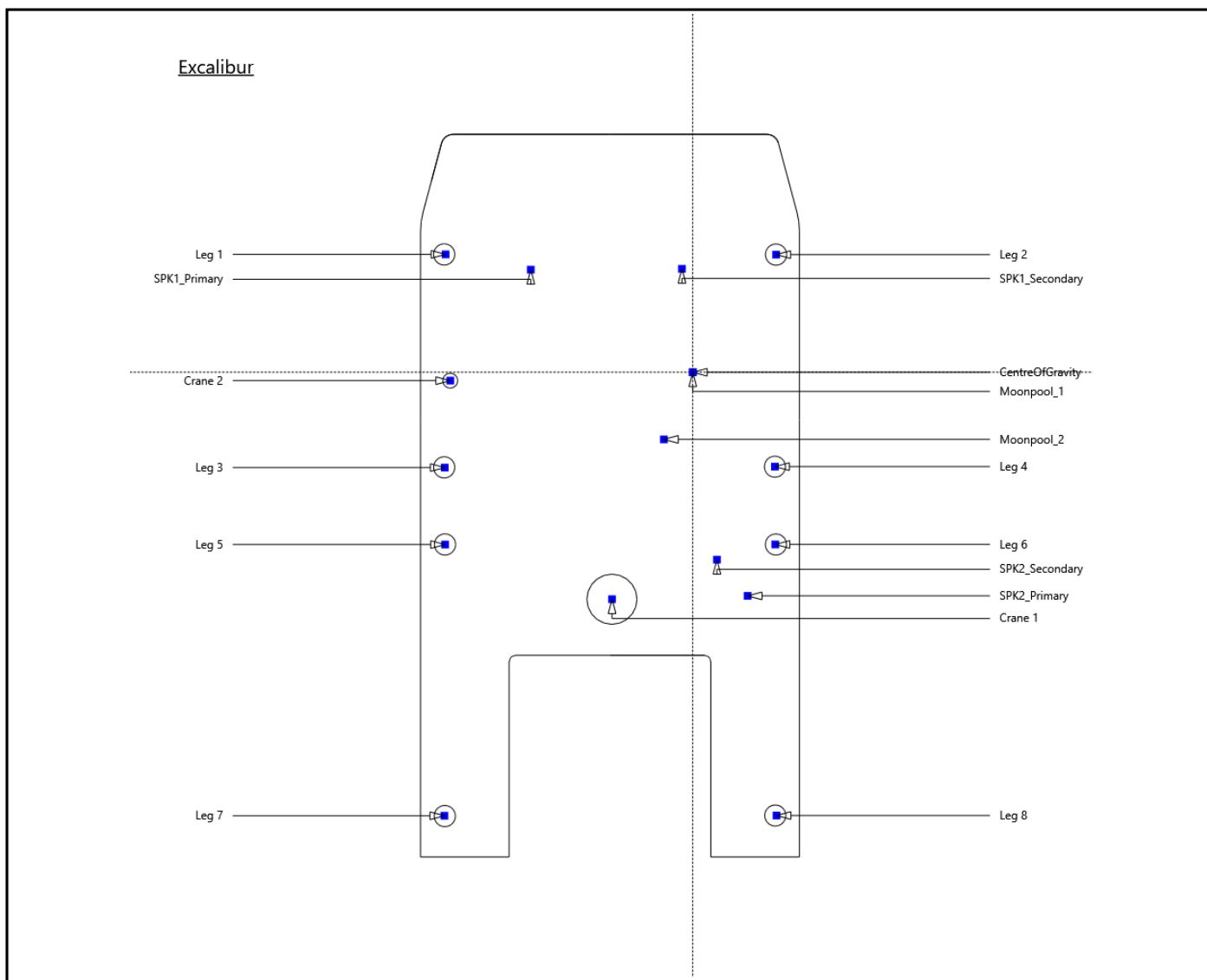
Position of Moonpool_1 from waypoint				
Range	2.48m		2.60m	
Bearing	342.63°True		342.34°True	

Scatter Plot



Sensor Group	Excalibur Mean Position at Moonpool_1 ETRS89 / UTM zone 32N [ETRF2000- ITRF2014][2023],DTU21 MSS height [DTU21 MSS]	Delta Easting	Delta Northing	Delta Height
Primary	409,446.31m E, 6,193,902.38m N, 7.30m MSS	0.00m	0.00m	0.00m
Secondary	409,446.30m E, 6,193,902.43m N, 7.14m MSS	-0.01m	0.04m	-0.16m
Tertiary	409,446.29m E, 6,193,902.38m N, 7.29m MSS	-0.02m	-0.01m	-0.01m
Quaternary	409,446.33m E, 6,193,902.30m N, 7.40m MSS	0.02m	-0.09m	0.10m
Quinary	409,446.26m E, 6,193,902.49m N, 7.23m MSS	-0.05m	0.11m	-0.07m

Excalibur Outline and Offsets



Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m



SPK2_Secondary		2.04m	-15.81m	6.97m
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EXCALIBUR_240149
FINAL FIX REPORT



Project ID: Excalibur_240149
 Starfix Version: v2022.1110.9 (build 0)
 Client: Fugro Geoservices Inc
 Client Rep: Rob Harwood
 Fugro Personnel: Jamie Davison
 Primary Vessel: Excalibur
 Location: UK
 Comment:

Session Name: 20240504-093600-v1
 Start Time: 04 May 2024, 10:37:00+01:00
 End Time: 04 May 2024, 10:45:19+01:00 (Session Length 0.139 hrs - No. Obs. 500)

Position Fix Summary for Excalibur at CPT221

Moonpool_1 position computed from SPK1 - Starfix.G4 Plus-10003 (Primary)

Geodetic Datum	European Terrestrial Reference System 1989	International Terrestrial Reference Frame 2014
Latitude	55°49.1336'N	55°49.1339'N
Longitude	07°37.9473'E	07°37.9479'E
Grid System	UTM zone 32N CM 9° E	
Easting	414,313.81m E	
Northing	6,186,769.24m N	
Height	8.13m MSS (DTU21 MSS height)	
Heading	86.02°True (87.15°Grid)	

Position for Moonpool_1 is 0.79m @ 192.803°True (193.935°Grid) FROM the waypoint.

Moonpool_1 from CRP:	Starboard = 0.00m	Forward = 0.00m	Up = 0.00m
SPK1_Primary from CRP:	Starboard = -13.67m	Forward = 8.65m	Up = 11.73m
Heading correction applied (C-O):	0.00°		
Convergence:	-1.13129°		

Waypoint

European Terrestrial Reference System 1989		UTM zone 32N CM 9° E	
Latitude: 55°49.1340'N	Longitude: 07°37.9475'E	Easting: 414,314.00m E	Northing: 6,186,770.00m N
Intended Vessel Heading	0.000°True		

Positioning System Comparison

Sensor	Mean Position	Delta Easting	Delta Northing	Delta Height
	UTM zone 32N CM 9° E			
Primary	414,313.81m E, 6,186,769.24m N, 8.13m MSS	0.00m	0.00m	0.00m
Secondary	414,313.80m E, 6,186,769.28m N, 8.11m MSS	-0.01m	0.04m	-0.03m
Tertiary	414,313.77m E, 6,186,769.24m N, 8.04m MSS	-0.04m	0.01m	-0.09m
Quaternary	414,313.84m E, 6,186,769.28m N, 8.08m MSS	0.03m	0.04m	-0.05m
Quinary	414,313.78m E, 6,186,769.26m N, 7.99m MSS	-0.03m	0.02m	-0.15m


 Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North Marine)


 Rob Harwood
 Client Representative
 Fugro Geoservices Inc



Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	414,313.81	6,186,769.24	8.13	55°49.1336'N	07°37.9473'E
Crane 1	414,294.36	6,186,775.08	8.13	55°49.1366'N	07°37.9286'E
Crane 2	414,312.09	6,186,789.63	8.13	55°49.1446'N	07°37.9453'E
Leg 1	414,322.70	6,186,790.56	8.13	55°49.1452'N	07°37.9554'E
Leg 2	414,324.06	6,186,762.70	8.13	55°49.1302'N	07°37.9573'E
Leg 3	414,304.74	6,186,789.73	8.13	55°49.1446'N	07°37.9383'E
Leg 4	414,306.21	6,186,761.91	8.13	55°49.1296'N	07°37.9402'E
Leg 5	414,298.27	6,186,789.38	8.13	55°49.1443'N	07°37.9321'E
Leg 6	414,299.66	6,186,761.56	8.13	55°49.1293'N	07°37.9339'E
Leg 7	414,275.43	6,186,788.31	8.13	55°49.1435'N	07°37.9102'E
Leg 8	414,276.84	6,186,760.32	8.13	55°49.1284'N	07°37.9121'E
Moonpool_1	414,313.81	6,186,769.24	8.13	55°49.1336'N	07°37.9473'E
Moonpool_2	414,308.04	6,186,771.39	8.10	55°49.1347'N	07°37.9418'E
SPK1_Primary	414,321.77	6,186,783.31	19.86	55°49.1413'N	07°37.9547'E
SPK1_Secondary	414,322.47	6,186,770.58	20.14	55°49.1344'N	07°37.9556'E
SPK2_Primary	414,295.21	6,186,763.68	14.96	55°49.1304'N	07°37.9296'E
SPK2_Secondary	414,298.13	6,186,766.41	15.10	55°49.1319'N	07°37.9324'E

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Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478



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Summary of Excalibur Positions

	Primary	SD	Secondary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK1 - Starfix.G4-10001	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	500 of 500 used		500 of 500 used	

ANTENNA POSITIONS	SPK1_Primary		SPK1_Primary	
Geodetic Datum	International Terrestrial Reference Frame 2014			
Latitude	55°49.1416'N	±0.01m	55°49.1416'N	±0.01m
Longitude	07°37.9552'E	±0.01m	07°37.9552'E	±0.01m
Height	60.59m Ell.	±0.03m	60.56m Ell.	±0.02m
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°49.1413'N	±0.01m	55°49.1413'N	±0.01m
Longitude	07°37.9547'E	±0.01m	07°37.9547'E	±0.01m
Height	60.56m Ell.	±0.03m	60.54m Ell.	±0.02m
Grid System	UTM zone 32N CM 9° E			
Easting	414,321.77m E	±0.01m	414,321.75m E	±0.01m
Northing	6,186,783.31m N	±0.01m	6,186,783.35m N	±0.01m
Height	19.86m MSS	±0.13m	19.84m MSS	±0.13m
Offsets from CRP				
Starboard	-13.67m		-13.67m	
Forward	8.65m		8.65m	
Up	11.73m		11.73m	

HDOP	0.68		0.68	
No. Satellites	20		20	
Age of Corrections	6.0 secs		5.0 secs	

Heading (Corrected)	86.02°True (C-O: 0.00°)	±0.06°	86.02°True (C-O: 0.00°)	±0.06°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°49.1336'N	±0.01m	55°49.1336'N	±0.01m
Longitude	07°37.9473'E	±0.02m	07°37.9473'E	±0.01m
Height	48.83m Ell.	±0.03m	48.81m Ell.	±0.02m
Grid System	UTM zone 32N CM 9° E			
Easting	414,313.81m E	±0.02m	414,313.80m E	±0.01m
Northing	6,186,769.24m N	±0.01m	6,186,769.28m N	±0.01m
Height	8.13m MSS	±0.13m	8.11m MSS	±0.13m
Delta Easting	0.00m		-0.01m	
Delta Northing	0.00m		0.04m	
Delta Height	0.00m		-0.03m	

Position of Moonpool_1 from waypoint				
Range	0.79m		0.75m	
Bearing	192.80°True		194.58°True	

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Summary of Excalibur Positions

	Primary	SD	Tertiary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK2 - Starfix.G4 Plus-20003	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	500 of 500 used		500 of 500 used	

ANTENNA POSITIONS	SPK1_Primary		SPK2_Primary	
Geodetic Datum	International Terrestrial Reference Frame 2014			
Latitude	55°49.1416'N	±0.01m	55°49.1307'N	±0.02m
Longitude	07°37.9552'E	±0.01m	07°37.9301'E	±0.02m
Height	60.59m Ell.	±0.03m	55.60m Ell.	±0.03m
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°49.1413'N	±0.01m	55°49.1304'N	±0.02m
Longitude	07°37.9547'E	±0.01m	07°37.9296'E	±0.02m
Height	60.56m Ell.	±0.03m	55.57m Ell.	±0.03m
Grid System	UTM zone 32N CM 9° E			
Easting	414,321.77m E	±0.01m	414,295.17m E	±0.02m
Northing	6,186,783.31m N	±0.01m	6,186,763.68m N	±0.02m
Height	19.86m MSS	±0.13m	14.87m MSS	±0.14m
Offsets from CRP				
Starboard	-13.67m		4.63m	
Forward	8.65m		-18.86m	
Up	11.73m		6.83m	

HDOP	0.68		0.75	
No. Satellites	20		14	
Age of Corrections	6.0 secs		9.0 secs	

Heading (Corrected)	86.02°True (C-O: 0.00°)	±0.06°	86.02°True (C-O: 0.00°)	±0.06°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°49.1336'N	±0.01m	55°49.1336'N	±0.03m
Longitude	07°37.9473'E	±0.02m	07°37.9473'E	±0.02m
Height	48.83m Ell.	±0.03m	48.74m Ell.	±0.03m
Grid System	UTM zone 32N CM 9° E			
Easting	414,313.81m E	±0.02m	414,313.77m E	±0.02m
Northing	6,186,769.24m N	±0.01m	6,186,769.24m N	±0.03m
Height	8.13m MSS	±0.13m	8.04m MSS	±0.14m
Delta Easting	0.00m		-0.04m	
Delta Northing	0.00m		0.01m	
Delta Height	0.00m		-0.09m	

Position of Moonpool_1 from waypoint			
Range	0.79m		0.79m
Bearing	192.80°True		195.48°True

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Summary of Excalibur Positions

	Primary	SD	Quaternary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK1 - Starfix.XP2-10002	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	500 of 500 used		500 of 500 used	

ANTENNA POSITIONS	SPK1_Primary		SPK1_Primary	
Geodetic Datum	International Terrestrial Reference Frame 2014			
Latitude	55°49.1416'N	±0.01m	55°49.1416'N	±0.01m
Longitude	07°37.9552'E	±0.01m	07°37.9552'E	±0.01m
Height	60.59m Ell.	±0.03m	60.54m Ell.	±0.03m
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°49.1413'N	±0.01m	55°49.1413'N	±0.01m
Longitude	07°37.9547'E	±0.01m	07°37.9547'E	±0.01m
Height	60.56m Ell.	±0.03m	60.51m Ell.	±0.03m
Grid System	UTM zone 32N CM 9° E			
Easting	414,321.77m E	±0.01m	414,321.79m E	±0.01m
Northing	6,186,783.31m N	±0.01m	6,186,783.36m N	±0.01m
Height	19.86m MSS	±0.13m	19.81m MSS	±0.14m
Offsets from CRP				
Starboard	-13.67m		-13.67m	
Forward	8.65m		8.65m	
Up	11.73m		11.73m	

HDOP	0.68		0.79	
No. Satellites	20		12	
Age of Corrections	6.0 secs		7.0 secs	

Heading (Corrected)	86.02°True (C-O: 0.00°)	±0.06°	86.02°True (C-O: 0.00°)	±0.06°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°49.1336'N	±0.01m	55°49.1336'N	±0.01m
Longitude	07°37.9473'E	±0.02m	07°37.9474'E	±0.02m
Height	48.83m Ell.	±0.03m	48.78m Ell.	±0.03m
Grid System	UTM zone 32N CM 9° E			
Easting	414,313.81m E	±0.02m	414,313.84m E	±0.02m
Northing	6,186,769.24m N	±0.01m	6,186,769.28m N	±0.01m
Height	8.13m MSS	±0.13m	8.08m MSS	±0.14m
Delta Easting	0.00m		0.03m	
Delta Northing	0.00m		0.04m	
Delta Height	0.00m		-0.05m	

Position of Moonpool_1 from waypoint			
Range	0.79m		0.74m
Bearing	192.80°True		191.64°True

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Summary of Excalibur Positions

	Primary	SD	Quinary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK2 - Starfix.G4-20001	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	500 of 500 used		500 of 500 used	

ANTENNA POSITIONS	SPK1_Primary		SPK2_Primary	
Geodetic Datum	International Terrestrial Reference Frame 2014			
Latitude	55°49.1416'N	±0.01m	55°49.1308'N	±0.01m
Longitude	07°37.9552'E	±0.01m	07°37.9301'E	±0.02m
Height	60.59m Ell.	±0.03m	55.54m Ell.	±0.04m
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°49.1413'N	±0.01m	55°49.1304'N	±0.01m
Longitude	07°37.9547'E	±0.01m	07°37.9296'E	±0.02m
Height	60.56m Ell.	±0.03m	55.52m Ell.	±0.04m
Grid System	UTM zone 32N CM 9° E			
Easting	414,321.77m E	±0.01m	414,295.18m E	±0.02m
Northing	6,186,783.31m N	±0.01m	6,186,763.70m N	±0.01m
Height	19.86m MSS	±0.13m	14.82m MSS	±0.14m
Offsets from CRP				
Starboard	-13.67m		4.63m	
Forward	8.65m		-18.86m	
Up	11.73m		6.83m	

HDOP	0.68		0.75	
No. Satellites	20		14	
Age of Corrections	6.0 secs		6.0 secs	

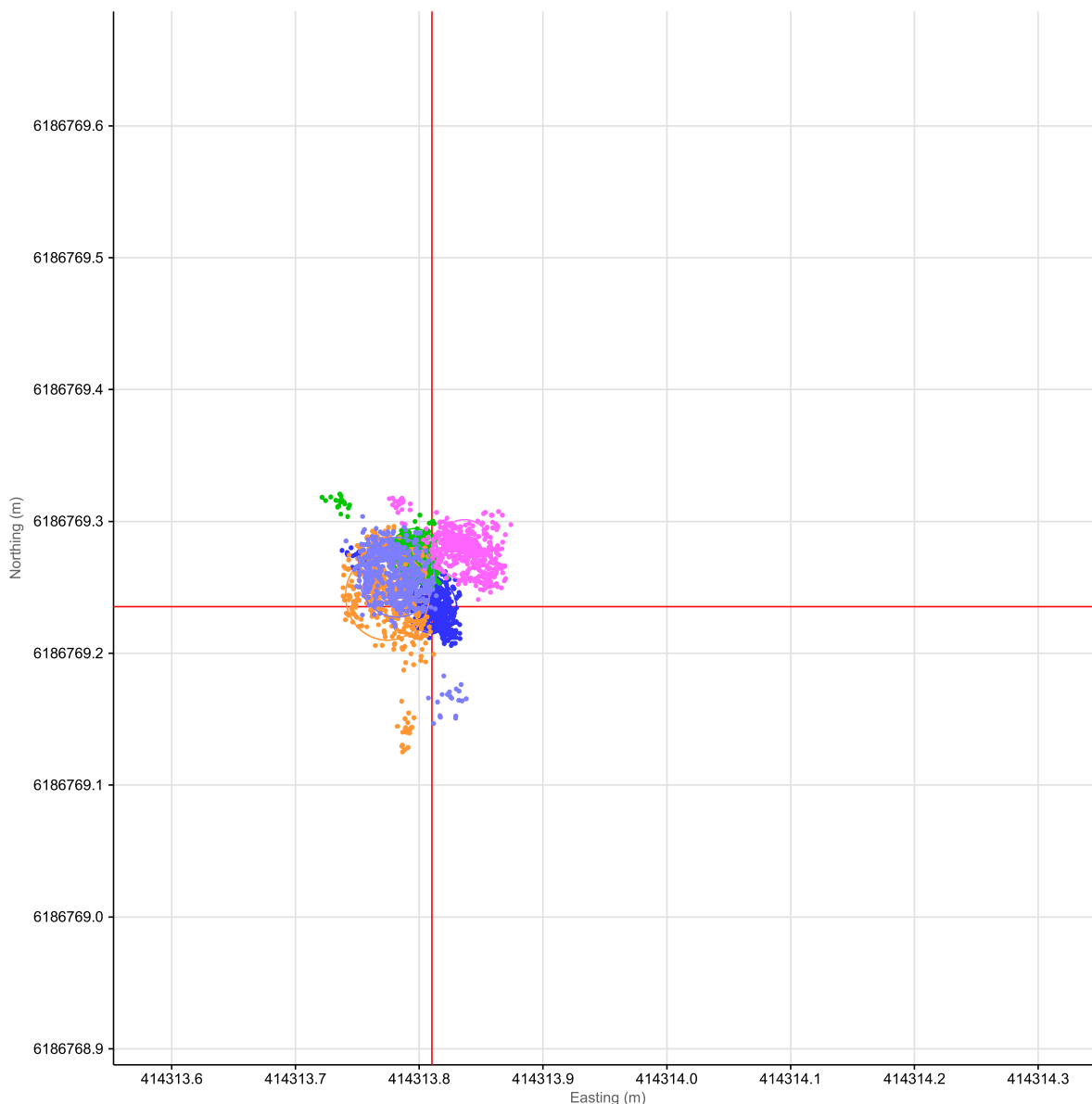
Heading (Corrected)	86.02°True (C-O: 0.00°)	±0.06°	86.02°True (C-O: 0.00°)	±0.06°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°49.1336'N	±0.01m	55°49.1336'N	±0.02m
Longitude	07°37.9473'E	±0.02m	07°37.9473'E	±0.02m
Height	48.83m Ell.	±0.03m	48.69m Ell.	±0.04m
Grid System	UTM zone 32N CM 9° E			
Easting	414,313.81m E	±0.02m	414,313.78m E	±0.02m
Northing	6,186,769.24m N	±0.01m	6,186,769.26m N	±0.02m
Height	8.13m MSS	±0.13m	7.99m MSS	±0.14m
Delta Easting	0.00m		-0.03m	
Delta Northing	0.00m		0.02m	
Delta Height	0.00m		-0.15m	

Position of Moonpool_1 from waypoint			
Range	0.79m		0.77m
Bearing	192.80°True		195.23°True

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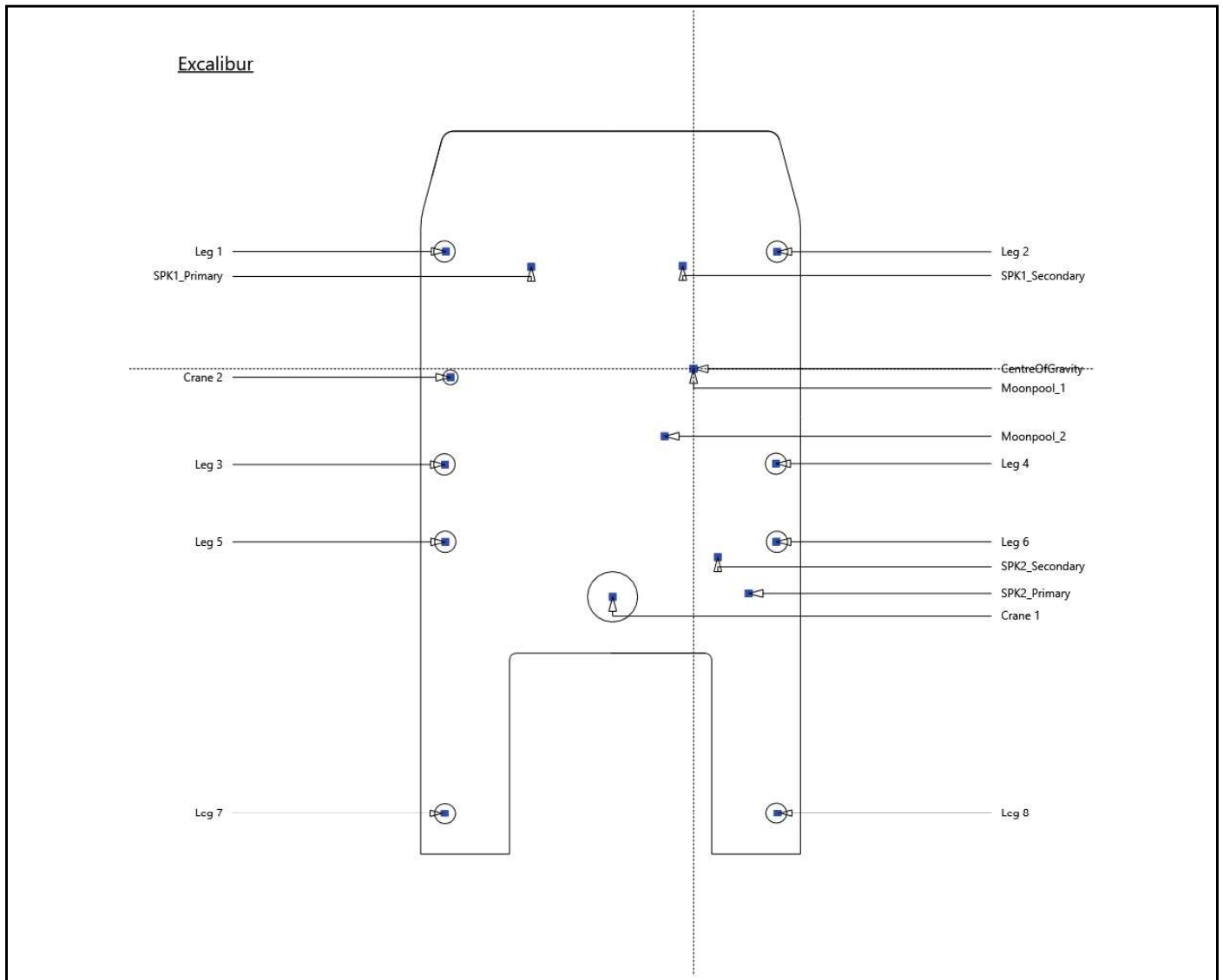
Scatter Plot



Sensor Group	Excalibur Mean Position at Moonpool_1 ETRS89 / UTM zone 32N [ETRF2000- ITRF2014][2023],DTU21 MSS height [DTU21 MSS]	Delta Easting	Delta Northing	Delta Height
Primary	414,313.81m E, 6,186,769.24m N, 8.13m MSS	0.00m	0.00m	0.00m
Secondary	414,313.80m E, 6,186,769.28m N, 8.11m MSS	-0.01m	0.04m	-0.03m
Tertiary	414,313.77m E, 6,186,769.24m N, 8.04m MSS	-0.04m	0.01m	-0.09m
Quaternary	414,313.84m E, 6,186,769.28m N, 8.08m MSS	0.03m	0.04m	-0.05m
Quinary	414,313.78m E, 6,186,769.26m N, 7.99m MSS	-0.03m	0.02m	-0.15m

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Excalibur Outline and Offsets



Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	8.3m
SPK1_Secondary		-0.91m	8.72m	8.1m
SPK2_Primary		4.63m	-18.86m	6.83m

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SPK2_Secondary		2.04m	-15.81m	6.97m
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Project ID	Excalibur_240149
Starfix Version	v2022.1110.9 (build 0)
Client	Fugro Geoservices Inc
Primary Vessel	Excalibur
Location Description	UK

Session Name	20240517-181046-v1	
Start Time	17 May 2024, 19:10:57+01:00	End Time 17 May 2024, 19:19:17+01:00

Position Source:	SPK1 - Starfix.G4 Plus-10003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.6472'N	±0.02m
Longitude - ETRS89	07°32.6298'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,820.24m E	±0.02m
Northing	6,189,689.74m N	±0.02m
Convergence	-1.20508°	
Heading ° True	83.20° T	±0.03°
Heading ° Grid	84.41° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.6476'N	±0.02m
Longitude - ITRF2014	07°32.6303'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

Seabed Depth :	0.0m
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The final position was computed from session "20240517-181046-v1" by averaging 500 observations from a total of 500 observations between 17/05/2024 19:10:58 (UTC+01:00) and 17/05/2024 19:19:17 (UTC+01:00).

Position from	Waypoint: CPT247
Excalibur at Moonpool_1	0.35m Geodetic @ 315.60° T

Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	408,820.24m E, 6,189,689.74m N, 7.18m MSS	0.00m	0.00m	0.00m
Secondary	408,820.37m E, 6,189,689.73m N, 7.20m MSS	0.13m	-0.01m	0.01m
Tertiary	408,820.36m E, 6,189,689.66m N, 7.04m MSS	0.12m	-0.08m	-0.14m
Quaternary	408,820.28m E, 6,189,689.76m N, 7.05m MSS	0.04m	0.02m	-0.13m
Quinary	408,820.39m E, 6,189,689.69m N, 7.03m MSS	0.15m	-0.05m	-0.15m

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc



Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	408,820.24	6,189,689.74	7.18	55°50.6472'N	07°32.6298'E
Crane 1	408,800.53	6,189,694.65	7.18	55°50.6497'N	07°32.6108'E
Crane 2	408,817.54	6,189,710.03	7.18	55°50.6581'N	07°32.6268'E
Leg 1	408,828.10	6,189,711.47	7.18	55°50.6590'N	07°32.6369'E
Leg 2	408,830.80	6,189,683.71	7.18	55°50.6441'N	07°32.6400'E
Leg 3	408,810.20	6,189,709.78	7.18	55°50.6579'N	07°32.6197'E
Leg 4	408,813.00	6,189,682.06	7.18	55°50.6430'N	07°32.6230'E
Leg 5	408,803.75	6,189,709.12	7.18	55°50.6575'N	07°32.6136'E
Leg 6	408,806.47	6,189,681.39	7.18	55°50.6426'N	07°32.6167'E
Leg 7	408,780.99	6,189,706.95	7.18	55°50.6561'N	07°32.5918'E
Leg 8	408,783.74	6,189,679.07	7.18	55°50.6411'N	07°32.5950'E
Moonpool_1	408,820.24	6,189,689.74	7.18	55°50.6472'N	07°32.6298'E
Moonpool_2	408,814.37	6,189,691.62	7.15	55°50.6482'N	07°32.6241'E
SPK1_Primary	408,827.52	6,189,704.19	18.91	55°50.6551'N	07°32.6364'E
SPK1_Secondary	408,828.83	6,189,691.50	19.19	55°50.6483'N	07°32.6380'E
SPK2_Primary	408,801.93	6,189,683.30	14.01	55°50.6436'N	07°32.6123'E
SPK2_Secondary	408,804.71	6,189,686.17	14.15	55°50.6451'N	07°32.6150'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

EXCALIBUR_240149
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Final Position for Moonpool_1 (Secondary)

Position Source:	SPK1 - Starfix.G4-10001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.6472'N	±0.01m
Longitude - ETRS89	07°32.6299'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,820.37m E	±0.01m
Northing	6,189,689.73m N	±0.01m
Convergence	-1.20508°	
Heading ° True	83.20° T	±0.03°
Heading ° Grid	84.41° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.6476'N	±0.01m
Longitude - ITRF2014	07°32.6304'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240517-181046-v1" by averaging 500 observations from a total of 500 observations between 17/05/2024 19:10:58 (UTC+01:00) and 17/05/2024 19:19:17 (UTC+01:00).

Position from	Waypoint: CPT247
Excalibur at Moonpool_1	0.46m Geodetic @ 304.92° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Tertiary)

Position Source:	SPK2 - Starfix.G4 Plus-20003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.6472'N	±0.02m
Longitude - ETRS89	07°32.6299'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,820.36m E	±0.02m
Northing	6,189,689.66m N	±0.02m
Convergence	-1.20508°	
Heading ° True	83.20° T	±0.03°
Heading ° Grid	84.41° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.6475'N	±0.02m
Longitude - ITRF2014	07°32.6304'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240517-181046-v1" by averaging 499 observations from a total of 499 observations between 17/05/2024 19:10:58 (UTC+01:00) and 17/05/2024 19:19:17 (UTC+01:00).

Position from	Waypoint: CPT247
Excalibur at Moonpool_1	0.50m Geodetic @ 311.88° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quaternary)

Position Source:	SPK1 - Starfix.XP2-10002
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.6472'N	±0.01m
Longitude - ETRS89	07°32.6298'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,820.28m E	±0.01m
Northing	6,189,689.76m N	±0.01m
Convergence	-1.20508°	
Heading ° True	83.20° T	±0.03°
Heading ° Grid	84.41° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.6476'N	±0.01m
Longitude - ITRF2014	07°32.6303'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240517-181046-v1" by averaging 500 observations from a total of 500 observations between 17/05/2024 19:10:58 (UTC+01:00) and 17/05/2024 19:19:17 (UTC+01:00).

Position from	Waypoint: CPT247
Excalibur at Moonpool_1	0.37m Geodetic @ 308.69° T

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FINAL FIX REPORT



Final Position for Moonpool_1 (Quinary)

Position Source:	SPK2 - Starfix.G4-20001
Heading Source:	SPK1 - GNSS Heading-10004

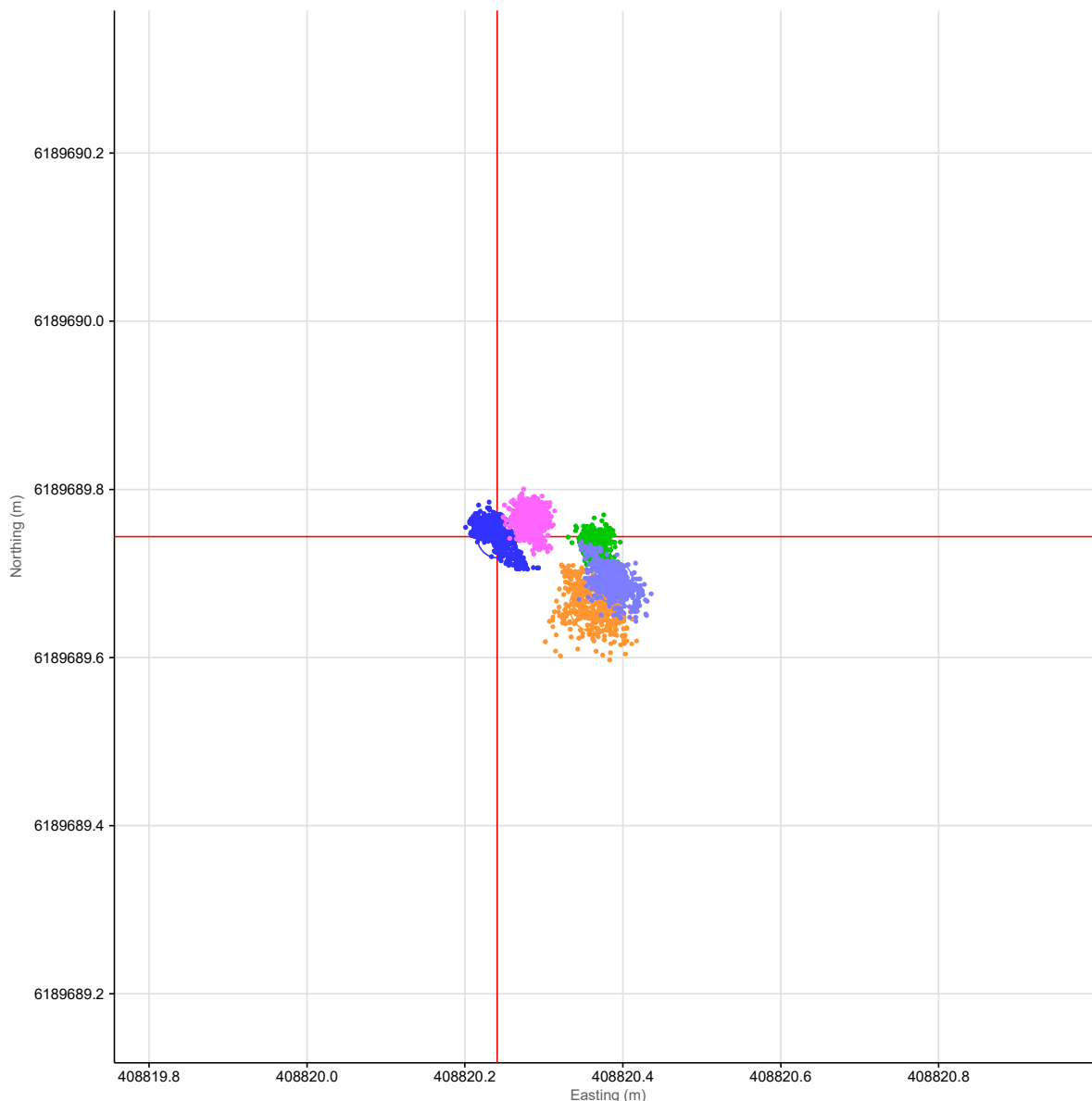
	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.6472'N	±0.02m
Longitude - ETRS89	07°32.6299'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,820.39m E	±0.02m
Northing	6,189,689.69m N	±0.02m
Convergence	-1.20508°	
Heading ° True	83.20° T	±0.03°
Heading ° Grid	84.41° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.6475'N	±0.02m
Longitude - ITRF2014	07°32.6304'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240517-181046-v1" by averaging 499 observations from a total of 499 observations between 17/05/2024 19:10:58 (UTC+01:00) and 17/05/2024 19:19:17 (UTC+01:00).

Position from	Waypoint: CPT247
Excalibur at Moonpool_1	0.50m Geodetic @ 307.43° T

Scatter Plot-ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	408,820.24m E, 6,189,689.74m N, 7.18m MSS	0.00m	0.00m	0.00m
Secondary	408,820.37m E, 6,189,689.73m N, 7.20m MSS	0.13m	-0.01m	0.01m
Tertiary	408,820.36m E, 6,189,689.66m N, 7.04m MSS	0.12m	-0.08m	-0.14m
Quaternary	408,820.28m E, 6,189,689.76m N, 7.05m MSS	0.04m	0.02m	-0.13m
Quinary	408,820.39m E, 6,189,689.69m N, 7.03m MSS	0.15m	-0.05m	-0.15m

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Antenna Positions

Primary

	Antenna Position for SPK1 - Starfix.G4 Plus-10003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.6551'N	±0.02m
Longitude - ETRS89	07°32.6364'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,827.52m E	±0.02m
Northing	6,189,704.19m N	±0.02m
Raw Rig Heading ° True	83.20° T	±0.03°
Raw Rig Heading ° Grid	84.41° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.6554'N	±0.02m
Longitude - ITRF2014	07°32.6370'E	±0.02m

Secondary

	Antenna Position for SPK1 - Starfix.G4-10001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.6551'N	±0.01m
Longitude - ETRS89	07°32.6366'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,827.64m E	±0.01m
Northing	6,189,704.18m N	±0.01m
Raw Rig Heading ° True	83.20° T	±0.03°
Raw Rig Heading ° Grid	84.41° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.6554'N	±0.01m
Longitude - ITRF2014	07°32.6371'E	±0.01m

Tertiary

	Antenna Position for SPK2 - Starfix.G4 Plus-20003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.6435'N	±0.02m
Longitude - ETRS89	07°32.6125'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,802.05m E	±0.02m
Northing	6,189,683.22m N	±0.02m
Raw Rig Heading ° True	83.20° T	±0.03°
Raw Rig Heading ° Grid	84.41° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.6438'N	±0.02m
Longitude - ITRF2014	07°32.6130'E	±0.02m

Quaternary

	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	

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FINAL FIX REPORT

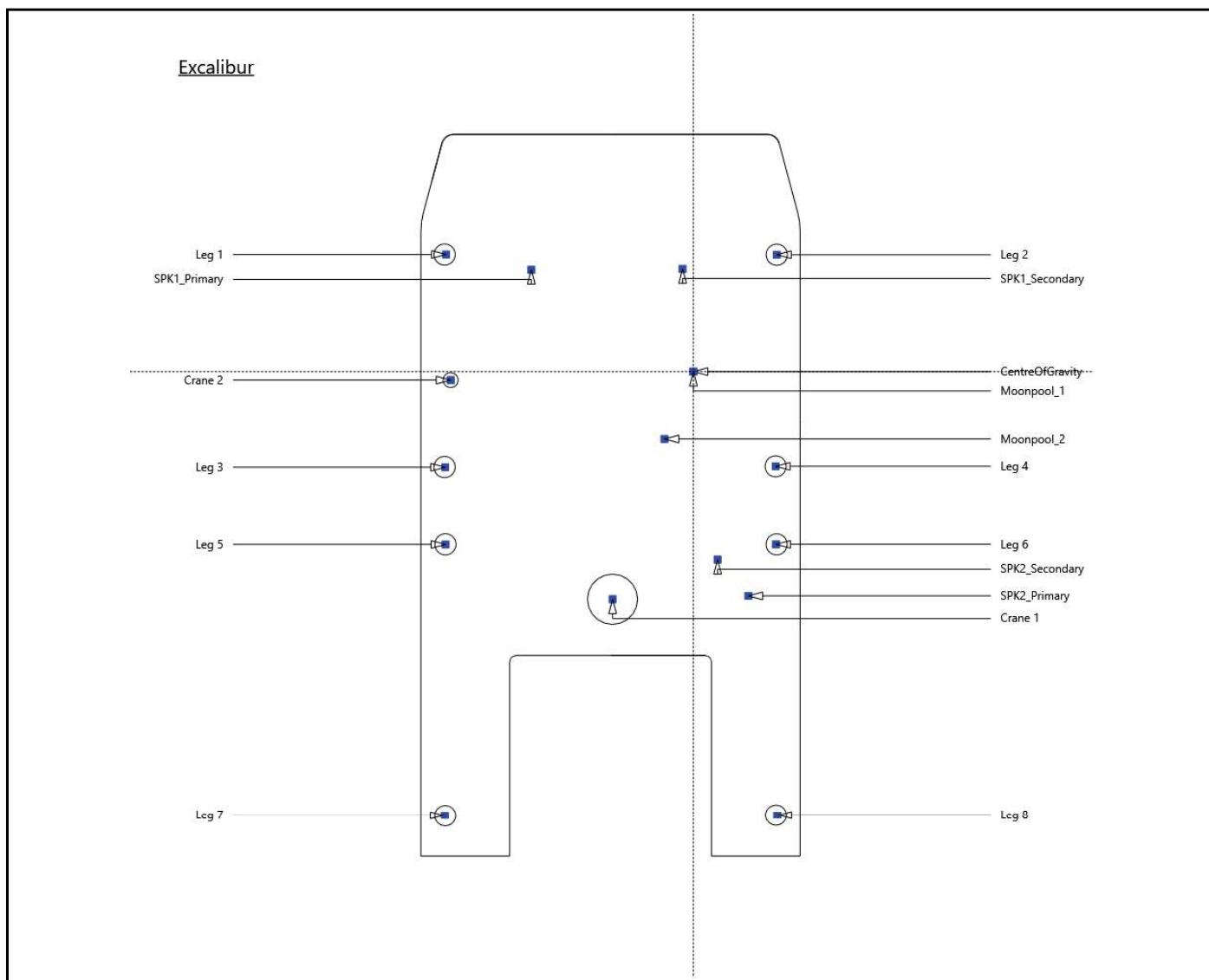


	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.6551'N	±0.01m
Longitude - ETRS89	07°32.6365'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,827.56m E	±0.01m
Northing	6,189,704.21m N	±0.01m
Raw Rig Heading ° True	83.20° T	±0.03°
Raw Rig Heading ° Grid	84.41° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.6554'N	±0.01m
Longitude - ITRF2014	07°32.6370'E	±0.01m

Quinary

	Antenna Position for SPK2 - Starfix.G4-20001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.6435'N	±0.02m
Longitude - ETRS89	07°32.6125'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	408,802.07m E	±0.02m
Northing	6,189,683.25m N	±0.02m
Raw Rig Heading ° True	83.20° T	±0.03°
Raw Rig Heading ° Grid	84.41° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.6439'N	±0.02m
Longitude - ITRF2014	07°32.6130'E	±0.02m

Vessel Outline and Offsets





Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m
SPK2_Secondary		2.04m	-15.81m	6.97m

EXCALIBUR_240149

FINAL FIX REPORT



Project ID: Excalibur_240149
Starfix Version: v2022.1110.9 (build 0)
Client: Fugro Geoservices Inc
Client Rep: OCR
Fugro Personnel: David Lloyd
Primary Vessel: Excalibur
Location: UK
Comment:

Session Name: CPT251-v1
Start Time: 25 Jun 2024, 07:26:58+01:00
End Time: 25 Jun 2024, 07:28:58+01:00 (Session Length 0.033 hrs - No. Obs. 120)

Position Fix Summary for Excalibur at CPT251

Moonpool_1 position computed from SPK1 - Starfix.G4 Plus-10003 (Primary)

Geodetic Datum	European Terrestrial Reference System 1989	International Terrestrial Reference Frame 2014
Latitude	55°52.1911'N	55°52.1914'N
Longitude	07°31.7381'E	07°31.7386'E
Grid System	UTM zone 32N CM 9° E	
Easting	407,950.64m E	
Northing	6,192,572.84m N	
Height	7.62m MSS (DTU21 MSS height)	
Heading	225.95°True (227.17°Grid)	

Position for Moonpool_1 is 3.87m @ 41.662°True (42.880°Grid) FROM the waypoint.

Moonpool_1 from CRP:	Starboard = 0.00m	Forward = 0.00m	Up = 0.00m
SPK1_Primary from CRP:	Starboard = -13.67m	Forward = 8.65m	Up = 11.73m
Heading correction applied (C-O):	0.00°		
Convergence:	-1.21771°		

Waypoint

European Terrestrial Reference System 1989		UTM zone 32N CM 9° E	
Latitude: 55°52.1896'N	Longitude: 07°31.7356'E	Easting: 407,948.00m E	Northing: 6,192,570.00m N
Intended Vessel Heading	0.000°True		

Positioning System Comparison

Sensor	Mean Position	Delta Easting	Delta Northing	Delta Height
	UTM zone 32N CM 9° E			
Primary	407,950.64m E, 6,192,572.84m N, 7.62m MSS	0.00m	0.00m	0.00m
Secondary	407,950.69m E, 6,192,572.82m N, 7.54m MSS	0.06m	-0.02m	-0.08m
Tertiary	407,950.64m E, 6,192,572.86m N, 7.55m MSS	0.00m	0.02m	-0.07m
Quaternary	407,950.64m E, 6,192,572.86m N, 7.65m MSS	0.01m	0.02m	0.03m
Quinary	407,950.72m E, 6,192,572.81m N, 7.58m MSS	0.08m	-0.03m	-0.04m

David Lloyd

Party Chief
FGBNM (Fugro Great Britain North Marine)

OCR

Client Representative
Fugro Geoservices Inc

Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	407,950.64	6,192,572.84	7.62	55°52.1911'N	07°31.7381'E
Crane 1	407,969.30	6,192,580.85	7.62	55°52.1957'N	07°31.7558'E
Crane 2	407,965.06	6,192,558.32	7.62	55°52.1835'N	07°31.7522'E
Leg 1	407,957.52	6,192,550.79	7.62	55°52.1793'N	07°31.7452'E
Leg 2	407,938.58	6,192,571.26	7.62	55°52.1901'N	07°31.7266'E
Leg 3	407,970.75	6,192,562.96	7.62	55°52.1860'N	07°31.7576'E
Leg 4	407,951.76	6,192,583.34	7.62	55°52.1968'N	07°31.7390'E
Leg 5	407,975.49	6,192,567.39	7.62	55°52.1885'N	07°31.7620'E
Leg 6	407,956.54	6,192,587.82	7.62	55°52.1993'N	07°31.7435'E
Leg 7	407,992.30	6,192,582.89	7.62	55°52.1970'N	07°31.7778'E
Leg 8	407,973.24	6,192,603.43	7.62	55°52.2079'N	07°31.7591'E
Moonpool_1	407,950.64	6,192,572.84	7.62	55°52.1911'N	07°31.7381'E
Moonpool_2	407,956.44	6,192,574.90	7.59	55°52.1923'N	07°31.7436'E
SPK1_Primary	407,953.58	6,192,556.94	19.35	55°52.1826'N	07°31.7413'E
SPK1_Secondary	407,944.86	6,192,566.25	19.63	55°52.1875'N	07°31.7327'E
SPK2_Primary	407,961.32	6,192,589.05	14.45	55°52.2000'N	07°31.7480'E
SPK2_Secondary	407,960.84	6,192,585.08	14.59	55°52.1978'N	07°31.7476'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

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Summary of Excalibur Positions

	Primary	SD	Secondary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK2 - Starfix.G4 Plus-20003	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	120 of 120 used		120 of 120 used	

Heading (Corrected)	225.95°True (C-O: 0.00°)	±0.02°	225.95°True (C-O: 0.00°)	±0.02°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°52.1911'N	±0.01m	55°52.1911'N	±0.02m
Longitude	07°31.7381'E	±0.01m	07°31.7382'E	±0.01m
Height	48.34m Ell.	±0.01m	48.26m Ell.	±0.05m
Grid System	UTM zone 32N CM 9° E			
Easting	407,950.64m E	±0.01m	407,950.69m E	±0.01m
Northing	6,192,572.84m N	±0.01m	6,192,572.82m N	±0.02m
Height	7.62m MSS	±0.13m	7.54m MSS	±0.14m
Delta Easting	0.00m		0.06m	
Delta Northing	0.00m		-0.02m	
Delta Height	0.00m		-0.08m	

Position of Moonpool_1 from waypoint				
Range	3.87m		3.90m	
Bearing	41.66°True		42.49°True	

Summary of Excalibur Positions

	Primary	SD	Tertiary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK1 - Starfix.G4-10001	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	120 of 120 used		120 of 120 used	

Heading (Corrected)	225.95°True (C-O: 0.00°)	±0.02°	225.95°True (C-O: 0.00°)	±0.02°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°52.1911'N	±0.01m	55°52.1911'N	±0.01m
Longitude	07°31.7381'E	±0.01m	07°31.7381'E	±0.01m
Height	48.34m Ell.	±0.01m	48.27m Ell.	±0.01m
Grid System	UTM zone 32N CM 9° E			
Easting	407,950.64m E	±0.01m	407,950.64m E	±0.01m
Northing	6,192,572.84m N	±0.01m	6,192,572.86m N	±0.01m
Height	7.62m MSS	±0.13m	7.55m MSS	±0.13m
Delta Easting	0.00m		0.00m	
Delta Northing	0.00m		0.02m	
Delta Height	0.00m		-0.07m	

Position of Moonpool_1 from waypoint				
Range	3.87m		3.89m	
Bearing	41.66°True		41.42°True	

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Summary of Excalibur Positions

	Primary	SD	Quaternary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK1 - Starfix.XP2-10002	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	120 of 120 used		120 of 120 used	

Heading (Corrected)	225.95°True (C-O: 0.00°)	±0.02°	225.95°True (C-O: 0.00°)	±0.02°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°52.1911'N	±0.01m	55°52.1911'N	±0.02m
Longitude	07°31.7381'E	±0.01m	07°31.7381'E	±0.02m
Height	48.34m Ell.	±0.01m	48.37m Ell.	±0.02m
Grid System	UTM zone 32N CM 9° E			
Easting	407,950.64m E	±0.01m	407,950.64m E	±0.02m
Northing	6,192,572.84m N	±0.01m	6,192,572.86m N	±0.02m
Height	7.62m MSS	±0.13m	7.65m MSS	±0.14m
Delta Easting	0.00m		0.01m	
Delta Northing	0.00m		0.02m	
Delta Height	0.00m		0.03m	

Position of Moonpool_1 from waypoint				
Range	3.87m		3.90m	
Bearing	41.66°True		41.55°True	

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Summary of Excalibur Positions

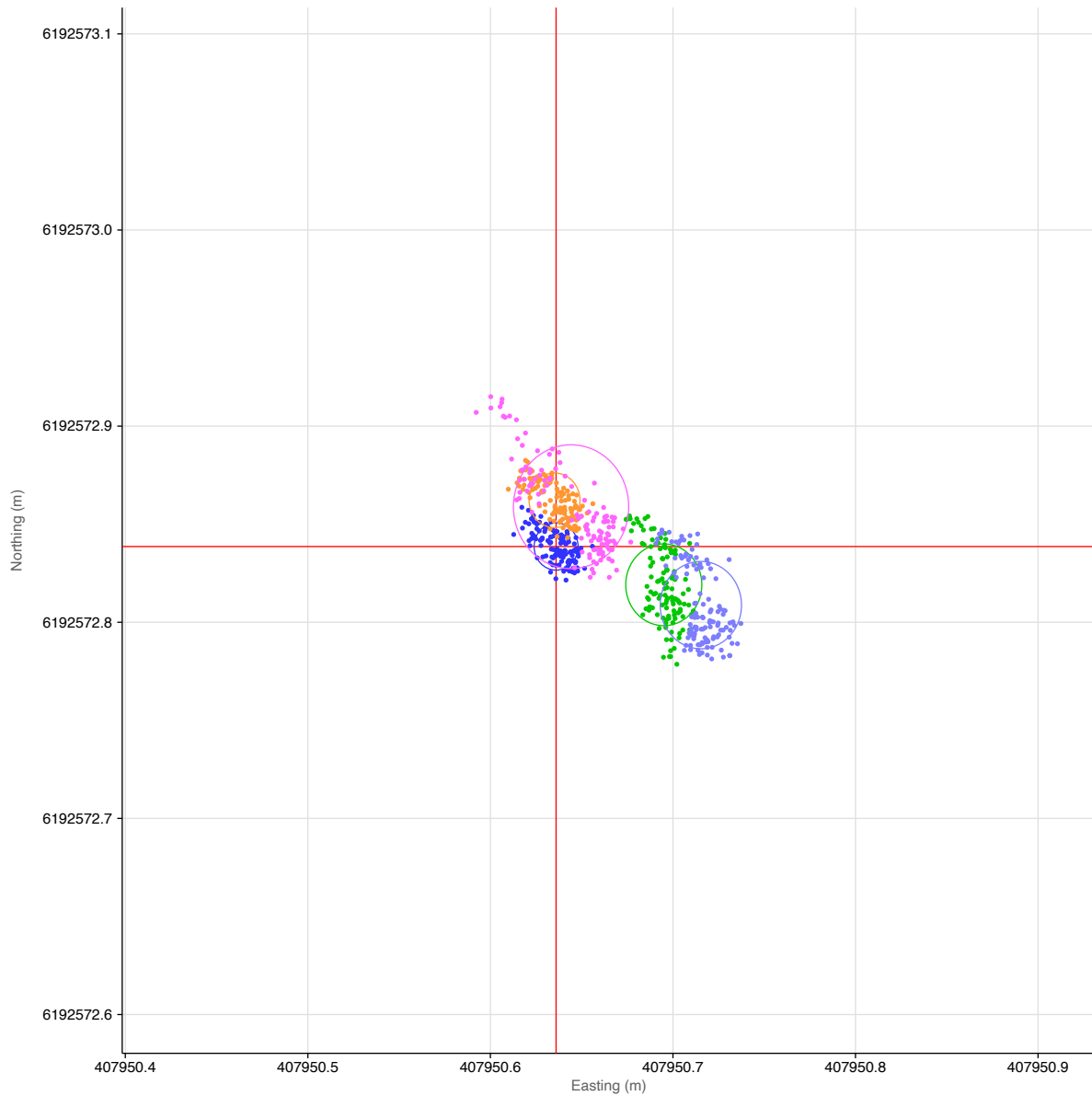
	Primary	SD	Quinary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK2 - Starfix.G4-20001	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	120 of 120 used		120 of 120 used	

Heading (Corrected)	225.95°True (C-O: 0.00°)	±0.02°	225.95°True (C-O: 0.00°)	±0.02°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°52.1911'N	±0.01m	55°52.1911'N	±0.02m
Longitude	07°31.7381'E	±0.01m	07°31.7382'E	±0.01m
Height	48.34m Ell.	±0.01m	48.30m Ell.	±0.05m
Grid System	UTM zone 32N CM 9° E			
Easting	407,950.64m E	±0.01m	407,950.72m E	±0.01m
Northing	6,192,572.84m N	±0.01m	6,192,572.81m N	±0.02m
Height	7.62m MSS	±0.13m	7.58m MSS	±0.14m
Delta Easting	0.00m		0.08m	
Delta Northing	0.00m		-0.03m	
Delta Height	0.00m		-0.04m	

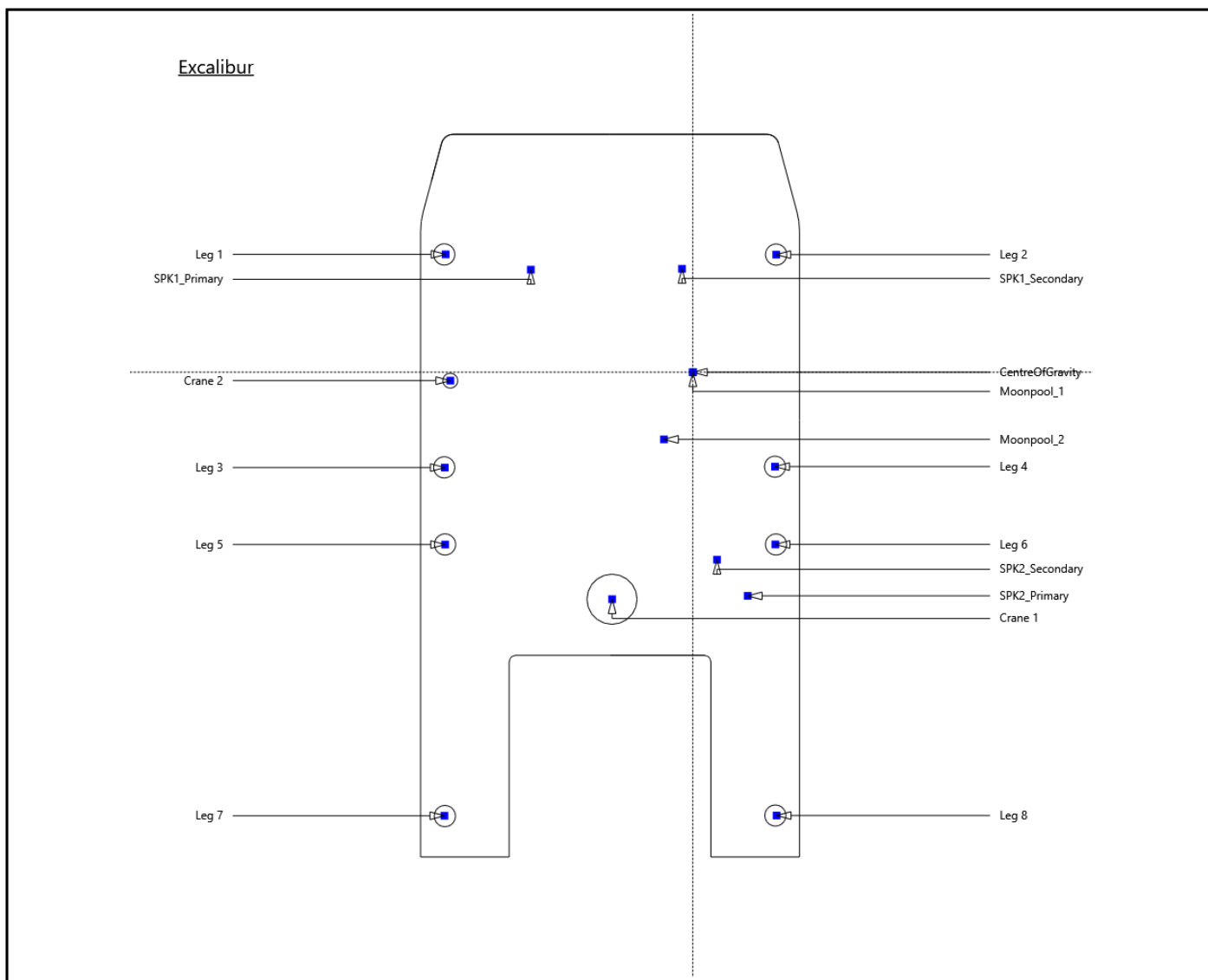
Position of Moonpool_1 from waypoint				
Range	3.87m		3.91m	
Bearing	41.66°True		42.81°True	

Scatter Plot



Sensor Group	Excalibur Mean Position at Moonpool_1 ETRS89 / UTM zone 32N [ETRF2000- ITRF2014][2023],DTU21 MSS height [DTU21 MSS]	Delta Easting	Delta Northing	Delta Height
Primary	407,950.64m E, 6,192,572.84m N, 7.62m MSS	0.00m	0.00m	0.00m
Secondary	407,950.69m E, 6,192,572.82m N, 7.54m MSS	0.06m	-0.02m	-0.08m
Tertiary	407,950.64m E, 6,192,572.86m N, 7.55m MSS	0.00m	0.02m	-0.07m
Quaternary	407,950.64m E, 6,192,572.86m N, 7.65m MSS	0.01m	0.02m	0.03m
Quinary	407,950.72m E, 6,192,572.81m N, 7.58m MSS	0.08m	-0.03m	-0.04m

Excalibur Outline and Offsets



Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m

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SPK2_Secondary		2.04m	-15.81m	6.97m
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Seabed Information

Seabed Depth 19.0m
Comment

EXCALIBUR_240149
FINAL FIX REPORT



Project ID	Excalibur_240149
Starfix Version	v2022.1110.9 (build 0)
Client	Fugro Geoservices Inc
Primary Vessel	Excalibur
Location Description	UK

Session Name	20240523-111916-v1		
Start Time	23 May 2024, 12:19:59+01:00	End Time	23 May 2024, 12:28:18+01:00

Position Source:	SPK1 - Starfix.G4 Plus-10003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.0464'N	±0.02m
Longitude - ETRS89	07°41.4300'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,947.38m E	±0.01m
Northing	6,186,537.15m N	±0.02m
Convergence	-1.08335°	
Heading ° True	352.47° T	±0.03°
Heading ° Grid	353.56° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.0467'N	±0.02m
Longitude - ITRF2014	07°41.4305'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

Seabed Depth :	0.0m
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The final position was computed from session "20240523-111916-v1" by averaging 500 observations from a total of 500 observations between 23/05/2024 12:19:59 (UTC+01:00) and 23/05/2024 12:28:18 (UTC+01:00).

Position from	Waypoint: CPT263
Excalibur at Moonpool_1	2.88m Geodetic @ 351.28° T

Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	417,947.38m E, 6,186,537.15m N, 6.93m MSS	0.00m	0.00m	0.00m
Secondary	417,947.39m E, 6,186,537.14m N, 6.87m MSS	0.00m	-0.01m	-0.07m
Tertiary	417,947.33m E, 6,186,537.17m N, 6.78m MSS	-0.06m	0.03m	-0.15m
Quaternary	417,947.37m E, 6,186,537.15m N, 6.98m MSS	-0.01m	0.01m	0.05m
Quinary	417,947.37m E, 6,186,537.14m N, 6.71m MSS	-0.01m	-0.01m	-0.23m

Jamie Davison
Site Manager/Supervisor
FGBNM (Fugro Great Britain North Marine)

Rob Harwood
Client Representative
Fugro Geoservices Inc

Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	417,947.38	6,186,537.15	6.93	55°49.0464'N	07°41.4300'E
Crane 1	417,942.77	6,186,517.37	6.93	55°49.0357'N	07°41.4259'E
Crane 2	417,927.14	6,186,534.15	6.93	55°49.0446'N	07°41.4107'E
Leg 1	417,925.55	6,186,544.68	6.93	55°49.0502'N	07°41.4089'E
Leg 2	417,953.26	6,186,547.79	6.93	55°49.0522'N	07°41.4354'E
Leg 3	417,927.49	6,186,526.81	6.93	55°49.0406'N	07°41.4111'E
Leg 4	417,955.17	6,186,530.02	6.93	55°49.0426'N	07°41.4376'E
Leg 5	417,928.25	6,186,520.37	6.93	55°49.0371'N	07°41.4120'E
Leg 6	417,955.94	6,186,523.50	6.93	55°49.0391'N	07°41.4384'E
Leg 7	417,930.76	6,186,497.64	6.93	55°49.0249'N	07°41.4148'E
Leg 8	417,958.60	6,186,500.81	6.93	55°49.0269'N	07°41.4414'E
Moonpool_1	417,947.38	6,186,537.15	6.93	55°49.0464'N	07°41.4300'E
Moonpool_2	417,945.59	6,186,531.25	6.90	55°49.0432'N	07°41.4284'E
SPK1_Primary	417,932.83	6,186,544.21	18.66	55°49.0500'N	07°41.4159'E
SPK1_Secondary	417,945.50	6,186,545.71	18.94	55°49.0510'N	07°41.4280'E
SPK2_Primary	417,954.10	6,186,518.93	13.76	55°49.0366'N	07°41.4367'E
SPK2_Secondary	417,951.18	6,186,521.67	13.90	55°49.0381'N	07°41.4339'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

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Final Position for Moonpool_1 (Secondary)

Position Source:	SPK1 - Starfix.G4-10001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.0464'N	±0.01m
Longitude - ETRS89	07°41.4300'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,947.39m E	±0.01m
Northing	6,186,537.14m N	±0.01m
Convergence	-1.08335°	
Heading ° True	352.47° T	±0.03°
Heading ° Grid	353.56° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.0467'N	±0.01m
Longitude - ITRF2014	07°41.4305'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240523-111916-v1" by averaging 500 observations from a total of 500 observations between 23/05/2024 12:19:59 (UTC+01:00) and 23/05/2024 12:28:18 (UTC+01:00).

Position from	Waypoint: CPT263
Excalibur at Moonpool_1	2.89m Geodetic @ 351.21° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Tertiary)

Position Source:	SPK2 - Starfix.G4 Plus-20003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.0464'N	±0.02m
Longitude - ETRS89	07°41.4299'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,947.33m E	±0.02m
Northing	6,186,537.17m N	±0.02m
Convergence	-1.08335°	
Heading ° True	352.47° T	±0.03°
Heading ° Grid	353.56° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.0467'N	±0.02m
Longitude - ITRF2014	07°41.4304'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240523-111916-v1" by averaging 500 observations from a total of 500 observations between 23/05/2024 12:19:59 (UTC+01:00) and 23/05/2024 12:28:18 (UTC+01:00).

Position from	Waypoint: CPT263
Excalibur at Moonpool_1	2.85m Geodetic @ 352.30° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quaternary)

Position Source:	SPK1 - Starfix.XP2-10002
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.0464'N	±0.03m
Longitude - ETRS89	07°41.4300'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,947.37m E	±0.01m
Northing	6,186,537.15m N	±0.03m
Convergence	-1.08335°	
Heading ° True	352.47° T	±0.03°
Heading ° Grid	353.56° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.0467'N	±0.03m
Longitude - ITRF2014	07°41.4305'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240523-111916-v1" by averaging 500 observations from a total of 500 observations between 23/05/2024 12:19:59 (UTC+01:00) and 23/05/2024 12:28:18 (UTC+01:00).

Position from	Waypoint: CPT263
Excalibur at Moonpool_1	2.87m Geodetic @ 351.45° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quinary)

Position Source:	SPK2 - Starfix.G4-20001
Heading Source:	SPK1 - GNSS Heading-10004

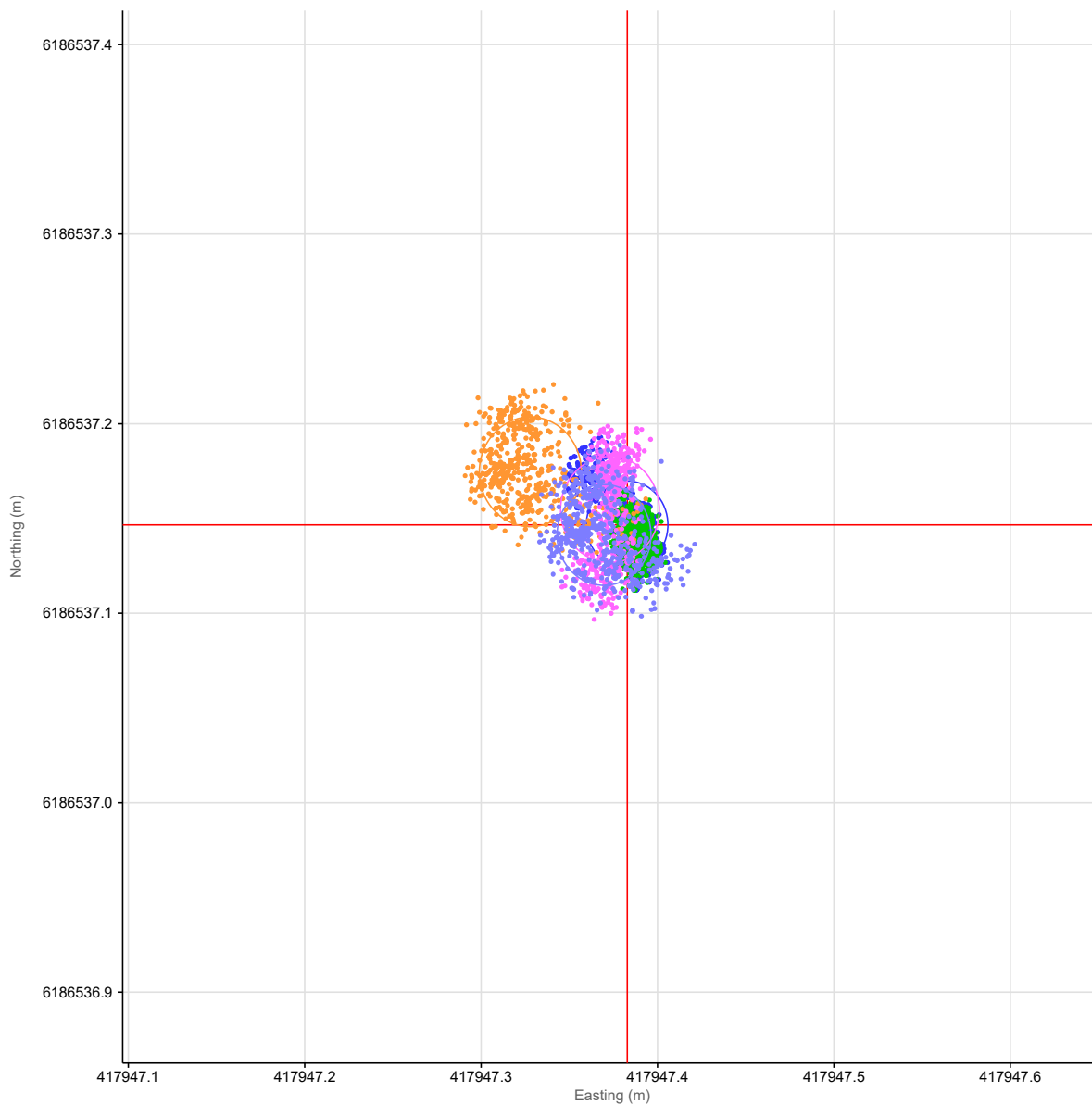
	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.0464'N	±0.02m
Longitude - ETRS89	07°41.4300'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,947.37m E	±0.02m
Northing	6,186,537.14m N	±0.02m
Convergence	-1.08335°	
Heading ° True	352.47° T	±0.03°
Heading ° Grid	353.56° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.0467'N	±0.02m
Longitude - ITRF2014	07°41.4305'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240523-111916-v1" by averaging 500 observations from a total of 500 observations between 23/05/2024 12:19:59 (UTC+01:00) and 23/05/2024 12:28:18 (UTC+01:00).

Position from	Waypoint: CPT263
Excalibur at Moonpool_1	2.88m Geodetic @ 351.55° T

Scatter Plot-ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	417,947.38m E, 6,186,537.15m N, 6.93m MSS	0.00m	0.00m	0.00m
Secondary	417,947.39m E, 6,186,537.14m N, 6.87m MSS	0.00m	-0.01m	-0.07m
Tertiary	417,947.33m E, 6,186,537.17m N, 6.78m MSS	-0.06m	0.03m	-0.15m
Quaternary	417,947.37m E, 6,186,537.15m N, 6.98m MSS	-0.01m	0.01m	0.05m
Quinary	417,947.37m E, 6,186,537.14m N, 6.71m MSS	-0.01m	-0.01m	-0.23m



Antenna Positions

Primary

	Antenna Position for SPK1 - Starfix.G4 Plus-10003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.0500'N	±0.02m
Longitude - ETRS89	07°41.4159'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,932.83m E	±0.01m
Northing	6,186,544.21m N	±0.02m
Raw Rig Heading ° True	352.47° T	±0.03°
Raw Rig Heading ° Grid	353.56° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.0504'N	±0.02m
Longitude - ITRF2014	07°41.4164'E	±0.01m

Secondary

	Antenna Position for SPK1 - Starfix.G4-10001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.0500'N	±0.01m
Longitude - ETRS89	07°41.4159'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,932.84m E	±0.01m
Northing	6,186,544.20m N	±0.01m
Raw Rig Heading ° True	352.47° T	±0.03°
Raw Rig Heading ° Grid	353.56° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.0504'N	±0.01m
Longitude - ITRF2014	07°41.4165'E	±0.01m

Tertiary

	Antenna Position for SPK2 - Starfix.G4 Plus-20003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.0366'N	±0.02m
Longitude - ETRS89	07°41.4367'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,954.04m E	±0.02m
Northing	6,186,518.96m N	±0.02m
Raw Rig Heading ° True	352.47° T	±0.03°
Raw Rig Heading ° Grid	353.56° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.0370'N	±0.02m
Longitude - ITRF2014	07°41.4372'E	±0.02m

Quaternary

	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	

EXCALIBUR_240149
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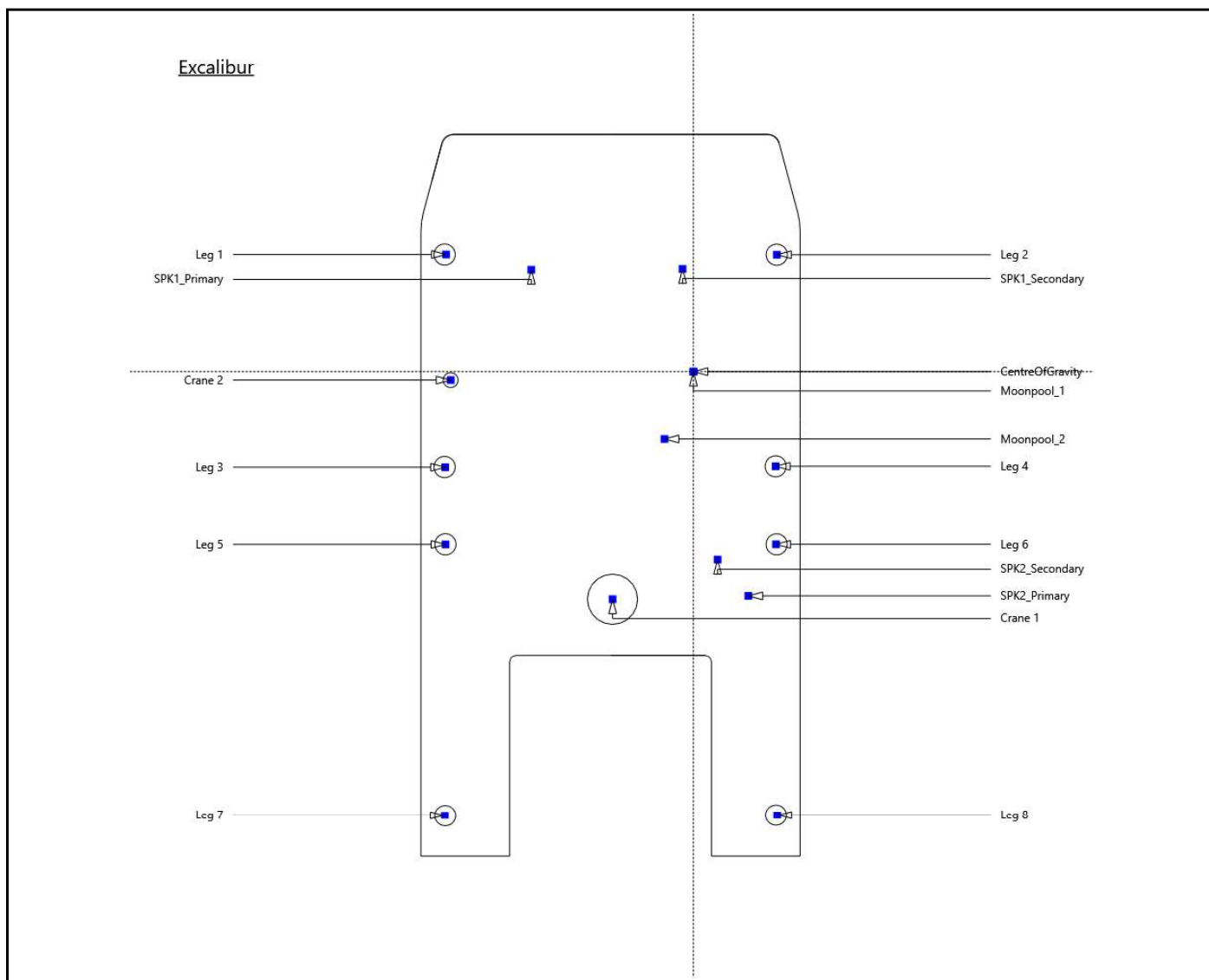


	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.0500'N	±0.02m
Longitude - ETRS89	07°41.4159'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,932.82m E	±0.01m
Northing	6,186,544.21m N	±0.02m
Raw Rig Heading ° True	352.47° T	±0.03°
Raw Rig Heading ° Grid	353.56° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.0504'N	±0.02m
Longitude - ITRF2014	07°41.4164'E	±0.01m

Quinary

	Antenna Position for SPK2 - Starfix.G4-20001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°49.0366'N	±0.02m
Longitude - ETRS89	07°41.4367'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	417,954.08m E	±0.02m
Northing	6,186,518.93m N	±0.02m
Raw Rig Heading ° True	352.47° T	±0.03°
Raw Rig Heading ° Grid	353.56° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°49.0369'N	±0.02m
Longitude - ITRF2014	07°41.4372'E	±0.02m

Vessel Outline and Offsets



Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m
SPK2_Secondary		2.04m	-15.81m	6.97m

EXCALIBUR_240149
FINAL FIX REPORT



Project ID	Excalibur_240149
Starfix Version	v2022.1110.9 (build 0)
Client	Fugro Geoservices Inc
Primary Vessel	Excalibur
Location Description	UK

Session Name	20240522-163700-v1		
Start Time	22 May 2024, 17:37:19+01:00	End Time	22 May 2024, 17:45:39+01:00

Position Source:	SPK1 - Starfix.G4 Plus-10003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.3547'N	±0.01m
Longitude - ETRS89	07°38.6708'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,113.64m E	±0.02m
Northing	6,189,019.07m N	±0.01m
Convergence	-1.12168°	
Heading ° True	128.17° T	±0.03°
Heading ° Grid	129.30° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.3550'N	±0.01m
Longitude - ITRF2014	07°38.6714'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

Seabed Depth :	0.0m
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The final position was computed from session "20240522-163700-v1" by averaging 500 observations from a total of 500 observations between 22/05/2024 17:37:20 (UTC+01:00) and 22/05/2024 17:45:39 (UTC+01:00).

Position from	Waypoint: CPT306
Excalibur at Moonpool_1	1.89m Geodetic @ 298.51° T

Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	415,113.64m E, 6,189,019.07m N, 7.90m MSS	0.00m	0.00m	0.00m
Secondary	415,113.65m E, 6,189,019.04m N, 7.84m MSS	0.01m	-0.02m	-0.07m
Tertiary	415,113.65m E, 6,189,019.10m N, 7.73m MSS	0.01m	0.03m	-0.17m
Quaternary	415,113.66m E, 6,189,018.97m N, 8.12m MSS	0.01m	-0.10m	0.22m
Quinary	415,113.60m E, 6,189,019.11m N, 7.78m MSS	-0.05m	0.04m	-0.12m

Jamie Davison
Site Manager/Supervisor
FGBNM (Fugro Great Britain North Marine)

Rob Harwood
Client Representative
Fugro Geoservices Inc



Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	415,113.64	6,189,019.07	7.90	55°50.3547'N	07°38.6708'E
Crane 1	415,103.15	6,189,036.45	7.90	55°50.3639'N	07°38.6605'E
Crane 2	415,126.05	6,189,035.34	7.90	55°50.3636'N	07°38.6824'E
Leg 1	415,134.54	6,189,028.91	7.90	55°50.3602'N	07°38.6907'E
Leg 2	415,116.86	6,189,007.34	7.90	55°50.3484'N	07°38.6741'E
Leg 3	415,120.67	6,189,040.35	7.90	55°50.3662'N	07°38.6772'E
Leg 4	415,103.09	6,189,018.74	7.90	55°50.3544'N	07°38.6607'E
Leg 5	415,115.63	6,189,044.43	7.90	55°50.3683'N	07°38.6723'E
Leg 6	415,098.00	6,189,022.87	7.90	55°50.3565'N	07°38.6558'E
Leg 7	415,097.98	6,189,058.96	7.90	55°50.3760'N	07°38.6551'E
Leg 8	415,080.25	6,189,037.26	7.90	55°50.3641'N	07°38.6385'E
Moonpool_1	415,113.64	6,189,019.07	7.90	55°50.3547'N	07°38.6708'E
Moonpool_2	415,110.81	6,189,024.54	7.87	55°50.3576'N	07°38.6680'E
SPK1_Primary	415,128.99	6,189,024.16	19.63	55°50.3576'N	07°38.6854'E
SPK1_Secondary	415,120.97	6,189,014.25	19.91	55°50.3521'N	07°38.6779'E
SPK2_Primary	415,096.12	6,189,027.42	14.73	55°50.3590'N	07°38.6539'E
SPK2_Secondary	415,100.12	6,189,027.50	14.87	55°50.3591'N	07°38.6577'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

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FINAL FIX REPORT



Final Position for Moonpool_1 (Secondary)

Position Source:	SPK1 - Starfix.G4-10001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.3546'N	±0.01m
Longitude - ETRS89	07°38.6708'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,113.65m E	±0.02m
Northing	6,189,019.04m N	±0.01m
Convergence	-1.12168°	
Heading ° True	128.17° T	±0.03°
Heading ° Grid	129.30° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.3550'N	±0.01m
Longitude - ITRF2014	07°38.6714'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240522-163700-v1" by averaging 500 observations from a total of 500 observations between 22/05/2024 17:37:20 (UTC+01:00) and 22/05/2024 17:45:39 (UTC+01:00).

Position from	Waypoint: CPT306
Excalibur at Moonpool_1	1.91m Geodetic @ 298.97° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Tertiary)

Position Source:	SPK2 - Starfix.G4 Plus-20003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.3547'N	±0.03m
Longitude - ETRS89	07°38.6708'E	±0.03m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,113.65m E	±0.03m
Northing	6,189,019.10m N	±0.03m
Convergence	-1.12168°	
Heading ° True	128.17° T	±0.03°
Heading ° Grid	129.30° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.3550'N	±0.03m
Longitude - ITRF2014	07°38.6714'E	±0.03m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240522-163700-v1" by averaging 500 observations from a total of 500 observations between 22/05/2024 17:37:20 (UTC+01:00) and 22/05/2024 17:45:39 (UTC+01:00).

Position from	Waypoint: CPT306
Excalibur at Moonpool_1	1.88m Geodetic @ 297.55° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quaternary)

Position Source:	SPK1 - Starfix.XP2-10002
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.3546'N	±0.02m
Longitude - ETRS89	07°38.6709'E	±0.03m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,113.66m E	±0.03m
Northing	6,189,018.97m N	±0.02m
Convergence	-1.12168°	
Heading ° True	128.17° T	±0.03°
Heading ° Grid	129.30° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.3549'N	±0.02m
Longitude - ITRF2014	07°38.6714'E	±0.03m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240522-163700-v1" by averaging 500 observations from a total of 500 observations between 22/05/2024 17:37:20 (UTC+01:00) and 22/05/2024 17:45:39 (UTC+01:00).

Position from	Waypoint: CPT306
Excalibur at Moonpool_1	1.95m Geodetic @ 300.78° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quinary)

Position Source:	SPK2 - Starfix.G4-20001
Heading Source:	SPK1 - GNSS Heading-10004

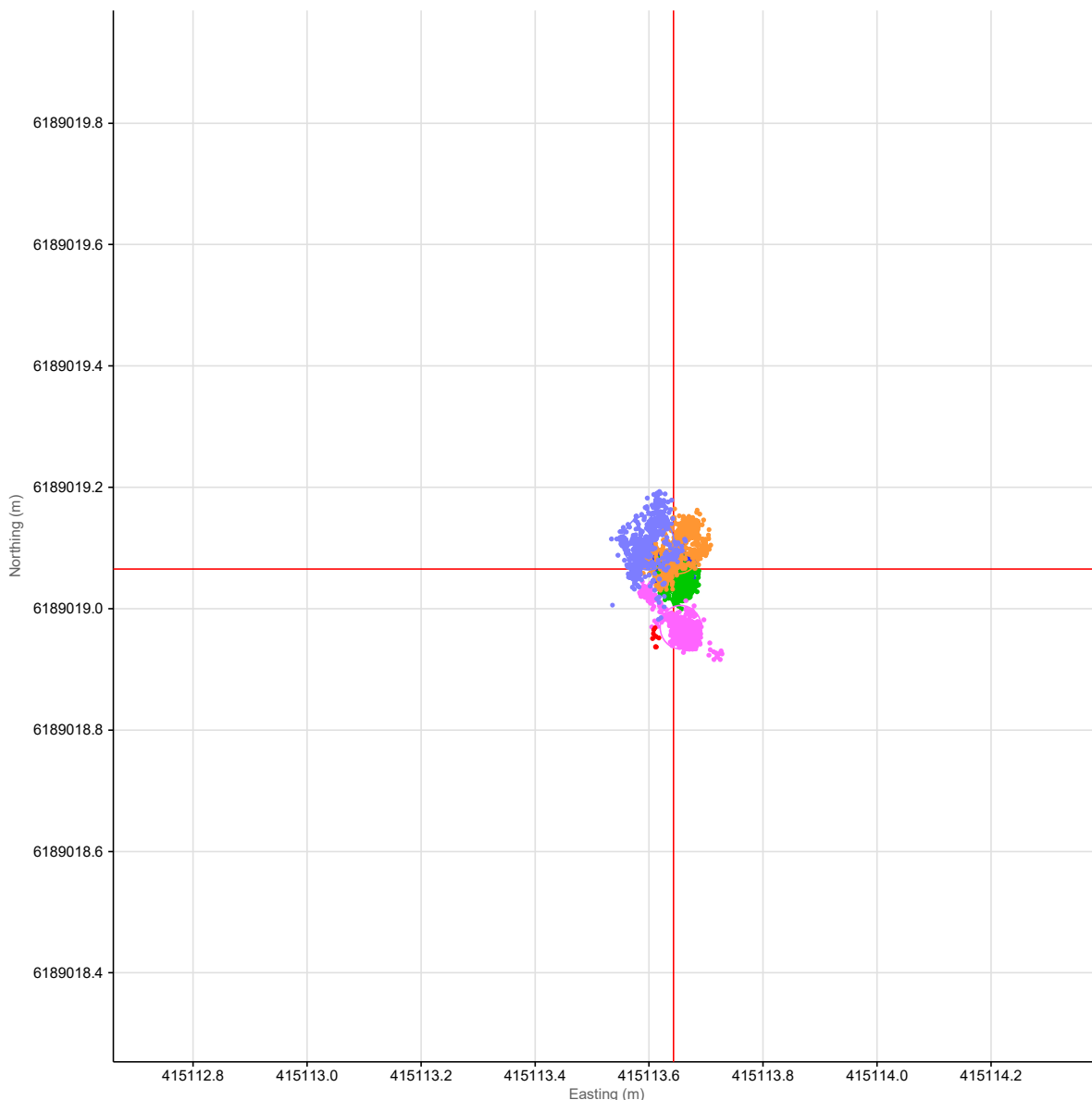
	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.3547'N	±0.04m
Longitude - ETRS89	07°38.6708'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,113.60m E	±0.02m
Northing	6,189,019.11m N	±0.04m
Convergence	-1.12168°	
Heading ° True	128.18° T	±0.03°
Heading ° Grid	129.30° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.3550'N	±0.04m
Longitude - ITRF2014	07°38.6713'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240522-163700-v1" by averaging 492 observations from a total of 500 observations between 22/05/2024 17:37:20 (UTC+01:00) and 22/05/2024 17:45:39 (UTC+01:00).

Position from	Waypoint: CPT306
Excalibur at Moonpool_1	1.83m Geodetic @ 298.01° T

Scatter Plot-ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	415,113.64m E, 6,189,019.07m N, 7.90m MSS	0.00m	0.00m	0.00m
Secondary	415,113.65m E, 6,189,019.04m N, 7.84m MSS	0.01m	-0.02m	-0.07m
Tertiary	415,113.65m E, 6,189,019.10m N, 7.73m MSS	0.01m	0.03m	-0.17m
Quaternary	415,113.66m E, 6,189,018.97m N, 8.12m MSS	0.01m	-0.10m	0.22m
Quinary	415,113.60m E, 6,189,019.11m N, 7.78m MSS	-0.05m	0.04m	-0.12m



Antenna Positions

Primary

	Antenna Position for SPK1 - Starfix.G4 Plus-10003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.3576'N	±0.01m
Longitude - ETRS89	07°38.6854'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,128.99m E	±0.02m
Northing	6,189,024.16m N	±0.01m
Raw Rig Heading ° True	128.17° T	±0.03°
Raw Rig Heading ° Grid	129.30° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.3579'N	±0.01m
Longitude - ITRF2014	07°38.6860'E	±0.02m

Secondary

	Antenna Position for SPK1 - Starfix.G4-10001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.3576'N	±0.01m
Longitude - ETRS89	07°38.6854'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,129.00m E	±0.02m
Northing	6,189,024.14m N	±0.01m
Raw Rig Heading ° True	128.17° T	±0.03°
Raw Rig Heading ° Grid	129.30° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.3579'N	±0.01m
Longitude - ITRF2014	07°38.6860'E	±0.02m

Tertiary

	Antenna Position for SPK2 - Starfix.G4 Plus-20003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.3590'N	±0.03m
Longitude - ETRS89	07°38.6539'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,096.13m E	±0.03m
Northing	6,189,027.46m N	±0.03m
Raw Rig Heading ° True	128.17° T	±0.03°
Raw Rig Heading ° Grid	129.30° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.3593'N	±0.03m
Longitude - ITRF2014	07°38.6544'E	±0.02m

Quaternary

	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	

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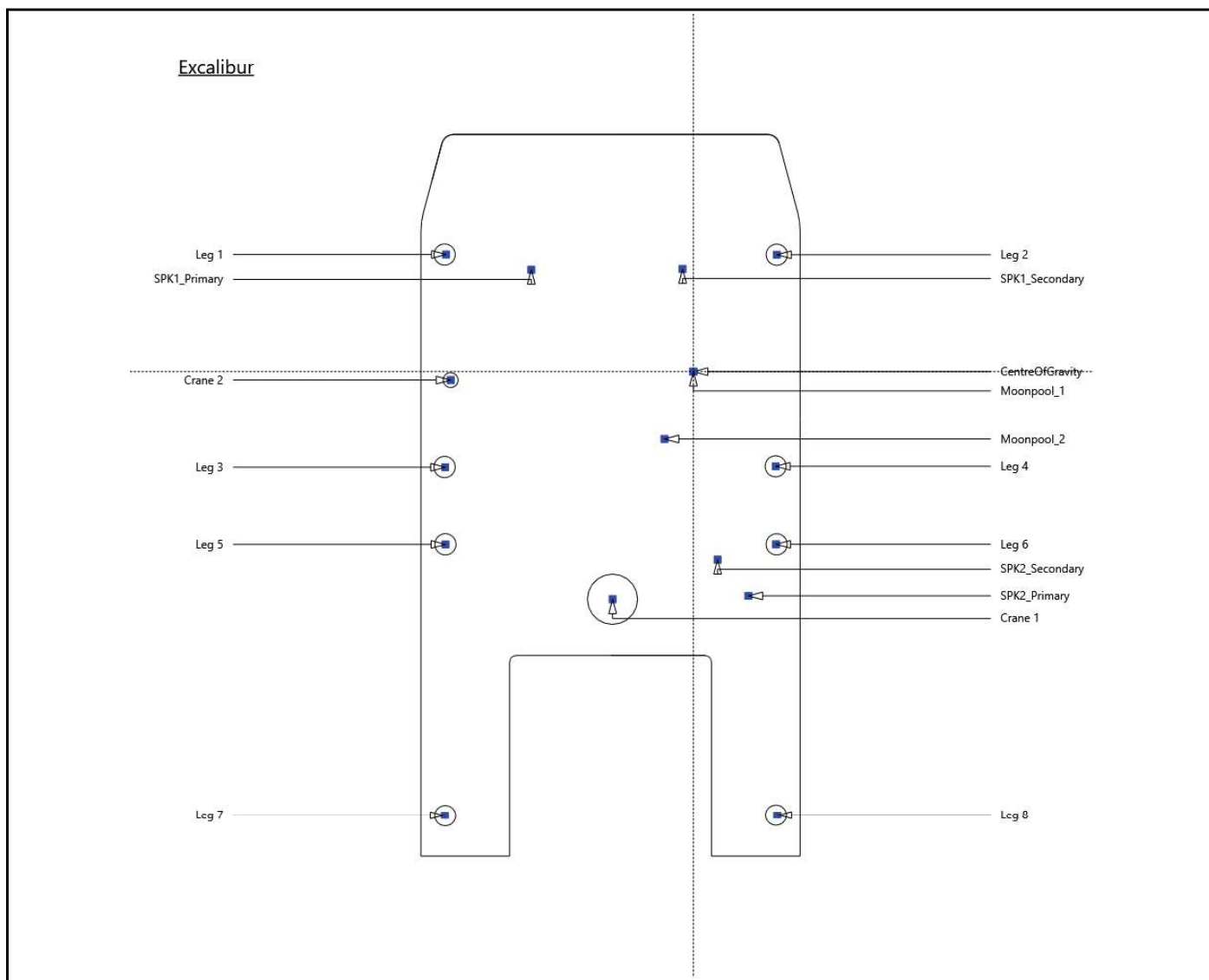


	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.3575'N	±0.02m
Longitude - ETRS89	07°38.6855'E	±0.03m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,129.00m E	±0.03m
Northing	6,189,024.07m N	±0.02m
Raw Rig Heading ° True	128.17° T	±0.03°
Raw Rig Heading ° Grid	129.30° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.3578'N	±0.02m
Longitude - ITRF2014	07°38.6860'E	±0.03m

Quinary

	Antenna Position for SPK2 - Starfix.G4-20001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.3590'N	±0.04m
Longitude - ETRS89	07°38.6539'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	415,096.08m E	±0.02m
Northing	6,189,027.47m N	±0.04m
Raw Rig Heading ° True	128.18° T	±0.03°
Raw Rig Heading ° Grid	129.30° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.3593'N	±0.04m
Longitude - ITRF2014	07°38.6544'E	±0.02m

Vessel Outline and Offsets



Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m
SPK2_Secondary		2.04m	-15.81m	6.97m

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FINAL FIX REPORT



Project ID: Excalibur_240149
 Starfix Version: v2022.1110.9 (build 0)
 Client: Fugro Geoservices Inc
 Client Rep:
 Fugro Personnel:
 Primary Vessel: Excalibur
 Location: UK
 Comment:

Session Name: CPT314-v3
 Start Time: 01 May 2024, 19:31:52+01:00
 End Time: 01 May 2024, 19:40:12+01:00 (Session Length 0.139 hrs - No. Obs. 500)

Position Fix Summary for Excalibur at CPT314

Moonpool_1 position computed from SPK1 - Starfix.G4 Plus-10003 (Primary)

Geodetic Datum	European Terrestrial Reference System 1989	International Terrestrial Reference Frame 2014
Latitude	55°48.1943'N	55°48.1947'N
Longitude	07°39.3250'E	07°39.3255'E
Grid System	UTM zone 32N CM 9° E	
Easting	415,718.55m E	
Northing	6,184,999.00m N	
Height	8.19m MSS (DTU21 MSS height)	
Heading	156.81°True (157.92°Grid)	

Position for Moonpool_1 is 1.14m @ 150.106°True (151.218°Grid) FROM the proposed location.

Moonpool_1 from CRP:	Starboard = 0.00m	Forward = 0.00m	Up = 0.00m
SPK1_Primary from CRP:	Starboard = -13.67m	Forward = 8.65m	Up = 11.73m
Heading correction applied (C-O):	0.00°		
Convergence:	-1.11198°		

Proposed Location

European Terrestrial Reference System 1989		UTM zone 32N CM 9° E	
Latitude: 55°48.1949'N	Longitude: 07°39.3244'E	Easting: 415,718.00m E	Northing: 6,185,000.00m N
Intended Vessel Heading	130.000°True		

Positioning System Comparison

Sensor	Mean Position			Delta Easting	Delta Northing	Delta Height
	UTM zone 32N CM 9° E					
Primary	415,718.55m E,	6,184,999.00m N,	8.19m MSS	0.00m	0.00m	0.00m
Secondary	415,718.52m E,	6,184,999.02m N,	8.14m MSS	-0.03m	0.02m	-0.06m
Tertiary	415,718.58m E,	6,184,999.02m N,	8.13m MSS	0.03m	0.02m	-0.06m
Quaternary	415,718.50m E,	6,184,999.04m N,	8.24m MSS	-0.05m	0.04m	0.04m
Quinary	415,718.52m E,	6,184,999.04m N,	8.11m MSS	-0.03m	0.04m	-0.08m

Project Engineer
 Jamie Davison

Client Representative
 Rob Harwood / Leumman Dos Santos

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

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Summary of Excalibur Positions

	Primary	SD	Secondary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK1 - Starfix.G4-10001	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	500 of 500 used		500 of 500 used	

Heading (Corrected)	156.81°True (C-O: 0.00°)	±0.03°	156.81°True (C-O: 0.00°)	±0.03°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°48.1943'N	±0.02m	55°48.1944'N	±0.01m
Longitude	07°39.3250'E	±0.01m	07°39.3250'E	±0.02m
Height	48.89m Ell.	±0.02m	48.84m Ell.	±0.03m
Grid System	UTM zone 32N CM 9° E			
Easting	415,718.55m E	±0.01m	415,718.52m E	±0.02m
Northing	6,184,999.00m N	±0.02m	6,184,999.02m N	±0.01m
Height	8.19m MSS	±0.13m	8.14m MSS	±0.13m
Delta Easting	0.00m		-0.03m	
Delta Northing	0.00m		0.02m	
Delta Height	0.00m		-0.06m	

Position of Moonpool_1 from proposed location				
Range	1.14m		1.11m	
Bearing	150.11°True		151.04°True	

EXCALIBUR_240149
FINAL FIX REPORT



Summary of Excalibur Positions

	Primary	SD	Tertiary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK2 - Starfix.G4 Plus-20003	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	500 of 500 used		500 of 500 used	

Heading (Corrected)	156.81°True (C-O: 0.00°)	±0.03°	156.81°True (C-O: 0.00°)	±0.03°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°48.1943'N	±0.02m	55°48.1944'N	±0.02m
Longitude	07°39.3250'E	±0.01m	07°39.3250'E	±0.02m
Height	48.89m Ell.	±0.02m	48.83m Ell.	±0.04m
Grid System	UTM zone 32N CM 9° E			
Easting	415,718.55m E	±0.01m	415,718.58m E	±0.02m
Northing	6,184,999.00m N	±0.02m	6,184,999.02m N	±0.02m
Height	8.19m MSS	±0.13m	8.13m MSS	±0.14m
Delta Easting	0.00m		0.03m	
Delta Northing	0.00m		0.02m	
Delta Height	0.00m		-0.06m	

Position of Moonpool_1 from proposed location				
Range	1.14m		1.14m	
Bearing	150.11°True		148.46°True	

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Summary of Excalibur Positions

	Primary	SD	Quaternary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK1 - Starfix.XP2-10002	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	500 of 500 used		500 of 500 used	

Heading (Corrected)	156.81°True (C-O: 0.00°)	±0.03°	156.81°True (C-O: 0.00°)	±0.03°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°48.1943'N	±0.02m	55°48.1944'N	±0.02m
Longitude	07°39.3250'E	±0.01m	07°39.3249'E	±0.02m
Height	48.89m Ell.	±0.02m	48.94m Ell.	±0.03m
Grid System	UTM zone 32N CM 9° E			
Easting	415,718.55m E	±0.01m	415,718.50m E	±0.02m
Northing	6,184,999.00m N	±0.02m	6,184,999.04m N	±0.02m
Height	8.19m MSS	±0.13m	8.24m MSS	±0.14m
Delta Easting	0.00m		-0.05m	
Delta Northing	0.00m		0.04m	
Delta Height	0.00m		0.04m	

Position of Moonpool_1 from proposed location				
Range	1.14m		1.08m	
Bearing	150.11°True		151.17°True	

EXCALIBUR_240149
FINAL FIX REPORT



Summary of Excalibur Positions

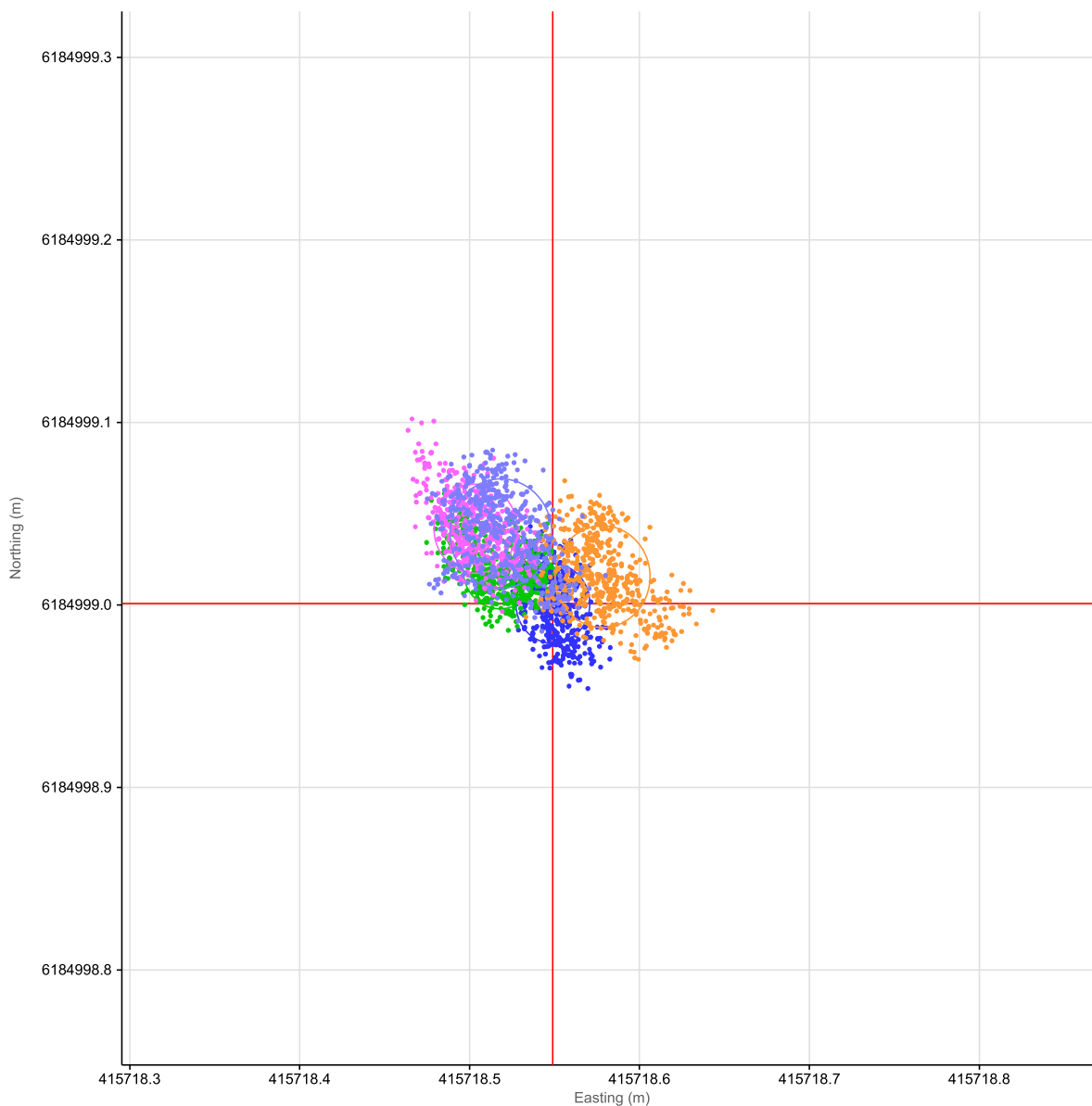
	Primary	SD	Quinary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK2 - Starfix.G4-20001	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	500 of 500 used		500 of 500 used	

Heading (Corrected)	156.81°True (C-O: 0.00°)	±0.03°	156.81°True (C-O: 0.00°)	±0.03°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°48.1943'N	±0.02m	55°48.1944'N	±0.02m
Longitude	07°39.3250'E	±0.01m	07°39.3250'E	±0.02m
Height	48.89m Ell.	±0.02m	48.81m Ell.	±0.04m
Grid System	UTM zone 32N CM 9° E			
Easting	415,718.55m E	±0.01m	415,718.52m E	±0.02m
Northing	6,184,999.00m N	±0.02m	6,184,999.04m N	±0.02m
Height	8.19m MSS	±0.13m	8.11m MSS	±0.14m
Delta Easting	0.00m		-0.03m	
Delta Northing	0.00m		0.04m	
Delta Height	0.00m		-0.08m	

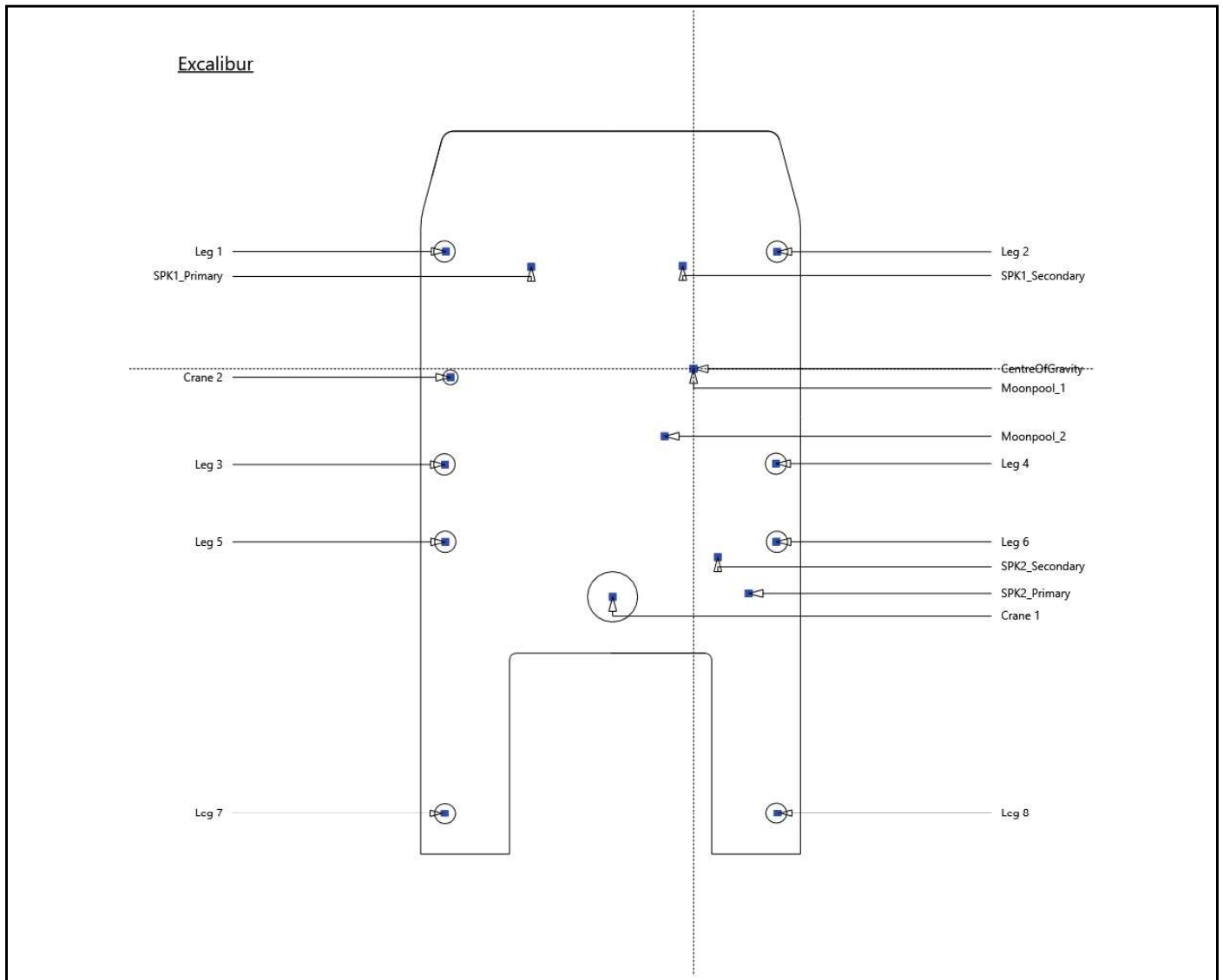
Position of Moonpool_1 from proposed location				
Range	1.14m		1.09m	
Bearing	150.11°True		150.54°True	

Scatter Plot



Sensor Group	Excalibur Mean Position at Moonpool_1 ETRS89 / UTM zone 32N [ETRF2000- ITRF2014][2023],DTU21 MSS height [DTU21 MSS]	Delta Easting	Delta Northing	Delta Height
Primary	415,718.55m E, 6,184,999.00m N, 8.19m MSS	0.00m	0.00m	0.00m
Secondary	415,718.52m E, 6,184,999.02m N, 8.14m MSS	-0.03m	0.02m	-0.06m
Tertiary	415,718.58m E, 6,184,999.02m N, 8.13m MSS	0.03m	0.02m	-0.06m
Quaternary	415,718.50m E, 6,184,999.04m N, 8.24m MSS	-0.05m	0.04m	0.04m
Quinary	415,718.52m E, 6,184,999.04m N, 8.11m MSS	-0.03m	0.04m	-0.08m

Excalibur Outline and Offsets



Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m

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SPK2_Secondary		2.04m	-15.81m	6.97m
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EXCALIBUR_240149
FINAL FIX REPORT



Project ID	Excalibur_240149
Starfix Version	v2022.1110.9 (build 0)
Client	Fugro Geoservices Inc
Primary Vessel	Excalibur
Location Description	UK

Session Name	20240511-072527-v1	
Start Time	11 May 2024, 08:25:40+01:00	End Time 11 May 2024, 08:34:01+01:00

Position Source:	SPK1 - Starfix.G4 Plus-10003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.4592'N	±0.01m
Longitude - ETRS89	07°35.4188'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	411,723.58m E	±0.01m
Northing	6,189,280.74m N	±0.01m
Convergence	-1.16657°	
Heading ° True	9.32° T	±0.04°
Heading ° Grid	10.48° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.4595'N	±0.01m
Longitude - ITRF2014	07°35.4193'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

Seabed Depth :	0.0m
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The final position was computed from session "20240511-072527-v1" by averaging 500 observations from a total of 500 observations between 11/05/2024 08:25:41 (UTC+01:00) and 11/05/2024 08:34:01 (UTC+01:00).

Position from	Waypoint: CPT316
Excalibur at Moonpool_1	0.94m Geodetic @ 216.71° T

Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	411,723.58m E, 6,189,280.74m N, 7.66m MSS	0.00m	0.00m	0.00m
Secondary	411,723.56m E, 6,189,280.73m N, 7.60m MSS	-0.01m	-0.01m	-0.06m
Tertiary	411,723.53m E, 6,189,280.53m N, 7.32m MSS	-0.04m	-0.22m	-0.34m
Quaternary	411,723.64m E, 6,189,280.74m N, 7.61m MSS	0.06m	0.00m	-0.05m
Quinary	411,723.48m E, 6,189,280.57m N, 7.35m MSS	-0.09m	-0.18m	-0.32m

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc



Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	411,723.58	6,189,280.74	7.66	55°50.4592'N	07°35.4188'E
Crane 1	411,713.40	6,189,263.16	7.66	55°50.4496'N	07°35.4094'E
Crane 2	411,703.33	6,189,283.76	7.66	55°50.4606'N	07°35.3994'E
Leg 1	411,704.88	6,189,294.31	7.66	55°50.4663'N	07°35.4006'E
Leg 2	411,732.30	6,189,289.21	7.66	55°50.4639'N	07°35.4270'E
Leg 3	411,701.54	6,189,276.64	7.66	55°50.4567'N	07°35.3978'E
Leg 4	411,728.95	6,189,271.65	7.66	55°50.4544'N	07°35.4241'E
Leg 5	411,700.39	6,189,270.26	7.66	55°50.4533'N	07°35.3968'E
Leg 6	411,727.79	6,189,265.20	7.66	55°50.4509'N	07°35.4231'E
Leg 7	411,696.17	6,189,247.79	7.66	55°50.4411'N	07°35.3932'E
Leg 8	411,723.73	6,189,242.71	7.66	55°50.4387'N	07°35.4197'E
Moonpool_1	411,723.58	6,189,280.74	7.66	55°50.4592'N	07°35.4188'E
Moonpool_2	411,720.15	6,189,275.62	7.63	55°50.4564'N	07°35.4156'E
SPK1_Primary	411,711.71	6,189,291.73	19.39	55°50.4650'N	07°35.4072'E
SPK1_Secondary	411,724.27	6,189,289.48	19.67	55°50.4639'N	07°35.4193'E
SPK2_Primary	411,724.70	6,189,261.36	14.49	55°50.4488'N	07°35.4203'E
SPK2_Secondary	411,722.71	6,189,264.83	14.63	55°50.4506'N	07°35.4183'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

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Final Position for Moonpool_1 (Secondary)

Position Source:	SPK1 - Starfix.G4-10001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.4592'N	±0.01m
Longitude - ETRS89	07°35.4188'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	411,723.56m E	±0.01m
Northing	6,189,280.73m N	±0.01m
Convergence	-1.16657°	
Heading ° True	9.32° T	±0.04°
Heading ° Grid	10.48° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.4595'N	±0.01m
Longitude - ITRF2014	07°35.4193'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240511-072527-v1" by averaging 499 observations from a total of 500 observations between 11/05/2024 08:25:41 (UTC+01:00) and 11/05/2024 08:34:01 (UTC+01:00).

Position from	Waypoint: CPT316
Excalibur at Moonpool_1	0.92m Geodetic @ 216.40° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Tertiary)

Position Source:	SPK2 - Starfix.G4 Plus-20003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.4591'N	±0.05m
Longitude - ETRS89	07°35.4188'E	±0.03m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	411,723.53m E	±0.03m
Northing	6,189,280.53m N	±0.05m
Convergence	-1.16657°	
Heading ° True	9.32° T	±0.04°
Heading ° Grid	10.48° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.4594'N	±0.05m
Longitude - ITRF2014	07°35.4193'E	±0.03m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240511-072527-v1" by averaging 499 observations from a total of 499 observations between 11/05/2024 08:25:41 (UTC+01:00) and 11/05/2024 08:34:01 (UTC+01:00).

Position from	Waypoint: CPT316
Excalibur at Moonpool_1	0.75m Geodetic @ 224.33° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quaternary)

Position Source:	SPK1 - Starfix.XP2-10002
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.4592'N	±0.04m
Longitude - ETRS89	07°35.4189'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	411,723.64m E	±0.02m
Northing	6,189,280.74m N	±0.04m
Convergence	-1.16656°	
Heading ° True	9.32° T	±0.04°
Heading ° Grid	10.48° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.4595'N	±0.04m
Longitude - ITRF2014	07°35.4194'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240511-072527-v1" by averaging 500 observations from a total of 500 observations between 11/05/2024 08:25:41 (UTC+01:00) and 11/05/2024 08:34:01 (UTC+01:00).

Position from	Waypoint: CPT316
Excalibur at Moonpool_1	0.97m Geodetic @ 219.77° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quinary)

Position Source:	SPK2 - Starfix.G4-20001
Heading Source:	SPK1 - GNSS Heading-10004

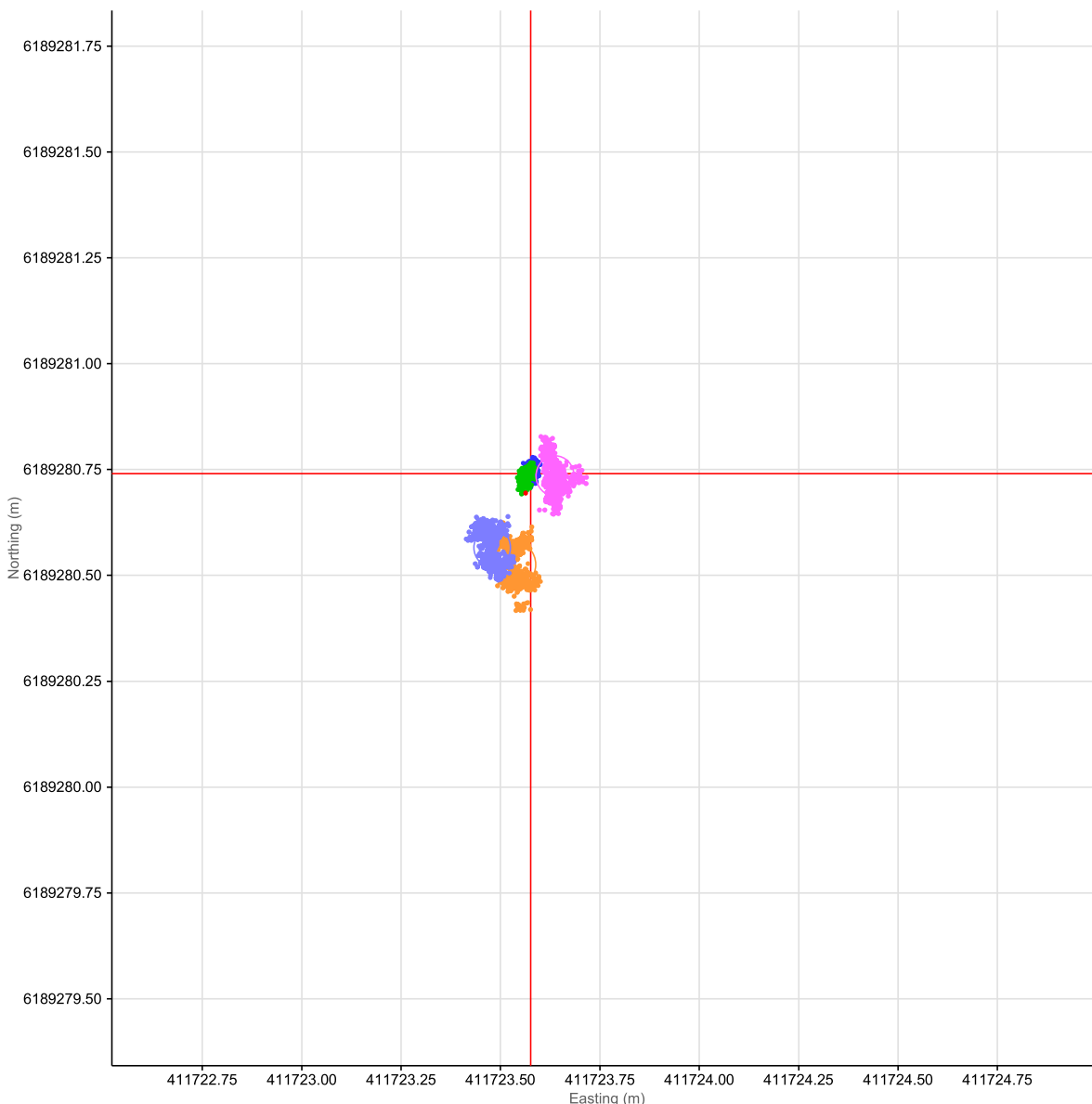
	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.4591'N	±0.04m
Longitude - ETRS89	07°35.4187'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	411,723.48m E	±0.02m
Northing	6,189,280.57m N	±0.04m
Convergence	-1.16657°	
Heading ° True	9.32° T	±0.04°
Heading ° Grid	10.48° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.4594'N	±0.04m
Longitude - ITRF2014	07°35.4192'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240511-072527-v1" by averaging 499 observations from a total of 499 observations between 11/05/2024 08:25:41 (UTC+01:00) and 11/05/2024 08:34:01 (UTC+01:00).

Position from	Waypoint: CPT316
Excalibur at Moonpool_1	0.74m Geodetic @ 219.10° T

Scatter Plot-ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	411,723.58m E, 6,189,280.74m N, 7.66m MSS	0.00m	0.00m	0.00m
Secondary	411,723.56m E, 6,189,280.73m N, 7.60m MSS	-0.01m	-0.01m	-0.06m
Tertiary	411,723.53m E, 6,189,280.53m N, 7.32m MSS	-0.04m	-0.22m	-0.34m
Quaternary	411,723.64m E, 6,189,280.74m N, 7.61m MSS	0.06m	0.00m	-0.05m
Quinary	411,723.48m E, 6,189,280.57m N, 7.35m MSS	-0.09m	-0.18m	-0.32m



Antenna Positions

Primary

	Antenna Position for SPK1 - Starfix.G4 Plus-10003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.4650'N	±0.01m
Longitude - ETRS89	07°35.4072'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	411,711.71m E	±0.01m
Northing	6,189,291.73m N	±0.01m
Raw Rig Heading ° True	9.32° T	±0.04°
Raw Rig Heading ° Grid	10.48° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.4653'N	±0.01m
Longitude - ITRF2014	07°35.4078'E	±0.01m

Secondary

	Antenna Position for SPK1 - Starfix.G4-10001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.4650'N	±0.01m
Longitude - ETRS89	07°35.4072'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	411,711.70m E	±0.01m
Northing	6,189,291.72m N	±0.01m
Raw Rig Heading ° True	9.32° T	±0.04°
Raw Rig Heading ° Grid	10.48° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.4653'N	±0.01m
Longitude - ITRF2014	07°35.4077'E	±0.01m

Tertiary

	Antenna Position for SPK2 - Starfix.G4 Plus-20003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.4486'N	±0.05m
Longitude - ETRS89	07°35.4202'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	411,724.66m E	±0.02m
Northing	6,189,261.14m N	±0.05m
Raw Rig Heading ° True	9.32° T	±0.04°
Raw Rig Heading ° Grid	10.48° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.4490'N	±0.05m
Longitude - ITRF2014	07°35.4208'E	±0.02m

Quaternary

	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	

EXCALIBUR_240149
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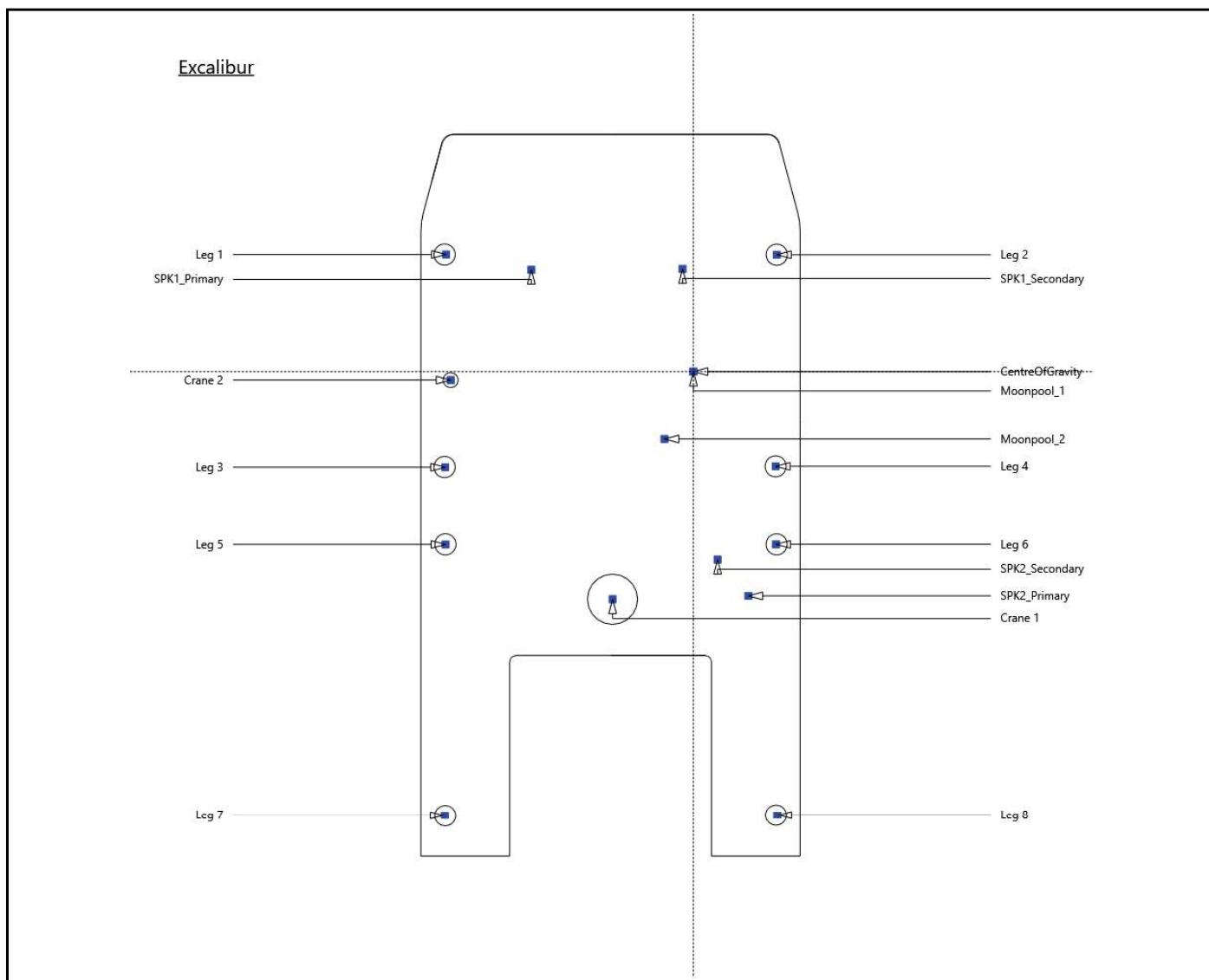


	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.4650'N	±0.05m
Longitude - ETRS89	07°35.4073'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	411,711.77m E	±0.02m
Northing	6,189,291.72m N	±0.05m
Raw Rig Heading ° True	9.32° T	±0.04°
Raw Rig Heading ° Grid	10.48° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.4653'N	±0.05m
Longitude - ITRF2014	07°35.4078'E	±0.02m

Quinary

	Antenna Position for SPK2 - Starfix.G4-20001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°50.4487'N	±0.04m
Longitude - ETRS89	07°35.4202'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	411,724.60m E	±0.02m
Northing	6,189,261.18m N	±0.04m
Raw Rig Heading ° True	9.32° T	±0.04°
Raw Rig Heading ° Grid	10.48° G	±0.04°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°50.4490'N	±0.04m
Longitude - ITRF2014	07°35.4207'E	±0.02m

Vessel Outline and Offsets





Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m
SPK2_Secondary		2.04m	-15.81m	6.97m

EXCALIBUR_240149
FINAL FIX REPORT



Project ID	Excalibur_240149
Starfix Version	v2022.1110.9 (build 0)
Client	Fugro Geoservices Inc
Primary Vessel	Excalibur
Location Description	UK

Session Name	20240510-110047-v1	
Start Time	10 May 2024, 12:01:08+01:00	End Time 10 May 2024, 12:09:29+01:00

Position Source:	SPK1 - Starfix.G4 Plus-10003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°51.8167'N	±0.02m
Longitude - ETRS89	07°37.3075'E	±0.03m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	413,744.80m E	±0.03m
Northing	6,191,758.87m N	±0.02m
Convergence	-1.14082°	
Heading ° True	101.85° T	±0.08°
Heading ° Grid	102.99° G	±0.08°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°51.8170'N	±0.02m
Longitude - ITRF2014	07°37.3081'E	±0.03m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

Seabed Depth :	0.0m
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The final position was computed from session "20240510-110047-v1" by averaging 500 observations from a total of 500 observations between 10/05/2024 12:01:09 (UTC+01:00) and 10/05/2024 12:09:29 (UTC+01:00).

Position from	Waypoint: CPT388
Excalibur at Moonpool_1	1.38m Geodetic @ 323.38° T

Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	413,744.80m E, 6,191,758.87m N, 7.84m MSS	0.00m	0.00m	0.00m
Secondary	413,744.84m E, 6,191,758.86m N, 7.85m MSS	0.03m	-0.01m	0.02m
Tertiary	413,744.78m E, 6,191,758.83m N, 7.76m MSS	-0.03m	-0.04m	-0.08m
Quaternary	413,744.74m E, 6,191,758.89m N, 7.67m MSS	-0.06m	0.02m	-0.17m
Quinary	413,744.76m E, 6,191,758.81m N, 7.80m MSS	-0.05m	-0.06m	-0.03m

Jamie Davison
Site Manager/Supervisor
FGBNM (Fugro Great Britain North Marine)

Rob Harwood
Client Representative
Fugro Geoservices Inc



Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	413,744.80	6,191,758.87	7.84	55°51.8167'N	07°37.3075'E
Crane 1	413,727.69	6,191,769.81	7.84	55°51.8224'N	07°37.2909'E
Crane 2	413,748.71	6,191,778.96	7.84	55°51.8276'N	07°37.3109'E
Leg 1	413,759.17	6,191,776.96	7.84	55°51.8266'N	07°37.3210'E
Leg 2	413,752.88	6,191,749.79	7.84	55°51.8119'N	07°37.3155'E
Leg 3	413,741.67	6,191,781.07	7.84	55°51.8286'N	07°37.3041'E
Leg 4	413,735.49	6,191,753.90	7.84	55°51.8139'N	07°37.2987'E
Leg 5	413,735.35	6,191,782.50	7.84	55°51.8294'N	07°37.2980'E
Leg 6	413,729.09	6,191,755.35	7.84	55°51.8147'N	07°37.2925'E
Leg 7	413,713.08	6,191,787.69	7.84	55°51.8319'N	07°37.2766'E
Leg 8	413,706.80	6,191,760.38	7.84	55°51.8171'N	07°37.2711'E
Moonpool_1	413,744.80	6,191,758.87	7.84	55°51.8167'N	07°37.3075'E
Moonpool_2	413,739.84	6,191,762.52	7.81	55°51.8186'N	07°37.3027'E
SPK1_Primary	413,756.30	6,191,770.25	19.57	55°51.8230'N	07°37.3183'E
SPK1_Secondary	413,753.50	6,191,757.80	19.85	55°51.8162'N	07°37.3159'E
SPK2_Primary	413,725.39	6,191,758.60	14.67	55°51.8164'N	07°37.2889'E
SPK2_Secondary	413,728.94	6,191,760.44	14.81	55°51.8174'N	07°37.2923'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Secondary)

Position Source:	SPK1 - Starfix.G4-10001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°51.8167'N	±0.01m
Longitude - ETRS89	07°37.3076'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	413,744.84m E	±0.02m
Northing	6,191,758.86m N	±0.01m
Convergence	-1.14082°	
Heading ° True	101.85° T	±0.08°
Heading ° Grid	102.99° G	±0.08°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°51.8170'N	±0.01m
Longitude - ITRF2014	07°37.3081'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240510-110047-v1" by averaging 500 observations from a total of 500 observations between 10/05/2024 12:01:09 (UTC+01:00) and 10/05/2024 12:09:29 (UTC+01:00).

Position from	Waypoint: CPT388
Excalibur at Moonpool_1	1.42m Geodetic @ 322.61° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Tertiary)

Position Source:	SPK2 - Starfix.G4 Plus-20003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°51.8167'N	±0.04m
Longitude - ETRS89	07°37.3075'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	413,744.78m E	±0.01m
Northing	6,191,758.83m N	±0.04m
Convergence	-1.14082°	
Heading ° True	101.85° T	±0.08°
Heading ° Grid	102.99° G	±0.08°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°51.8170'N	±0.04m
Longitude - ITRF2014	07°37.3080'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240510-110047-v1" by averaging 501 observations from a total of 501 observations between 10/05/2024 12:01:09 (UTC+01:00) and 10/05/2024 12:09:29 (UTC+01:00).

Position from	Waypoint: CPT388
Excalibur at Moonpool_1	1.40m Geodetic @ 325.28° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quaternary)

Position Source:	SPK1 - Starfix.XP2-10002
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°51.8167'N	±0.02m
Longitude - ETRS89	07°37.3075'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	413,744.74m E	±0.02m
Northing	6,191,758.89m N	±0.02m
Convergence	-1.14082°	
Heading ° True	101.85° T	±0.08°
Heading ° Grid	102.99° G	±0.08°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°51.8171'N	±0.02m
Longitude - ITRF2014	07°37.3080'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240510-110047-v1" by averaging 500 observations from a total of 500 observations between 10/05/2024 12:01:09 (UTC+01:00) and 10/05/2024 12:09:29 (UTC+01:00).

Position from	Waypoint: CPT388
Excalibur at Moonpool_1	1.33m Geodetic @ 325.07° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quinary)

Position Source:	SPK2 - Starfix.G4-20001
Heading Source:	SPK1 - GNSS Heading-10004

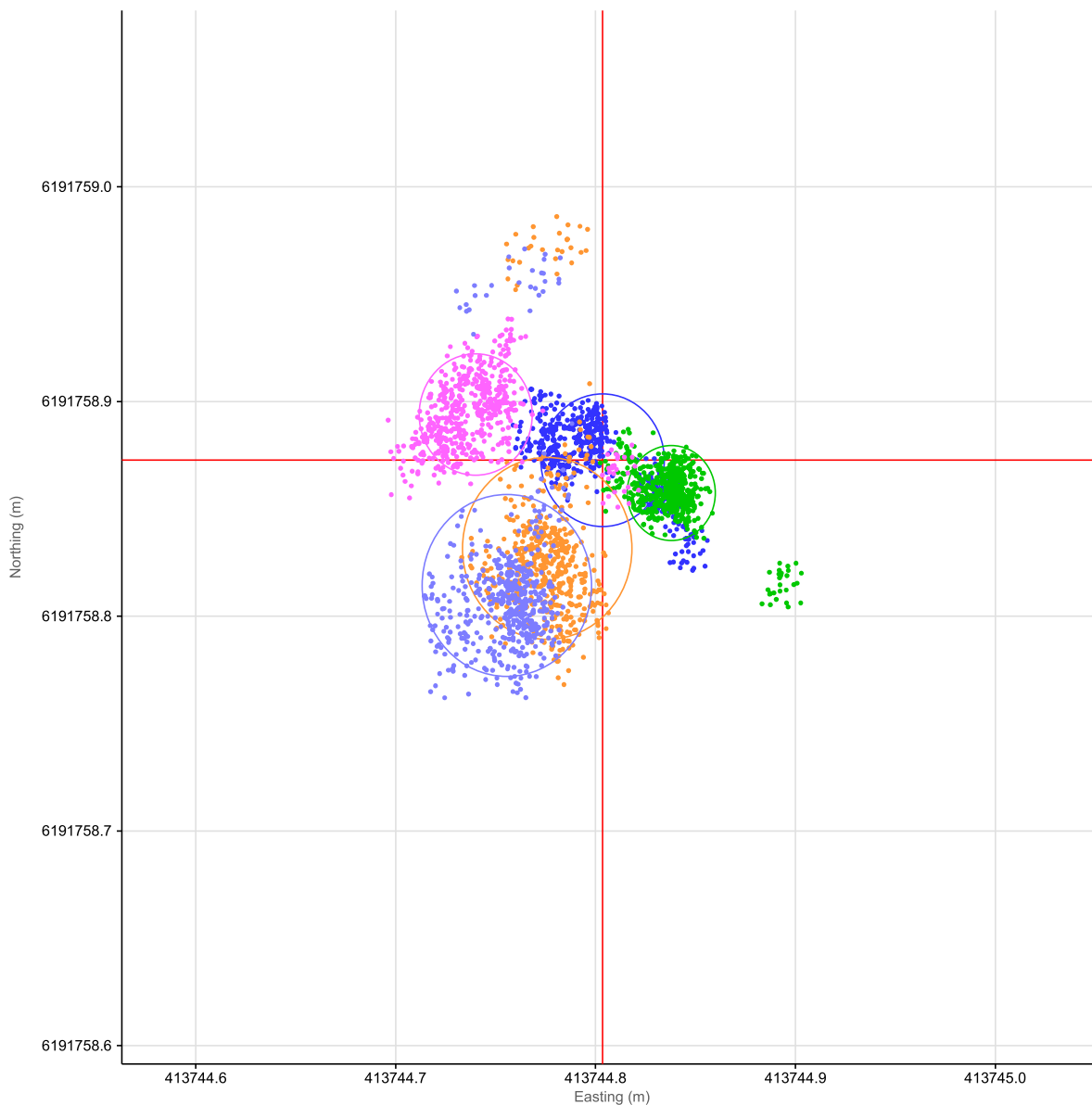
	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°51.8167'N	±0.04m
Longitude - ETRS89	07°37.3075'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	413,744.76m E	±0.02m
Northing	6,191,758.81m N	±0.04m
Convergence	-1.14082°	
Heading ° True	101.85° T	±0.08°
Heading ° Grid	102.99° G	±0.08°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°51.8170'N	±0.04m
Longitude - ITRF2014	07°37.3080'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240510-110047-v1" by averaging 501 observations from a total of 501 observations between 10/05/2024 12:01:09 (UTC+01:00) and 10/05/2024 12:09:29 (UTC+01:00).

Position from	Waypoint: CPT388
Excalibur at Moonpool_1	1.41m Geodetic @ 326.35° T

Scatter Plot-ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	413,744.80m E, 6,191,758.87m N, 7.84m MSS	0.00m	0.00m	0.00m
Secondary	413,744.84m E, 6,191,758.86m N, 7.85m MSS	0.03m	-0.01m	0.02m
Tertiary	413,744.78m E, 6,191,758.83m N, 7.76m MSS	-0.03m	-0.04m	-0.08m
Quaternary	413,744.74m E, 6,191,758.89m N, 7.67m MSS	-0.06m	0.02m	-0.17m
Quinary	413,744.76m E, 6,191,758.81m N, 7.80m MSS	-0.05m	-0.06m	-0.03m

EXCALIBUR_240149
FINAL FIX REPORT



Antenna Positions

Primary

	Antenna Position for SPK1 - Starfix.G4 Plus-10003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°51.8230'N	±0.02m
Longitude - ETRS89	07°37.3183'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	413,756.30m E	±0.02m
Northing	6,191,770.25m N	±0.02m
Raw Rig Heading ° True	101.85° T	±0.08°
Raw Rig Heading ° Grid	102.99° G	±0.08°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°51.8233'N	±0.02m
Longitude - ITRF2014	07°37.3189'E	±0.02m

Secondary

	Antenna Position for SPK1 - Starfix.G4-10001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°51.8230'N	±0.01m
Longitude - ETRS89	07°37.3184'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	413,756.34m E	±0.01m
Northing	6,191,770.23m N	±0.01m
Raw Rig Heading ° True	101.85° T	±0.08°
Raw Rig Heading ° Grid	102.99° G	±0.08°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°51.8233'N	±0.01m
Longitude - ITRF2014	07°37.3189'E	±0.01m

Tertiary

	Antenna Position for SPK2 - Starfix.G4 Plus-20003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°51.8163'N	±0.02m
Longitude - ETRS89	07°37.2889'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	413,725.36m E	±0.01m
Northing	6,191,758.56m N	±0.02m
Raw Rig Heading ° True	101.85° T	±0.08°
Raw Rig Heading ° Grid	102.99° G	±0.08°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°51.8167'N	±0.02m
Longitude - ITRF2014	07°37.2894'E	±0.01m

Quaternary

	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	

EXCALIBUR_240149
FINAL FIX REPORT

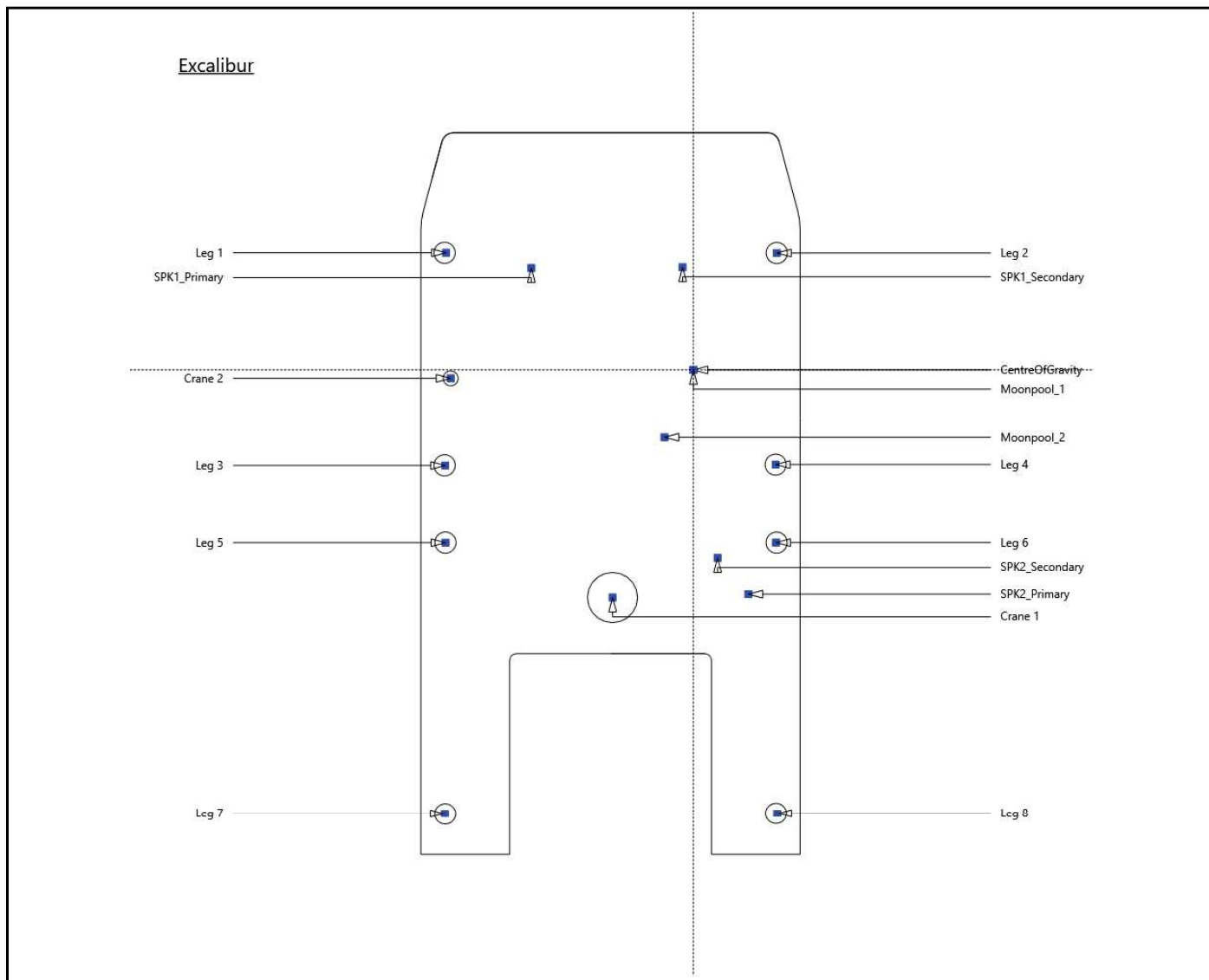


	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°51.8230'N	±0.02m
Longitude - ETRS89	07°37.3183'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	413,756.24m E	±0.01m
Northing	6,191,770.27m N	±0.02m
Raw Rig Heading ° True	101.85° T	±0.08°
Raw Rig Heading ° Grid	102.99° G	±0.08°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°51.8233'N	±0.02m
Longitude - ITRF2014	07°37.3188'E	±0.01m

Quinary

	Antenna Position for SPK2 - Starfix.G4-20001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°51.8163'N	±0.02m
Longitude - ETRS89	07°37.2889'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	413,725.34m E	±0.02m
Northing	6,191,758.54m N	±0.02m
Raw Rig Heading ° True	101.85° T	±0.08°
Raw Rig Heading ° Grid	102.99° G	±0.08°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°51.8167'N	±0.02m
Longitude - ITRF2014	07°37.2894'E	±0.02m

Vessel Outline and Offsets





Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m
SPK2_Secondary		2.04m	-15.81m	6.97m

EXCALIBUR_240149
FINAL FIX REPORT



Project ID	Excalibur_240149
Starfix Version	v2022.1110.9 (build 0)
Client	Fugro Geoservices Inc
Primary Vessel	Excalibur
Location Description	UK

Session Name	20240512-145849-v2	
Start Time	12 May 2024, 15:59:11+01:00	End Time 12 May 2024, 16:07:31+01:00

Position Source:	SPK1 - Starfix.G4 Plus-10003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°48.7220'N	±0.01m
Longitude - ETRS89	07°30.7400'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,771.48m E	±0.01m
Northing	6,186,160.92m N	±0.01m
Convergence	-1.23068°	
Heading ° True	161.10° T	±0.03°
Heading ° Grid	162.33° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°48.7223'N	±0.01m
Longitude - ITRF2014	07°30.7405'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

Seabed Depth :	0.0m
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The final position was computed from session "20240512-145849-v2" by averaging 500 observations from a total of 500 observations between 12/05/2024 15:59:12 (UTC+01:00) and 12/05/2024 16:07:31 (UTC+01:00).

Position from	Waypoint: CPT390
Excalibur at Moonpool_1	1.04m Geodetic @ 206.48° T

Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	406,771.48m E, 6,186,160.92m N, 7.73m MSS	0.00m	0.00m	0.00m
Secondary	406,771.51m E, 6,186,160.92m N, 7.71m MSS	0.03m	0.00m	-0.02m
Tertiary	406,771.59m E, 6,186,160.78m N, 7.65m MSS	0.11m	-0.14m	-0.08m
Quaternary	406,771.58m E, 6,186,160.92m N, 7.74m MSS	0.10m	0.00m	0.01m
Quinary	406,771.59m E, 6,186,160.82m N, 7.58m MSS	0.11m	-0.10m	-0.15m

Jamie Davison
 Site Manager/Supervisor
 FGBNM (Fugro Great Britain North Marine)

Rob Harwood
 Client Representative
 Fugro Geoservices Inc



Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	406,771.48	6,186,160.92	7.73	55°48.7220'N	07°30.7400'E
Crane 1	406,772.16	6,186,181.22	7.73	55°48.7329'N	07°30.7402'E
Crane 2	406,790.76	6,186,167.81	7.73	55°48.7259'N	07°30.7583'E
Leg 1	406,794.37	6,186,157.78	7.73	55°48.7205'N	07°30.7619'E
Leg 2	406,767.79	6,186,149.33	7.73	55°48.7157'N	07°30.7367'E
Leg 3	406,788.98	6,186,174.93	7.73	55°48.7297'N	07°30.7564'E
Leg 4	406,762.46	6,186,166.40	7.73	55°48.7248'N	07°30.7312'E
Leg 5	406,786.98	6,186,181.10	7.73	55°48.7330'N	07°30.7544'E
Leg 6	406,760.44	6,186,172.63	7.73	55°48.7281'N	07°30.7292'E
Leg 7	406,780.10	6,186,202.91	7.73	55°48.7447'N	07°30.7473'E
Leg 8	406,753.40	6,186,194.38	7.73	55°48.7398'N	07°30.7220'E
Moonpool_1	406,771.48	6,186,160.92	7.73	55°48.7220'N	07°30.7400'E
Moonpool_2	406,772.09	6,186,167.05	7.70	55°48.7253'N	07°30.7404'E
SPK1_Primary	406,787.13	6,186,156.83	19.46	55°48.7199'N	07°30.7550'E
SPK1_Secondary	406,775.00	6,186,152.89	19.74	55°48.7177'N	07°30.7435'E
SPK2_Primary	406,761.35	6,186,177.48	14.56	55°48.7308'N	07°30.7299'E
SPK2_Secondary	406,764.74	6,186,175.36	14.70	55°48.7297'N	07°30.7332'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Secondary)

Position Source:	SPK1 - Starfix.G4-10001
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°48.7220'N	±0.01m
Longitude - ETRS89	07°30.7400'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,771.51m E	±0.01m
Northing	6,186,160.92m N	±0.01m
Convergence	-1.23068°	
Heading ° True	161.10° T	±0.03°
Heading ° Grid	162.33° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°48.7223'N	±0.01m
Longitude - ITRF2014	07°30.7405'E	±0.01m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240512-145849-v2" by averaging 500 observations from a total of 500 observations between 12/05/2024 15:59:12 (UTC+01:00) and 12/05/2024 16:07:31 (UTC+01:00).

Position from	Waypoint: CPT390
Excalibur at Moonpool_1	1.05m Geodetic @ 207.94° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Tertiary)

Position Source:	SPK2 - Starfix.G4 Plus-20003
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°48.7219'N	±0.04m
Longitude - ETRS89	07°30.7401'E	±0.04m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,771.59m E	±0.04m
Northing	6,186,160.78m N	±0.04m
Convergence	-1.23068°	
Heading ° True	161.10° T	±0.03°
Heading ° Grid	162.33° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°48.7222'N	±0.04m
Longitude - ITRF2014	07°30.7406'E	±0.04m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240512-145849-v2" by averaging 498 observations from a total of 498 observations between 12/05/2024 15:59:12 (UTC+01:00) and 12/05/2024 16:07:31 (UTC+01:00).

Position from	Waypoint: CPT390
Excalibur at Moonpool_1	0.98m Geodetic @ 216.02° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quaternary)

Position Source:	SPK1 - Starfix.XP2-10002
Heading Source:	SPK1 - GNSS Heading-10004

	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°48.7220'N	±0.01m
Longitude - ETRS89	07°30.7401'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,771.58m E	±0.02m
Northing	6,186,160.92m N	±0.01m
Convergence	-1.23068°	
Heading ° True	161.10° T	±0.03°
Heading ° Grid	162.33° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°48.7223'N	±0.01m
Longitude - ITRF2014	07°30.7406'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK1_Primary	-13.67m	8.65m	11.73m			0.00°	0.00°

The final position was computed from session "20240512-145849-v2" by averaging 500 observations from a total of 500 observations between 12/05/2024 15:59:12 (UTC+01:00) and 12/05/2024 16:07:31 (UTC+01:00).

Position from	Waypoint: CPT390
Excalibur at Moonpool_1	1.09m Geodetic @ 210.98° T

EXCALIBUR_240149
FINAL FIX REPORT



Final Position for Moonpool_1 (Quinary)

Position Source:	SPK2 - Starfix.G4-20001
Heading Source:	SPK1 - GNSS Heading-10004

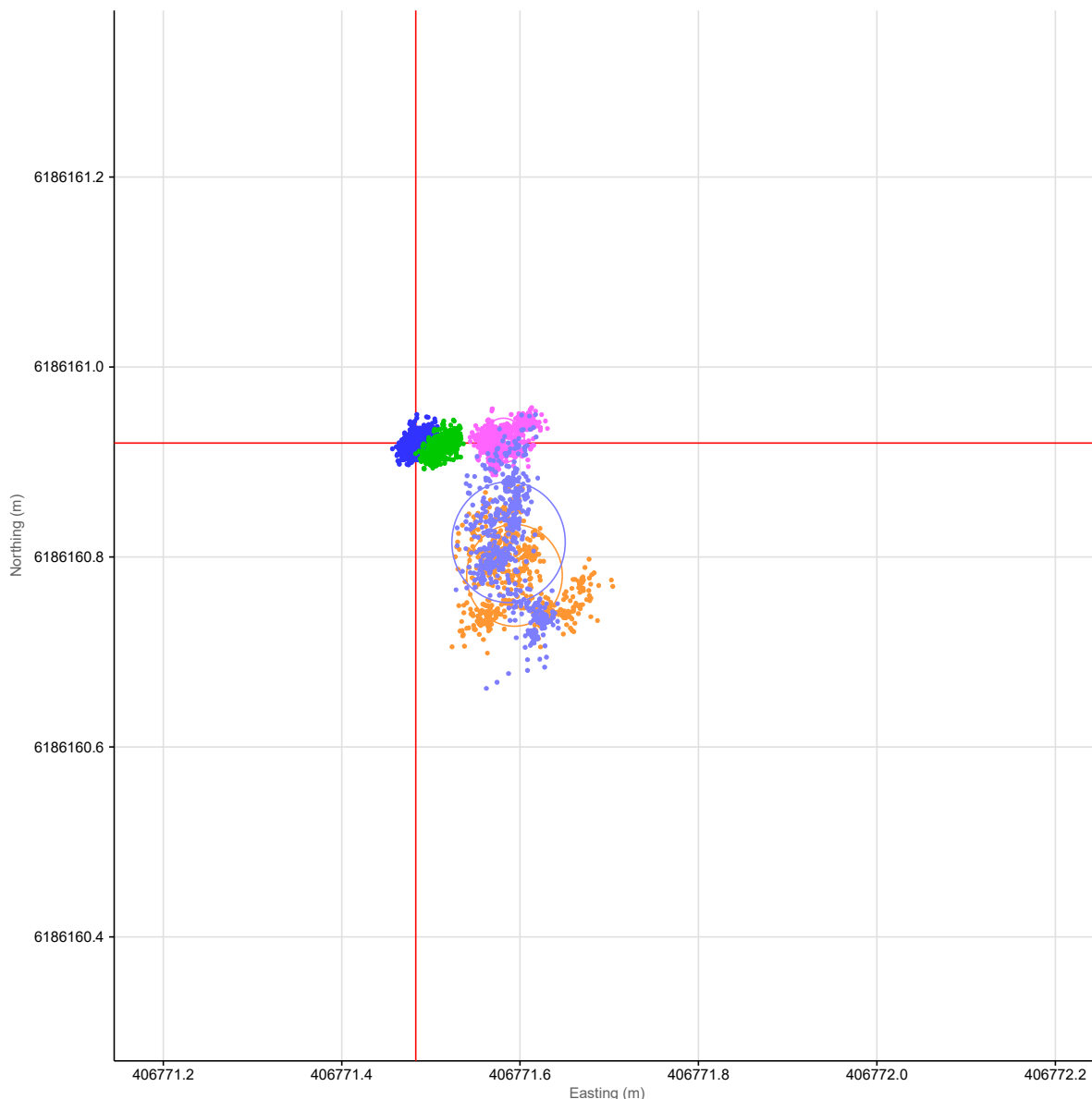
	Excalibur at Moonpool_1	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°48.7219'N	±0.06m
Longitude - ETRS89	07°30.7401'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,771.59m E	±0.02m
Northing	6,186,160.82m N	±0.06m
Convergence	-1.23068°	
Heading ° True	161.10° T	±0.03°
Heading ° Grid	162.33° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°48.7222'N	±0.06m
Longitude - ITRF2014	07°30.7406'E	±0.02m

Vessel	Offset from CRP	Starboard	Forward	Up	Corrections	Yaw	Pitch	Roll
Excalibur	Moonpool_1	0.00m	0.00m	0.00m	SPK1	0.00°		
Excalibur	SPK2_Primary	4.63m	-18.86m	6.83m			0.00°	0.00°

The final position was computed from session "20240512-145849-v2" by averaging 498 observations from a total of 498 observations between 12/05/2024 15:59:12 (UTC+01:00) and 12/05/2024 16:07:31 (UTC+01:00).

Position from	Waypoint: CPT390
Excalibur at Moonpool_1	1.01m Geodetic @ 214.52° T

Scatter Plot-ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]



Sensor Group	Excalibur Mean Position at Moonpool_1	Delta Easting	Delta Northing	Delta Height
Primary	406,771.48m E, 6,186,160.92m N, 7.73m MSS	0.00m	0.00m	0.00m
Secondary	406,771.51m E, 6,186,160.92m N, 7.71m MSS	0.03m	0.00m	-0.02m
Tertiary	406,771.59m E, 6,186,160.78m N, 7.65m MSS	0.11m	-0.14m	-0.08m
Quaternary	406,771.58m E, 6,186,160.92m N, 7.74m MSS	0.10m	0.00m	0.01m
Quinary	406,771.59m E, 6,186,160.82m N, 7.58m MSS	0.11m	-0.10m	-0.15m

Antenna Positions

Primary

	Antenna Position for SPK1 - Starfix.G4 Plus-10003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°48.7199'N	±0.01m
Longitude - ETRS89	07°30.7550'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,787.13m E	±0.01m
Northing	6,186,156.83m N	±0.01m
Raw Rig Heading ° True	161.10° T	±0.03°
Raw Rig Heading ° Grid	162.33° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°48.7203'N	±0.01m
Longitude - ITRF2014	07°30.7555'E	±0.01m

Secondary

	Antenna Position for SPK1 - Starfix.G4-10001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°48.7199'N	±0.01m
Longitude - ETRS89	07°30.7551'E	±0.01m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,787.16m E	±0.01m
Northing	6,186,156.82m N	±0.01m
Raw Rig Heading ° True	161.10° T	±0.03°
Raw Rig Heading ° Grid	162.33° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°48.7203'N	±0.01m
Longitude - ITRF2014	07°30.7556'E	±0.01m

Tertiary

	Antenna Position for SPK2 - Starfix.G4 Plus-20003	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°48.7307'N	±0.04m
Longitude - ETRS89	07°30.7300'E	±0.03m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,761.46m E	±0.03m
Northing	6,186,177.34m N	±0.04m
Raw Rig Heading ° True	161.10° T	±0.03°
Raw Rig Heading ° Grid	162.33° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°48.7310'N	±0.04m
Longitude - ITRF2014	07°30.7306'E	±0.03m

Quaternary

	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	

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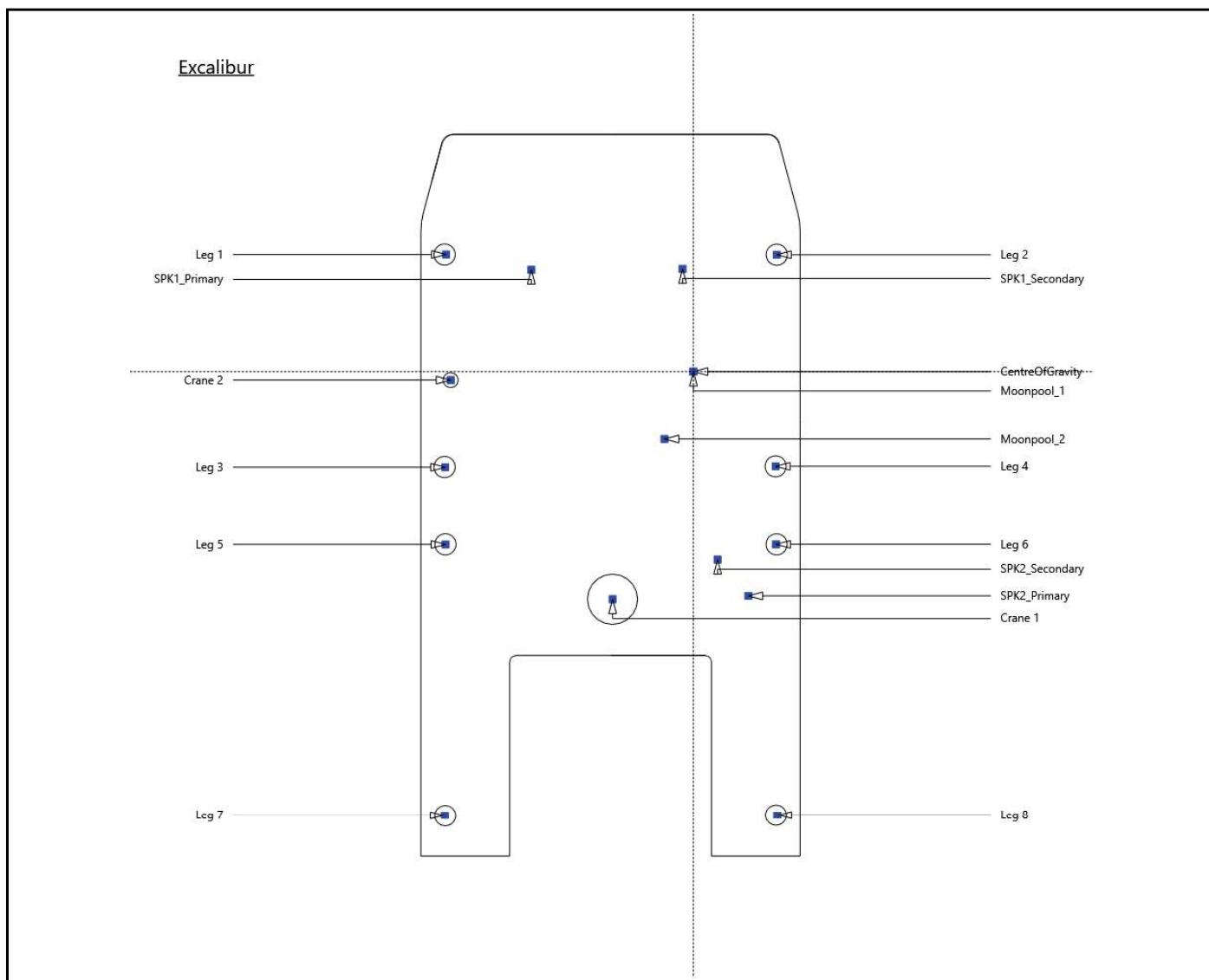


	Antenna Position for SPK1 - Starfix.XP2-10002	SD
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°48.7199'N	±0.01m
Longitude - ETRS89	07°30.7551'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,787.23m E	±0.02m
Northing	6,186,156.83m N	±0.01m
Raw Rig Heading ° True	161.10° T	±0.03°
Raw Rig Heading ° Grid	162.33° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°48.7203'N	±0.01m
Longitude - ITRF2014	07°30.7556'E	±0.02m

Quinary

	Antenna Position for SPK2 - Starfix.G4-20001	SD
Coordinate Reference System	ETRS89 / UTM zone 32N - EPSG:25832	
Geodetic Datum	European Terrestrial Reference System 1989	
Latitude - ETRS89	55°48.7307'N	±0.06m
Longitude - ETRS89	07°30.7300'E	±0.02m
Map Projection	ETRS89 / UTM zone 32N - EPSG:16032	
Easting	406,761.45m E	±0.02m
Northing	6,186,177.37m N	±0.06m
Raw Rig Heading ° True	161.10° T	±0.03°
Raw Rig Heading ° Grid	162.33° G	±0.03°
Coordinate Transformation from ITRF2014 to ETRS89	ETRS89 to ITRF2014 - FUGRO:41366	
Latitude - ITRF2014	55°48.7310'N	±0.06m
Longitude - ITRF2014	07°30.7306'E	±0.02m

Vessel Outline and Offsets



Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m
SPK2_Secondary		2.04m	-15.81m	6.97m

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Project ID: Excalibur_240149
Starfix Version: v2022.1110.9 (build 0)
Client: Fugro Geoservices Inc
Client Rep: OCR
Fugro Personnel: David Lloyd
Primary Vessel: Excalibur
Location: UK
Comment:

Session Name: CPT400-v1
Start Time: 24 Jun 2024, 08:19:10+01:00
End Time: 24 Jun 2024, 08:21:10+01:00 (Session Length 0.033 hrs - No. Obs. 120)

Position Fix Summary for Excalibur at CPT400

Moonpool_1 position computed from SPK1 - Starfix.G4 Plus-10003 (Primary)

Geodetic Datum	European Terrestrial Reference System 1989	International Terrestrial Reference Frame 2014
Latitude	55°53.0399'N	55°53.0402'N
Longitude	07°38.0252'E	07°38.0257'E
Grid System	UTM zone 32N CM 9° E	
Easting	414,538.11m E	
Northing	6,194,012.61m N	
Height	7.16m MSS (DTU21 MSS height)	
Heading	311.40°True (312.53°Grid)	

Position for Moonpool_1 is 3.90m @ 310.992°True (312.123°Grid) FROM the waypoint.

Moonpool_1 from CRP:	Starboard = 0.00m	Forward = 0.00m	Up = 0.00m
SPK1_Primary from CRP:	Starboard = -13.67m	Forward = 8.65m	Up = 11.73m
Heading correction applied (C-O):	0.00°		
Convergence:	-1.13139°		

Waypoint

European Terrestrial Reference System 1989		UTM zone 32N CM 9° E	
Latitude: 55°53.0385'N	Longitude: 07°38.0280'E	Easting: 414,541.00m E	Northing: 6,194,010.00m N
Intended Vessel Heading	0.000°True		

Positioning System Comparison

Sensor	Mean Position			Delta Easting	Delta Northing	Delta Height
	UTM zone 32N CM 9° E					
Primary	414,538.11m E	6,194,012.61m N	7.16m MSS	0.00m	0.00m	0.00m
Secondary	414,538.10m E	6,194,012.61m N	7.15m MSS	-0.02m	-0.01m	-0.01m
Tertiary	414,538.10m E	6,194,012.61m N	7.15m MSS	-0.01m	0.00m	-0.01m
Quaternary	414,538.07m E	6,194,012.63m N	7.06m MSS	-0.04m	0.02m	-0.10m

David Lloyd
 Party Chief
 FGBNM (Fugro Great Britain North Marine)

OCR
 Client Representative
 Fugro Geoservices Inc

Offset Positions

The position of offsets: (ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS])

Offsets	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
CentreOfGravity	414,538.11	6,194,012.61	7.16	55°53.0399'N	07°38.0252'E
Crane 1	414,547.61	6,193,994.66	7.16	55°53.0303'N	07°38.0346'E
Crane 2	414,524.81	6,193,997.06	7.16	55°53.0313'N	07°38.0127'E
Leg 1	414,516.69	6,194,003.96	7.16	55°53.0350'N	07°38.0048'E
Leg 2	414,535.56	6,194,024.50	7.16	55°53.0462'N	07°38.0225'E
Leg 3	414,529.89	6,193,991.76	7.16	55°53.0285'N	07°38.0177'E
Leg 4	414,548.66	6,194,012.35	7.16	55°53.0398'N	07°38.0353'E
Leg 5	414,534.69	6,193,987.40	7.16	55°53.0262'N	07°38.0224'E
Leg 6	414,553.52	6,194,007.94	7.16	55°53.0375'N	07°38.0400'E
Leg 7	414,551.50	6,193,971.90	7.16	55°53.0181'N	07°38.0388'E
Leg 8	414,570.43	6,193,992.56	7.16	55°53.0294'N	07°38.0566'E
Moonpool_1	414,538.11	6,194,012.61	7.16	55°53.0399'N	07°38.0252'E
Moonpool_2	414,540.63	6,194,006.99	7.13	55°53.0369'N	07°38.0277'E
SPK1_Primary	414,522.50	6,194,008.39	18.89	55°53.0374'N	07°38.0103'E
SPK1_Secondary	414,531.07	6,194,017.83	19.17	55°53.0426'N	07°38.0183'E
SPK2_Primary	414,555.13	6,194,003.28	13.99	55°53.0350'N	07°38.0417'E
SPK2_Secondary	414,551.14	6,194,003.43	14.13	55°53.0350'N	07°38.0378'E

Geodetic Parameters

Name : ETRS89 / UTM zone 32N [ETRF2000-ITRF2014][2023],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25832	
Global Navigation Satellite System (GNSS) Geodetic Parameters		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6,378,137.000 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.056 m	X-axis rotation -0.002754"	Scale difference 0.00355 ppm
Y-axis translation 0.0535 m	Y-axis rotation -0.01666"	Coordinate Frame rotation
Z-axis translation -0.0988 m	Z-axis rotation 0.026928"	FUGRO:41366
Local Projection Parameters		
Map Projection	Transverse Mercator	
Grid System	UTM zone 32N	EPSG:16032
Latitude Origin	00° 00' 00.000" N	
Central Meridian	009° 00' 00.000" E	
Scale factor at natural origin	0.9996	
False Easting	500 000 m	
False Northing	0 m	
Project Vertical Parameters		
Vertical Coordinate Reference System	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478

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Summary of Excalibur Positions

	Primary	SD	Secondary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK2 - Starfix.G4 Plus-20003	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	120 of 120 used		120 of 120 used	

Heading (Corrected)	311.40°True (C-O: 0.00°)	±0.02°	311.40°True (C-O: 0.00°)	±0.02°
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MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°53.0399'N	±0.01m	55°53.0399'N	±0.01m
Longitude	07°38.0252'E	±0.01m	07°38.0252'E	±0.02m
Height	47.87m Ell.	±0.01m	47.86m Ell.	±0.02m
Grid System	UTM zone 32N CM 9° E			
Easting	414,538.11m E	±0.01m	414,538.10m E	±0.02m
Northing	6,194,012.61m N	±0.01m	6,194,012.61m N	±0.01m
Height	7.16m MSS	±0.13m	7.15m MSS	±0.13m
Delta Easting	0.00m		-0.02m	
Delta Northing	0.00m		-0.01m	
Delta Height	0.00m		-0.01m	

Position of Moonpool_1 from waypoint				
Range	3.90m		3.90m	
Bearing	310.99°True		310.77°True	

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Summary of Excalibur Positions

	Primary	SD	Tertiary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK1 - Starfix.G4-10001	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	120 of 120 used		120 of 120 used	

Heading (Corrected)	311.40°True (C-O: 0.00°)	±0.02°	311.40°True (C-O: 0.00°)	±0.02°
----------------------------	--------------------------	--------	--------------------------	--------

MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°53.0399'N	±0.01m	55°53.0399'N	±0.01m
Longitude	07°38.0252'E	±0.01m	07°38.0252'E	±0.01m
Height	47.87m Ell.	±0.01m	47.86m Ell.	±0.01m
Grid System	UTM zone 32N CM 9° E			
Easting	414,538.11m E	±0.01m	414,538.10m E	±0.01m
Northing	6,194,012.61m N	±0.01m	6,194,012.61m N	±0.01m
Height	7.16m MSS	±0.13m	7.15m MSS	±0.13m
Delta Easting	0.00m		-0.01m	
Delta Northing	0.00m		0.00m	
Delta Height	0.00m		-0.01m	

Position of Moonpool_1 from waypoint				
Range	3.90m		3.90m	
Bearing	310.99°True		310.90°True	

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Summary of Excalibur Positions

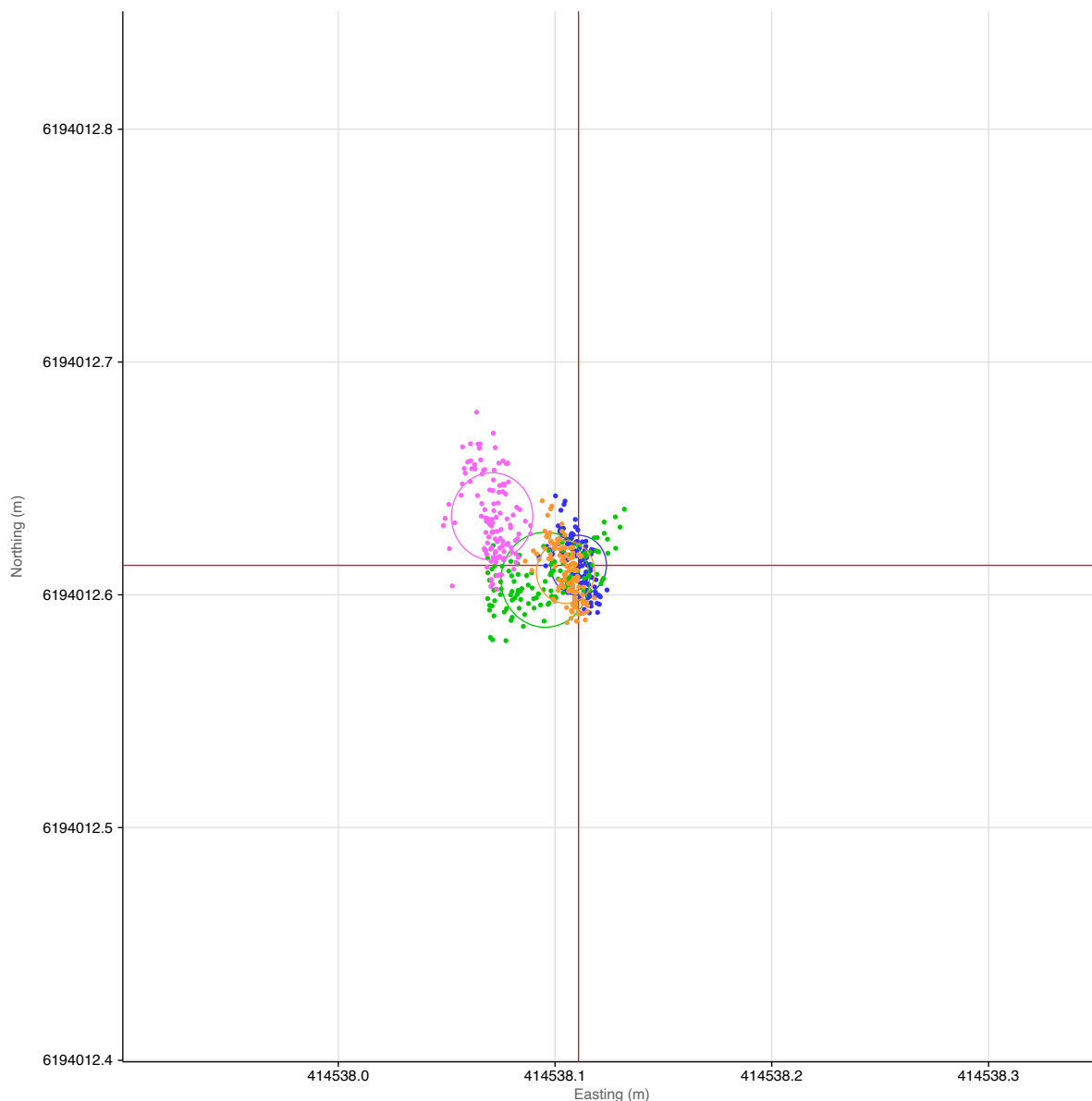
	Primary	SD	Quaternary	SD
Position System	SPK1 - Starfix.G4 Plus-10003		SPK1 - Starfix.XP2-10002	
Heading System	SPK1 - GNSS Heading-10004		SPK1 - GNSS Heading-10004	
Observations	120 of 120 used		120 of 120 used	

Heading (Corrected)	311.40°True (C-O: 0.00°)	±0.02°	311.40°True (C-O: 0.00°)	±0.02°
----------------------------	--------------------------	--------	--------------------------	--------

MOONPOOL_1 POSITION				
Geodetic Datum	European Terrestrial Reference System 1989			
Latitude	55°53.0399'N	±0.01m	55°53.0399'N	±0.02m
Longitude	07°38.0252'E	±0.01m	07°38.0251'E	±0.01m
Height	47.87m Ell.	±0.01m	47.77m Ell.	±0.02m
Grid System	UTM zone 32N CM 9° E			
Easting	414,538.11m E	±0.01m	414,538.07m E	±0.01m
Northing	6,194,012.61m N	±0.01m	6,194,012.63m N	±0.02m
Height	7.16m MSS	±0.13m	7.06m MSS	±0.13m
Delta Easting	0.00m		-0.04m	
Delta Northing	0.00m		0.02m	
Delta Height	0.00m		-0.10m	

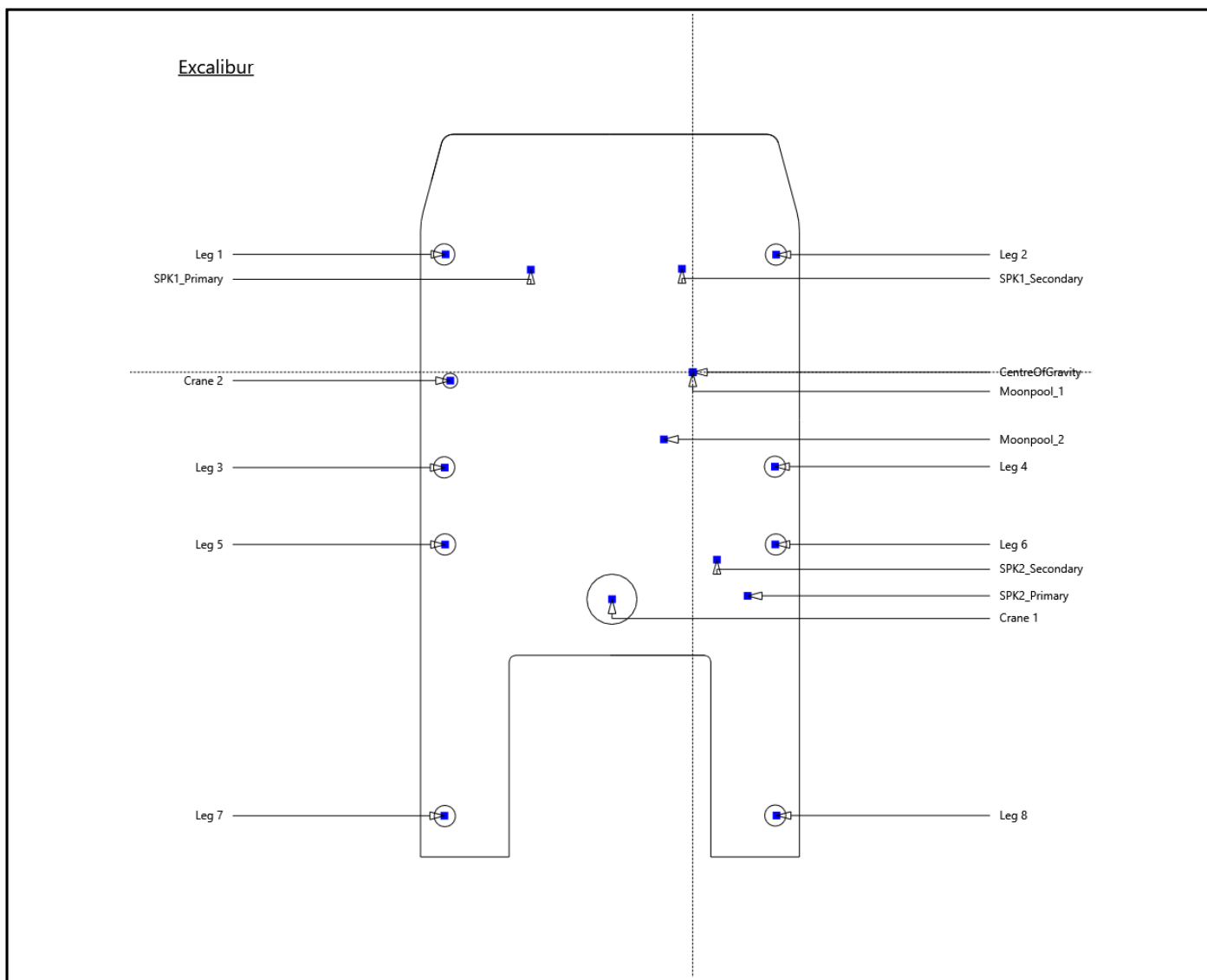
Position of Moonpool_1 from waypoint				
Range	3.90m		3.94m	
Bearing	310.99°True		310.83°True	

Scatter Plot



Sensor Group	Excalibur Mean Position at Moonpool_1 ETRS89 / UTM zone 32N [ETRF2000- ITRF2014][2023],DTU21 MSS height [DTU21 MSS]	Delta Easting	Delta Northing	Delta Height
Primary	414,538.11m E, 6,194,012.61m N, 7.16m MSS	0.00m	0.00m	0.00m
Secondary	414,538.10m E, 6,194,012.61m N, 7.15m MSS	-0.02m	-0.01m	-0.01m
Tertiary	414,538.10m E, 6,194,012.61m N, 7.15m MSS	-0.01m	0.00m	-0.01m
Quaternary	414,538.07m E, 6,194,012.63m N, 7.06m MSS	-0.04m	0.02m	-0.10m

Excalibur Outline and Offsets



Excalibur - Defined Offsets

Name	Purpose	X Offset	Y Offset	Z Offset
CentreOfGravity	CentreOfGravity	0.00m	0.00m	0.00m
Crane 1		-6.81m	-19.14m	0.00m
Crane 2		-20.46m	-0.71m	0.00m
Leg 1		-20.86m	9.94m	0.00m
Leg 2		7.04m	9.92m	0.00m
Leg 3		-20.93m	-8.04m	0.00m
Leg 4		6.94m	-7.96m	0.00m
Leg 5		-20.90m	-14.53m	0.00m
Leg 6		6.97m	-14.52m	0.00m
Leg 7		-20.96m	-37.40m	0.00m
Leg 8		7.07m	-37.38m	0.00m
Moonpool_1	CommonReferencePoint	0.00m	0.00m	0.00m
Moonpool_2		-2.44m	-5.66m	-0.03m
SPK1_Primary		-13.67m	8.65m	11.73m
SPK1_Secondary		-0.91m	8.72m	12.01m
SPK2_Primary		4.63m	-18.86m	6.83m

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SPK2_Secondary		2.04m	-15.81m	6.97m
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D.4 Survey Mobilisation and Calibration Documents

List of Plates

Survey Mobilisation and Calibration Report

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Excalibur – Mobilisation and Calibration Report

FGBNM-240149-R0 01 | 20 March 2024

For Review

Fugro GeoServices Limited

Document Control

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Initials	Name	Role
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BB	Blaze Bobkowski	Surveyor
MT	Marketa Thornhill	Project Surveyor
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-

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Abbreviations

C-O	Computed minus Observed
CRP	Common Reference Point
CRS	Coordinate Reference System
DGNSS	Differential Global Navigation Satellite System
DRMS	Distance Root Mean Square
DTU	Technical University of Denmark
ETRS89	European Terrestrial Reference System 1989
FGBNM	Fugro GB North Marine
FGSL	Fugro GeoServices Limited
G4+	Fugro Starfix positioning solution
GNSS	Global Navigation Satellite System
HDOP	Horizontal Dilution of Precision
JUB	Jack-Up Barge
LAT	Lowest Astronomical Tide
MPR	Mean Positioning Report
MSS	Mean Sea Surface
OGUK	Oil and Gas UK
PDOP	Position Dilution of Precision
ROC	Remote Operations Centre
RTK	Real-Time Kinematic
SD	Standard Deviation
UPS	Uninterruptible Power Supply
UTC	Universal Time Coordinated
UTM	Universal Transverse Mercator
WGS 84	World Geodetic System 1984

1. Introduction and Scope of Work

1.1 Project Description

Fugro GB (North) Marine Limited (FGBNM) was subcontracted by Fugro GeoServices Limited (FGSL) to provide, install and calibrate surface positioning equipment and software onboard the Excalibur jack-up barge (JUB) whilst alongside Holyhead.

FGBNM provided the JUB with surface positioning and survey services during operations. FGSL will utilise the FGBNM supplied equipment for all operations and positioning.

DGNSS positioning used the Fugro Starfix.G4+ solution which met the horizontal and vertical accuracy specification. Heading control was provided by two ProTrack GNSS heading solutions and one mechanical gyro providing redundancy.

Antenna position data was combined with the JUB heading in Starfix navigation software to compute the JUB CRP position. DGNSS derived JUB position, JUB outline, and nearby structures were displayed by the online graphics system, together with their relative position, plus course and speed data if applicable.

Post mobilisation DGNSS and heading verifications were required to prove the JUB positioning system validity.

Connection to ROC was tested and confirmed operational before FGBNM personnel departed the JUB.

The horizontal and vertical uncertainty of the vessel position shall be less than 0.5m. The accuracy of the horizontal positioning shall be better than 0.2m for 95% of time (2σ).

During the survey operations, the elevation of the seabed at each exploratory hole location shall be recorded at the location and expressed relative to DTU21 MSS.

1.2 Scope of Work

The scope of work involving Fugro during the operations was as follows:

- Mobilised personnel and positioning equipment to JUB;
- Conducted risk assessment, toolbox talk, installation and system checks;
- Installed four antennas with two dual card StarPack solution;
- Positioned all antennas such that they performed to an optimum;
- Installed Meridian gyro;
- Installed and tested 4G modem;
- Confirmed with FGSL their preferred vertical reference point (deck level);
- Photographed all equipment installed and compiled JUB information sheet;
- Conducted offset determination using dimensional control techniques:
 - Clearly marked the CRP;
 - Antennas (three dimensions, height to deck level);
 - JUB leg centres.
- Conducted heading alignment checks using a DGNSS validated baseline;
- Configured the position and elevation logging of CRP in Starfix.;
- Configured the MPR;
- Tested 4G modem and confirmed with ROC that connection was established on both navigation PCs;
- Configured logging and monitoring of position quality data (HDOP, PDOP, SD, number of satellites in view, etc.);
- Completed fault logs as necessary;
- Prepared equipment for return;
- Returned data and deliverables to the office (including photographs of CRP, antennas etc.).

2. Calibration Results

2.1 Alongside Calibration Results

A series of alongside checks and calibrations were undertaken between 8 and 9 March 2024, while the Excalibur JUB was alongside Holyhead.

2.2 Vessel Offset Measurement

Offsets of installed GNSS antennas relative to the CRP (Moonpool 1) were measured using total station observations. The zero elevation was set to be the deck level. Refer to Table 2.1 and Figure 2.1 for Excalibur offsets.

Table 2.1: Excalibur Offsets

Description	X [m]	Y [m]	Z [m]	Notes
Moonpool 1 CRP	0.00	0.00	0.00	Common Reference Point, deck level
GNSS Antenna Aft 1	4.63	-18.86	6.83	SPK2 primary, Phase centre
GNSS Antenna Aft 2	2.04	-15.81	6.97	SPK2 secondary, Phase centre
GNSS Antenna Bow Port	-13.67	8.65	11.73	SPK1 primary, Phase centre
GNSS Antenna Bow Starboard	-0.91	8.72	12.01	SPK1 secondary, Phase centre
LEG 1	-20.86	9.94	0.00	Centre
LEG 2	7.04	9.92	0.00	Centre
LEG 3	-20.93	-8.04	0.00	Centre
LEG 4	6.94	-7.96	0.00	Centre
LEG 5	-20.90	-14.53	0.00	Centre
LEG 6	6.97	-14.52	0.00	Centre
LEG 7	-20.96	-37.40	0.00	Centre
LEG 8	7.07	-37.38	0.00	Centre
Moonpool 2	-2.44	-5.66	-0.03	Centre
Crane 1	-6.81	-19.14	0.00	Centre
Crane 2	-20.46	-0.71	0.00	Centre

Excalibur

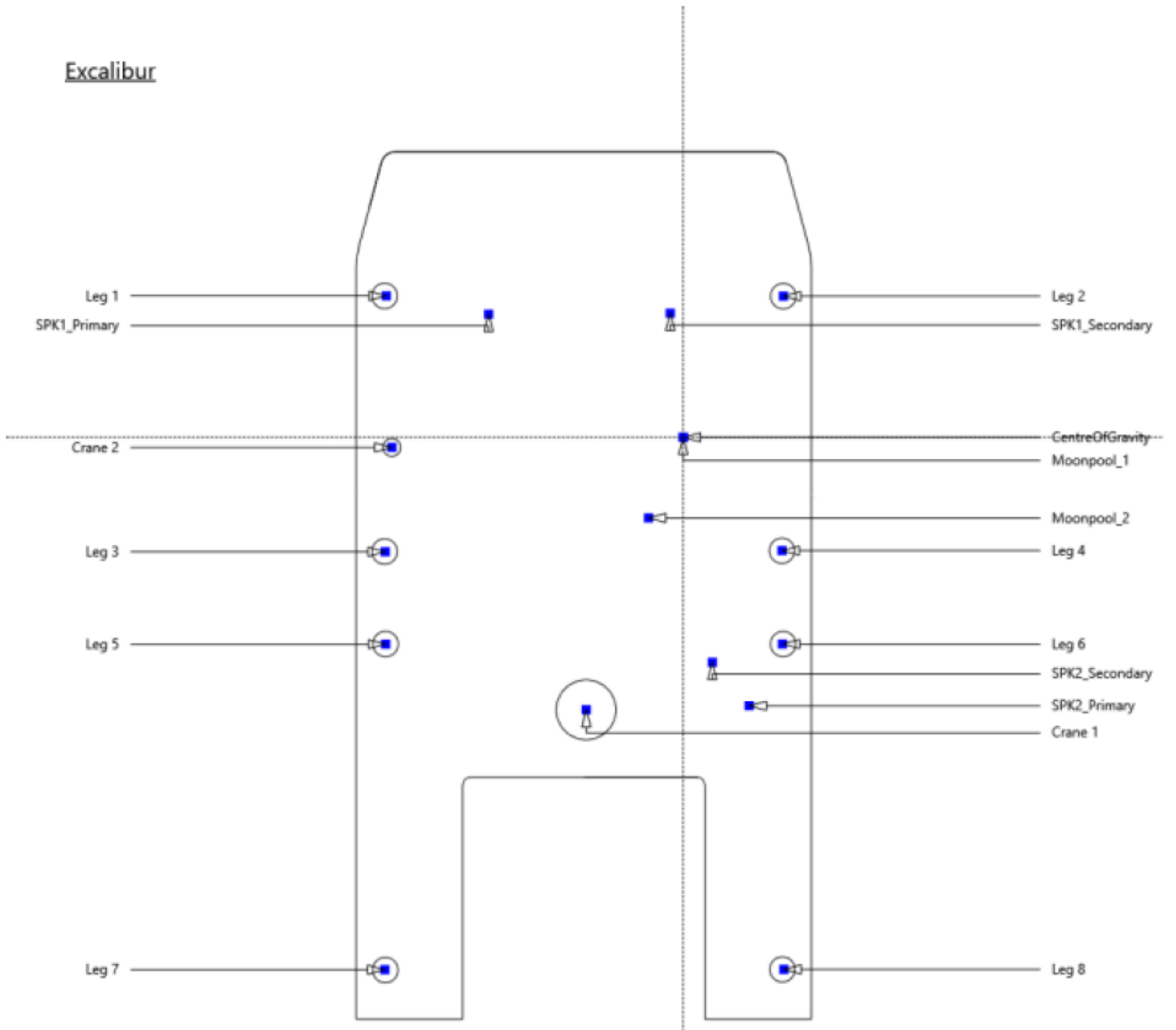


Figure 2.1: Excalibur offset diagram

2.3 Heading Sensors Verifications and Calibration

Observations for the heading verifications and calibration were conducted whilst the Excalibur JUB was jacked-up alongside Holyhead. Two DGNS heading solutions were installed on the JUB. Two coordinated quayside control points were used for the heading verification. Measurements were taken from the total station to targets placed on a straight length of the side of the JUB, which were offset relative to the JUB centreline.

Onboard ProTrack readings were recorded simultaneously with total station measurements. These logged values were then averaged over the logged period (vessel was stable) and compared with the calculated values to determine the average C-O correction. Prior to the onboard data recording, any existing C-Os were removed from the navigation where applicable. Refer to Appendix A for details.

Table 2.2: Vessel Heading Sensor Verification

Solution	Computed [°]		Observed [°]		Mean Difference [°]	
	Mean	SD	Mean	SD	Mean	SD
ProTrack SPK1	211.81	0.01	211.85	0.06	-0.04	0.07

Note: Protrack SPK2 logged data had a higher standard deviation than expected. This can be due to a possible interference from antennas nearby or legs masking. A third heading solution was additionally configured utilising SPK1 primary antenna and SPK2 primary antenna. A gyroscope was also additionally installed to provide more redundancy for heading solutions.

The gyro calibration was conducted by running a two-hour gyro comparison against the primary heading solution SPK1 in the Starfix software. For details see Appendix B.2.

Table 2.3: Gyro calibration

Sensor	Computed [°]		Observed [°]		Mean C-O [°]	
	Mean	SD	Mean	SD	Mean	SD
ProTrack SPK1	211.86	0.04	-	-	-	-
Meridian gyro	-	-	211.14	0.05	+0.71	0.06

2.4 Final Vessel Heading System Verification

A comparison of all heading solutions was conducted whilst the Excalibur JUB was jacked-up alongside Holyhead. Heading data was logged simultaneously for one hour. The Fugro ProTrack SPK1 was used as a primary heading and all other heading solutions were compared to it. Refer to Appendix B for details.

Table 2.4: Final Vessel Heading Systems Verification

Heading Solution	Mean [°T]	SD [°]	Difference [°]
GNSS ProTrack SPK1	211.83	0.05	-
Dual GNSS Heading Solution	211.68	0.06	+0.15
Meridian Gyro	211.91	0.00	-0.08
GNSS ProTrack SPK2	211.89	0.18	-0.06

2.5 Position Verification

A position verification was completed whilst the Excalibur was jacked-up alongside in Holyhead. Reference position point (MoonPool 2) on the JUB was logged for one hour at a sample rate of 1 Hz using RTK GNSS whilst also the same position was being logged in Starfix using SPK1 antenna and SPK2 antenna. The resulting positions were compared against each other.

An overview of the results from the position verification are listed and shown in the following table.

Table 2.5: Vessel Position Verification Results – from SPK1

Deme Neptune	Easting [m]	Northing [m]	Height [m]	ΔE [m]	ΔN [m]	ΔHt [m]
Check Point from RTK	391425.37	5908034.31	7.33	-	-	
Check Point from SPK1 G4+	391425.44	5908034.36	7.35	-0.07	-0.05	-0.02

Table 2.6: Vessel Position Verification Results – from SPK2

Deme Neptune	Easting [m]	Northing [m]	Height [m]	ΔE [m]	ΔN [m]	ΔHt [m]
Check Point from RTK	391425.37	5908034.31	7.33	-	-	
Check Point from SPK2 G4+	391425.33	5908034.36	7.30	+0.04	-0.05	+0.03

2.6 Vessel DGNSS CRP Position Comparison

A final comparison check was conducted on the Fugro StarPacks DGNSS CRP position solutions whilst the Excalibur JUB was jacked-up alongside Holyhead.

Positioning data was logged for one hour at a sample rate of 1 Hz. Table 2.7 shows the delta Easting and Northing value of CRP for each position solution compared to the primary solution (G4+ SPK1). The mean deltas are all < 0.15 m which demonstrates a good consistency within project specification for surface positioning systems. Refer to Appendix C for details.

Table 2.7: Excalibur Mean Position at Moonpool_1 (UTM zone 30N CM -3° W)

System	Easting [m]	Northing [m]	Height [m]	1 x DRMS [m]	Difference [m]		
					Easting	Northing	Height
SPK1- Starfix.G4 Plus	391 420.29	5 908 030.94	7.40	0.03	-	-	-
SPK1- Starfix.G4	391 420.28	5 908 030.95	7.35	0.03	-0.02	0.01	-0.04
SPK1- Starfix.XP2	391 420.30	5 908 030.95	7.38	0.03	0.01	0.01	-0.01
SPK2- Starfix.G4 Plus	391 420.20	5 908 030.95	7.35	0.04	-0.09	0.02	-0.05
SPK2- Starfix.G4	391 420.16	5 908 030.96	7.35	0.03	-0.14	0.02	-0.05
SPK2- Starfix.XP2	391 420.26	5 908 030.96	7.36	0.04	-0.03	0.02	-0.04

3. Summary of Events

A summary of operations is listed in Table 3.1:

Table 3.1: Summary of Events

Date		Task
Start	End	
08/03/2024	09/03/2024	Vessel safety familiarisation and project briefing. Commence mobilisation. JUB offsets by dimensional control survey. Calibrations and verifications. Demobilisation of personnel.

Refer to Appendix D for daily progress reports.

4. Survey Control

4.1 Geodetic Parameters

The calibration/verification CRS is based on ETRS89 UTM 30N.

Table 4.1: Geodetic Parameters

Name: ETRS89 / UTM zone 30N [ETRF2000-ITRF2014][2024.250254],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25830	
Global Navigation Satellite System (GNSS) Geodetic Parameters*		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6 378 137.00 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6 378 137.00 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.05613 m	X-axis rotation -0.0028553"	Scale difference 0.00368753 ppm
Y-axis translation 0.05363 m	Y-axis rotation -0.0172726"	Coordinate Frame rotation
Z-axis translation -0.10118 m	Z-axis rotation 0.0279182"	FUGRO:41366
Local Projection Parameters		
Map projection	Transverse Mercator	
Grid system	UTM zone 30N	EPSG:16030
Latitude origin	00° 00' 00.000" N	
Central meridian	003° 00' 00.000" W	
Scale factor on central meridian	0.9996	
False easting	500 000 m	
False northing	0 m	
Project Vertical Parameters		
Vertical coordinate reference system	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478
Notes		
* The geodetic datum of Fugro's global GNSS correction data is ITRF2014, epoch 2024.250254 (01/04/2024 14:14:00)		

Vertical reference datum is DTU21 MSS height.

5. Personnel and Equipment

5.1 Personnel

Table 5.1: Personnel List

Name	Job Title	Joined Vessel	Departed Vessel
Blaze Bobkowski	Surveyor	08/03/2024	09/03/2024
Stephen Ewing	Engineer	04/03/2024	09/03/2024
Sunny Singh	Engineer	04/03/2024	09/03/2024
Kayode Adenuga	Engineer	15/03/2024	16/03/2024

5.2 Equipment

Table 5.2: Positioning Equipment

Item	Quantity	Spare
Dual StarPack	2	1
Starpac	1	1
AD492 antenna	5	1
Starfix PC	4	1
Rig rack	1	
Meridian gyroscope	1	-
Samsung Galaxy A7 tablet	1	
IP Phone + headset (for ROC)	1	
Juniper switch (for ROC)	1	
Toolbox	1	
UPS	1	1
24" monitor	4	2
Satel	3	1
100m belden cable	3	
60m belden cable	3	
25m belden cable	1	
20m Belden cable	2	
In-line amplifier	1	
Network cable reel	2	
USB Hub	?	
Tug pack Europod Europod PSU Europod cable WLAN access point WLAN omni antenna	1	1

Item	Quantity	Spare
UPS Monitor		

Table 5.3: Calibrations Equipment - returned after calibrations

Item	Quantity
Leica TS11 Total Station with batteries and charger	1
1 x RTK Kit	2
Accura Bestfit Dongle	1
Full size prism	3
Optical Tribrach	3
Tribrach adapter	3
Magnetic mount (5/8")	4
Mini Prism with extendable pole	1
Spike prism	1
Ball prism	1
Detail Pole	1
Tripod with Spider	3
Station Marking Kit	1
Sheet of sticky targets	1
Roll of duct tape	1
Roll of insulation tape	1
Disto	1
30m Tape Measure	1
5m Tape Measure	1

6. General Safety

Upon arrival on the Excalibur JUB all personnel underwent an induction briefing, carried out by a member of the marine crew, addressing the primary safety issues surrounding the JUB. Following the completion of the initial briefing, a safety tour on the JUB was taken to show and indicate the safety features. In addition, various meetings were held with members from both the marine and survey crew to define the project and general offshore operations.

6.1 Protective Clothing

All Fugro personnel carry the following protective clothing:

- Hard hat;
- Safety boots;
- Safety glasses;
- Coveralls;
- Gloves.

6.2 Documentation

All Fugro personnel were in possession of the following MLC2006 compliant documentation:

- Current passport;
- OGUK/Norwegian approved offshore medical certificate;
- Vaccination booklet;
- Current employment contract;
- Recent pay slip;
- Current curriculum vitae (CV);
- Certificate of employer's liability insurance;
- Minimum Industry Safety Training (MIST) certificate.

A project specific emergency response document was issued to the JUB at mobilisation.

6.3 Hazardous Operations

During the JUB mobilisation and calibration all safety procedures were adhered to.

6.4 Toolbox Meetings

Toolbox meetings are a regular feature of the safety culture onboard. Task specific toolbox talks were conducted before a new or specific project task taking place.

Appendix A

Heading

Verifications/Calibrations

B.1 ProTrack SPK1



HEADING SENSOR CALIBRATION WITH TOTAL STATION

Project: 240149	Location: Holyhead, UK	Datum: WGS84
Vessel: Excalibur	Date: 09/03/2024	Spheroid: WGS84
Client: FGSL	Heading Sensor: SPK1	Hemisphere: North
		Projection and zone: Universal Transverse Mercator 30
		Central Meridian: -3° W
		False Easting: 500000
		Scale Factor: 0.9996

"BOW PRISM" STATION:	"STERN PRISM" STATION:	
Instrument Station ID: B1	Instrument Station ID: B1	
Easting: 391466.516	Easting: 391466.516	
Northing: 5908044.948	Northing: 5908044.948	
Instrument Type:	Instrument Type:	
Instrument Serial Number:	Instrument Serial Number:	
		<input type="button" value="Load Geodesy"/>
Backsight station ID (RO): B2	Backsight station ID (RO): B2	
Easting: 391474.582	Easting: 391474.582	
Northing: 5907988.796	Northing: 5907988.796	
Backsight HA Reading: 000° 00' 00"	Backsight HA Reading: 000° 00' 00"	Convergence: 1.30600 deg
Calculated Baseline Grid Bearing: 171° 49' 32"	Calculated Baseline Grid Bearing: 171° 49' 32"	

Fix No.	INPUT								Calculated True Vessel Heading (C)	Results (C-O)
	UTC time	Observations to bow prism			Observations to stern prism			Vessel Logg Raw Heading S. (O)		
		Horizontal Angle	Horizontal Distance		Horizontal Angle	Horizontal Distance				
[hh:mm:ss]	[deg] [min] [sec]	[m]		[deg] [min] [sec]	[m]		[deg]	[deg]		
1	09:26:01	53 15 47	40.338		115 40 03	8.696		211.82	211.80	-0.02
2	09:26:36	53 15 17	40.338		115 39 20	8.695		211.71	211.79	0.08
3	09:28:57	53 16 05	40.337		115 40 22	8.695		211.66	211.81	0.15
4	09:29:32	53 16 34	40.338		115 39 44	8.696		211.78	211.81	0.03
5	09:33:33	53 16 24	40.337		115 41 46	8.696		211.67	211.81	0.14
6	09:34:07	53 16 41	40.337		115 42 03	8.696		211.89	211.81	-0.08
7	09:34:41	53 16 53	40.338		115 42 53	8.696		211.78	211.82	0.04
8	09:35:08	53 17 04	40.337		115 42 34	8.696		211.84	211.82	-0.02
9	09:35:34	53 17 17	40.337		115 42 09	8.696		211.82	211.82	0.00
Average:								+ 211.77	+ 211.81	+ 0.04
St. dev.								0.08	0.01	0.07



B.2 Gyro Calibration

Starfix Gyro Calibration

Table 1: Project details

Project Name	Excalibur_240149
Project Number	Excalibur_240149
Vessel	Excalibur
Client	Fugro Geoservices Inc
Project Type	Positioning
Location	UK

Table 2: Calibration settings

Calibration Type	Multi-Target
------------------	--------------

Table 3: Calibration results



Reference Gyro						
 SPK1						
Target Gyro	Calculated C-O [°]	SD [°]	Minimum C-O [°]	Maximum C-O [°]	Observations Used	Observations Rejected
 TSS Meridian	0.71	0.06	0.50	0.89	6934	1

Table 4: Gyro configuration

	Reference Gyro	SPK1		Target Gyro	TSS Meridian
	Model	Nmea		Model	Nmea
	C-O Correction	0.00°		C-O Correction	0.00°
	Sensor Latitude			Sensor Latitude	53° 18' 37.1917" N

Table 5: Gyro information

Gyro	Average [°]	Standard Deviation [°]
Reference	211.86	0.04
Target	211.14	0.05

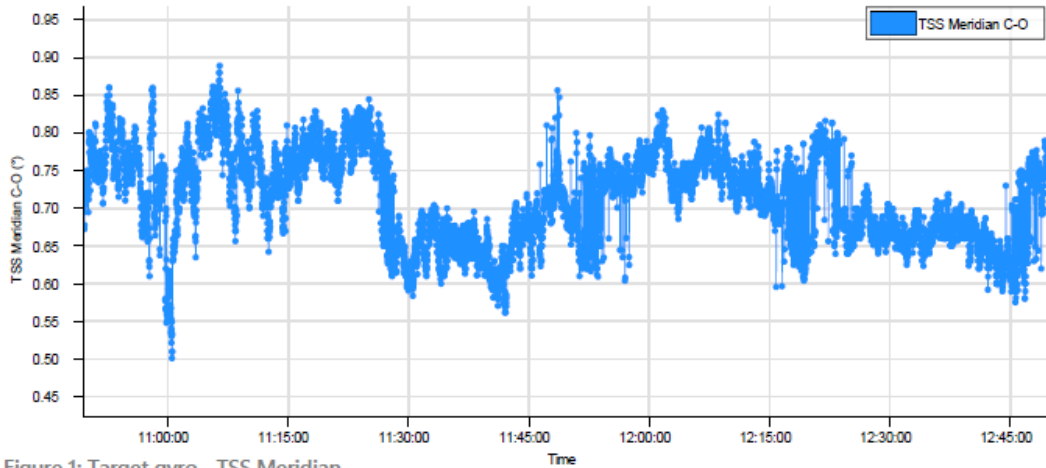


Figure 1: Target gyro - TSS Meridian

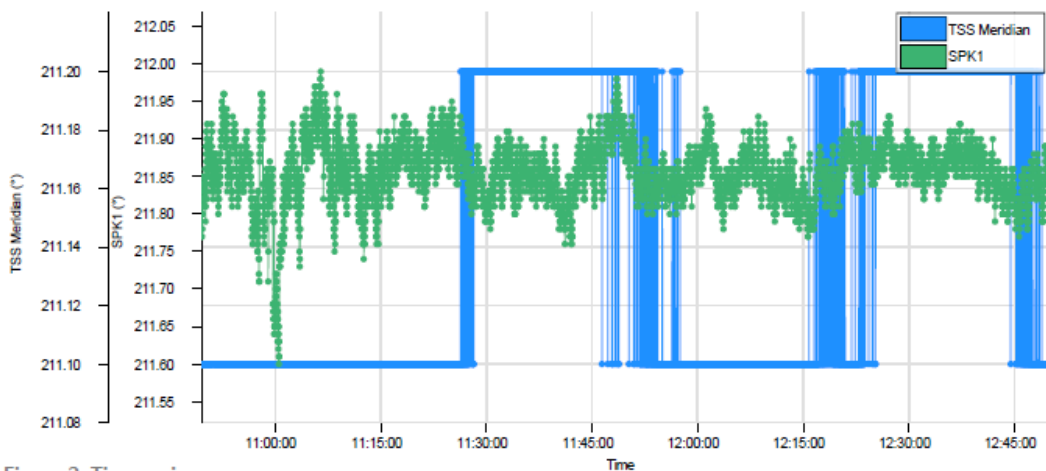


Figure 2: Time series

Appendix B

CRP Position and Heading
Comparison Check

C.1 DGNS CRP Position and Heading Check

Session name	20240319-132223_NAV1-v2
Units and Format	Local grid (World Standard)
Start Time	19 Mar 2024, 13:26:23+00:00
End Time	19 Mar 2024, 14:26:22+00:00
Duration	59m 59s
Number of Observations	3599

Table 3: Positioning system CRS and offsets

	System	CRS	X [m]	Y [m]	Z [m]
1	SPK1-Starfix.G4 Plus 10003	WGS 84(2D)	-13.67	8.65	11.73
2	SPK1-Starfix.G4 10001	WGS 84(2D)	-13.67	8.65	11.73
3	SPK2-Starfix.G4 Plus 20003	WGS 84(2D)	4.63	-18.86	6.83
4	SPK1-Starfix.XP2 10002	WGS 84(2D)	-13.67	8.65	11.73
5	SPK2-Starfix.G4 20001	WGS 84(2D)	4.63	-18.86	6.83
6	SPK2-Starfix.XP2 20002	WGS 84(2D)	4.63	-18.86	6.83

Table 4: Sensor data (mean values over data periods)

	Antenna Positions	East [m]	North [m]	H [m]	East SD [m]	North SD [m]	H SD [m]	Obs
1	SPK1-Starfix.G4 Plus 10003	391 427.01 E	5 908 016.22 N	19.13 MSS	± 0.02	± 0.02	± 1.46	3599
2	SPK1-Starfix.G4 10001	391 426.99 E	5 908 016.24 N	19.08 MSS	± 0.02	± 0.01	± 1.46	3599
3	SPK2-Starfix.G4 Plus 20003	391 426.63 E	5 908 049.27 N	14.18 MSS	± 0.03	± 0.02	± 1.46	3599
4	SPK1-Starfix.XP2 10002	391 427.01 E	5 908 016.24 N	19.11 MSS	± 0.02	± 0.02	± 1.46	3599
5	SPK2-Starfix.G4 20001	391 426.59 E	5 908 049.27 N	14.18 MSS	± 0.01	± 0.02	± 1.46	3599
6	SPK2-Starfix.XP2 20002	391 426.69 E	5 908 049.28 N	14.19 MSS	± 0.02	± 0.02	± 1.46	3599

Table 5: Heading sensor data

	Heading Sensors	Obs T [°]	Obs G [°]	Conv [°]	SD [°]	(C-O) [°]	Obs T [°]	Obs G [°]	Diff [°]	Records
1	SPK1	211.83	213.14	-1.30695	0.05	0.00	211.83	213.14	0.00	3599
2	DualPositionHeading	211.68	212.98	-1.30695	0.06	0.00	211.68	212.98	0.16	3599
3	TSS Meridian	211.20	212.51	-1.30695	0.00	0.71	211.91	213.22	-0.08	3599
4	SPK2	211.89	213.20	-1.30695	0.18	0.00	211.89	213.20	-0.06	3599

Table 6: Pitch sensor data

	Pitch Sensors	Observed [°]	SD [°]	(C-O) [°]	Computed [°]	Difference [°]	Records
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Table 7: Roll sensor data

	Roll Sensors	Observed [°]	SD [°]	(C-O) [°]	Computed [°]	Difference [°]	Records
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Table 8: Results: Excalibur Mean Position at Moonpool_1 (UTM zone 30N CM -3° W)

	Name	East [m]	North [m]	H [m]	1 \times DRMS [m]	Δ East [m]	Δ North [m]	Δ H [m]	Obs
1	SPK1-Starfix.G4 Plus 10003	391 420.29 E	5 908 030.94 N	7.40 MSS	0.03	0.00	0.00	0.00	3599
2	SPK1-Starfix.G4 10001	391 420.28 E	5 908 030.95 N	7.35 MSS	0.03	-0.02	0.01	-0.04	3599
3	SPK2-Starfix.G4 Plus 20003	391 420.20 E	5 908 030.95 N	7.35 MSS	0.04	-0.09	0.02	-0.05	3599
4	SPK1-Starfix.XP2 10002	391 420.30 E	5 908 030.95 N	7.38 MSS	0.03	0.01	0.01	-0.01	3599
5	SPK2-Starfix.G4 20001	391 420.16 E	5 908 030.96 N	7.35 MSS	0.03	-0.14	0.02	-0.05	3599
6	SPK2-Starfix.XP2 20002	391 420.26 E	5 908 030.96 N	7.36 MSS	0.04	-0.03	0.02	-0.04	3599

Table 9: Geodetic parameters

Name: ETRS89 / UTM zone 30N [ETRF2000-ITRF2014][2024.250254],DTU21 MSS height [DTU21 MSS]		
EPSG Code	EPSG:25830	
Global Navigation Satellite System (GNSS) Geodetic Parameters*		
Datum	International Terrestrial Reference Frame 2014	EPSG:1165
Ellipsoid	GRS 1980	
Semi major axis	a = 6 378 137.00 m	
Inverse flattening	1/f = 298.257222101	
Local Geodetic Datum Parameters		
Datum	European Terrestrial Reference System 1989	EPSG:6258
Ellipsoid	GRS 1980	
Semi major axis	a = 6 378 137.00 m	
Inverse flattening	1/f = 298.257222101	
Datum Transformation Parameters from ITRF2014 to ETRS89		
X-axis translation 0.05613 m	X-axis rotation -0.0028553"	Scale difference 0.00368753 ppm
Y-axis translation 0.05363 m	Y-axis rotation -0.0172726"	Coordinate Frame rotation
Z-axis translation -0.10118 m	Z-axis rotation 0.0279182"	FUGRO:41366
Local Projection Parameters		
Map projection	Transverse Mercator	
Grid system	UTM zone 30N	EPSG:16030
Latitude origin	00° 00' 00.000" N	
Central meridian	003° 00' 00.000" W	
Scale factor on central meridian	0.9996	
False easting	500 000 m	
False northing	0 m	
Project Vertical Parameters		
Vertical coordinate reference system	DTU21 MSS height	FUGRO:41088
Datum	DTU21 MSS height	FUGRO:40943
Transformation	WGS 84 to DTU21 MSS height	FUGRO:41478
Notes		
* The geodetic datum of Fugro's global GNSS correction data is ITRF2014, epoch 2024.250254 (01/04/2024 14:14:00)		

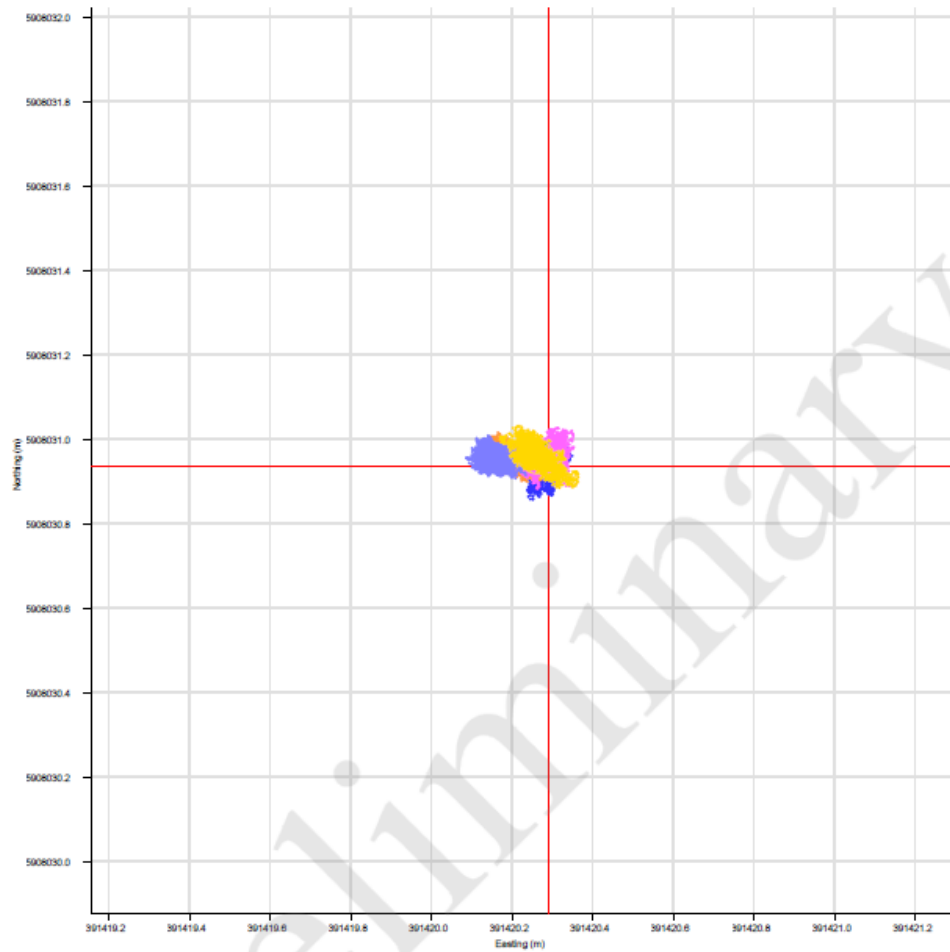


Figure 7: Position scatter plot

Table 11: Position scatter groups

	Sensor Group	East [m]	North [m]	H [m]	Δ East [m]	Δ North [m]	Δ H [m]
	SPK1-Starfix.G4 Plus 10003	391 420.29 E	5 908 030.94 N	7.40 MSS	0.00	0.00	0.00
	SPK1-Starfix.G4 10001	391 420.28 E	5 908 030.95 N	7.35 MSS	-0.02	0.01	-0.04
	SPK2-Starfix.G4 Plus 20003	391 420.20 E	5 908 030.95 N	7.35 MSS	-0.09	0.02	-0.05
	SPK1-Starfix.XP2 10002	391 420.30 E	5 908 030.95 N	7.38 MSS	0.01	0.01	-0.01
	SPK2-Starfix.G4 20001	391 420.16 E	5 908 030.96 N	7.35 MSS	-0.14	0.02	-0.05
	SPK2-Starfix.XP2 20002	391 420.26 E	5 908 030.96 N	7.36 MSS	-0.03	0.02	-0.04

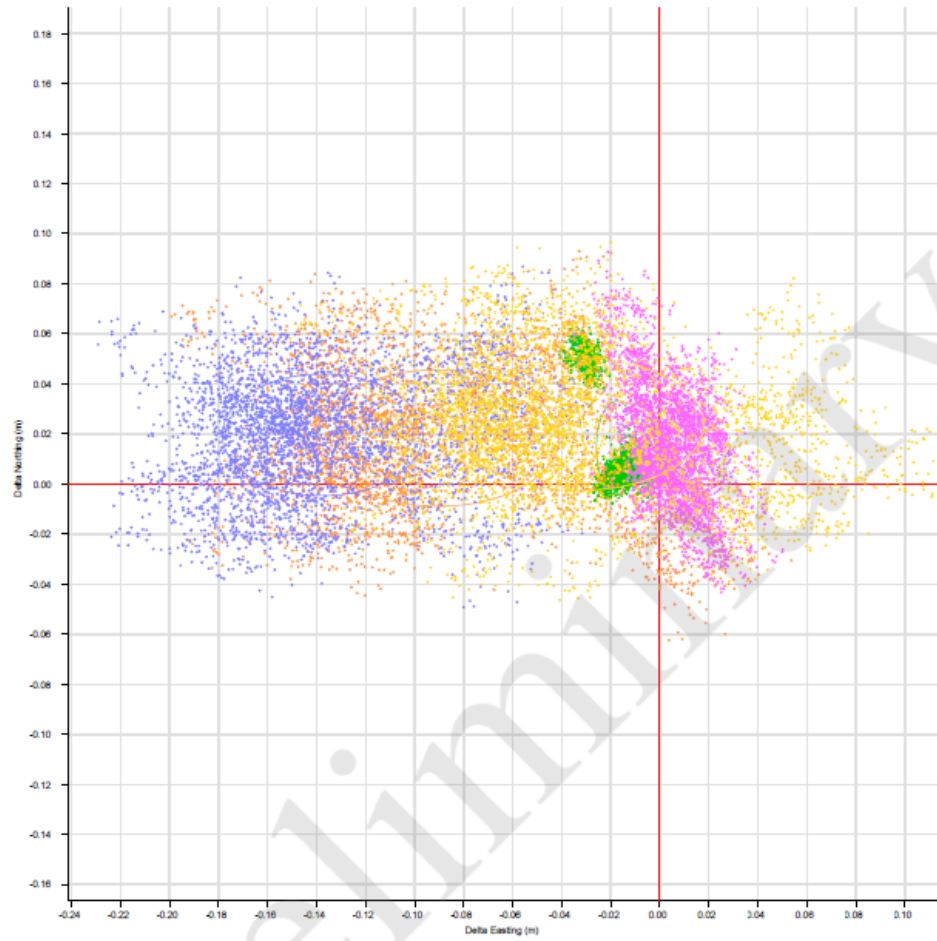


Figure 8: Delta scatter plot

Table 12: Delta scatter groups

Sensor Group	Δ East [m]	Δ North [m]	Δ H [m]	Δ East SD [m]	Δ North SD [m]	Δ H SD [m]
SPK1-Starfix.G4 Plus 10003	0.00	0.00	0.0	± 0.00	± 0.00	± 0.00
SPK1-Starfix.G4 10001	-0.02	0.01	0.0	± 0.01	± 0.02	± 0.01
SPK2-Starfix.G4 Plus 20003	-0.09	0.02	0.0	± 0.05	± 0.03	± 0.04
SPK1-Starfix.XP2 10002	0.01	0.01	0.0	± 0.01	± 0.02	± 0.03
SPK2-Starfix.G4 20001	-0.14	0.02	0.0	± 0.04	± 0.02	± 0.05
SPK2-Starfix.XP2 20002	-0.03	0.02	0.0	± 0.05	± 0.03	± 0.05

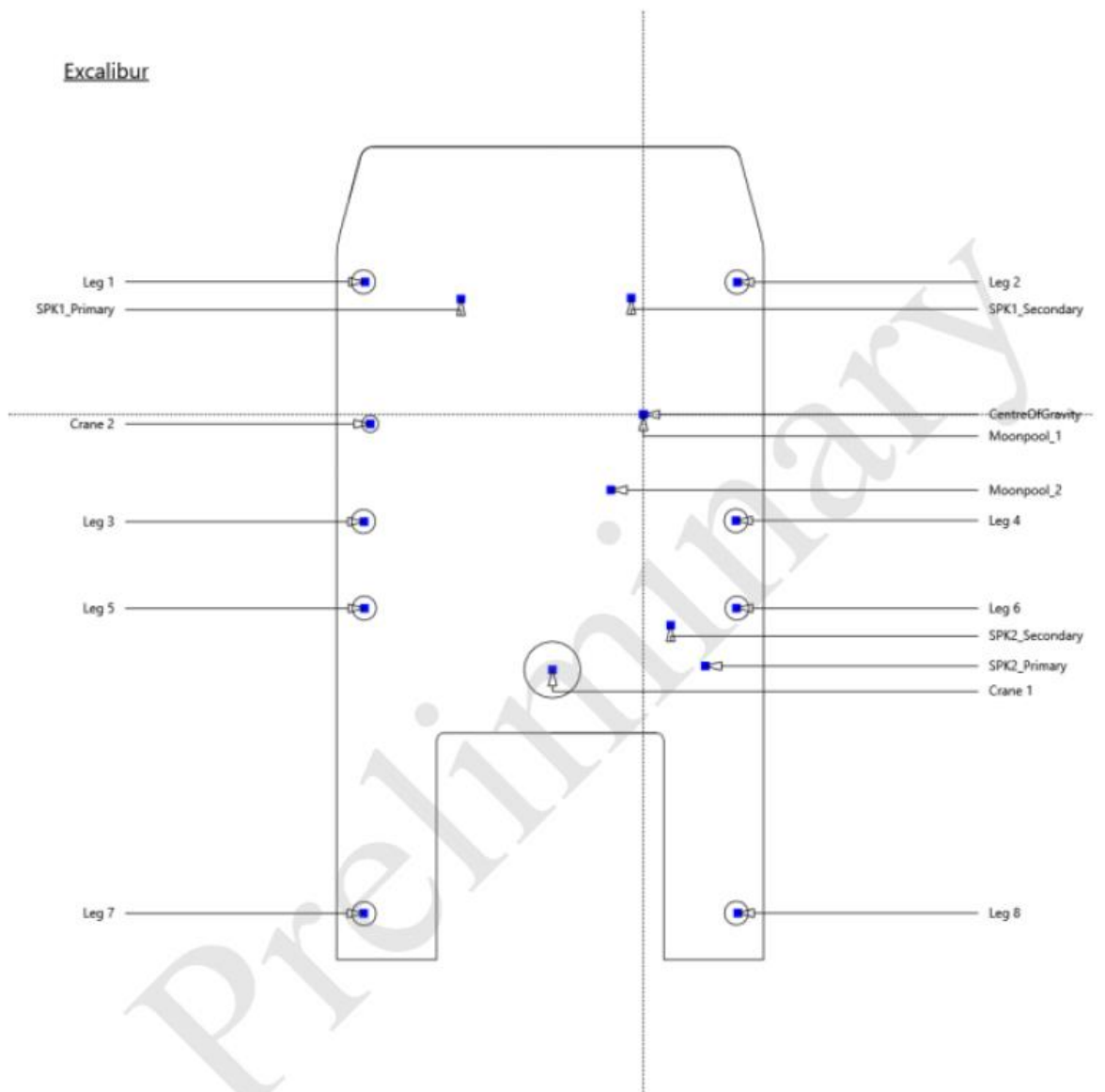


Figure 9: Vessel outline and offsets

Table 13: Excalibur - defined offsets

Name	Purpose	X offset [m]	Y offset [m]	Z offset [m]
CentreOfGravity	Centre of gravity	0.00	0.00	0.00
Moonpool_1	The common reference point of the vessel.	0.00	0.00	0.00
Moonpool_2		-2.44	-5.66	-0.03
SPK1_Primary		-13.67	8.65	11.73
SPK1_Secondary		-0.91	8.72	12.01
SPK2_Primary		4.63	-18.86	6.83
SPK2_Secondary		2.04	-15.81	6.97
Leg 1	Centre	-20.86	9.94	0.00
Leg 2	Centre	7.04	9.92	0.00
Leg 3	Centre	-20.93	-8.04	0.00
Leg 4	Centre	6.94	-7.96	0.00
Leg 5	Centre	-20.90	-14.53	0.00
Leg 6	Centre	6.97	-14.52	0.00
Leg 7	Centre	-20.96	-37.40	0.00
Leg 8	Centre	7.07	-37.38	0.00
Crane 1	Centre	-6.81	-19.14	0.00
Crane 2	Centre	-20.46	-0.71	0.00

Appendix C

Photos

D.1 Excalibur Photos

Excalibur Moonpool 1



Excalibur Moonpool 2



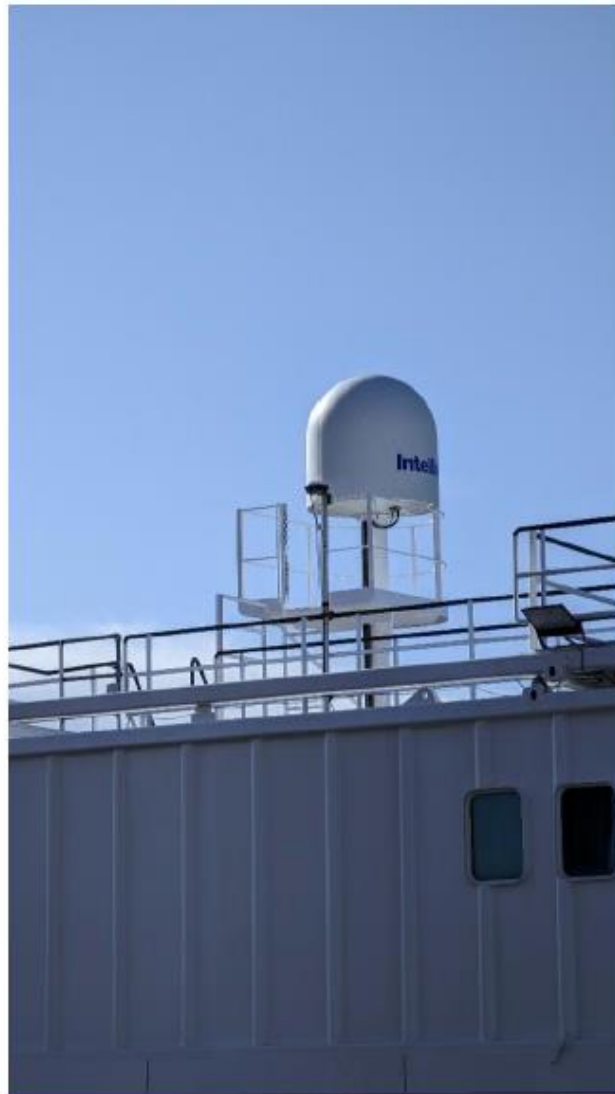
Location

Photo

FWD Antenna Overview
(Looking FWD from pilothouse)



Primary GPS (Port FWD)



Location

Photo

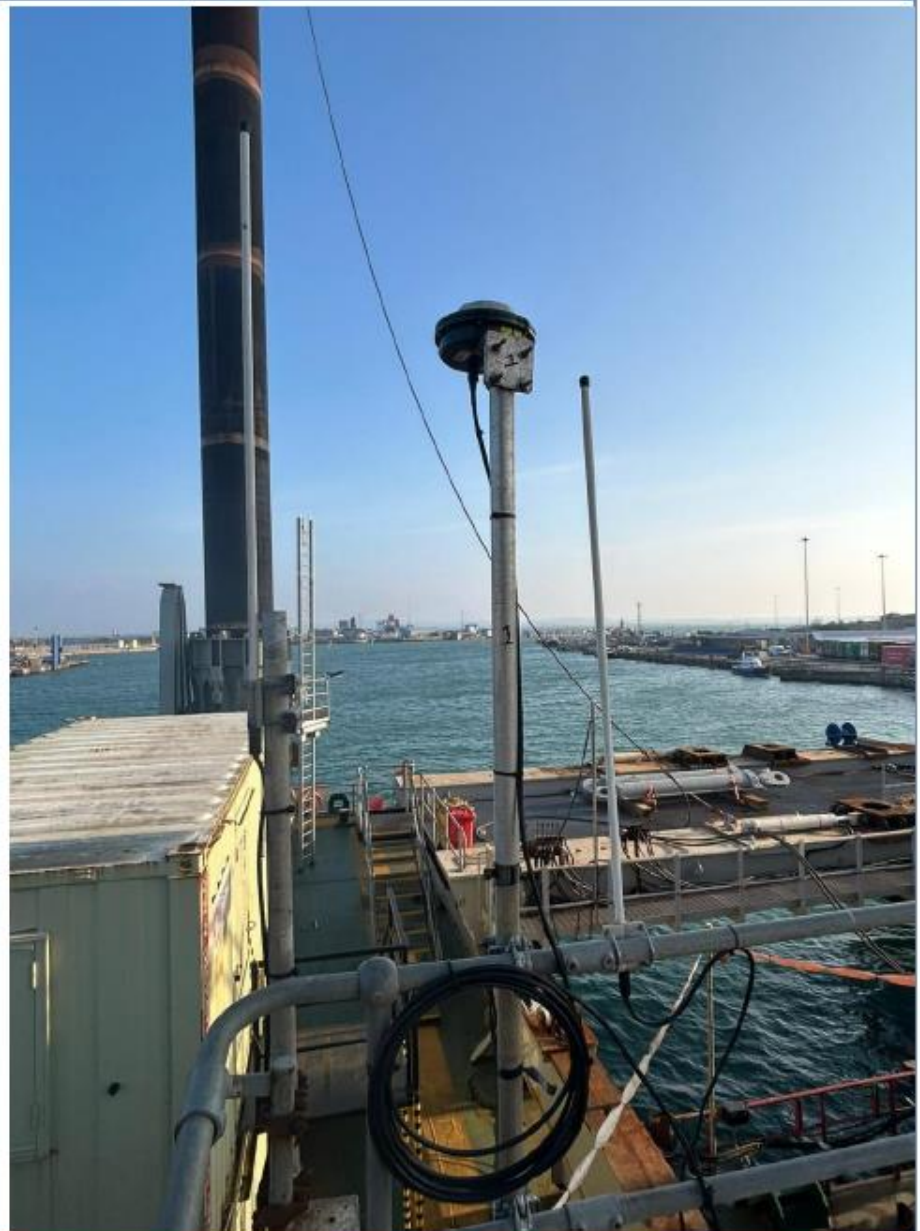
Secondary GPS (Stbd FWD)



Location

Photo

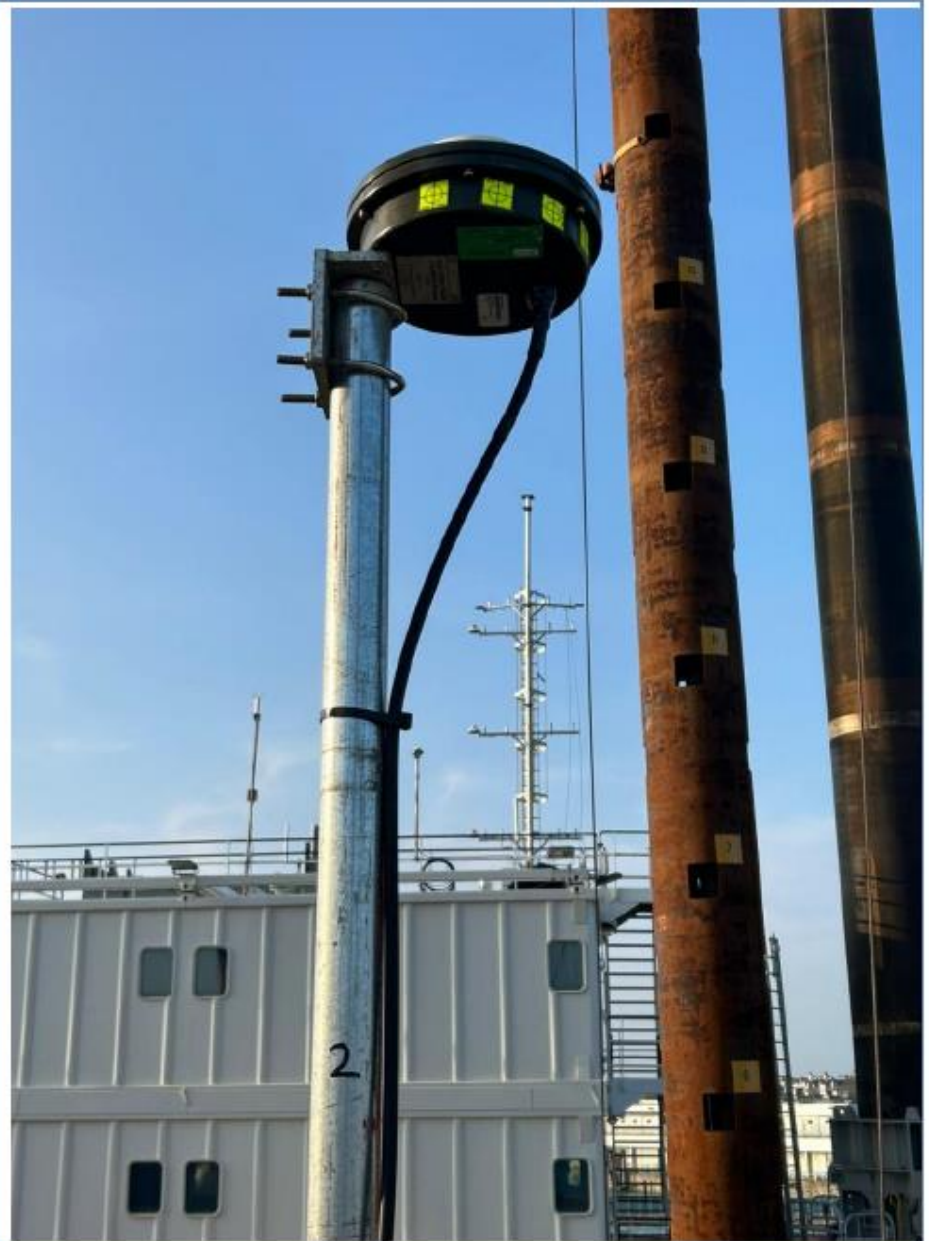
AFT Antenna_SPK02_Primary
Overview
(View looking AFT)



Location

Photo

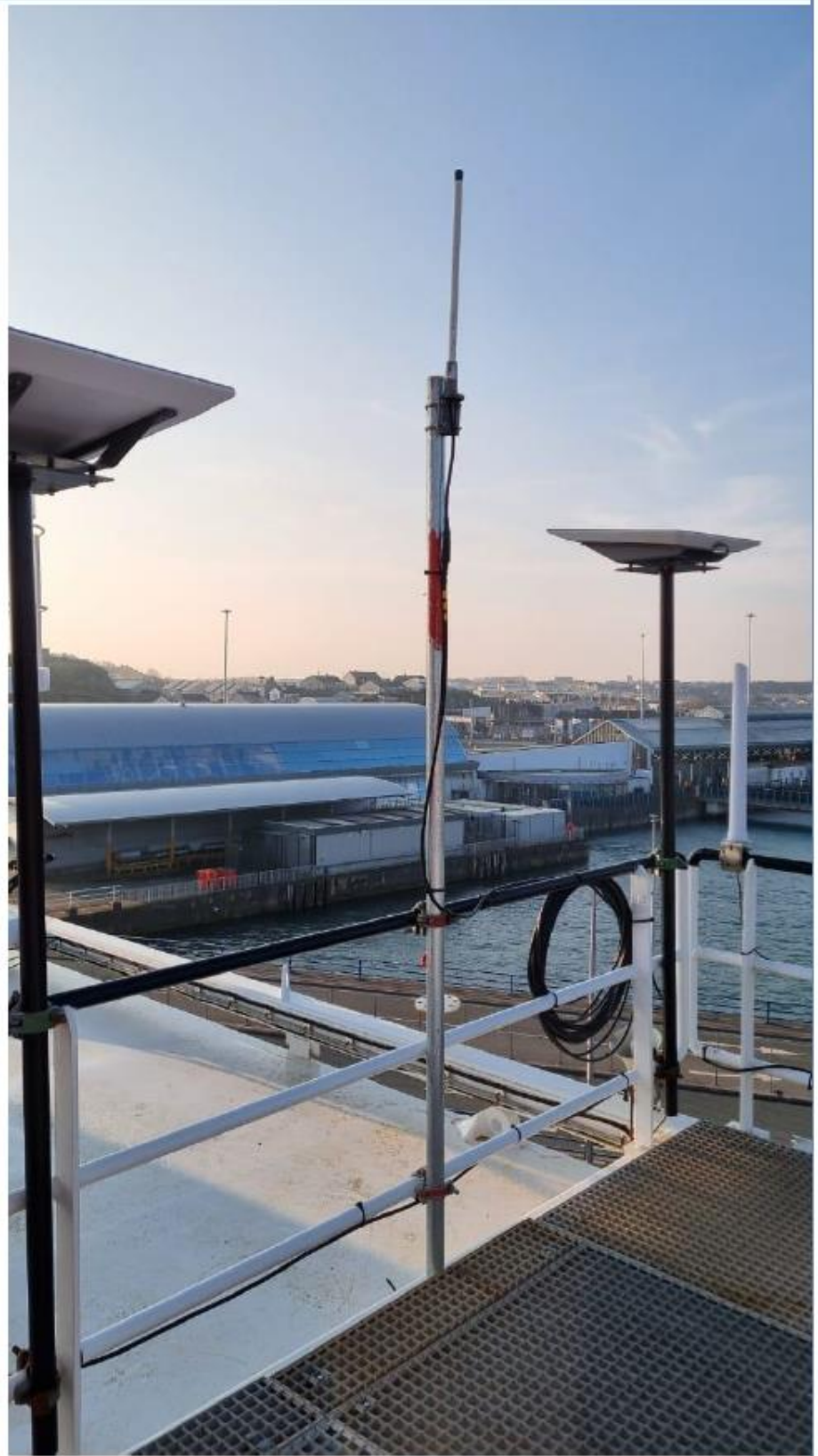
AFT Antenna_SPK02_Secondary
Overview (View looking FWD)



Location

Photo

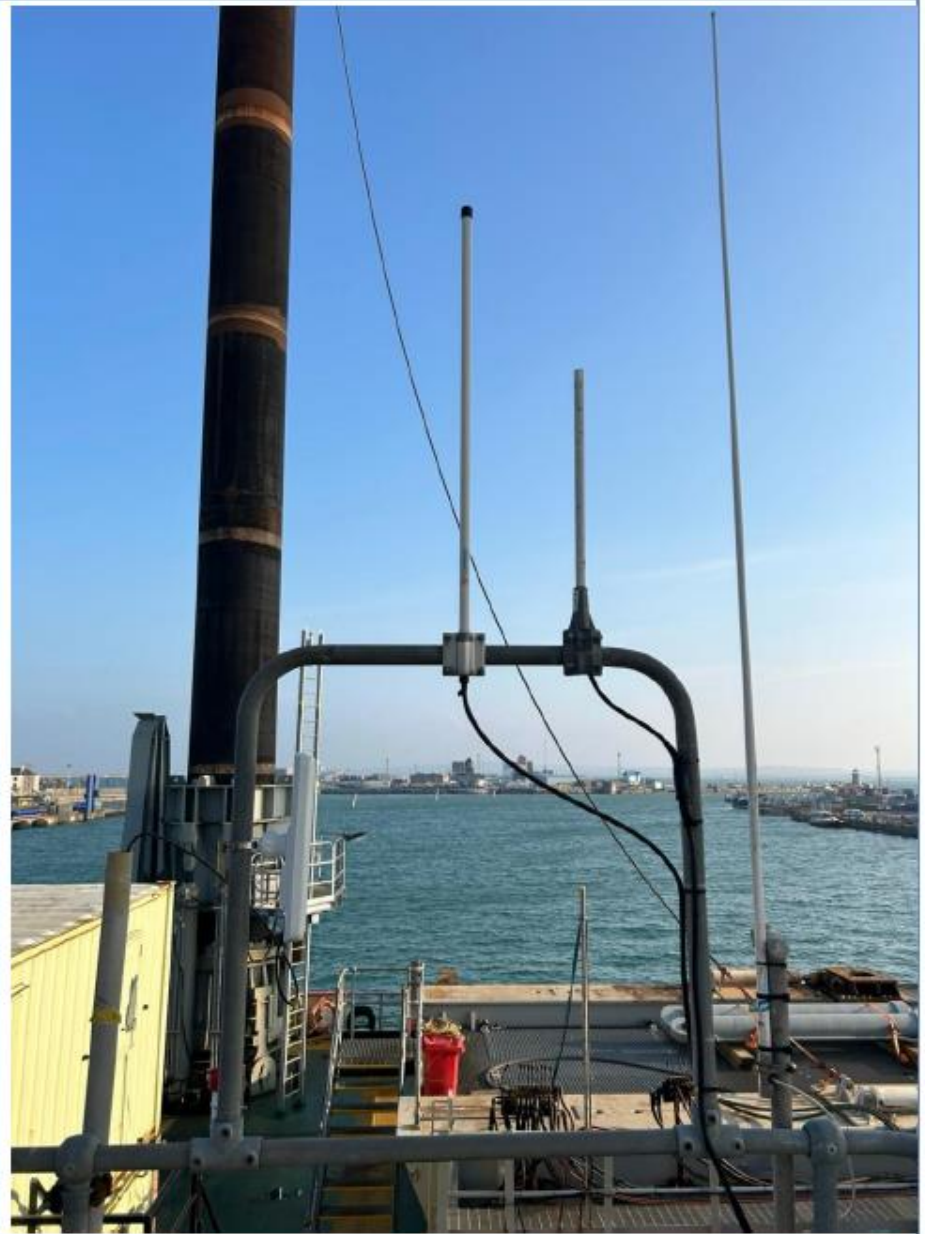
Satel telemetry Antennae_FWD



Location

Photo

Satel telemetry Antennae_AFT



Appendix D

Sequence of Events

E.1 Sequence of Events

Date	Time	Description
04/03/24	8:30	S. Singh and S. Ewing arrive Excalibur
		Vessel and safety induction, JUB familiarisation.
		Equipment shipment delayed, arrived in the evening.
05/03/24	08:30	Located equipment, mobilisation commenced.
06/03/24		Mobilisation continued.
07/03/24		Mobilisation continued.
		All mobilised, ready for dimcon survey and verifications.
08/03/24	8:30	B. Bobkowski arrivea Excalibur
	9:30	Safety induction
	10:00	Checking survey equipment
	10:30	Familiarise with Excalibur and old Dimcon control left in April 2023
	12:30	Dimcon Survey 4 antennas, Moonpool 1 and 2, crane centre line position. Using Survey Control 2023. Moonpool 2 and crane centre lines match with the Survey 2023. All the survey was shifted to the new Moonpool 1 Centre (CRP)
	17:00	Setting up Trimble GNSS antennas on two control points, quay side for a 6 minutes RTK reading
	18:30	Job paused
09/03/24	08:00	Fugro team arrive Excalibur
	09:30	Heading verification from quayside
	12:30	Heading verification complete for Starpack 1 and 2, data sent to onshore for quality check
	17:30	Fugro team depart Excalibur.

Appendix E

Health, Safety and Environment

Contents Appendix E: Health, Safety and Environment

- E.1: **Toolbox Meetings**
- E.2: **Incident Notification Reports**
- E.3: **Hazard Observation Cards**

E.1 Toolbox Meetings

Toolbox meetings have been shared with Energinet Eltransmission A/S separately.

E.2 Incident Reports

Incident reports have been shared with Energinet Eltransmission A/S separately.

E.3 Hazard Observation Cards

Hazard Observation Card Register has been shared with Energinet Eltransmission A/S separately.