SCOPE OF SERVICES

LOT 3

Energinet
Eltransmission A/S
Tonne Kjærsvej 65
DK-7000 Fredericia

+45 70 10 22 44
info@energinet.dk
VAT no. 39 31 48 78

Project		Energy Islands					
Assignment		Preliminary geotechnical investigations for offshore wind farms, Baltic Sea					
Document Title		Scope of Services, LOT 3					
Document No.		21-03351-9					
Audience		Tenderers					
Version	**Document status**	**Preparer**		**Reviewer**		**Approver**	
		Name	**Date**	**Name**	**Date**	**Name**	**Date**
1	For tender	XKAGL	08-06-2021	XSTPE	08-06-2021	JRA	08-06-2021

SCOPE OF SERVICES FOR NEGOTIATED PROCEDURE

PRELIMINARY GEOTECHNICAL SITE INVESTIGATIONS FOR OFFSHORE WIND FARMS IN THE DANISH BALTIC SEA

Table of Contents

Enclosure	No.
Technical Requirements	1
Standards of Deliverables	2
HSE requirements	3
Quality requirements	4

1. Introduction

1.1 Political background

Following a decision in the Danish Parliament June 2020, Denmark is on the path to establish two new offshore energy hubs in the Danish North Sea and in the Danish Baltic Sea. The energy hubs consist of energy islands and offshore wind turbine farms, providing a total of 5 GW offshore energy to the Danish mainland and neighbouring countries. Figure 1-1 illustrate the regional locations of the energy hubs.

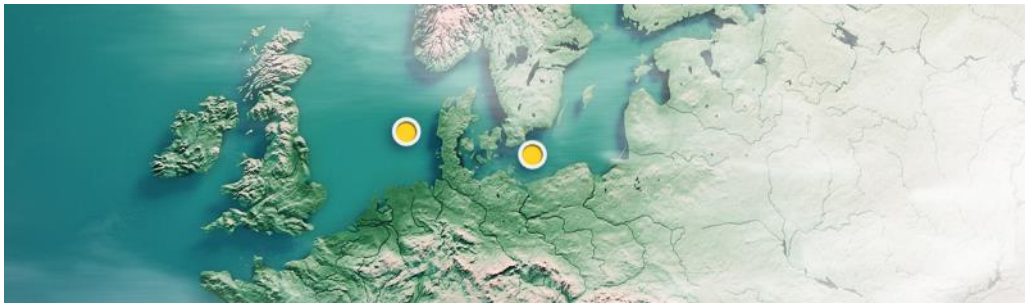


Figure 1-1. Location of energy hubs in the North Sea and Baltic Sea.

1.2 The project

The offshore part of the project includes the following main parts:

North Sea:

- Offshore wind farm area, with a total capacity of 3 GW.
- 1 energy island (caisson structure) to host substation functionality and potentially Power-to-X and maintenance facilities.
- Subsea cables from energy island to offshore wind farms.
- Subsea cables from energy island to Denmark.
- Subsea cables from energy island to neighbouring countries.

Baltic Sea:

- 2 offshore wind farm areas with a total capacity of 2 GW.
- Subsea cables from energy island (Bornholm) to offshore wind farms.
- Subsea cables from energy island (Bornholm) to Denmark.
- Subsea cables from energy island (Bornholm) to neighbouring countries.

The locations of the energy islands and offshore wind farm areas are illustrated in Figure 1-2 and Figure 1-3. Note that only one (1) area is currently being assessed in the North Sea for the energy island.

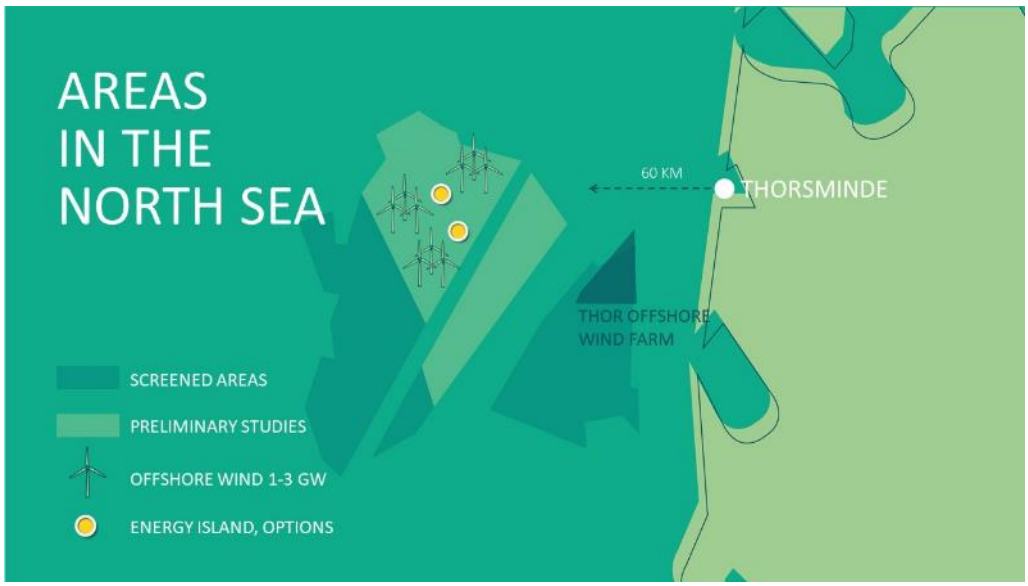


Figure 1-2. Conceptual illustration of the project areas in the North Sea.

Figure 1-3. Conceptual illustration of the project areas in the Baltic Sea.

1.3 Site investigations

Following the political decision, the Danish Energy Agency has instructed the Client to initiate site investigations, environmental and metocean studies for the abovementioned main project parts.

On the basis of the instruction from the Danish Energy Agency, the Client requests consultancy services to commence geotechnical site investigations in 2022. The geotechnical site investigations comprise of the following work:

- Cone Penetration Tests (CPTu and SCPT)
- Boreholes
- Laboratory testing
- Reporting

The overall project has been split into 3 individual contract lots, this document concern LOT 3, comprising preliminary geotechnical investigations for two offshore wind farms in the Baltic Sea.

A detailed description of the project work for LOT 3 is further detailed in section 2.4.

Surveys for the subsea cables are not included in the present scope of services.

2. Scope or Services

To support the development of the project, the tenderer (from now on referred to as the Consultant) must provide a geotechnical site investigation for the area described in Chapter 5.

2.1 Prior geophysical survey

The geophysical surveys will be carried out in 2021-2022. The results are expected to be available before start of the geotechnical investigations.

The geophysical surveys include Multi-Beam Echo-Sounding for bathymetric mapping, Side Scan Sonar for mapping of the seabed surface, Magnetometer for screening for ferrous objects, Seismic profiling with a Sub-bottom profiler system and with a Sparker, Grab sampling to support the interpretation of the sea-bed surface geology.

2.2 Permissions

The Client has obtained permission from the Danish Energy Agency to perform geotechnical investigations in the project area, described in Section 5.

As such the Client will take care of securing all required permissions for the preliminary geotechnical site investigation.

The Consultant shall be prepared to issue Notice to Mariners and liaise with the fishing industry that operates in the project area.

2.3 Purpose of assignment

The purpose of the preliminary geotechnical investigations is to gather geotechnical data and information as basis for evaluation of preliminary wind tubine foundation design and installation, as well as preliminary design of wind turbine configuration.

The results of the preliminary geotechnical investigations shall be used as basis for the tenderers for the offshore wind farms, and provide information 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 seabed when installing the wind turbines
- evaluation of transport of sediments around the wind turbine foundations after installation
- preliminary engineering site assessments
- general risk assessments for foundation conditions of the wind farms.

The geotechnical investigation is intended for preliminary geotechnical zonation as well as for indicative foundation design. Detailed geotechnical investigations are expected to be performed at a later stage by the Developers of the wind farms.

2.4 Scope of assignment

The Scope of Services is expected to comprise the below listed main amounts;

- 90 continuous, seabed CPT to target depth 70m below seabed or refusal

- 30 geotechnical boreholes with soil sampling to target depth 70m below seabed
- Seismic CPT at 7 selected CPT positions
- P-S logging in 6 selected boreholes
- Down the hole CPT in 7 selected boreholes, below refusal of continuous CPT
- Optional blind drilling of 2 selected separate boreholes for CPT, below refusal of seabed CPT
- An online Marine Weather Forecast System
- Laboratory testing
- Reporting

The geotechnical boreholes will be adjacent to one of the seabed CPT at the same location.

The locations of the boreholes/CPT's have not been determined yet, but will be distributed within the project area to investigate the geotechnical soil properties of the geology described in Section 5 and from the geophysical surveys.

A PID gas monitoring system and a minimum of fifteen (15) lab-spec jars must be onboard the vessel at mobilization in case needed for the offshore works. The jars are preferably plastic or glass, gas tight and offer a diameters suitable for storing samples from geotechnical drilling.

The water depth in the project areas is expected to be between 20 and 55 m.

The above amounts are preliminary and can be revised when the reporting of the geophysical surveys are finished, and can depend on the ongoing results of the geotechnical investigation.

The Consultant will receive the data and reports from the geophysical surveys, see section 2.1, and shall be familiar with the results in order to optimize the drilling and sampling works.

The Technical Specifications plus the requirements to the deliverables for the Services are outlined in Enclosure 1 and 2.

The HSE Requirements for the Services are outlined in Enclosure 3.

The Quality Requirements for the Services are outlined in Enclosure 4.

This document - including enclosures - describe the requirements to the fulfillment of the assignment.

3. Time Schedule

The Client has the following suggestions to the time schedule:

1. Commencement of seabed CPT spread (vessel mobilization and first test) from April 1, 2022.
2. Commencement of borehole spread (vessel mobilization and first borehole) from April 1, 2022.

The Client has the following requirements to the time schedule:

3. Commencement of CPT after UXO survey is completed
4. Commencement of boreholes after UXO survey is completed
5. Factual Geotechnical Report delivered, incl. the Clients time for comments, before June 15, 2023

The Client expects dates for milestones in Table 3-1 is to be decided in agreement with The Consultant.

The Client anticipates that the UXO box survey is finalized ultimo March 2022 .

The Consultants detailed Time Schedule shall include dates for the milestones in Table 3-1.

Together with the Consultants detailed Time Schedule the dates provided for Table 3-1 will constitute the contracted time schedule.

Table 3-1. Overview of the Consultancy Agreement milestones that are subject to liquidated damages as described in the the Consultancy Agreement. TBC = "To Be Clarified": Fields must be completed by Consultant as part of proposal.

Event	Milestone	Date
Premobilization deliverables provided	M31	TBC
Commencement of seabed CPT	M32	TBC
Commencement of borehole	M33	TBC
Factual Geotechnical Report - Revised issue, provided	M38	TBC

Premobilization deliverables must be provided within 30 calendar days of the Consultancy Agreement signature.

Premobilization deliverables include evidence for meeting the insurrance requirements and the performance guarantee. See the Consultancy Agreement for detailed requirements.

4. Requirements

Within the areas of investigation described in section 5, the Consultant must provide geotechnical investigations including sampling, testing, laboratory analyses, data interpretation and reporting.

4.1 Technical Requirements

The technical requirements described in Enclosure 1 shall apply.

4.2 Standards of Deliverables

The Standards of Deliverables described in Enclosure 2 shall apply.

4.3 UXO risk mitigation

The investigation are likely to be located in areas with elevated probability for encountering UXO objects.

To mitigate the risk to ALARP the Client will arrange an UXO box survey at the investigation locations, see Section 6.

The Consultant will receive the results of the UXO box survey and shall position the boreholes and CPT in safe distance from potential anomalies within the boxes.

4.4 HSE requirements

To manage the Health, the Safety and the Environmental under the assignment a number of requirements attached as Scope of Services - Enclosure 3 must apply for Consultants provision of the services.

4.5 Quality requirements

To manage the Quality under the assignment a number of requirements attached as Scope of Services - Enclosure 4 must apply for Consultants provision of the services.

5. Area of investigation

The areas of investigation are located approxiamtely 20 km off the south coast of Bornholm, Denmark, and covers a total area of approxiamtely 550 km^2. The nearest port is Rønne Havn, located in the south-west corner of Bornholm as shown in Figure 5-1.

The coordinates for the locations of investigations subject to this assignment will be provided before commencing the offshore operations.

The coordinates for the two areas of investigation, respectively Bornholm I and Bornholm II, are given in Table 5-1 and Table 5-2.

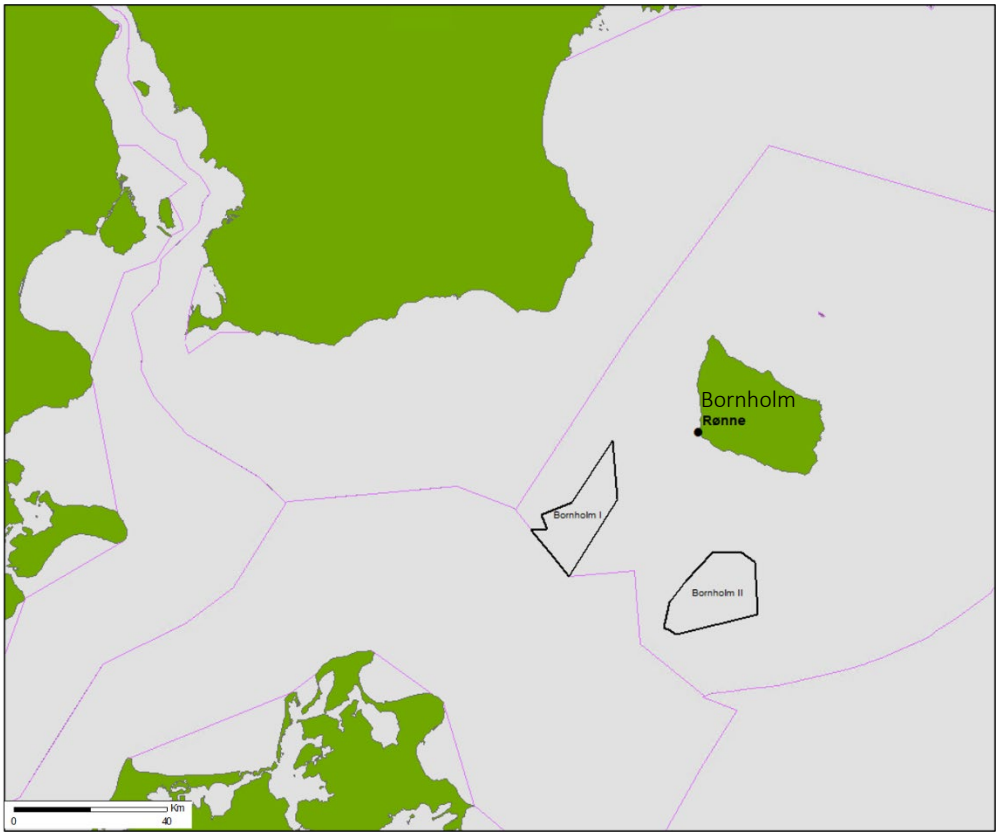


Figure 5-1. Areas of investigation approx. 20 km off the south coast of Bornholm, Denmark.

Table 5-1 Coordinate list for Bornholm I OWF area. Reference ETRS89 UTM33N.

POINTID	EASTING [meter]	NORTHING [meter]	LATITUDE [DD mm.mmm]	LONGITUDE [DD mm.mmm]
1	438 848	6 085 950	54° 55.008' N	14° 2.759' E
2	442 635	6 085 900	54° 55.008' N	14° 6.304' E
3	441 494	6 089 210	54° 56.785' N	14° 5.196' E
4	449 026	6 091 630	54° 58.139' N	14° 12.225' E
5	459 856	6 105 370	55° 5.606' N	14° 22.258' E
6	459 773	6 091 350	54° 58.047' N	14° 22.299' E
7	446 750	6 074 200	54° 48.728' N	14° 10.285' E

Table 5-2 Coordinate list for Bornholm II OWF area. Reference ETRS89 UTM33N.

POINTID	EASTING [meter]	NORTHING [meter]	LATITUDE [DD mm.mmm]	LONGITUDE [DD mm.mmm]
1	490 998	6 073 870	54° 48.714' N	14° 51.596' E
2	490 487	6 061 450	54° 42.017' N	14° 51.143' E
3	471 025	6 058 420	54° 40.339' N	14° 33.042' E
4	468 094	6 060 170	54° 41.272' N	14° 30.303' E
5	469 981	6 066 000	54° 44.422' N	14° 32.024' E
6	470 209	6 066 260	54° 44.563' N	14° 32.234' E
7	474 267	6 070 700	54° 46.970' N	14° 35.993' E
8	481 015	6 076 960	54° 50.364' N	14° 42.264' E
9	487 876	6 076 510	54° 50.134' N	14° 48.674' E

The areas of investigation - as described in this section - are subject to change. The Client has the right to modify the areas of investigation to implement instructions from the Danish Energy Agency. At time of the Consultancy Agreement signature, the Client will confirm the areas of investigation.

5.1 Admiralty Chart

Figure 5-2 present the areas of investigation with Admiralty Chart 188.

In the Baltic Sea, it is seen that the area of Bornhom II OWF is intersected by multiple utilities including existing (NordStream) and planned pipelines (Baltic Pipe).

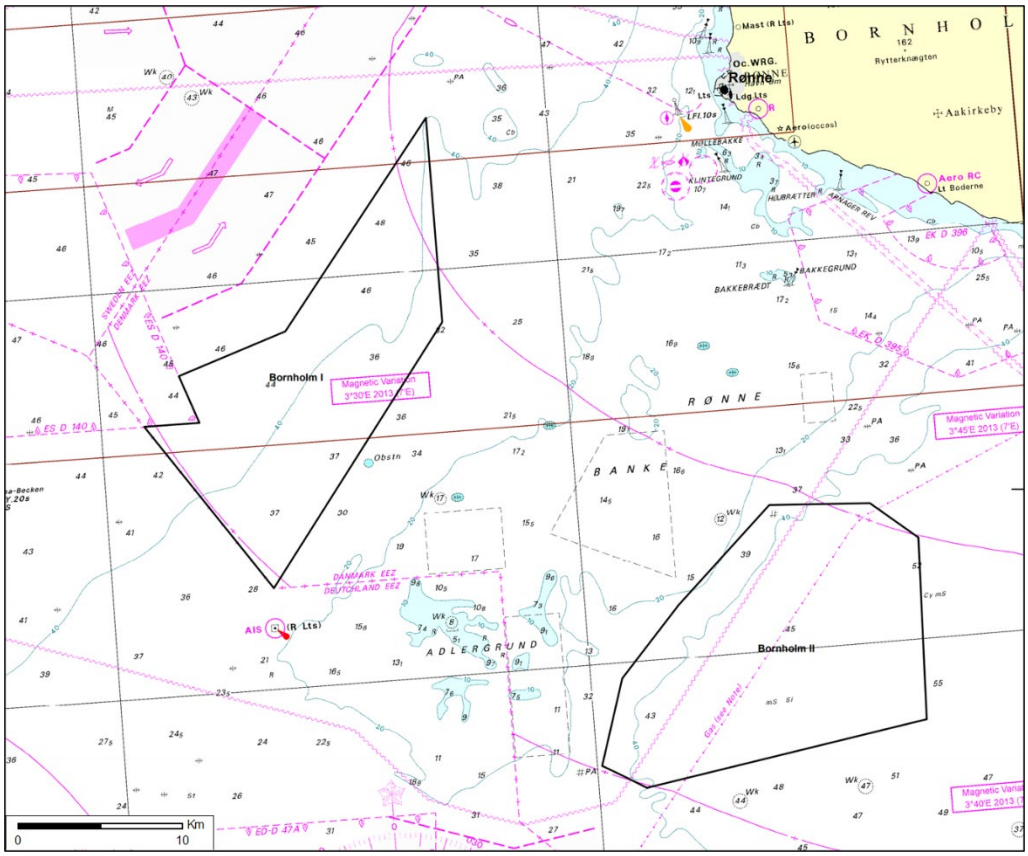


Figure 5-2. Areas of investigation presented with admiralty Chart 188. © Danish Geodata Agency.

5.2 Water depths

The Clients expectations to the water depths in the areas of investigation are seen in Table 5-3 and Figure 5-3. The bathymetrical DTM information in the figures are based on regional models of ca. 100m spatial resolution (Emodnet 2018 MSL). From the figures the expectations to the minimum/maximum water depths are listed in Table 5-3.

Table 5-3 Expected water depths within the areas of investigation

Site	Water depth ranges
Bornholm I	28 m to 48 m
Bornholm II	20 m to 55 m

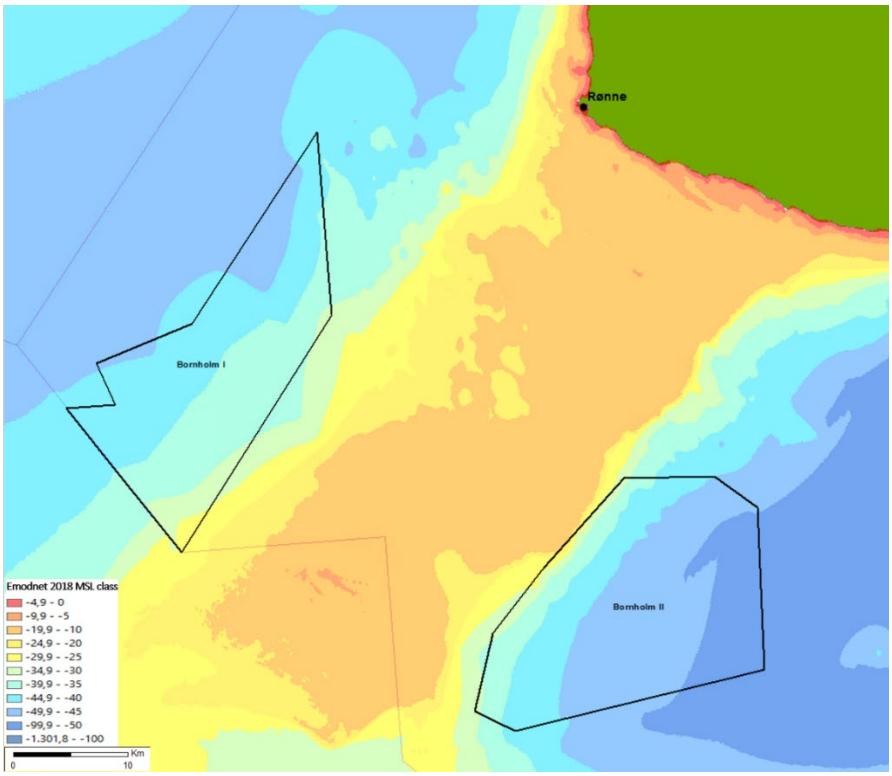


Figure 5-3. Areas of investigation presented with water depth based on regional depth model. The SW-NE going shallow water feature represents "Rønne Banke".

5.3 Geology

Figure 5-4 show the seabed surface geology in the area of investigation based on models from GEUS (Danish Geological Survey) 2015.

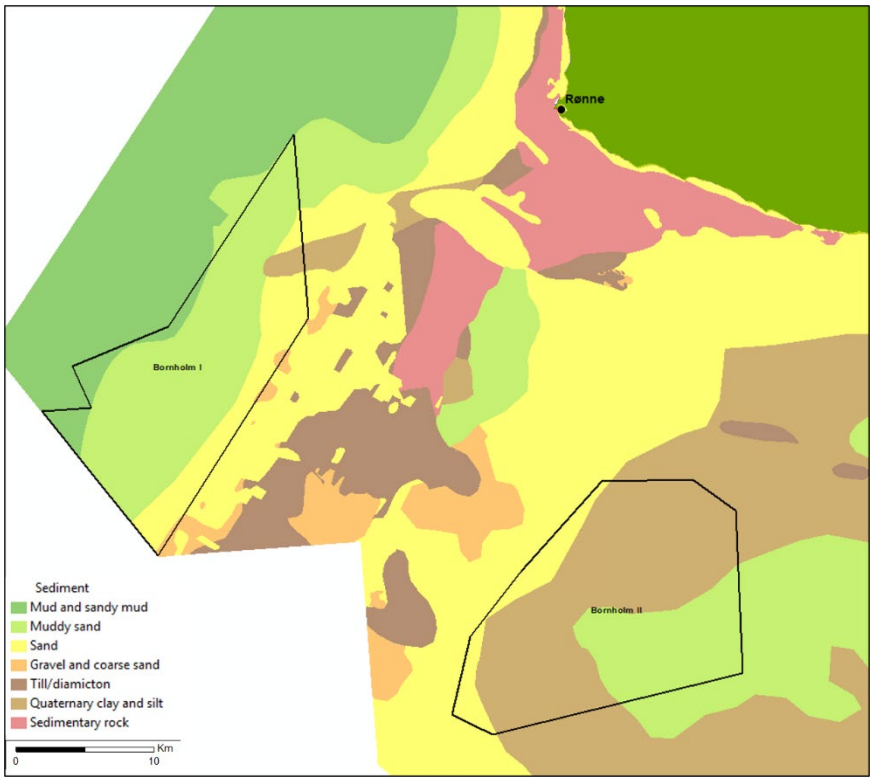


Figure 5-4. Area of investigations presented with seabed surface geology. © GEUS 2015.

A Geology desk study has been carried out by GEUS in May 2021, intended for supporting the interpretation of the site investigations. Reference is made to "Rapport 2021/18. Geology desk study offshore Bornholm, Baltric Sea, Windfarm investigations". The study will be made available for the Consultant.

Based on the desk top study the following geology can be expected in the Bornholm 1 and Bornholm 2 areas:

Under seabed level, a few meters of postglacial (Holocene) deposits are expected in parts of the areas. Hereunder, or from seabed level, Late glacial (Glaciolacustrine) deposits and glacial till, from a few meters and locally up to 30m thickness, are expected.

Under the Quaternary deposits, Danien and Cretaceous deposits are expected. Very hard layers of limestone, chalk, shale and cemented soil can be expected.

Geological sections from Bornholm 1 and Bornholm 2 are shown in Figure 5-5 and Figure 5-6.

It is noted that potential gas accumulations in the Late glacial deposits can occur.

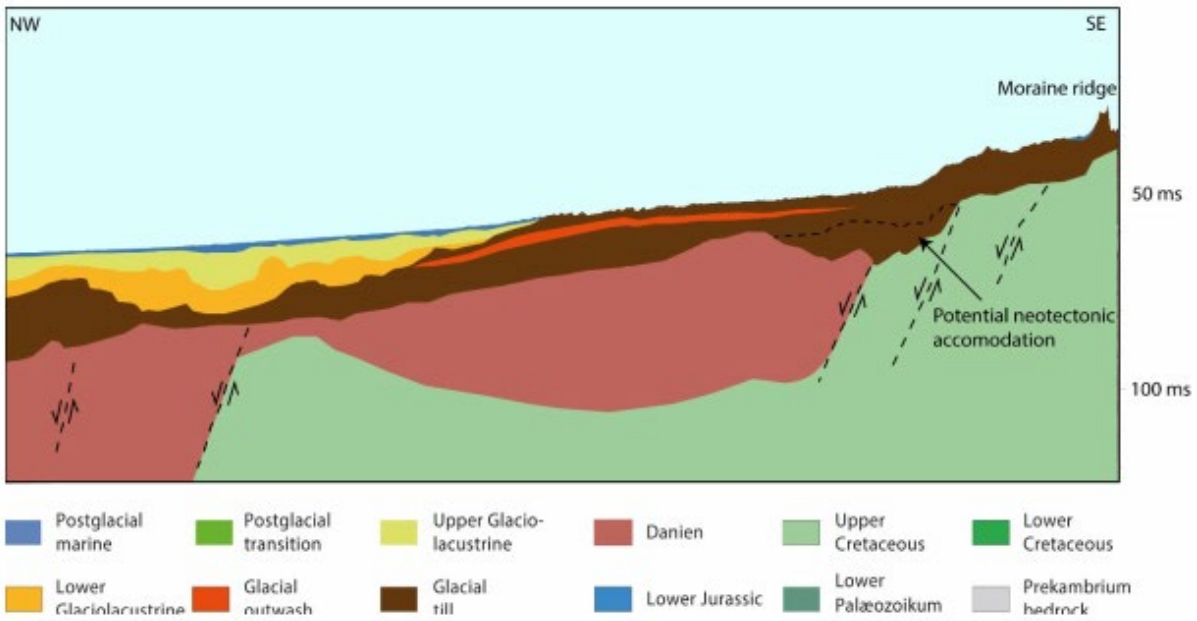
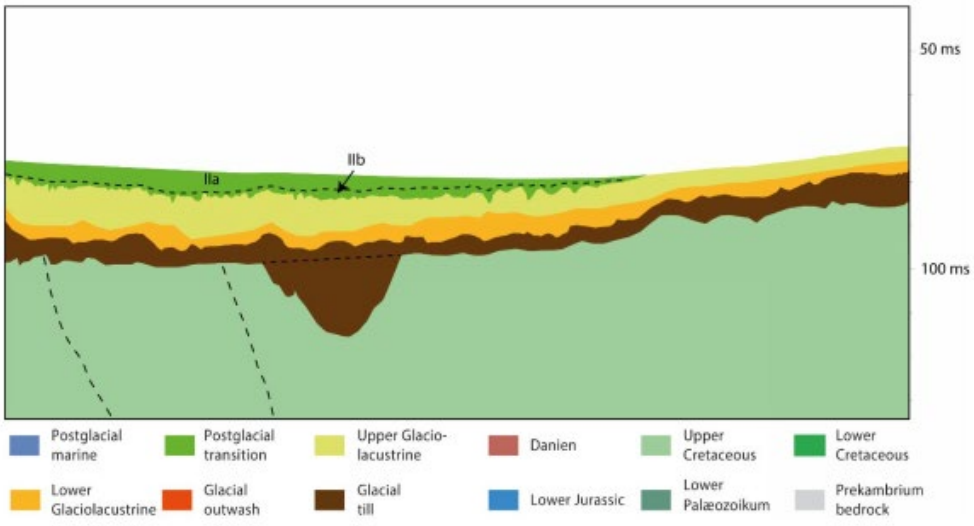


Figure 5-5: Geological section for Bornholm 1



6. UXO box survey

An UXO box survey is planned to be carried out in February-March 2022. The results will be available before start of the geotechnical investigations. This survey will cover the seabed at all the planned CPT and borehole positions.

The primary purpose of the UXO box survey is to minimize the risk of obstructions to the geotechnical offshore activities from objects on the seabed surface and UXO objects under the seabed surface.

The UXO box survey will be performed in boxes around each borehole and CPT position. The size of the boxes are planned to be approximately 200m x 150m for borehole positions and 100m x 150m for CPT positions.

The UXO box survey will consist of a high-resolution mapping of the seabed with magnetometer, side scan sonar and multibeam echosounding.

The Provider of the UXO box survey is required to provide documentation of the results on a sequential basis. This is expected to be ready for provision to the awarded Consultant in February-March 2022.

The results from the UXO box survey will include the following

- Survey report, UXO box survey
- Charts, panels with imagery of magnetometry, multibeam, side scan sonar, anomalies and survey lines
- Multibeam Echosounding, XYZ data, gridded and ungridded
- Side Scan Sonar, XTF files and GeoTiff
  Magnetometer data, measurements (CSV) and grids-files of residual magnetic field

TECHNICAL REQUIREMENTS

Project	Energy Islands
Assignment	Preliminary geotechnical investigations for Energy Islands and Off-shore Wind Farms
Document Title	Scope of Services – Enclosure 1 – Technical Requirements
Document No.	21/03351-10
Audience	Tenderers

Version	Document status	Prepared by		Reviewed by		Approved by	
		Name	Date	Name	Date	Name	Date
1	For tender	XSTPE	08-06-2021	XMAFO	08-06-2021	JRA	08-06-2021

Energinet
Eltransmission A/S
Tonne Kjærsvej 65
DK-7000 Fredericia
+45 70 10 22 44
info@energinet.dk
Vat-nr. 39 31 48 78

Table of Contents

1. Introduction

In the document “Scope of Services” the objectives and the general outcome of the geotechnical investigation activities are described.

This specification, when read in conjunction with the Consultancy Agreement, referenced standards, specifications and other listed documentation, defines the technical, functional and procedural requirements for the Services associated with the project.

The Consultant shall take responsibility to ensure all operations are conducted safely and with full regard to national, international and area specific environmental considerations.

The planned amount and depths of boreholes and CPT are presented in the Scope of Services.

The Technical requirements are valid for LOT 1, LOT 2 and LOT 3. Some items might not be relevant for all LOT´s – regarding relevant items for each LOT, reference is made to Scope of Services and the Price List.

1.1 Constraints

The Client’s approval of the Consultant’s time schedule, organisation plan, list of subcontractors, list of equipment, etc., shall not relieve the Consultant of any responsibility for the performance of his obligations.

The Consultant shall perform the Services in accordance with best professional standards and practice within the industry plus in accordance with equipment and software manufacturer’s recommendations and descriptions.

The presence of and the inspection and supervision by the Client at the worksite as well as any approval, consent, comments and the like given to the Consultant by or on behalf of the Client shall not relieve the Consultant from his obligations and responsibilities.

All data and reports that are a result of the Services are confidential and cannot be distributed to third parties without written permission from the Client.

2. Geodetic Reference System

2.1 Horizontal reference

The geodetic reference system for the assignment shall be ETRS89.

Charts, drawings, borehole logs, CPT logs and digital data that need to be based on a projected reference system shall use the reference system ETRS89 UTM32N for LOT 1 and LOT 2, and system ETRS89 UTM33N for LOT 3.

2.1.1 Vertical reference

All vertical reference must be provided as elevations relative to *Mean Sea Level* (MSL) based on the model DTU18_MSL.

3. Vessels

3.1 General requirements

It is the Clients assessment that a ship for the seabed CPT and a jackup or a ship for the boreholes can be applied advantageously. The ships shall be equipped with a dynamic position (DP) system. In the following the word "vessel" is used for either a ship or a jackup.

The borings shall be performed from a steady platform or ship deck, effectively heave compensated and hard-tied to the seabed frame, to ensure the highest sample quality.

Based on the Consultants experience and detailed operational knowledge, it's the responsibility of the Consultant to select specifications of vessels proposed in the tender, in order to meet and perform Scope of Services in the designated geographic areas.

Using a jackup, the length of the legs shall allow for the indicated water depths, the expected weather conditions and penetration in the seabed.

All necessary tug boats, boats for transportation of crew etc. shall be included. Such services could be acquired from local providers in nearby ports.

For the offshore geotechnical investigation, the Client assumes the optimal mode of daily operation is 24 hours of operation. Based on the Consultants experience and availability of appropriate vessels, it's the responsibility of the Consultant to propose and carry out the most favourable mode of operations.

The vessels shall have been purpose built or suitably converted to undertake geotechnical testing and sampling in the designated geographic areas.

The vessels shall be able to operate under the meteorological and oceanographic conditions within the limitations stated by the Consultant in his tender.

The Client reserves the right to carry out Health, Safety and Environmental (HSE) audits of the vessels, and previous audit records, where accessible, shall be made available for examination by the Client. Following the audit, the Consultant will be required to address any serious/major non-compliances raised prior to operation (see document 21/03351-10).

Vessel deck areas used for operations shall have good lighting and be free of trip hazards. All areas of the vessel used for operation of equipment shall be either visible from the bridge, or good quality closed-circuit television pictures of such areas shall be provided on the bridge at all times of such operations.

The vessels shall be equipped with adequate communication equipment for telephone communication plus continuously high-speed internet connections with a speed of at least 1 Mbit/s for digital data distribution.

3.2 AIS

The vessels shall be equipped with AIS. The AIS transponder on board the vessels shall automatically, and with the required accuracy and update rate, provide other vessels and authorities with relevant information about the vessels and their navigation.

3.3 Offshore Client Representative

The Client will employ a Client Representative to provide offshore presence during the mobilisation and operation at any vessel offered by the Consultant.

The specific roles and responsibilities of the offshore Client Representatives will be addressed at the project kick-off meeting.

On the offshore vessels, operated at 24 hours basis, the Consultant must allow for two (2) Client Representatives. If vessels are operated at 12 hours basis, the Consultant must allow for one (1) Client Representative.

As a minimum the Client Representative cabin shall be a single cabin and fitted with telephone, at least 1 Mbit/s internet connections and adequate offline facilities for evaluation of the results.

4. Personnel and crew

The manning of the investigation team is the responsibility of the Consultant. The Consultant must provide sufficient competent supervisory, technical and other personnel to properly perform the service.

A qualified geologist/geotechnical engineer shall supervise the sampling and testing onboard, and shall as well perform geological descriptions of retrieved soil and rock samples, including photographs.

The Consultant may not replace key personnel without written approval from the Client. See detailed requirements in the Consultancy Agreement.

All marine personnel should be qualified in accordance with the requirements of the flag of registration.

The master and other principal vessel officers must be fluent in written and spoken English. All personnel sailing on the vessels are expected to be medically fit and the Consultant is required to ensure that regular medical examinations are undertaken.

The Party Chief shall be the Consultant's nominated offshore Survey Representative and shall liaise directly with the offshore Client Representative.

5. General requirements to Equipment

The Consultant's equipment, materials, supplies and tools shall be in good and safe operational condition, approved for use and calibrated.

The Consultant shall maintain and repair all equipment and tools and maintain adequate stock levels and spare parts and spare equipment in order to ensure timely operations.

All equipment shall be installed and operated in such a way no interferences or disturbances between the various equipment units or the vessel and the equipment units occur.

All equipment and instruments must be able to operate under the meteorological and oceanographic limitations stated by the Consultant in his tender.

6. Positioning

6.1 Vessel Positioning System

The positioning of the vessels and boreholes/CPT shall be determined with a highly accurately Global Navigation and Satellite System (GNSS) positioning system(s). Positioning shall be carried out such that coordinates are derived with sufficient accuracy to meet the objectives and needs of the project as specified in section 6.3.

As part of the mobilisation and acceptance test in the port(s) of mobilisation, the GNSS antennas position determined by the GNSS-system(s) shall be compared with the GNSS antennas position determined by land survey methods.

At least two independent vessel positioning systems need to be available. Dual antennas is not considered two (2) independent systems.

Furthermore the vessel(s) shall be equipped with motion sensor and gyro (unless a jack-up type vessel is applied for the services).

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).

6.2 Utility desk study

It is the responsibility of the Consultant to ensure that the geotechnical investigations are carried out with sufficient safety distance to seabed utilities. Therefore – as a part of the mobilization – the Consultant must undertake a desk study to map out known utilities in the investigation area, such as but not limited to oil and gas pipelines, power cables (both operational and dead) and telecommunication cables.

6.3 Positioning of boreholes and CPT

The horisontal 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.

The elevation of the seabed shall be compared to the results of the bathymetric survey from the geophysical survey. These results will be delivered to the Consultant before start of the investigations.

The boreholes and CPT´s shall be carried out at the designated positions. However, the Consultant shall determine the final positions with respect to possible local obstructions, utilities, boulders, UXO objects etc., based on the results from the geophysical survey, the UXO box survey and the utility desk study.

If the final position is more than 5 m from the designated position, the position shall be approved by the Client.
The distance between the boreholes and the CPT next to the borehole shall be minimum 3 m.

7. Codes and Standards

The current issue of the publications of the organisations listed below shall govern.

The applicable revisions and dates shall be recorded on the specific test reports, quality assurance/ quality control documents, and related reports.

EC7:	Eurocode 7 (EC7)*
CEN/ISO:	European Committee for Standardization/ International Organization for Standardization
ISSMGE:	International Society for Soil Mechanics and Geotechnical Engineering
ASTM:	American Society for Testing and Materials
BS:	British Standards (British Standards Institution)
DGS:	Danish Geotechnical Society

*All references to EC7 includes Danish National Annexes.

8. CPT Testing

All CPT testing shall be in accordance with EN/ISO 22476-1:2012 (or equivalent).

All CPT testing shall be carried out as piezocone CPTU testing, class 2.

The Consultant shall provide, maintain and operate equipment for in-situ CPT-testing plus evaluate and report the testing carried out.

8.1 Seabed CPT

A continuous deep CPT to the target depth, or to refusal, shall be performed at all seabed CPT locations.

For seabed CPT performed next to a borehole, the CPT shall be performed prior to the borehole at the same location.

In case of refusal less than 10m below seabed, a rerun of the CPT shall be performed within 5 m from the first position.

8.2 Down the hole CPT

In case the target depth of the seabed CPT is not reached, it can for selected positions of CPT next to a borehole, be agreed with the Client to perform down the hole CPT.

Down the hole CPT can either be performed in the adjacent sampling borehole, or in a “blind” drilled separate hole. Down the hole CPT shall be performed from the level of refusal of the seabed CPT.

Down the hole CPT or blind drilling for CPT shall be agreed with the Client.

Down the hole CPT in blind drilled borehole shall be performed continuous.

In case of blind drilling of a separate hole, this shall be performed after the borehole for sampling within a distance of 5m from the sampling borehole.

The final depths of down the hole CPT will be agreed between the Client's Representative and the Consultant.

8.3 Seismic CPT (SCPT)

At selected seabed CPT positions, seismic CPT shall be performed.

SCPT testing shall be performed as part of the normal CPT.

The SCPT shall be equipped with geophone sensors. These sensors shall measure the magnitude and arrival time of seismic shear and compression waves. P- and S-velocities shall be measured and P- and S-curves shall be presented.

Seismic measurements shall be performed in 1m intervals.

8.4 Equipment

All CPT equipment shall be in accordance with EN/ISO 22476-1:2012 (or equivalent). The following publications, where relevant, shall also govern: IRTP (2001), *International Reference*

Test Procedure (IRTP) for the Cone Penetration Test (CPT) and the *Cone Penetration Test with pore pressure (CPTU)* (or equivalent), Report of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE), 2001 (or equivalent).

For the seabed CPT the pressure device shall have a thrust capacity of minimum 200 kN. The cone shall have a tip resistance capacity of minimum 75 MPa and a sleeve capacity of minimum 3 MPa.

For down the hole CPT the pressure device shall have a thrust capacity of minimum 90 kN. The cone shall have a tip resistance capacity of minimum 75 MPa and a sleeve capacity of minimum 3 MPa.

All CPTs shall be performed with conical (60 degree) electrical cones, which permits simultaneous measurement of the cone tip resistance, local sleeve friction and pore pressure. The pore pressure filter and transducer position shall be at the cone shoulder (u2).

Standard cones of 10 and 15cm^2, calibrated according to EN/ISO 22476-1:2012 (or equivalent) and ISSMGE recommendations, shall be applied. All assigned field cones shall be newly calibrated before start of the Services and copies of the calibration documentation shall be available to Energinet as part of the list of pre-investigation deliverables.

At least ten calibrated piezocones (10 and 15cm^2 type) shall be on board the vessel.

The porous filter shall be accurate vacuum de-aerated and positioned in order to ensure self-saturation.

The CPT units shall be controlled from the deck of the investigation vessel. Online results of thrust force, tip resistance, sleeve friction, pore pressure, inclination and seismic measurements shall be shown graphically during the testing.

8.5 Procedures

The following information at each test location shall be recorded:

- elevation of seabed at CPT
- coordinates of CPT
- coordinates of legs of jackup – if relevant
- penetration of each leg of jackup – if relevant
- penetration of seabed rig – if relevant

The CPT shall be positioned in such a way as to provide the perfect verticality of push rods.

The continuous CPTs shall be carried out from the seabed to target depth or refusal.

For seabed CPT, the seabed elevation at the test location shall be recorded by pressure transducers mounted on the seabed rig and corrected for specific gravity of the water column at the location.

Field checks of cones and the data acquisition system shall be performed as part of the mobilisation and before a new cone is used.

Before conducting each CPT, the tip and sleeve friction readings must be zeroed and the pore pressure reading checked to comply with the water depth. Zero readings shall be reported.

The cone shall be pushed into the soil at a constant rate of 20mm per second.

During CPT operations and before start of the penetration of the push rods into the soil, the Consultant shall record simultaneous, continuously and in real-time the following data in digital and graphical format and in strict accordance with the EN/ISO 22476-1:2012 (or equivalent) and ISSMGE guidelines:

- A record of the individual test offsets and zeros.
- The tip resistance.
- The sleeve friction.
- The pore pressure.

The raw measured results shall be stored in digital format, and backed up for subsequent processing and interpretation.

Refusal of the CPT is defined as follows:

- Total thrust equals nominal reaction provided
- Cone tip resistance exceeds the tip capacity
- Sleeve friction exceeds the sleeve capacity
- Cone inclination exceeds 15°
- Sudden change of cone inclination exceeds 3°
- The operator feels that further penetration would damage the equipment, in which case an explanation is to be provided

CPT logs shall, as a minimum, present the following information:

- Providers name
- Project name
- CPT number and location
- CPT rig make and model number
- CPT cone no.
- Elevation
- Coordinates
- Date and time commenced and completed
- Depth at stop
- Reason for stop

Preliminary CPT logs and print of results shall be submitted to the Client's Representative for comments upon completion of the individual test.

9. Drilling and sampling

The drilling shall be performed to secure high quality samples and continuous registration of the soils/layers. All layers shall be sampled and all layer boundaries determined accurately.

The drilling and sampling shall be performed in accordance with EN/ISO 22475-1 (or equivalent) and EC7 (or equivalent).

The final depths shall be according to the agreed target depths.

Where blind drilling for down the hole CPT is performed, the drilling shall be performed to the level of refusal of the continuous CPT, or maximum 0.5 m below. The blind drilling shall be performed so the soil below the drilled depth is not disturbed.

The Consultant shall provide, maintain and operate equipment for sampling plus evaluate and report the sampling carried out.

9.1 Equipment

Sampling category A according to EN/ISO 22475-1 (or equivalent) shall govern.

The Provider shall propose fit for purpose equipment and appropriate procedures for the drilling, to ensure the highest possible sample quality.

The expected geology, according to the desk tp study, the geophysical survey, the Consultants experience and the results of the seabed CPT next to the borehole, shall be basis for the choice of drilling equipment and procedure.

Equipment for rotary core drilling (Geobor-S or similar), diameter minimum 80mm, using Triple-tube corebarrel shall be used, where suitable.

In soils not suitable for core drilling, suitable drilling equipment for the actual soil conditions shall be used.

Different types of core catchers, steel tubes etc. shall be available on board.

Shelby tubes, minimum Ø67mm, shall be used for push samples.

9.2 Procedures

The following information at each test location shall be recorded:

- elevation of seabed at borehole
- coordinates to borehole
- coordinates to legs of jackup – if relevant
- penetration of each leg of jackup – if relevant

Continuous core drilling shall be performed where suitable.

Where core drilling is performed, continuous samples shall be taken.

In soils not suitable for core drilling, suitable drilling method for the actual soil conditions shall be used.

In fine grained soils, intact soil samples of at least Quality class 2 (CEN ISO 22475-1 (or equivalent)) shall be taken in intervals of 1.0 m, and have a minimum length of 0.3m. Minimum one sample per layer shall be taken.

If down the hole CPT is performed in the sample borehole, intact samples are replaced by disturbed samples.

In coarse grained soils, samples of at least Quality class 4 (CEN ISO 22475-1 (or equivalent)) shall be taken in intervals of 1.0 m.

Preferable push samples shall be taken.

Further, bulk samples and small bag samples shall be taken for classification test and chemical tests.

Sample sizes shall fit the planned laboratory tests.

Samples must at all times be handled so risk of disturbance is minimized.

Borehole logs shall, as a minimum, present the following information:

- Providers name
- Project name
- Borehole number and location
- Methods of advance
- Drill rig make and model number
- Circulating drill fluid employed
- Elevation
- Coordinates
- Dates commenced and completed
- Daily progress
- Casing sizes and depths
- Soil sample types, numbers, depths, and recoveries
- Rock core numbers, depths, total and solid core recoveries and rock quality designation (RQD) – if relevant
- Complete soil strata descriptions, depths, registration of blows/pressure to penetrate the cores, and remarks on losses or gains in drill fluid pressure, rod drops, and any other unusual occurrences.

Preliminary borehole records shall be submitted to the Client's Representative for comment upon completion of the individual borehole.

10. P-S Logging in boreholes

P-S Logging shall be performed in selected boreholes.

The logging eqiupment shall be equipped with geophone sensors. These sensors shall measure the magnitude and arrival time of seismic shear and compression waves. P- and S-velocities shall be measured and P- and S-curves shall be presented.

P-S logging shall be performed in 1m intervals.

11. Laboratory Tests

Laboratory tests shall be performed on selected samples.

Laboratory tests on board the vessel shall contain:

- Visual geological description and denomination by geologist and soil classification
- Photographs of samples
- Pocket penetrometer or shear vane test on appropriate cohesive soil samples

After the above works, all undisturbed samples and core runs shall be carefully sealed, labelled and stored in boxes for later transportation to onshore laboratory.

Laboratory tests at the onshore geotechnical laboratory shall contain:

- Classification tests
- Chemical tests
- Special laboratory tests

Parts of the onshore geotechnical laboratory tests can be performed on board after agreement with the Client.

11.1 Classification tests

The below listed classification tests are expected to be relevant for the investigation.

The Consultant shall issue laboratory testing schedule for the Clients review and approval.

Test Standards are listed below. Use of other Standards shall be approved by the Client.

11.1.1 Geological description and classification

Geological descriptions and classification of soil and rock shall be in performed on all samples in accordance with Danish Geotechnical Society Bulletin No. 1E: “A Guide to engineering geological soil description”.

The interpreted geological environment and age shall be added to the geological descriptions.

11.1.2 Water content

Determination of water content of soil samples shall be carried out according to CEN ISO/TS 17892-1 (or equivalent).

11.1.3 Saturated moisture content

Determination of saturated moisture content shall be carried out according to BS 1377-2:1990 (or equivalent).

11.1.4 Bulk density

Bulk density shall be carried out in accordance with CEN ISO/TS 17892-2 (or equivalent).

11.1.5 Grain size distribution

Wet Sieve analysis of soil samples shall be performed in accordance with CEN ISO/TS 17892-4 (or equivalent).

If content of fines (<0.063 mm) exceeds 10%, combined sieve and hydrometer analysis of soil samples shall be carried out according to CEN ISO/TS 17892-4 (or equivalent).

The test report shall include the gradation curve, presented as a plot of grain size versus per cent passing by dry weight.

11.1.6 Atterberg limits

Atterberg Limits Tests shall be performed in accordance with CEN ISO/TS 17892-12 (or equivalent).

11.1.7 Particle density

Particle density shall be performed in accordance with CEN ISO/TS 17892-3 (or equivalent).

11.1.8 Density index of granular soils (e_{min}/e_{max})

Density index of granular soils shall be performed in accordance with Danish Geotechnical Society, Bulletin 15. Test No. 3.6 or alternatively BS 1377-4:1990 (or equivalent), Part 4.

11.1.9 Loss on ignition (organic content)

Loss of ignition shall be performed in accordance with ASTM D2974 (or equivalent).

11.1.10 Degree of Roundness of Sand

Degree of Roundness of Sand shall be performed for selected coarse grained samples.

The provider shall suggest a procedure for the test.

11.2 Chemical tests

The below listed chemical tests are expected to be relevant for the investigation.

The Consultant shall issue laboratory testing schedule for the Clients review and approval.

Test Standards are listed below. Use of other Standards shall be approved by the Client.

11.2.1 Chloride content

Tests shall be performed according to BS 1377-3 (or equivalent).

11.2.2 Content of $CaCO_3$

Tests shall be performed according to BS 1377-3 (or equivalent).

11.2.3 Sulphate content

Tests shall be performed according to BS 1377-3 (or equivalent).

11.3 Special Laboratory Tests

The Consultant shall suggest a testing program for special laboratory tests, including specifications for the individual test for the laboratory, for the Clients review and approval. The program shall cover samples and relevant tests, considered suitable for foundation of a wind turbine.

When planning the test specifications, the insitu conditions, the results of CPT, classification tests etc. shall be taken into consideration.

The Client will comment on the suggested program within 1 week after receiving the program/specifications.

Test Standards are listed below. Use of other Standards shall be approved by the Client.

The below listed laboratory tests are considered relevant.

11.3.1 Thermal resistivity

Thermal resistivity tests shall be performed on samples within 1.5 m below seabed - preferable on intact samples - according to ASTM D5334-08 (or equivalent).

11.3.2 Oedometer test

One-Dimensional Consolidation Tests shall be performed according to CEN ISO/TS 17892-5 (or equivalent).

In the first part of a test (IL1) the preconsolidation stress of the soil shall be determined on a part of the sample.

The following test (IL2) shall be performed on a new part of the sample.

The results shall include the geotechnical parameters found by the test.

The preconsolidation stress determined by IL1 shall be used for planning program and specifications for the other special laboratory tests (triaxial tests etc.).

11.3.3 Unconsolidated Undrained (UU) triaxial test

The tests shall be carried out in accordance with CEN ISO/TS 17892-8 (or equivalent).

The results shall include the geotechnical parameters found by the test.

11.3.4 Consolidated Undrained (CAU) triaxial compression test

The tests shall be performed as consolidated, anisotropic, undrained, triaxial compression tests with pore pressure measurement in accordance with CEN ISO/TS 17892-9 (or equivalent).

The results shall include the geotechnical parameters found by the test.

11.3.5 Consolidated Undrained (CIU) triaxial compression test

The tests shall be performed as consolidated, isotropic, undrained, triaxial compression tests with pore pressure measurement in accordance with CEN ISO/TS 17892-9 (or equivalent).

The results shall include the geotechnical parameters found by the test.

11.3.6 Consolidated Drained (CID) triaxial compression test

The tests shall be performed as consolidated, drained, isotropic triaxial compression tests with pore pressure measurement in accordance with CEN ISO/TS 17892-9 (or equivalent).

The results shall include the geotechnical parameters found by the test.

11.3.7 Direct Simple Shear test

The tests shall be carried out in accordance with ASTM D6528 – 07 (or equivalent).

The results shall include the geotechnical parameters found by the test.

11.3.8 Consolidated Undrained (CAU) triaxial test – cyclic

Consolidated undrained triaxial cyclic tests shall be performed to examine the behavior of the soil for cyclic loads. The test shall include up to 1500 cycles.

The provider shall suggest a procedure for the test.

11.3.9 Unconfined Compression test on fine grained soil

Determination of the unconfined compressive strength of fine grained soil specimens shall be according to CEN ISO/TS 17892-7 (or equivalent). Minimum Height/Diameter ratio shall be at least 2.

The test report shall include the soil type, rate of loading and the calculated unconfined compressive strength (and elastic modulus) of the core specimen, water content, and density.

12. Sample storage

The Consultant shall retain all untested soil samples and cores at a location to be agreed with the Client for a period of three years.

The soil samples and cores shall be stored in an appropriate environment so that they can be accessed and will not be subject to deterioration.

All sample boxes shall be marked “Energinet´s property”.

Soil samples and rock cores shall under no circumstances be discarded without the written authority of the Client.

13. Marine Weather Forecasts

The Consultant shall arrange a web based marine weather forecast system (MFS) that include a representative point location at the area of investigation. The MFS service shall be made available to the Client.

At least the following parameters shall be in the MFS service:

1. Wind (speed, direction and gusts)
2. Waves (significant height, maximum heights and period)
3. Swell (height, direction and period)
4. Sea current (speed and direction)
5. Temperature (sea/air)
6. Precipitation
7. Air pressure

The parameters shall be available as charts, graphs and as exportable table formats.

The meteorological model(s) used for the prediction of the parameters shall have a spatial resolution such that the resulting forecasts are suitable for operational planning of the activities in the Scope of Services.

14. Reporting Requirements

All reporting and other kind of documentations and communication must be prepared in English.

During the various stages of the assignment the Consultant has to deliver a number of plans, reports and digital deliverables.

Figure 14-1 provides a schematic and staged overview of the outputs that must be provided as an integrated part of performing the Scope of Services.

Section 14 gives in conjunction with the document "Scope of Services – Enclosure 2 – Standards of Deliverables" a description of the requirements that apply to the deliverables.

Furthermore - in order for the Client to complete his part of the application for permissions the Consultant must upon request and without delay provide the Client with any supplementary relevant master data or metadata relating the vessels, instruments, crew or other parameters related to the survey.

Event	Deliverable	Document reference
Consultancy Agreement	Evidence for meeting insurances, Performance Guarantee Project Execution Plan HSE Management Plan Quality Management Plan	Consultancy Agreement Consultancy Agreement Section 14.1 Section 14.1 Section 14.1
Kick-off meeting		
Mobilization start Mobilization end	Acceptance Test Report	Section 14.2
Investigation operations	Daily Progress Reports Preliminary results Weekly Management Reports Monthly HSE Reports	Section 14.3 Section 14.4 Section 14.5 Section 14.6
Demobilization end	Operational Report	Section 14.7
Provision of **Draft** deliverables	Factual Geotechnical Report Digital Deliverables	Section 14.8 Section 14.9
Provision of **Revised** deliverables	Do.	Do.

Figure 14-1. Schematic overview of the various deliverables that must be provided during the Consultancy Agreement period.

14.1 Project Execution, HSE and Quality management plan's

As a part of his project mobilization prior to marine activities the Consultant must prepare and forward three plans to the Client:

- A plan for Project execution
- A plan for HSE management
- A plan for Quality management

The Consultant shall forward the plans to the Client in due time for the Client to review before the kick-off meeting.

The Project Execution Plan shall at least include the following parts:

1. Program planning.
    a. A high-level description of main activities and their order of performance.
    b. Technical method statement regarding marine operations (e.g. LARS activities).
    c. Templates for all requested reporting incl. digital deliverables.
2. Plan for technical quality assurance and quality control.
    a. Templates for borehole profiles, logs and charts.
    b. Plan for nomenclature and denomination of digital deliverables.
3. Plan for the execution of the acceptance tests including pass criteria
    a. Template for the acceptance test reports for instruments applied for the execution of the Services.

The HSE management plan shall fulfil the requirements specified in the document:

- Scope of Services - Enclosure 3 - HSE requirements

The Quality management plan meets the requirements in the document:

- Scope of Services - Enclosure 4 - Quality requirements

Based on the Client's comments the Consultant shall forward a final Project Execution Plan to the Client for approval.

No quality related services must be commenced prior to the approval of the Project Execution Plan by the Client. This means that the plan needs to be approved prior to commencing offshore activities.

14.2 Acceptance Test Reports

The vessels are mobilized when all equipment are tested and calibrated and the activities can begin.

As part of the mobilization of the vessels, the final testing and calibrating shall be witnessed by the Client Representative and reported by the Consultant in an Acceptance Test Report for each vessel to be applied for execution of the services.

The Client Representative and the Consultant's party chief shall by signing the Acceptance Test Report agree that the vessels are mobilized and ready for operation.

14.3 Daily Progress Reports

For each applied vessel, a separate Daily Progress Report (DPR) shall be prepared and submitted from the Party Chief and the Clients Representative not later than 12 hours after end of a day.

The format and the recipients of the DPR's shall be agreed between the Consultant and the Client at the kickoff meeting.

Daily Progress Reports for a vessel shall be from start of mobilization and uninterrupted until end of demobilization.

The Daily Progress Reports must include information regarding:

- Status of works: Completed quantities (current day and cumulated) and remaining quantities.
- Time break down: Mobilization, Operation, Standby, Transit, etc. (current day and cumulated).
- Weather observations (sea state, wind and visibility).
- Weather forecast – next 24 hours.
- Deviations from normal operation (break downs, calibration issues, etc.).
- HSE incidents.

The Daily Progress Report must be submitted to the Client before 09.00 am the following day.

The final format of the Daily Progress Report should be addressed at the project kick-off meeting and agreed with the Client.

14.4 Preliminary results

Preliminary borehole logs, CPT logs and printed CPT results shall be issued within 4 hours of completion of each borehole and test. The logs shall be reviewed by the Clients Representative.

Preliminary borehole data and CPT data shall be provided within 24 hours after completion of each CPT/borehole position.

A list of planned and performed laboratory tests, including test results, shall be issued each week.

The Consultant shall within 48 hours of completion of each borehole issue a laboratory testing schedule, showing the taken samples (sample type, soil description, depth etc.) and suggest samples for classification and chemical test for the Clients review and approval.

The Consultant shall, in due time to be able to finish the Report in time, suggest samples and procedures for advanced laboratory test for the Clients review and approval.

14.5 Weekly Management Reports

From commencement to completion of contract, weekly management reports shall be prepared and submitted by the Consultants contract manager.

The weekly management reports shall cover the previous weeks services plus the actual status of the project as on Sunday at 24:00 hrs. UTC. Among many other subjects, the weekly management reports shall include an updated list of the projects actual deviations from the Consultancy Agreement.

The weekly management reports shall be comprehensive and cover all relevant topics to be able for the Client's project management to maintain an overview plus manage the project.

The weekly management reports shall be used as a basis for the Client's informing of and dialogues with authorities and other stakeholders about the progress and status of the project.

From commencement of the services and uninterrupted until the completion of the services, the Weekly Management Reports must be issued every Monday before EOB.

14.6 Monthly HSE reports

On a monthly basis the Consultant is required to submit work hour statistics to the Client. The requirements to the HSE report is described in the document "Scope of Services - Enclosure 3 - HSE requirements", section 1.23.

The specific format of delivery is discussed and agreed at the project kick-off meeting.

14.7 Operational Report

The Consultant must submit an Operational Report that documents vessels, instruments and equipment, methods and procedures, etc.

The Operational Report must cover the operations of all on- and offshore resources. The Acceptance tests reports must be attached the Operational Report.

Requirements to the Operational Report are described in the document "Scope of Services – Enclosure 2 – Standards of Deliverables".

14.8 Factual Geotechnical Report

A draft Factual Geotechnical Report, incl. digital data deliverables, shall be prepared and submitted to the Client.

The draft Factual Geotechnical Report, incl. digital data deliverables, shall have the same content as specified for the final Factual Geotechnical Report.

The draft report shall be finalised and checked by the Consultant before issue.

In general, the Factual Geotechnical Report inclusive digital deliverables shall present the results and findings of the geotechnical investigation.

The preparation of the Factual Geotechnical Report must follow the requirements described in the document "Scope of Services – Enclosure 2 – Standards of Deliverables".

After receiving the draft Factual Geotechnical Report and the digital data deliverables the Client will use three weeks for reviewing and commenting on the delivery.

Hereafter the Consultant must amend the Factual Geotechnical Report including digital deliverables according to the feedback from the Client and issue a revised version.

The Consultant must submit the Factual Geotechnical Report by the time indicated in the contracted time schedule.

14.9 Geotechnical digital deliverables

Together with the reports a number of digital deliverables must be supplied.

The format and specifications of these deliverables must follow the requirements described in the document "Scope of Services – Enclosure 2 – Standards of Deliverable".

15. Meetings

15.1 Kick-off meeting

The Consultant must facilitate a project kick-off meeting at his own premises where at least the following topics will be a part of the agenda:

- Mobilization and acceptance test criteria
- Project execution plan and Daily Progress Reports
- Principles for planning and adjusting the program of work
- Project Deliverables
- Time Schedule
- Organisation, roles and responsibilities
- QHSE
- Commercial matters
- Contractual matters

The project kick-off meeting shall be scheduled prior to the mobilization of the marine resources.

15.2 Weekly Management Meetings

From commencement of the services and uninterrupted until the completion of the services, every Tuesday morning and based on the previous days weekly management and technical reporting, management web-meetings between the Consultants and the Client's project management incl. reporting manager shall be held.

The Consultant shall facilitate the web-meetings.

The Consultant shall minute the meetings and not later than 24 hours after ending of the meeting, the minutes shall be distributed as on the project kick-off meeting.

15.3 Monthly Status Meeting

The Consultant must participate in monthly status meetings that will be hosted every second month by the Client in Frederica, Denmark and every second month by the Consultant.

The purpose of the Status Meeting is to address the status and progress, the work quality, the deliverables as well as the commercial and contractual status of the contract. Furthermore relevant technical key topics may be addressed depending on current project phase.

The Consultant shall at least be represented by two persons of whom the Consultants project manager is one of them.

Unless otherwise agreed the Monthly Status meetings shall be held until revised issues of the Factual Geotechnical Report has been accepted by the Client.

STANDARDS OF DELIVERABLES

Project	Energy Islands
Assignment	Preliminary geotechnical investigations for Energy Islands
Document Title	Scope of Services - Enclosure 2 - Standards of Deliverables
Document No.	21/03351-11
Audience	Tenderers

Version	Document status	Prepared by		Reviewed by		Approved by	
		Name	Date	Name	Date	Name	Date
1	For tender	XMAFO	08-06-2021	XSTPE	08-06-2021	JRA	08-06-2021

ENERGINET

Energinet
Eltransmission A/S
Tonne Kjærsvej 65
DK-7000 Fredericia
+45 70 10 22 44
info@energinet.dk
Vat-nr. 39 31 48 78

Table of Contents

1. Introduction

This document specifies a set of base requirements that must apply for the deliverables supplied to the Client by Consultants.

The described requirements is used to express a set of general requests for the deliverables supplied to the Client. This does not relieve the Consultant from producing deliverables that meet the general industry standard.

The Consultant can only deviate from these specifications upon agreement with the Client.

All reports including all attached charts, profiles, enclosures and annexes must be provided in English language and as standard PDF files.

The Scope of Service does not require that any deliverable is provided as printed paper reports.

2. Acceptance Test Report

Documentation for all equipment must be documented, including but not limited to:

- 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.
- Calibration reports for all drilling equipment.
- Calibration reports for P-S logging equipment
- Calibration reports for all laboratory equipment.

The Acceptance Test Report shall be delivered to the Client prior to commencement of the Services.

3. Operational Report

The Operational Report must in general describe how the investigations were completed. As such the Operational report must at least include the following:

ENERGINET

a. Executive summary.
b. Description of any QHSE events
c. Project introduction and background.
d. Description of the applied vertical and horizontal reference systems.
e. Description of all applied vessels.
f. Detailed description of all equipment.
g. Documentation of the calibration and system tests (enclose Acceptance Test Reports).
h. Definition of area of investigation.
i. Description of all methods for performed works.
j. Description of completed offshore scope including cumulative quantities.
k. Description of penetratration of legs, seabed frame etc.
l. Description of deviations from the Scope of Services.
m. Description of norms and standards applied for the work.
n. Description of the cumulative time breakdown from the start of the mobilization to the end of the demobilization.

4. Factual Geotechnical Report

The geotechnical investigations must be documented in a Factual Geotechnical Report.

Reference can be made to the Operational Report - where relevant.

The Report shall as a minimum include the following:

a. Executive summary.
b. Project introduction and background.
c. Description of area of investigation.
d. Applied geodetic system including both location and vertical elevation.
e. All information about the performed field operations, including navigation, vessels, equipment, procedures, performed works etc.
f. All results from the CPT, SCPT, geotechnical boreholes and P-S logging
g. All information about the Laboratory tests, including standards, specific procedures
h. All results of the Laboratory tests
i. Description of the overall geology in the area, the geology found in the boreholes and comparison with the geology interpreted in the geological model from the geophysical survey
j. Presentation of typical geotechnical characteristics for the found layers
k. Enclosures presenting general and detailed location plans, borehole profiles, CPT profiles (including measured and calculated data, interpreted soil profiles and summaries of results), geological cross sections, Laboratory test results, Summary tables, Photos of samples, Documentation of used equipment.

The CPT measurements shall be interpreted in respect to soil type, angle of internal friction, undrained shear strength and relative density. Method for interpretation shall be stated in the Factual Geotechnical Report.

The typical geotechnical characteristics for the layers shall be presented in a table, and shall for each soil type and geological unit as a minimum present the typical range for the results for each classification test, special laboratory tests and relevant in situ tests.

Minimum 3 number of north – south going and 3 number of west – east going geological cross sections shall be performed. The geological cross sections shall include boreholes, interpreted CPT layers and the bathymetry. Each soil type and each geological age/environment shall be shown in different colours. The bathymetry along the cross sections shall be represented by the results from the geophysical survey.

An indicative Table of Content for the Reports, including Enclosures, with minimum requirements, is given below:

1. Executive Summary
2. Introduction and scope of Report
3. Project introduction and background.
4. Description of area of investigation.
5. Applied geodetic system including both location and vertical elevation.
6. Summary of equipment setup and calibration
7. Summary of jack up leg penetration
8. Factual results
   8.1. Geotechnical boreholes
   8.2. CPT results – measured data
   8.3. CPT results – calculated values
   8.4. SCPT results

8.5. P-S Logging results
8.6. Dissipation test results
9. Laboratory test
9.1. Standards
9.2. Results
10. Soil conditions
10.1. Geological overview
10.2. Description of found results
11. Presentation of typical geotechnical characteristics
12. Presentation of digital deliverables
13. References

Enclosures:

- General location plan
- Detailed location plan with test locations
- Legends of definition
- Borehole profiles including geological description, laboratory tests
- CPT profiles, including measured and calculated data
- CPT profiles, including soil profile
- CPT profiles, including calculated parameters
- P-S curves for SCPT
- P-S curves for P-S Logging
- Curves for dissipation tests
- Laboratory test results
- Summary table for penetration of legs and seabed units
- Summary table for boreholes
- Summary table for CPT
- Summary table for SCPT and P-S Logging
- Summary table for laboratory tests
- Photos of samples

The exact Report format and content shall be proposed by the Consultant for the Clients commenting and approval.

For all maps the Consultant shall propose for Client approval the formats of the maps. This should at least include content, symbology, paper size, map scale and layout.

5. Digital deliverables

This section describes the digital deliverables that must be provided as a part of the delivery.

The package of digital deliverables must be provided with a suitable spreadsheet that lists the individual deliverables, including the following information:

- Unique deliverable ID number
- Deliverable name
- Deliverable type
- Revision number
- Date of issue
- Data file format

The digital deliverables are provided on external hard drives in two (2) copies.

5.1 AGS data file

All information about the geotechnical investigations, including positions, dates etc. and all results, including insitu tests, laboratory testsetc., must be delivered in AGS-format (Version 4.1).

Specific content and structure of the AGS data shall be proposed by the Consultant and approved by the Client.

5.2 Legs of jackup

A CSV file with the following data columns must be delivered:

Borehole No.	Unique number
LegID	Number or ID identifying the specific jackup leg of the vessel
Vessel	Name of vessel
Time	Time and date of leg installation in seabed
Easting, Northing	Coordinate of jackup leg
Penetration	Penetration in seabed of jackup leg

5.3 Subsea CPT unit

A CSV file with the following data columns must be delivered:

Borehole/CPT No.	Unique number
UnitID	Number or ID identifying the specific subsea Unit
Vessel	Name of vessel
Time	Time and date of Unit installation in seabed
Easting, Northing	Centre coordinate of unit
Penetration	Penetration of in Seabed of subsea unit

5.4 CPT Overview

A CSV file with the following data columns must be delivered:

Start date and time	YYYY-MM-DD, HH:MM
Finish date and time	YYYY-MM-DD, HH:MM
CPT No.	Unique number
Easting, Northing	Coordinates, meters
Elevation	Elevation of seabed
Depth	Penetration depth

Reason for stop	Target depth, Inclination of the cone, Maximum Cone Resistance, etc.

5.5 CPT and SCPT Results

A CSV file with the following data columns must be delivered:

CPT No.	Unique number
Elevation	Elevation of seabed
Measured data	Penetration depth, Inclination of the cone, Total thrust, Cone Resistance, Sleeve friction, Pore pressure, dissipation test results, P- and S-velocities for SCPT.
Calculated data	The friction ration (ratio of sleeve friction to cone resistance), Total cone resistance corrected for pore pressure effects, Pore pressure ratio (ratio of excess pore pressure to cone resistance)
Remarks	-

5.6 Boreholes Overview

A CSV file with the following data columns must be delivered:

Start date and time	YYYY-MM-DD, HH:MM
Finish date and time	YYYY-MM-DD, HH:MM
Borehole No.	Unique number
Easting, Northing	Coordinates of borehole, meters
Elevation	Elevation of seabed
Depth	Drilling depth, meters
Drilling method	Rotary, percussion, core, drill fluid, etc.
Reason for stop	Target depth, boulder, etc.
Remarks	-

5.7 Boreholes Samples

A CSV file with the following data columns must be delivered:

Borehole No.	Unique number
Sample No.	Unique number
Sample type	Intact, disturbed, core, etc.
Sample depth	Depth below seabed, meters
Sample description	Geological description, including environment and age
Laboratory tests	Classification tests, chemical tests, special laboratory tests
Remarks	-

5.8 P-S Logging

A CSV file with the following data columns must be delivered:

Borehole No.	Unique number
Elevation	Elevation of seabed
P-S Logging depth	Depth below seabed, meters
Measured data	P- and S-velocities
Remarks	-

5.9 Dissipation tests

A CSV file with the following data columns must be delivered:

CPT No.	Unique number
Elevation	Elevation of seabed
Measured data	Depth, Pore pressure, Time
Remarks	-

5.10 Sample photos

Photos of samples must be provided as image files organized in a logical file folder structure.

File format, resolution and file folder structure shall be proposed by the Consultant and approved by the Client.

Enclosure 3 – HSE requirements

Excluded.

Enclosure 4 – Quality requirements

Excluded.