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# Marine Characterisation Research Project (MCRP)

## Technical Survey Specifications – Morlais Tidal Demonstration Zone

**MarineSpace**

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Menter Môn Marine Characterisation Research Project (MCRP)  
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Demonstration Zone  
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## Technical Survey Specifications - Morlais Tidal Demonstration Zone

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Specification

Originator: Corrine Buckmaster/Charles Addison

Date: 15/01/2023

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# Technical Survey Specifications - Morlais Tidal Demonstration Zone

## Glossary

Abbreviation	Description
BS	British Standards
CTD	Conductivity Temperature Depth
CPT	Cone Penetration Test
CRP	Common Reference Point
ECC	Export Cable Corridor
ECR	Export Cable Route
ERM	Environmental Resource Management
GIS	Geographical Information Systems
HSE	Health Safety and Environment
H&S	Health and Safety
IHO	International Hydrographic Organization
m	Metre (unit of length, SI)
MAG	Magnetometer Data
MBES	Multibeam echosounder
MDZ	Morlais Demonstration Zone
QC	Quality Control
RTK	Real-Time Kinematic
SBP	Sub-bottom Profiler
SSS	Sidescan Sonar
SVP	Sound Velocity Profile

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SVT	Survey Verification Test
THU	Total Horizontal Uncertainty
TVG	Time Variable Gain
TVU	Total Vertical Uncertainty
USBL	Ultra Short Baseline
UTC	Universal Time Coordinated
UTM	Universal Transverse Mercator

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## 1. Introduction

The Morlais Demonstration Zone (MDZ) project is designed for the installation and commercial demonstration of multiple arrays of tidal energy devices up to an installed capacity of 240 MW. The offshore development area where installation can take place covers an area of 35 km<sup>2</sup> to the west of Anglesey. The project will include communal infrastructure for tidal technology developers which provides a shared route to a grid connection onshore. The location of the MDZ is shown in Figure 1.1.

### 1.1. Project Background

In accordance with the Marine Licence (Licence number ORML1938) the marine elements include construction and operation of the following:

- Up to nine export cables;
- Up to nine export cable tails (shared with onshore components);
- Navigation and environmental monitoring equipment;
- Mooring and foundation structures;
- Offshore electrical infrastructure, including submerged, floating or surface emergent hubs;
- Up to 620 tidal devices, each comprising of:
  - foundation or anchors on or within the seabed;
  - a supporting substructure or mooring;
  - one or more Tidal Energy Convertors (TEC);
  - cable connections.

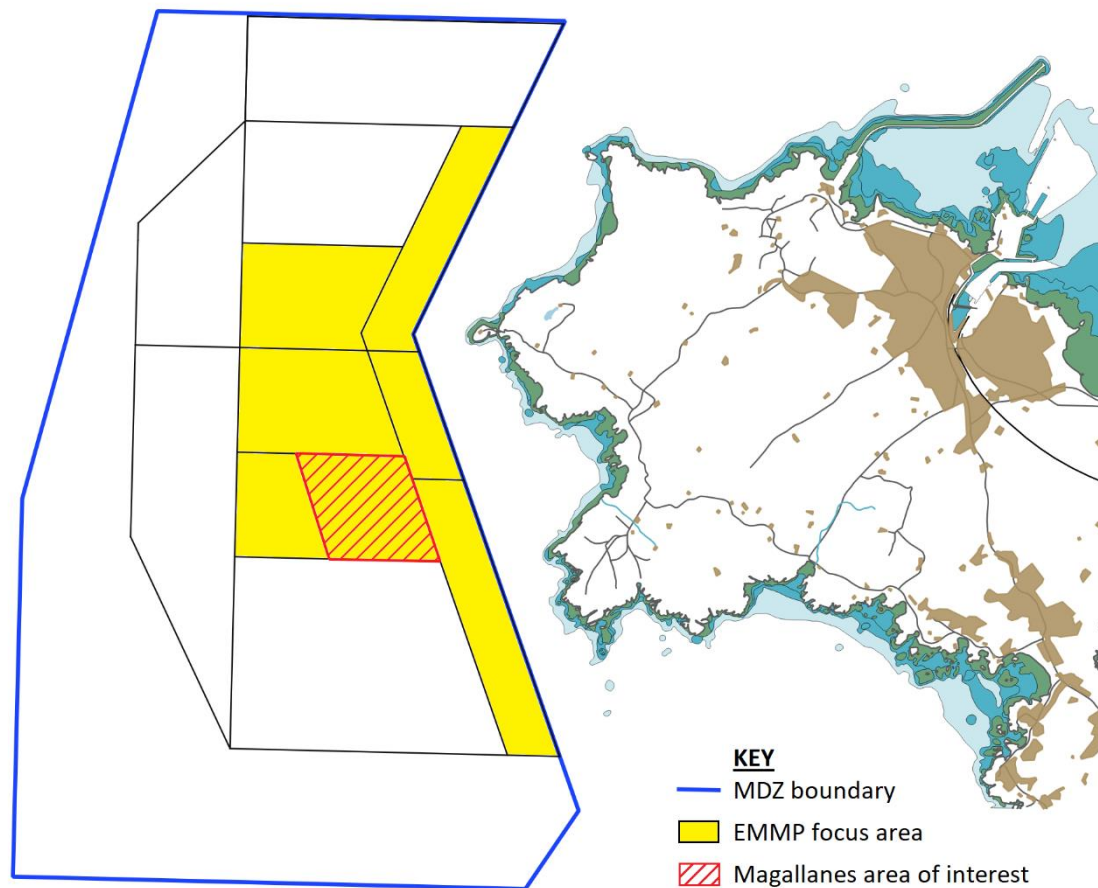
### 1.2. Project Specific Information

Coordinates of the MDZ and Export Cable Corridor (ECC) are presented in Table 1-1 and Table 1-2. Expected water depths in the MDZ are approximately 20 m-55 m.



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Figure 1.1: Location and zoning of the Morlais Demonstration Zone (as of June 2023)





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**Table 1-1: Coordinates of Array Deployment Area (Marine Development Zone)**

Latitude	Longitude
53.333720	-4.746740
53.291500	-4.764430
53.259000	-4.764430
53.259004	-4.690923
53.265839	-4.683548
53.306470	-4.708880
53.333720	-4.688160

**Table 1-2. Coordinates of Export Cable Corridor**

Latitude	Longitude
53.26583900	-4.683548000
53.30647000	-4.708880000
53.33372000	-4.688160000
53.32425456	-4.681530061
53.30653813	-4.702619801
53.30039003	-4.690896150
53.29971193	-4.688653340
53.29132163	-4.684062472
53.28783785	-4.690413178
53.28018190	-4.686168105

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## **1.3. Objectives of Proposed Surveys**

This Technical Survey Specification includes the requirements for Geophysical and Environmental Survey Data collection within the MDZ sufficient to discharge some of the conditions of the Marine Licence (ML). Specific conditions of the ML to be discharged via these surveys are presented below in Table 1-3, along with the broad objectives of each survey. In addition to discharging the relevant Marine Licence conditions, survey data will also be utilised for engineering purposes during the Phase 1 deployments within the MDZ.

To effectively meet the objectives detailed in Table 1-3, a survey spread of MBES, SSS and magnetometer would be used to obtain full coverage to characterise the site. As a minimum this would cover at least the 'focus area' in the initial survey stage but may encompass the entire MDZ. The MBES and SSS data will be used to determine the locations of the benthic samples, with the exact number of locations for characterisation being dependant on the area covered and the seabed variability. It is anticipated that further seabed sampling will be required for micrositeing purposes.

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**Table 1-3 Objectives of Proposed Surveys**

ML Condition No.	Survey Type	Expected Survey Tools	Specific Condition Wording	Overall Objective
<b>3.26</b>	UXO Survey	Magnetometer  Sidescan Sonar (SSS)  Multibeam echosounder (MBES)	The Licence Holder must carry out a UXO survey prior to the commencement of any Licensed Activity. The findings of the UXO survey should be used to inform cable routes and device placement. This licence does not authorise the detonation of any UXO.	To determine the presence of any potential UXO contamination to inform device placement and export cable routing.
<b>3.28</b>	Pre-Construction Marine Archaeology	SSS  MBES	The survey must: <ul style="list-style-type: none"> <li>• Satisfy the requirement of the WSI detailed in condition 3.27.3;</li> <li>• Be sufficient to determine any potential impact on the historic environment; and</li> <li>• Encompass the area with the potential to be directly impacted by the activity.</li> </ul>	To determine the position, condition and status of all known (and any previously unrecorded) marine archaeological features in the study area, i.e. produce a baseline against which potential impacts on these features via installation and/or operation can be monitored via future surveys.
<b>3.29</b>	Bathymetric survey - Navigation Monitoring	MBES	The survey specification must include; <ul style="list-style-type: none"> <li>• Detailed periodic hydrographic surveys of the consented area, or subsections thereof, to the International Hydrographic Office (IHO) Order 1a survey standard extending to an</li> </ul>	To monitor bathymetric conditions and ensure safety of navigation around the MDZ. The multibeam echosounder bathymetry survey specification within this technical specification will meet IHO Order 1a

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			appropriate buffer around the site.	standards.
<b>3.40</b>	Pre-Construction Monitoring Survey	SSS Drop Down Video (DDV) Grab Sampling	<p>The Pre-construction monitoring survey specifications must:</p> <ul style="list-style-type: none"> <li>• Allow for the determination of the location, identification and abundance of habitats of conservation importance (i.e.; Annex I habitat, OSPAR and Section 7 habitats); and</li> <li>• Encompass the area with the potential to be directly impacted by the Licensed Activity.</li> </ul>	To provide a specification in line with the submitted outline Marine Biodiversity Enhancement Strategy for pre-construction benthic intertidal and subtidal monitoring surveys. These surveys will include provision for surveying Annex I and OSPAR/Section 7 habitats to help inform placing of infrastructure.
<b>3.42</b>	Environmental Monitoring	Grab sampling DDV	<p>The monitoring specification must include the following unless otherwise agreed with the Licensing Authority:</p> <ul style="list-style-type: none"> <li>• bathymetric surveys of that part of the seabed within the Marine Development Zone within which tidal devices are to be deployed in a proposed phase, which includes a survey buffer based on the predicted near-field effects</li> </ul>	To provide a specification sufficient to satisfy the Licence condition requiring bathymetric monitoring, providing a baseline against which future monitoring surveys can be compared.



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## **2. Vessels**

### **2.1. Vessel Characteristics**

#### **2.1.1. Vessel Suitability**

The Vessel(s) is required to be a purpose built or professionally converted survey vessel. Vessels shall be well-maintained and include all relevant certification for the vessel(s) and equipment. Vessel(s) will be suitably equipped and capable of an appropriate endurance to efficiently meet the needs of the surveys. Proposed vessel(s) must be able to accommodate all personnel and equipment to allow safe and efficient survey operations.

#### **2.1.2. Navigation and Manoeuvrability**

Vessel(s) shall be capable of good manoeuvrability as well as constant survey speed with a range of at least 2 knots to 8 knots. Vessel(s) speed through water and over ground must be measured and logged at all times during survey to an accuracy of 0.25 knots or better and be readily visible in real-time to both bridge and survey crew. The vessel(s) shall be equipped with an auto-pilot interfaced with the survey software such that vessel and towed sensor tracks can be steered along survey lines.

#### **2.1.3. Accommodation and Work Areas**

Accommodation, communal and work areas shall be of a high standard. Vessel(s) shall have sufficient cabins to accommodate all personnel (crew, survey, Employer Representative(s)).

The vessels shall have the following minimum work areas that should be clean and tidy and have adequate space for the work to be carried out:

- Survey positioning instrumentation work area;
- Geophysical instrumentation room;
- Data processing/interpretation rooms;
- Survey work-deck.

Work-decks shall be free of trip hazards, suitably lit and either visible from the bridge or with CCTV cameras fitted to allow monitoring of all survey operations from the bridge and survey work areas. For offshore vessels, CCTV cameras are mandatory for all exterior work areas.

Sufficient certified and suitably located handling machinery shall be provided for the safe and efficient deployment and recovery of survey equipment available on the vessel.

All cabins and internal work areas shall be adequately ventilated to ensure a comfortable and healthy work environment. If climatic conditions are expected to be humid and/or hot, then ventilation shall be supported by a suitable air conditioning system.



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## 2.1.4. Communication

The vessel(s) shall be equipped with the following communication equipment as a minimum:

- Ship-shore R/T with a minimum range of 300 km or capable of communicating with the nearest offshore support base offering emergency response facilities, whichever distance is greater;
- Broadband satellite internet access with minimum dedicated bandwidth of 1 mb/s upload; 1 mb/s download for geophysical operations and use by the Employer Representative, in addition to that required for other use by personnel (either through WiFi or cabled network ports);
- Good quality voice two-way communications system linking the vessel bridge and instrument room with all the main areas of survey operation;
- Hand-held radios for operating in areas of the vessel not covered by the internal communication system.

## 2.1.5. Noise and interference

The vessel(s) shall be acoustically quiet with an acoustic noise signature outside the acoustic frequency range of the survey equipment to be used during survey operations. A noise test of the Survey Vessel and/or data examples of noise-free geophysical data acquisition shall be provided to the Employer prior the acceptance of any vessel(s) by the Employer.

There shall be no interference of vessel and survey equipment power supplies, with high voltage systems suitably separated and insulated from survey systems. A stabilised, clean AC power supply shall be available for operating survey equipment, separate to the vessel(s) services power supply.

## 2.1.6. Winches

The vessel(s) shall have well-maintained winches and sufficient spares for repair during survey without the need for returning to port. The planned maintenance procedure for preventing down time due to winch failure must be supplied for Employer approval. Winch specifications shall be provided to the Employer for approval and as a minimum shall allow for variable speed spooling across the range of operational survey speeds and be capable of deploying survey equipment to the required height above seabed for the range of water depths across the survey area. All winches shall be suitably protected by safety guarding and shall have valid certification.

## 2.1.7. Weather Limits

The Contractor is required to provide details of operational weather limits for the vessel(s). These should include limits for: current velocity, wind speed and significant wave height.

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## **2.2. Other**

### **2.2.1. Language**

The primary language for all vessel communications onboard and to shore shall be English. The Master and all supervisory personnel shall be proficient in English. Notices shall be displayed in English at appropriate locations throughout the vessels.

### **2.2.2. Port of Operations**

The contractor shall propose a suitable operational port nearby to the survey area that allows for safe and efficient survey operations, 24-hour vessel port access and suitable facilities for safe loading/unloading of personnel, equipment and supplies. This includes safe means of access/departure for the vessel(s) being utilised for the survey.

### **2.2.3. Security**

The contractor shall be responsible for the security of all personnel, sub-contractor, equipment and materials throughout the Project.

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## 3. Personnel

### 3.1. Contractor Personnel

Curriculum Vitae (CV) for project and survey personnel (or their equivalents) will be provided for acceptance prior to mobilisation.

Onshore personnel are expected to consist of, as a minimum:

- Project Director;
- Project Manager;
- QHSE Manager;
- Offshore Project Manager/Party Chief;
- Lead Geophysicist;
- Lead Environmental Scientist.

Offshore personnel will include appropriate crewing for the vessel(s) and an offshore survey team that is sufficient for onboard data acquisition, QC, processing and reporting as required. Persons onboard are expected to consist of, as a minimum:

- Master;
- Chief Officer;
- Chief Engineer;
- 2nd Engineer;
- Party Chief;
- Surveyors;
- Survey Engineers;
- Geophysicists;
- Environmental Scientists/MMO/Marine archeologist.

Key personnel are required to have extensive survey industry experience. If the Employer reasonably deems an individual unfit for a specified role (due to competency or prior experience of working with the individual) then the Contractor shall be obliged to offer an alternate candidate.

All marine officers and crew shall have appropriate qualifications and experience to enable them to conduct their duties in accordance with IMCA guidelines. Proof of qualifications and experience shall be provided to the Employer upon request.

The Contractor must inform the Employer of any changes to key personnel during the project. The Employer has the right to approve or reject changes, although these will not be unreasonably withheld following review of CVs, training and HSE training certificates.

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## **3.2. Subcontractors**

The Contractor shall submit a list of all subcontractors with a description and scope of subcontracted services at least 30 days before vessel mobilisation. The Employer retains the right to both audit any subcontractor and accept or reject their involvement on the Project.

The Contractor is solely responsible for its subcontractor's activities and for the coordination with other Contractors where applicable. Sub-contractors must meet and adhere to the same Health, safety, Quality and Environmental standards as the Contractor, as agreed between the Contractor and the Employer.



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## 4. Positioning

### 4.1. Cartographic Reference System

The project Cartographic Reference System (CRS) is ETRS89 UTM Zone 30N, parameters for this are outlined in Table 4-1 and Table 4-2.

**Table 4-1. Geodetic Parameters**

Parameter	Value
Datum	ETRS 89 (EPSG 4258)
Ellipsoid	GRS1980 (EPSG 7019)
Semi Major Axis [m]	6378137.0
Inverse Flattening (1/f)	298.257 222 101
Angular Unit	Degree (EPSG 9116)

**Table 4-2. Projection Parameters**

Parameter	Value
Projection	UTM Zone 30N (EPSG 25831)
Central Meridian	003°00'00.0" W
Latitude of Origin	000°00'00.0" N
False Easting [m]	500 000
False Northing [m]	0
Scale Factor CM	0.9996
Linear Unit	Metre (EPSG 9001)



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**Table 4-3: Time parameters**

Parameter	Value
Epoch	Starting 2023.6
Time Datum	UTC

## 4.2. Vertical Datum

**Table 4-4: Vertical Datum**

Parameter	Value
Name	LAT
Unit	Metre (EPSG 9001)
Axis Orientation	Positive up
EPSG Reference	Inverse EPSG 5861
Height Model	VORF

All vertically referenced data acquired are required to be reduced to the project specific vertical datum using the specified height model.

## 4.3. Heading Equipment Requirements

The equipment shall meet the following minimum requirements:

- A minimum of two independent heading sensors should be utilized. If both are gyrocompass, minimum one must be survey grade. DGNSS-derived heading is also acceptable as a secondary or below heading source;
- Resolution 0.10° or better;
- Frequency 1 Hz or better.

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## **4.4. GNSS Equipment Requirements**

The equipment shall meet the following minimum requirements:

- A minimum of a primary and secondary multi reference station DGPS should be utilised for each survey vessel;
- Primary, secondary and other stations should be independent of each other;
- The DGPS/RTK service should consistently provide horizontal positioning accuracy of 0.2 m or less ( $2\sigma$  confidence level).

The Contractor shall provide full specification of DGPS or RTK service utilized.

## **4.5. USBL System Equipment Requirements**

The equipment shall meet the following minimum requirements:

- The USBL system should interfaced with the DGPS, Heading sensors and motion sensor systems to correct for heading, heave pitch and roll;
- Positioned within close proximity to the vessel's centre of gravity;
- Positioned away from any forms of vessel noise;
- Preferably mounted within a gate valve or similar.

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## 5. Geophysical Survey Sensors

The geophysical surveys will include multibeam bathymetry, sidescan sonar, sub-bottom profiler (boomer) and magnetometer data collection. The survey is required to meet IHO Order 1A standards.

An appropriate line spacing (including tie lines) will be chosen, that can achieve full coverage of data over the area. Sub-bottom profiler, high resolution sidescan sonar, and magnetometer will be run concurrently over the multibeam line plan devised for this area.

### 5.1. Multibeam Echosounder Bathymetry

The MBES should be suitable for, and be set up accurately to record water depth across, the water depths expected in the MDZ.

The contractor shall state the following in their proposal:

- Type and model of MBES;
- Confirmation on system deployment, hull mounted, pole mounted or towed;
- Instrument positioning method and equipment used;
- Confirmation that system is heave and roll compensated and details on the MRU;
- Details on equipment frequency range and noise levels;
- Confirmation of MBES system (e.g. single or dual head);
- Data examples in a similar environment;
- How the contractor will monitor coverage and positioning during acquisition;
- How instrument verification tests will be completed;
- An indication of the proposed online processing and QA/QC procedures for the data;
- How backscatter data are intended to be processed and interpreted;
- State the chosen type and make of sound velocity probe(s).

#### 5.1.1. MBES Equipment Requirements

The equipment shall meet the following minimum requirements:

- Motion compensated (heave pitch and roll);
- Backscatter data to be recorded to augment SSS data, only processed where required by SSS data quality;
- Data acquisition in accordance with specified IHO S-44 Edition 6.1.0 specification matrix parameters as outlined in Table 5-1.

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Table 5-1. IHO S-44 Specification Matrix Parameters

IHO Ref. B	Bathymetry	Custom – 0.5 m Object Detection
a	Depth THU [m]	0.35, Ba12
c	Depth TVU "a" [m]	0.1, Bc13
d	Depth TVU "b"	0.004, Bd9
e	Feature Detection [m]	0.3, Be10
g	Feature Search [%]	100%, Bg9
h	Bathymetric Coverage [%]	100%, Bh9

## 5.1.2. MBES Mobilisation and Calibration

The following shall be completed during mobilisation as a minimum:

- Wet test of the system to confirm operation;
- Patch test;
- Sound velocity measurements on site using CTD or SVP probe;
- Comparison between targets and depths measured against a known benchmark, or those acquired during the previous surveys (in a non-mobile area) (or an object of known depth) shall be performed to ensure that the data fulfils the required accuracy and acquisition and processing are of high quality;
- Target depth comparison larger than vertical uncertainty shall be investigated and reported.

## 5.1.3. MBES Data Acquisition Requirements

The following data acceptance criteria shall apply, data that do not meet these acceptance criteria are subject to re-run at the contractors expense.

Data acceptance criteria:

- Fulfilment of data specifications;
- No positioning data gaps along survey line;
- Low levels of weather/operational noise;
- Absence of data artefacts/busts due to instrument;
- SVP shall be measured within site boundaries at intervals of twelve hours.



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An on-line operator will monitor data quality.

## 5.1.4. MBES Processing

The contractor will provide details of the MBES processing workflows used. Additionally, the following will be provided offshore for QA/QC purposes:

- Instrument track plot showing X/Y positioning;
- MBES bathymetric coverage and ping density plots;
- Bathymetry plots/profiles;
- MBES backscatter coverage plots;
- Backscatter plots;
- Data examples as requested by the EMPLOYER;
- Plot of SVP (x,y) distribution. Labelled with acquisition date.

The contractor will process all data acquired during the survey operations. The MBES data will be processed off-line on the vessel to ensure data quality and completeness of coverage.

## 5.1.5. MBES Deliverables and Reporting

Bathymetry data will be reduced to the vertical datum stated for the project.

Details of the processing workflow used will be included in a processing memo, included in the final report as an appendix. Areas of the site where data is of higher or lower quality and the reasons behind variations in data quality will be discussed.

Processing software make and version must be clearly stated. Supplied databases must be possible to open within the stated tool for any 3rd party.

Unless stated otherwise, TIFF files are to be 32-bit float encoded Cloud-Optimised GeoTIFF or Big TIFF. Deliverables requirements for MBES data sets are outlined in Table 5-2.

**Table 5-2. Deliverable requirements for MBES datasets**

Type	Stage	Content	Dimension	Format
Point clouds	De-spiked Motion corrected, reduced	X, Y, Z	n/a	ASCII
Grid (Average)	Processed Motion corrected, reduced	X, Y, Z (Average Z value binning)	0.50 m	ASCII
Grid (Average)	Processed Motion corrected, reduced	X, Y, Z (Average Z value binning)	0.50 m	TIFF



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Type	Stage	Content	Dimension	Format
Grid (Minimum)	Processed, motion corrected, reduced	X, Y, Z (Shoalest Z value binning)	0.50 m	ASCII
Grid (Minimum)	Processed, motion corrected, reduced	X, Y, Z (Shoalest Z value binning)	0.50 m	TIFF
Contours	Processed Motion corrected, reduced	Attributed Z	1.0m 5.0m 10.0m	ESRI Shapefile
THU	n/a	X, Y, THU	1 m	ASCII, TIFF
TVU	n/a	X, Y, TVU	1 m	ASCII, TIFF
Vessel Track	n/a	Line name	n/a	ESRI Shapefile
Soundings	Raw MBES and Backscatter	All parameters fed into processing, ellipsoid and project vertical reference	n/a	(e.g. .all, .raw, .imb, .m3)
Backscatter	Provided where processed	X, Y, Intensity	0.50 m	ASCII, Value encoded geotiff
Combined target list	Correlated with Mag and SSS	X, Y, size, confidence level, description	n/a	xlsx, ESRI Shapefile
Sand Wave Crests		SSDM format layers, attributes and metadata		ESRI Shapefile
Seabed features		SSDM format layers, attributes and metadata		ESRI Shapefile
Sound velocity profile (SVP)	Processed	#Date/time, location z,c	n/a	Kongsberg .SVP format

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## 5.2. Sidescan Sonar

SSS utilised will be suitable for the task set out in the scope of work and the data will be acquired according to specification set out in this section.

The contractor shall state the following in their proposal:

- Type and model of SSS;
- Details on deployment and equipment setup;
- Instrument positioning method and proposed equipment specification;
- Details on equipment frequency ranges and proposed frequencies;
- Resolution along track for selected frequencies;
- Resolution across track for selected frequencies;
- Data examples in similar seabed environments;
- How the contractor will monitor resolution and positioning during acquisition;
- How instrument verification tests will be completed;
- An indication of the proposed online processing and QA/QC procedures for the data.

### 5.2.1. SSS Equipment Requirements

The equipment shall meet the following minimum requirements:

- Dual frequency system to be mobilized;
- High frequency of 500 kHz or greater;
- Horizontal beam width less than 0.3 degrees;
- Seabed objects of 0.5 m x 0.5 m x 0.5 m or greater to be detectable over the entire range;
- Tow speed adjusted so that a minimum of 4 samples per metre are recorded;
- SSS altitude to be approximately 10% of the range scale used, altitude to remain constant;
- Overlap between adjacent lines required to record data at nadir;
- System must be decoupled from vessel heave, pitch and roll;
- The sidescan towfish is to be positioned using USBL (Section 4.5).

### 5.2.2. SSS Data Acquisition Requirements

The following data acceptance criteria shall apply, data that do not meet these acceptance criteria are subject to re-run at the contractors expense. Partial re-runs are acceptable, with a minimum 50 m overlap of contiguous in specification survey lines.

Data acceptance criteria:

- No positioning data gaps along survey line;
- Low levels of weather/operational noise over the entire range;
- Absence of data artefacts/busts due to instrument movement;
- Specified object detection size achieved over the whole effective range;

# Technical Survey Specifications - Morlais Tidal Demonstration Zone

- Specified object insonification criteria met over the whole range;
- Full data coverage including overlap of adjacent lines nadir gaps.

An on-line operator will monitor data quality, to achieve the best possible dataset and where necessary acquisition parameters shall be adjusted if changes in site conditions require.

## 5.2.3. SSS Processing

The contractor will provide details of the SSS processing workflows used. Additionally, the following will be provided offshore for QA/QC purposes:

- Instrument track plot showing X/Y positioning;
- Instrument track plot showing altitude;
- SSS coverage plots and mosaics.

The contractor will process all data acquired during the survey operations. The SSS data will be processed off-line on the vessel to ensure data quality and completeness of coverage. Processing will at least include, but not limited to; correction of navigation and heading if required, bottom track, application of TVG and generation of mosaics.

## 5.2.4. SSS Deliverables and Reporting

Details of the processing workflow used will be included in a processing memo, included in the final report as an appendix. Areas of the site where data is of higher or lower quality and the reasons behind variations in data quality will be discussed. The data will be analysed and incorporated into the final geophysical integrated report, and will include identification and interpretation of the following:

- Raw and digital processed data (xtf or Coda) of both frequencies;
- Mosaics of both frequencies in GeoTiff format;
- Individual lines of both frequencies in GeoTiff format;
- Interpretation of the seabed morphology and seabed sediments including:
  - Correlation to MBES and MBES Backscatter data seabed sediment classification;
  - Correlation to grab samples;
- A detailed description of targets found with at least the following information:
  - Unique SSS target ID;
  - XTF file reference;
  - High or low frequency;
  - Target interpretation (e. g. Boulder, Debris...);
  - Target dimensions, length, width and height;
- Correlation to MBES, MAG and SBP targets;
- Correlation with older datasets when available.

The deliverable requirements for SSS datasets are outline in Table 5-3.

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**Table 5-3. Deliverable requirements for SSS datasets**

Type	Stage	Content	Dimension	Format
Raw	Corrected navigation	High frequency Low frequency	n/a	XTF, native format (.SDF, .JSF etc)
Navigation files	Corrected navigation	X, Y, Line name	n/a	ASCII Native format
Combined Mosaic	Processed	High frequency Low frequency	HF: 0.1 m and 1.0m LF: 0.3 m and 1.0m	Value encoded GeoTiff
Individual Line Mosaics	Processed	High frequency Low frequency	HF: 0.1 m LF: 0.3 m	Value encoded GeoTiff
Instrument track	Corrected navigation	X, Y, Reference to XTF file in attribute		Shapefile
Target list		X, Y, size, description	.	xlsx, Shapefile
Combined target list	Correlated with Mag and MBES	X, Y, size, description, correlation to MBES/SBP/magnetometer data		xlsx, Shapefile
Linear seabed targets & features and seabed sediment classification	Interpreted	Correlated with ground truthing (where applicable)		Shapefile



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## 5.3. Sub-bottom Profiler

SBP utilised will be suitable for the task set out in the scope of work, will be set up accurately for the expected geology in the MDZ and the data will be acquired according to specification set out in this section.

The contractor shall state the following in their proposal:

- Type and model of SBP;
- Confirmation on system deployment, hull mounted, pole mounted or towed;
- Instrument positioning method and equipment used;
- Confirmation that system is heave and roll compensated and details on the MRU;
- Details on equipment frequency range, pulse length and noise levels;
- Sampling frequency of instrument;
- Estimation on penetration in expected sediment and water depth;
- Expected layer resolution;
- Data examples in similar ground conditions;
- How the contractor will monitor penetration and positioning during acquisition;
- How and where instrument verification tests will be completed;
- An indication of the proposed online processing and QA/QC procedures for the data.

### 5.3.1. SBP Equipment Requirements

The equipment shall meet the following minimum requirements:

- Motion compensated (heave and roll);
- Primary frequency band between 0.2 – 200 kHz;
- Vertical layer resolution 0.15 m or smaller within 5 m of the seabed;
- Penetration of 10 m or better;
- Pulse rate of at least 5 pulses per second;
- Beam width  $< \pm 2^\circ$  (standard vessel mounted).

### 5.3.2. SBP Data Acquisition Requirements

The following data acceptance criteria shall apply, data that do not meet these acceptance criteria are subject to re-run at the contractors expense. Partial re-runs are acceptable, with a minimum 50 m overlap of contiguous in specification survey lines.

Data acceptance criteria:

- Seabed reflection consistent;
- No positioning data gaps larger than 2.0 m along survey line and not exceeding 0.4% within a 500 m line (no more than 2 m within any 500 m line);
- Low levels of weather/operational noise;

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- Vertical layer resolution 0.15 m or smaller <5 m below seabed;
- Target penetration achieved (dependent on geological conditions);
- Crosslines and mainlines must be checked for correct tie;
- Tide-correction consistent across all lines.

An on-line operator will monitor data quality, to achieve the best possible dataset and where necessary acquisition parameters shall be adjusted if changes in site conditions require.

## **5.3.3. SBP Processing**

The contractor will provide details of the SBP processing workflows used. Additionally, the following will be provided offshore for QA/QC purposes:

- Instrument track plot showing X/Y positioning;
- SBP data plots/profiles as requested by the Employer.

Processing shall include correction of navigation, tidal corrections and, where necessary, filtering.

## **5.3.4. SBP Deliverables and Reporting**

Details of the processing workflow used will be included in a processing memo, included in the final report as an appendix. Areas of the site where data is of higher or lower quality and the reasons behind variations in data quality will be discussed. The data will be analysed and incorporated into the final geophysical integrated report, and will include identification and interpretation of the following:

- Seabed reflector;
- Up to 4 main subsurface reflectors in vertical succession (where appropriate, within 10 m of the seabed), these should correlate with VC, CPT if available;
- Base of any mobile sediments (base of sand waves);
- Shallow gas;
- Peat layers;
- Faults;
- Point diffractors (boulders, gravel, UXO, etc);
- Paleo channels;
- Areas of deformation;
- Buried obstructions/infrastructure;
- Any other features that may be of interest.

The deliverable requirements for SBP datasets are detailed in Table 5-4.

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**Table 5-4. Deliverable requirements for SBP datasets**

Type	Stage	Content	Dimension	Format
Seismic data	Raw Signed (nonenveloped)	Fully populated headers and EBCDIC	TWT	SEG-Y Native format
Seismic data	Processed Signed (non enveloped)	Fully populated headers and EBCDIC  Setup optimised to provide one seg-y per survey line.	TWT & Depth converted  Optimised for one seg-y per survey line (in fill to be merged)	SEG-Y
Track lines (SBP)	Offset corrected, processed navigation data	X, Y, Line name	n/a	Shapefile, ASCII
Interpretation Horizons & areas	Fully interpreted and miss-tie corrected	Line ID, X, Y, Z(ms), Z(m LAT), amplitude	All traces Depth below seabed Vertical reference system	ASCII, Shapefile, Value encoded geotiff
Target list	Interpreted from processed data	Identified point diffractors (ID), X, Y, Z (below seabed), Interpretation, association with other diffractor ID's (unique line-ID), correlation to MBES/SSS/magnetometer data	n/a	ASCII, Xlsx, Shapefile

## 5.4. Magnetometer

The magnetometer utilised will be suitable for the task set out in the scope of work and the data will be acquired according to specification set out in this section.

The contractor shall state the following in their proposal:

- Type and model of magnetometer;
- Instrument positioning (X,Y,Z) method and equipment used;

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- Sampling frequency of instruments;
- Offset to vessel and other equipment;
- How the contractor intends to maintain the tow height below the threshold;
- Line Spacing;
- How instrument verification tests will be completed;
- An indication of the proposed online processing and QA/QC procedures for the data.

## **5.4.1. Magnetometer Equipment Requirements**

The equipment shall meet the following minimum requirements:

- Magnetometer should be towed/flown at height of 2-5 m;
- Magnetometer should be towed/flown at sufficient layback to minimise interference from the hull;
- Data sampling interval 5 Hz.

## **5.4.2. Magnetometer Data Acquisition Requirements**

The following data acceptance criteria shall apply, data that do not meet these acceptance criteria are subject to re-run at the contractors expense. Partial re-runs are acceptable, with a minimum 50 m along-track overlap of contiguous in specification survey lines.

Data acceptance criteria:

- Level of background noise <2 nT;
- Sample rate of 5 Hz;
- Minimum noise from vessel and other equipment;
- Altitude of 2-5 m;
- Minor magnetic or positioning data gaps along the survey line. e.g., USBL drop outs.

An on-line operator will monitor data quality.

## **5.4.3. Magnetometer Processing**

The contractor will provide details of the magnetometer processing workflows used. Additionally, the following will be provided offshore for QA/QC purposes:

- Instrument track plot showing X/Y positioning;
- Instrument track plot showing altitude;
- Magnetic data plots/profiles as requested by the Employer.

## **5.4.4. Magnetometer Deliverables and Reporting**

Details of the processing workflow used will be included in a processing memo, included in the operational and calibrations reporting as an appendix. The memo will present testing of key



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parameters as well as the final processing workflow identified for the project. Any limitations or assumptions will be identified and clearly stated, and areas of the site where data is of higher or lower quality and the reasons behind variations in data quality will be discussed. The data will be analysed and incorporated into the final geophysical integrated report, this will include a detailed description of anomalies ( $\geq 5$  nT) identified.

The deliverable requirements for magnetometer datasets are detailed in Table 5-5

**Table 5-5. Deliverable requirements for magnetometer datasets**

Type	Stage	Content	Dimension	Format
Data	Processed	Date (YYYY-MM-DD) Time (HH:MM:SS) Location ID (Unique location ID number) Magnetometer line ID (Unique line number) Survey line Heading Total field (Raw magnetic measurement, nT) Residual Field (Raw magnetic measurement, nT) Sensor Easting, Northing (Processed coordinate) Altitude (Instrument altitude above seabed, meters)		ASCII
Instrument track lines		X, Y, Line ID as attribute		ESRI Shapefile
Anomaly list		Unique MAG anomaly ID, Magnetometer line ID, Anomaly interpretation, correlation to MBES/SSS/SBP data		xlsx, ESRI Shapefile
Total magnetic field		X, Y, nT/m	TBA	ASCII, Value encoded geotiff,
Analytic signal	Processed	X, Y, nT/m	TBA	ASCII, Value encoded geotiff,
Altitude Grid	Processed Motion	X, Y, Z	All survey lines	ASCII, Value

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Type	Stage	Content	Dimension	Format
	Corrected			encoded geotiff

## 5.5. Mobilization and Calibration

Survey systems shall be accepted for survey only after the approved calibrations and testing have been undertaken and accepted by the ERM Representative. Prior to commencement of work, it will be demonstrated and documented that all components of the positioning system fulfil individual requirements and that the total propagated error of the complete positioning system is low enough to allow fulfilment of the required accuracy.

An experienced competent surveyor will carry out a control survey of the entire system. The control survey report will be issued before the offshore work commences.

### 5.5.1. Surface Positioning Mobilization

Each GNSS antenna location shall have offsets to CRP measured by tape or laser distometer. Each GNSS antenna location should then have independent measurements to CRP undertaken by high accuracy land survey techniques, and a vessel offset diagram produced.

Over a 60-minute period, the raw logged positions of the GNSS antennae shall be compared against quayside control through the use of high accuracy land survey techniques, and the resultant dXY presented in the survey report.

CRP position shall be logged as derived from GNSS1 and GNSS2, and the resultant positions compared, with dXY presented in the survey report.

A draft check shall be carried out to measure the waterline relative to project specific datum once the vessel is fully mobilised and all bunkering and storing is complete. This is to be repeated each time vessel comes alongside

A test transformation to survey datum must be carried out and verified against a known benchmark on the quayside or nearby.

### 5.5.2. Heading Mobilization

Heading reference units are to be calibrated (with C-O values removed) using contractor's choice of the following methods. Vessel heading is to be calculated either using satellite-photogrammetry derived quay azimuth and time-stamped laser distometer measurements taken before and after from quayside, OR using simultaneously-shot total station observations from quayside control points, OR using RTK points on (or offset to) the vessel centreline. This calculated vessel heading is to

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be compared with the observed gyro log, and appropriate C-O values derived. C-O values are to then be applied (for preference in the hardware), and a minimum 1-hour confirmation log taken at 1 Hz comparing each calibrated gyro to each other.

## 5.5.3. USBL Mobilization

If the USBL system is a permanent installation on the vessel, which has been calibrated within the prior 2-year period AND without change to sensors in that time, a USBL verification shall be completed during mobilization. If the USBL system does not conform to the above stipulation, a full USBL calibration and verification will be completed. Note that if transit to worksite is to be undertaken prior to USBL calibration and/or verification, the mobilization is not considered complete until acceptance of the calibration and/or verification results. The offshore USBL calibration shall be undertaken preferably in water depths at least equivalent to the deepest expected during the project, or else in deepest water reasonably possible.

The following methods will be used:

- USBL Verification:
  - A slow vessel spin around the transducer, offset to a transponder deployed on a structure at a known location on the seabed (note if a transponder bucket at known point is not available, a box-in to determine the transponder position can be undertaken). Suggested transponder – transducer offset at  $\frac{1}{2}$  water depth;
- USBL Calibration followed by a verification, comprised of:
  - Preferred to remove pitch, roll, offsets from USBL operator system and reset gear offset to nearest appropriate angle to match installation ( $0^\circ$ ,  $90^\circ$ ,  $180^\circ$ , or  $270^\circ$ ).
  - Deployment of transponder followed by initial fix of minimum 120 samples
  - Observations taken from 4 cardinal points around transponder. A minimum of 300 observations should be recorded at each cardinal point at  $1 \times$  water depth transducer/transponder plane offset
  - Application of offsets / corrections
  - Offset Spin Check at suggested transducer/ transponder plane offset at  $\frac{1}{2}$  water depth

## 5.5.4. MBES Mobilization

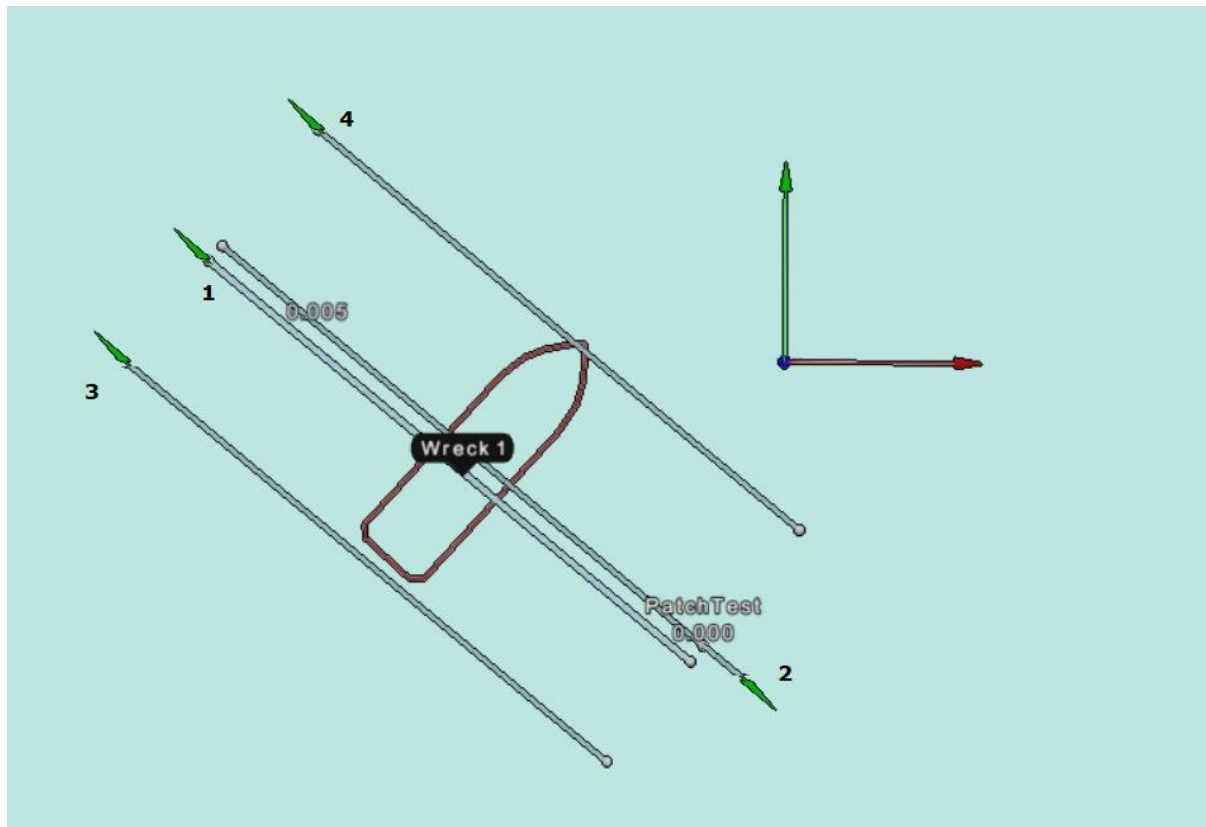
The contractor shall calibrate the MBES using a patch test procedure to calculate pitch, roll, alignment corrections, and latency verification. The patch test area shall be selected to be generally flat and include at least one significant and easily identifiable linear seabed feature.

A 100m length Centerline shall be surveyed on a survey heading normal to the identified feature azimuth, plus reciprocal heading. Winglines shall be surveyed each on survey heading, at an offset calculated so that the port beams of the starboard offset line and the starboard beams of the port offset line provide overlap of minimum 25% of total swath width.

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Corrections are to be calculated and applied, and a confirmation survey line of the feature undertaken.

**Figure 5.1: Example Patch Test line plan**



## 5.5.5. SSS Mobilization

SSS shall be deck-tested prior to SVT with a rub test, with cable marks or winch cable out counter manually verified by the following method:

- Take the swivel to the zero mark and verify that wire out = 0 in winch control software and/or survey software;
- Pay out wire on deck to the first cable mark or an appropriate reading in winch control software;
- Manually measure the length of wire out using surveyor tape or laser distometer;
- If deck space permits, repeat with second and subsequent cable marks;
- Present the dL at each cable mark in the mobilization report, with a scale factor to be applied if error appears to be accumulating in either direction throughout the measurements.

Survey test lines to be performed during the SVT.



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## **5.5.6. SBP Mobilization**

Wet test and survey test lines to be performed during SVT. Parameter testing (where applicable) to select appropriate frequency and pulse settings for optimal resolution and penetration for the survey area;

## **5.5.7. MAG Mobilization**

A spanner check is to be performed on deck once interface is complete, if an array is to be used the magnetometer numbering and position in the array must be provided in a diagram / schematic in the mobilization report.

## **5.5.8. Survey Verification Test**

An appropriate area should be selected for SVT, of water depth approximately equal to that in survey block. Clearance lines should be undertaken with Magnetometer and MBES to ensure that the area selected is free from debris and magnetic interference. Once clearance lines are complete and processed, surrogate item (provided by contractor) is to be deployed and position fixed, with an error budget and estimation of THU in the position fixing method provided.

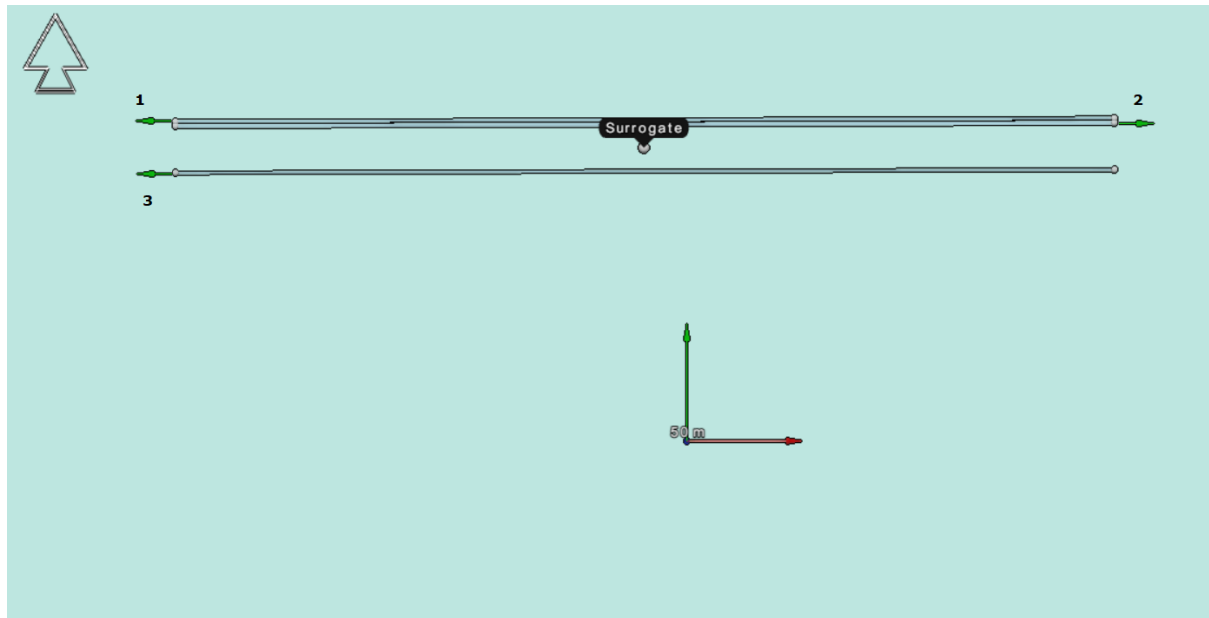
Survey lines are to be undertaken at a distance offset from the surrogate of half line spacing. Magnetometry data from Lines 1 and 2 (layback / alongline positioning test) are to be combined and processed, with the picked target position reported and dXY from surrogate item position included in report.

Lines 1 and 3 (yaw test) are to be combined and processed, with the picked target position reported and dXY from surrogate item position included in report. Difference between both picked targets should be equal to or less than the positioning accuracy requirement for magnetometry. Difference between each picked target and the fixed position of surrogate should be equal to or less than the positioning accuracy requirement for magnetometry, plus the estimated error associated with the position fixing method used to position the surrogate item.

MBES, SSS, and SBP should be logged during the SVT and test lines processed and onboard QC undertaken.

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Figure 5.2: Example SVT line plan



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## 6. Environmental Sampling

### 6.1. Grab Samples and Drop Down Video

#### 6.1.1. Grab Equipment Requirements

The equipment shall meet the following minimum requirements:

- Capable of acquiring required volumes of sediment grab samples in anticipated substrate;
- Sample positioning via USBL system.

#### 6.1.2. Grab Mobilisation and Calibration

The following shall be completed during mobilization as a minimum:

- Wet performance test of the system at a location of similar water depth and seabed conditions to the survey area, to confirm operation in accordance with sampling guidelines and survey objectives;
- Verification that positioning system is operating correctly.

#### 6.1.3. Grab Sample Data Acquisition Requirements

Grab samples shall be acquired as described in the following guidelines:

- JNCC's Marine Monitoring Handbook (Davies *et al.*, 2001);
- Guidelines for data acquisition to support marine environmental assessments for offshore renewable energy projects (Judd, 2012);
- Monitoring guidance for marine benthic habitats, JNCC Report No. 598 (Noble-James *et al.*, 2018);
- The National Marine Biological Analytical Quality Control Scheme (NMBAQC).

DDV transects will be undertaken at between 10-20 sample stations within the Focus Area and Export Cable Corridor (ECC) for pre-construction survey, which cover the full area predicted to be directly impacted by the Project and aim identify location, sensitivity, and abundance of Habitats of Conservation Interest. Environmental monitoring surveys will be undertaken at a refined number of those stations identified for the purpose of pre-construction survey. Additional stations may also be included, as informed by geophysical survey data, to focus monitoring on HOCl and areas most likely to be impacted by the Project. DDV will also be undertaken for microsites as required.

DDV data shall be acquired at each grab location prior to sampling operations beginning. Grab samples will be taken at a subset of these stations, as informed by the DDV data and previous baseline data from the area. The footage will be recorded in order to aid interpretation, and to

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identify features of interest, protected species, or obstructions. Where protected species or obstructions are identified, the sample will be relocated to an appropriate alternative site.

The following data acceptance criteria shall apply:

- At each sample location, the following information must be recorded:
  - A log of sample positions, date, time, water depth, and other relevant field notes;
  - A visual description of sediment type;
  - A visual description of biotopes;
  - Estimation of sample volumes;
- Absence of shells or larger stones preventing proper closure of sampler's jaws;
- No loss of finer fractions of the sediment suspected;
- Depth of sediment is greater than 5 cm;
- Sufficient sample volume for planned analysis to be undertaken.

To maintain the quality of samples, analyses, and data interpretation, grab samples will be considered unacceptable if:

- The sample represents less than sample volume stated;
- The grab has struck the seabed at an angle resulting in an incomplete sample;
- A hagfish and/or other mucus coagulants are found in the sample;
- There is obvious contamination of the sample e.g. from equipment, paint chips etc.;
- There has been incomplete closure of the grab, and subsequent spillage or wash-out of material during sampling and retrieval.

Should the first 3 samples at a proposed station not meet the above requirements, the sample station should be moved at least 50 m before additional samples are attempted and acquired.

## **6.1.4. Grab Sample Processing and Storage Requirements**

A sample naming convention is to be agreed with the Employed for all grab sampling locations prior to acquisition of the first sample. The following information should be included in the sample naming:

- Name of the Project;
- Sample type;
- Contractor name;
- Date (and/or period) when the dataset was collected (YYYY/MM);
- Sample location.

All acquired samples should be prepared and retained for later possible detailed analysis. This may include the following:



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- Particle Size Analysis (PSA):
  - To determine sediment type, taken as a sub-sample from the contents of each benthic grab;
  - Particle size analysis should be done using a combination of dry sieving and laser particle size analysis. Laser diffraction will be used for those samples where the <63 µm fraction makes up greater than 5% of the sample;
  - Any cobbles in the sediment to be evaluated using Cefas guidelines, as appropriate;
- Benthic infaunal analysis:
  - Species identification and enumeration;
  - Fully quantitative abundance recorded where possible;
  - Taxonomic nomenclature in accordance with the World register of Marine Species;
  - Wet weight biomass estimates for each taxonomic group (family);

## 6.1.5. Grab Sample Deliverables and Reporting

Grab sampling data will be incorporated into interpretive reporting. The data will be used to complete habitat mapping/assessments as well as sediment ground-truthing. As part of the final report, the following shall be delivered:

- Grab sample data:
  - Content to include date and time, type, visual descriptions, and estimated sample volume;
  - Format should be provided as .xlsx and ArcGIS shape within gdb;
- DDV images:
  - Each photograph is to contain sample identification information, location information, and should be linked to the associated grab sample data;
  - Format should be provided as JPEG and PDF.

## 6.1.6. Drop Down Video Deliverables and Reporting

A minimum of 5 clear seabed images and 1 continuous seabed video is required for each sample station investigated. Back-up of all imagery data should be made offshore and checked prior to vessel demobilisation. If turbidity prevents the Contractor from obtaining an acceptable image of the seabed a freshwater lens should be used. Any transects of unsuitable quality will be re-run where conditions allow and practical to do so.

Video footage and stills will be reviewed and analysed and the data will be incorporated into interpretive reporting. The data will be used to complete habitat mapping/assessments as well as ground truthing. As part of the final report, the following shall be delivered:

- Videos and stills (raw):
  - To be provided as native format, JPEG, and mp4;
- Videos and stills (processed):

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- To be provided as native format, JPEG, and mp4;
- Surveys logs:
  - To include location, time, duration of video, and a unique ID.
  - To be provided as .xlsx format.

## 6.2. Intertidal Surveys

### 6.2.1. Intertidal Survey Equipment Requirements

The equipment shall meet the following minimum requirements:

- Capable of acquiring samples from soft sediment where required, sufficient for species identification;
- Location of sampling points to be recorded via GPS;
- Specifications of any proposed Unmanned Aerial Vehicles (UAV) to facilitate intertidal surveys with walkover surveys for ground-truthing of aerial data.

### 6.2.2. EIA Intertidal Data Acquisition Requirements

Intertidal surveys should cover the main biotopes of the area of interest. All sampling points are to be noted using GPS. Photographs of biotopes shall also be required to accompany field surveys, providing visual information on the condition of the biotope.

Should soft sediments be encountered, a series of samples with associated photos may need to be taken from representative biotopes for visual inspection. The following data may need to be collected from acquired samples:

- Species identification (up to 30 cm depth);
- Texture and presence of surface features (e.g., algae, accretions etc.);
- Colour;
- Smell;
- Depth of RPD layer.

Biological samples should be collected and stored as agreed.

Alternatively, intertidal surveys may also be required to be undertaken via UAV and cover the main biotopes of the area of interest. Walkover surveys will be used to ground truth the aerial data collected, with sediment samples acquired as described above.

### 6.2.3. Intertidal Data Processing

Habitat classification for intertidal surveys will follow the approach set out in:

- The Marine Habitat Classification for Britain and Ireland Version 04.05 (Connor *et al.*, 2004);
- Marine Monitoring Handbook (Davies *et al.*, 2001);

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- Handbook for Phase 1 Habitat Survey – a technique for environmental audit (JNCC, 2010);
- Guidance on assigning benthic biotopes using EUNIS or the Marine Habitat Classification of Britain and Ireland, JNCC Report No. 546 (Parry, 2019);
- Unmanned Aerial Vehicles for use in marine monitoring – JNCC Marine Monitoring Platform Guidelines No. 3 2019;
- Handbook for Marine Intertidal Phase 1 Biotope Mapping Survey (Wyn *et al.*, 2006).

The shoreline mapping may be required to measure the following attributes:

- Distribution of individual or groups of biotopes, biotope complexes, and life forms present;
- Extent of individual or groups of biotopes, biotope complexes, and life forms present;
- Diversity of biotopes present;
- Other attributes attached to polygons in the form of target notes, such as species information, condition of biotopes, and sensitivity.

All biotope determination will be undertaken in line with JNCC guidance on assigning benthic biotopes (Parry, 2019) within the EUNIS habitat classification system and through consideration of other available datasets. When samples are unrepresentative of existing EUNIS biotopes, new potential biotopes will be suggested in line with JNCC guidance (Parry, 2019).

## **6.2.4. Intertidal Deliverables and Reporting**

Following successful completion of the survey, key findings from the intertidal survey will be incorporated into the Intertidal Survey Report. Details will include:

- Fieldwork summary;
- Biotope map for each area;
- Presence of any protected, rare, or otherwise notable species and habitats present.

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## 7. Reporting and Deliverables

### 7.1. Pre-mobilisation

At least 30 days before vessel mobilization, the following shall be provided by the Contractor:

- Project Execution Plan (PEP) including a description of each proposed vessel, associated survey spread, survey methods to be employed, mobilization plan, and proposed timeline;
- Risk assessment and methods statement (RAMS);
- Hazard identification and risk assessment (HIRA);
- All vessel and sensor documentation as required by this document;
- All vessel certification document (e.g., class, inspection, insurance etc.);
- All HSE document including vessel(s) HSE operations manual and emergency response plan;
- Personnel CVs, certificates, training, and next of kin details;
- Proposed reporting formats for daily reporting and deliverables;
- Details of any proposed sub-contractors and their roles.

### 7.2. Mobilisation

The Contractor shall produce a mobilisation report prior to the commencement of survey operations. All relevant equipment must be tested and calibrated to ensure the required performance will be achieved, as described in Section 5.5. Documentation of all calibration observations and results, vessel offset diagram, list of equipment, list of personnel, permits, diagrams and documents shall be included in the report. All offset and project parameter software settings shall be logged and the Employer Representative informed of proposed changes to those outlined in the PEP. Mobilization certificates shall only be approved and signed by the Employer Representative once the mobilization report has been accepted following the Contractor satisfactorily addressing any comments from the Employer Representative or Employer.

### 7.3. Onboard

#### 7.3.1. Daily Reports

The Contractor shall submit Daily Reports (DR) to the Employer Representative and Employer-requested distribution list throughout the offshore campaign. The reports will provide, as a minimum, full details of previous 24 hours' operations and timings, progress and total production to date, forward planning, HSE and weather. The daily report shall also include a section that summarizes the status of the onboard interpretation and highlights any issues that may influence the survey (e.g., variations to the planned coverage, operational issues).



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The DR shall be emailed to the Client Representative by 09:00 hours UTC on the day following the day the work was executed. Contractor is invited to propose their own DR format, but content must include the following sections:

- Health, security, safety and environmental to include all incidents, near misses, H&S observations, and daily toolbox talks;
- Weather and sea state recorded every 3 hours;
- Issues or problems of any nature (also to be reported directly to the Client Representative);
- List of tasks completed that day and the planned activities for the next 24 hours.

In the event where modifications are identified that will have an impact on time, quality or cost to the project, these proposed modifications should be raised directly with the Client Representative. Any modifications, additions or reductions to the works must have the authorization of the Client Representative in the form of an agreed and signed variation order with duplicate copy prior to the carrying out of such modified, additional or reduced work.

## **7.3.2. Interim Deliverables**

Offline processing of all geophysical sensor data is required onboard the vessel for quality control and survey planning purposes. Onboard processing of all geophysical sensor data is required with interim deliverables provided to the onboard Employer Representative for review in intervals of not greater than 48 hours (24 hours for coverage plots). For sub-survey area (block) work, interim deliverables may be tied to completion of a block, subject to Employer Representative approval. The Employer Representative may request deliverables sooner if, for example, time-critical decisions need to be made such as re-routing and sample site selection. The following interim deliverables are required:

- Coverage plot showing coverage achieved for each geophysical sensor over the previous 24-hour period and cumulative for the survey;
- Track plots in GIS format (shapefile or equivalent) for the vessel and all acquisition sensors;
- Preliminary processed geophysical sensor data:
  - MBES data as X, Y, Z grids of depth, ping density, and THU and TVU;
  - SSS high and low frequency data as geotiff mosaics;
  - Magnetometer data as X, Y, Z grids of magnetic field;
  - SBP data as SEGY;
- A summary of any gaps in coverage (for any sensor) shall be provided in a PDF chart format along with an equivalent GIS file (shapefile or equivalent).

## **7.3.3. Weekly Calls**

The Contractor shall facilitate a weekly call with the vessel, office project manager and Employer to review progress, major issues, HSE reports/incidents and to discuss any update on strategy or scope variations.

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## 7.4. Post Survey

### 7.4.1. Reports to Discharge Marine Licence Conditions

In addition to the general reporting requirements outlined below, Marine Licence ORML1938 for the Morlais MDZ set out specific reporting requirements which must be undertaken in order to discharge the associated Licence conditions. These requirements are outlined in Table 7-1 below.

**Table 7-1: ORML1938 Marine Licence condition reporting requirements**

ML Condition No.	Report Type	Specific Condition Wording
3.28	Pre-Construction Marine Archaeology	<p>The pre-construction survey report must:</p> <ul style="list-style-type: none"><li>• Be in accordance with the WSI detailed in condition 3.27.3;</li><li>• Determine any potential impact on the historic environment;</li><li>• Include the identification of archaeological exclusion zones if required.</li></ul>
3.40	Pre-Construction Monitoring Survey	<p>The pre-construction monitoring survey report must:</p> <ul style="list-style-type: none"><li>• Identify the location, sensitivity and abundance of habitats of conservation importance in the vicinity of the location proposed for deployment of any tidal device and export cable corridor;</li><li>• Propose mitigation measures, to include details of the need to micro-site individual tidal device, inter-array cables and/or export cable(s) in order to minimise adverse effects to habitats of conservation importance;</li><li>• Where it is not possible to avoid damage/loss of habitats of conservation importance, include a tidal device, array or cable specific "Detailed Marine Biodiversity Enhancement Strategy (DMBES)" in accordance with the "Outline BES" (Document MMC555 MOR-RHDHV-DOC-0164).</li></ul>

### 7.4.2. Field Survey Reports

The Contractor shall present field reports after the completion of the survey in PDF format at a timescale to be agreed with Client. Charts shall be produced in PDF and AutoCAD (.dwg) format and profiles shall be supplied in Excel format.

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Quoted prices should allow for the inclusion of one set of Employer comments on the field report addressed to the Employer's satisfaction.

## **7.4.2.1. Survey Field Report (Including Preliminary Habitat Assessment)**

The Contractor shall submit an operational and technical survey report, including details of operations, navigation including offsets, equipment used (geophysical and environmental), calibrations and checks, TS dips, data processing, trackplots and daily logs, within 14 days of the completion of the data acquisition phase.

The report shall include a full account of the survey activities, methodologies and results together with a discussion and interpretation.

The content shall include:

- Executive summary – to include a clear statement of the purpose of the investigation;
- Brief summary of operations;
- Work completed;
- HSE performance;
- Introduction to include a summary of the operational diary;
- Methodology - full description of the work carried out, including reference to specification and standards adopted and any deviations from them. This will include maps and tables describing the exact location of vessel transects and camera/sampling stations where applicable;
- Clearly labelled data examples demonstrating data quality and all significant observations for all geophysical sensors;
- Coverage plots demonstrating the survey objectives and specifications have been met;
- Conclusions:
  - Summary of all results and key conclusions;
  - Habitat Assessment and biotope mapping summary confirming if any Annex I habitats were/were not identified.

## **7.4.3. Final Survey Reports**

Final versions of the Geophysical and Intertidal survey reports shall be delivered at a timescale to be agreed with Client, and shall include the content of the field reports.

### **7.4.3.1. Integrated Geophysical and Habitat Assessment Report**

The geophysical and habitat assessment findings are to be provided within one integrated report covering all nearshore, offshore and intertidal surveys and shall include as a minimum the following results and interpretation:

- Bathymetry and seabed features:

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- Summary of Habitat Assessment findings;
  - Presence/absence of Annex I habitats and their extent;
  - Selected images presented alongside maps summarizing geophysical findings;
  - If required, particle size analysis results should be included to support conclusions;
- SSS mosaics, picked targets and listing;
- SBP isopachs of major reflectors and representative interpreted cross sections through the area and along the proposed export cable route center line;
- Magnetic anomaly map, picked targets and listing;
- Clearly labelled data examples of all significant features that may present a hazard to development;
- All associated charts and digital deliverables (see Section 7.4.4).

## 7.4.3.2. Environmental Baseline Survey Report

The Contractor is to submit one EB report containing the findings of the potential export cable routes (nearshore and offshore) as well as the windfarm survey area. The report shall be delivered 2 months after the sample data arrives at the Contractor's office. The report shall contain as a minimum:

- Executive summary;
- Location map and positional plots;
- Survey description including scope of work, sampling strategy, and methods summary;
- Results including:
  - Seabed imagery (habitat assessment) summary;
  - Sediment particle size analysis;
  - Sediment baseline contamination analysis;
  - Sediment macrofaunal analysis;
  - Water CTD profiles;
  - Water quality analysis;
  - Discussion (including any relevant statistical analyses) and conclusions;
  - Appendices (including deck logs, photoplates for each station, laboratory methods, PSA results, fauna results, and chemistry results).

## 7.4.3.3. Intertidal Survey Report

Within 28 days from completion of intertidal surveys, the Contractor will provide the first draft of a detailed intertidal habitat survey report. The report will include the following:

- Project summary and background information;
  - Georeferenced photography;
  - Biotope map for each area;
  - Presence of any protected, rare, or otherwise notable species and habitats.



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## 7.4.4. Charting Deliverables

The following are the minimum requirements for chart outputs to accompany the final reports.

- Main Array Area: Multiple charts will be required to cover the survey area at a scale of 1:10,000 along with overview charts covering the whole area on a single sheet (approximate scale of 1:40,000). Each chart should have a suitable overlap with each adjacent chart. Charts should include a suitable location image to indicate location of the chart in the legend;
- Cable corridor: The charts will be presented as Alignment Charts at 1:10,000 scale running along the corridor. Each chart should have a suitable overlap with each adjacent chart. The horizontal scale will match the horizontal chart scale;
- Nearshore area: Charts will be provided at 1:5,000 scale covering each nearshore landfall option.

Charts will be required to show depth contours and bathymetry; backscatter, SSS mosaic and with interpreted seabed features; sub-bottom profiles; and the location of all picked objects, anomalies and magnetometer targets.

For the seabed features charts, interpreted MBES, SSS and SBP data (and/or seabed imagery data) will be used to chart and annotate the geology, lithology, sedimentology and geomorphologic features, including sediment slumps, faults, scours, and unconformities.

Where sand waves occur, the orientation, wavelength and amplitude must be shown. Direction of sediment mobility, if apparent, will be indicated and annotated. Where deemed necessary, in areas of complex geology, isopachs will be shown.

With regard to any man-made features, all existing and proposed pipes, cables and all other man-made features will be shown. All charted and found wrecks must also be clearly shown. If a charted wreck is not found its symbol should have a suitable annotation. Symbols of found wrecks will be annotated with dimensions (length, width and height) and the true orientation.

Charts shall be delivered electronically as in PDF and AutoCAD (.dwg) format.

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## 8. References

Davies J, Baxter J, Bradley M, Connor D, Khan J, Murray E, Sanderson W, Turnbull C, and Vincent M, 2001. Marine Monitoring Handbook, pp.405.

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Judd A, 2012. Guidelines for Data Acquisition to Support Marine Environmental Assessments of Offshore Renewable Energy Projects. Cefas contract report: ME5403 – Module 15.

Noble-James T, Jesus A, and McBreen F, 2018. Monitoring guidance for marine benthic habitats (Revised 2018). JNCC Report No. 598. JNCC, Peterborough.

Parry MEV, 2019. Guidance on Assigning Benthic Biotopes using EUNIS or the Marine Habitat Classification of Britain and Ireland. JNCC report No. 546. Joint Nature Conservation Committee, Peterborough.

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