

APPENDIX 2.2 – ROUTE SURVEY SPECIFICATION

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1. SCOPE

1.1 Objectives

The Contractor shall conduct a survey, including but not limited to measurement, study and investigation of the bathymetry, seabed features and shallow geology along the tentative route of the Submarine Cable ("**Survey**").

The principal objective of the Survey is for the Contractor to recommend the best possible, i.e. suitable, safe and economic, route for the Submarine Cables, including landing punch-out positions, within the defined Segments in respect of bathymetry, seabed features, marine installations and objects, fishing activities and other environmental aspects.

Contractor shall perform all necessary data acquisition as requested by the Purchaser Representative until an acceptable route is found.

As the cable will be buried, this Survey shall provide comprehensive information on seabed conditions in order to enable decisions to be made concerning the appropriate methods of protection of the cable, i.e. burial and/or additional armouring, and to minimise risk of damage to the installation plant.

This Survey shall provide information useable for engineering, installation and subsequent maintenance of the future Submarine Cables.

The Survey shall also indicate if the cable route is passing through ecologically sensitive areas or impose an impact on the environment and marine biodiversity, for example cold water corals.

At the conclusion of the Survey the Contractor shall deliver the Survey Results to the Purchaser, including Survey Data, Survey Charts and the Survey Report as further set out in Appendix 2.3 (Requirements to Survey Results).

1.2 Segments

The following cable route shall be surveyed:

- Qaqortoq – Ilulissat including branches to Nuuk and Aasiaat.

The cable route is divided into the following segments ("**Segments**"):

- Tusass Connect Segment 1 – QAQ – AAS
 - Tusass Connect Segment 1.A – AAS BMH – BU AAS
 - Subsegment 1.A.1 – Alternative route via Manitsoq Island
 - Subsegment 1.A.1.1 – Alternative landing point on Manitsoq Island.
 - Subsegment 1.A.2 – Alt. route via Manitsoq Island.
 - Subsegment 1.A.3 – Michaels alt.
 - Subsegment 1.A.4 – Interlink to GCN
 - Subsegment 1.A.4.1 – Alt. link to GCN
 - Tusass Connect Segment 1.B – BU AAS – BU QAQ
 - Tusass Connect Segment 1.C – QAQ BMH – BU QAQ

- [Subsegment 1.C.1 – Alternative landing point in QAQ](#)
- [Subsegment 1.C.2 – Second Alternative landing point at QAQ](#)
- Tusass Connect Segment 2 – ILU BMH – BU ILU
- Tusass Connect Segment 3 – Nuuk BMH – BU Nuuk
- Tusass Connect Segment 6 – PAA BMH – BU PAA (Optional)
 - Subsegment 6.1 – Alternative landing point in PAA (Optional)
- Tusass Connect Segments 4A and 5A – Towards Uumanaq and Upernavik (Optional)
- Tusass Connect Segments 4A and 5A – Towards Uumanaq and Upernavik (Alt) (Optional)

The branch to Paamiut in Segment 6, Segments 4A and 5A, and Segment 4A and 5A (Alt) are optional and could be included in the Survey, if decided by Purchaser.

The Segments to be surveyed include 9 landings:

- Qaqortoq (QAQ) – 2 landings (a preferred and a secondary)
- Paamiut (PAA) – 2 landings (a preferred and a secondary) (Optional)
- Maniitsoq Island North (MANIN) – 1 landing
- Maniitsoq Island South (MANIS) – 2 landings (a preferred and a secondary)
- Aasiaat (AAS) – 1 landing
- Ilulissat (ILU) – 1 landing

All landings will be protected by use of directional drilling (adapted HDD) from beach to a water depth between 10 and 250 meters depending on the location. Contractor shall confirm the suitability of the landing punch-out positions as provided by Purchaser, or in case these are unfit, recommend the best possible landing punch-out positions.

The Route Positions of the Segments, the landing punch-out positions, positions of branching units, and other positions relevant for the Survey is set out in Appendix 2.1 (Route Position Lists).

Contractor shall confirm or amend this tentative cable route such that the objectives are met.

As the principal objective of the Survey is to find a suitable route for burial of the Submarine Cable, the Survey route cannot be precisely predetermined. It is to be expected that there will be some variation between the Route Positions given in Appendix 2.1 (Route Position Lists) and the co-ordinates of the route to be surveyed by the Contractor due to route development as information on seabed conditions is acquired.

1.3 Variations

The Purchaser reserves the right by judgement of the Purchaser Representative during the Survey to change the scope of Work in accordance with the Master Terms. Such changes may extend or reduce the total amount of Work to be carried out during the Survey.

1.4 Survey Specifications

This document addresses the minimum requirements and minimum acceptable standards for conducting the Survey, including but not limited to the method and procedures, Equipment, Vessel, personnel, Contractor's Staff, operation and mobilisation (the "**Survey Specifications**").

1.5 Survey Area

The Survey Area covers the tentative submarine cable route linking Qaqortoq in Southern Greenland with Ilulissat in Northern Greenland including branches to Paamiut, Nuuk and Aasiaat as set out in Appendix 2.1 (Route Position Lists) ("**Survey Area**").

1.6 Planning

Contractor's planning of the general logistics of the Survey shall be carried out in the following order:

- Planning and preparations including application and permit procedures are carried out instantly after signing the Agreement.
- Establishing of survey programme and procedures in co-operation with Purchaser.
- Finalizing logistic plans to fit the time schedule
- Establishing a work plan for the entire Survey and a project specific Quality Plan.

1.7 Contractor's general responsibilities

The Contractor shall be responsible for successfully fulfilling the Survey objectives and all associated aspects of Survey operations itemised in this document.

The Contractor shall be solely responsible for providing all Equipment, charts, Staff, and any other items required for successful data acquisition. Staff, sufficient replacement parts for Equipment, and spare Equipment during the Survey shall be the Contractor's responsibility.

It is emphasized that completion of all Works, including delivery of the Survey Results, in accordance with the critical milestones as set out by Purchaser and incorporated by Contractor in Appendix 3.1 (Survey Plan of Work) is considered of essence for Purchaser.

Where additional requirements of Survey operations are not specified, the Contractor shall perform the duties in accordance with Good Industry Practice and in the most efficient and economical manner possible.

The Contractor shall be solely responsible for obtaining all necessary approvals and permissions for all Equipment, procedures and Staff to fulfil this Specification.

The requirements for obtaining consents, operational permissions and operational notifications for all operations carried out during the Survey shall be the responsibility of the Contractor except if explicitly stated otherwise.

2. PURCHASER'S DELIVERABLES

2.1 As part of the Contract, Purchaser has provided the following information:

- (a) Route Positions of the Segments, purchaser's tentative punch-out positions, and information on all known cable crossings in Appendix 2.1 (Route Position Lists)

2.2 Purchaser will provide the following information and deliverables:

- (a) Prior studies of landing sites and punch-out positions.
- (b) Available information of all known cables in use and out of use which affect the routes
- (c) other supporting information outlining the Purchaser's target cable performance requirements;
- (d) Purchaser will apply for a national survey permit.
- (e) Advising local authorities prior to Contractor entering into site and when the Survey is completed.
- (f) Ice-pilot, if requested by Contractor or deemed necessary by Purchaser.
- (g) Guard Vessel, if requested by Contractor or deemed necessary by Purchaser.

3. QUALITY ASSURANCE

3.1 Quality Plan

The Contractor's quality systems shall be based upon or conform to ISO 9001:2015.

The Contractor shall provide a Quality Plan for all the operations described in this Survey Specification for the Purchaser's approval 2 weeks prior to commencement of the marine operations ("**Quality Plan**"). The Quality Plan shall include:

- outlines of all standard procedures for all the operations specified.
- details of the proposed management structure during all operations and the responsibilities of all the Contractor's Staff.

All of the Contractor's Equipment, procedures and Contractor's Staff shall be approved by the Purchaser prior to the commencement of the Survey, and the actual work will be witnessed by the Purchaser Representative.

The Quality Plan and all other survey quality system documents shall be available onboard the Vessel.

3.2 Calibrations and QA/QC procedures

Contractor shall propose a comprehensive Acceptance Test which shall document the proper function of all Equipment, including but not limited to resolution, accuracy and operating functions.

Project specific items shall be addressed in the project manual, which shall be an integrated part of the QA system.

The Survey procedures shall guarantee that all collected data are QA/QC checked and that data processing and evaluation is conducted in accordance with Good Industry Practice.

4. REQUIREMENTS TO THE SURVEY

4.1 General

4.1.1 Method

Purchaser propose the following method for the Survey, carried out in the following order:

- (a) For the entire route, i.e. all Segments, Contractor shall carry out 2 swathe bathymetry runs using multibeam echosounder.
- (b) For parts of the Segments with less than 1600 meter water depth the Contractor shall carry out:
 - (i) 3 survey lines using side-scan sonar and sub-bottom profiler and multibeam echosounder.
 - (ii) 1 final line using sub-bottom profiler and multibeam echosounder of the selected cable route as determined based on the previous lines.
 - (iii) 1 seabed sample for each 10 km of the selected cable route as determined based on the previous lines.

~~The centre line of the tentative cable route shall be run using multibeam echosounder in its entirety in order to give an initial assessment of the suitability of the tentative route.~~ The assessment of data as it is acquired may require deviations from the tentative route given in Appendix 2.1 (Route Position Lists). This assessment will be performed by the Purchaser Representative onboard the Vessel in cooperation with Contractor. The Purchaser Representative's decision shall be final.

The number of runs may be reduced in areas where prior runs has given sufficient information. This decision shall be made by the Purchaser Representative.

4.1.2 Alternative proposals

Contractor may offer alternative proposals for conducting any or all aspects of the Survey. It shall be clearly stated if any part of the Contractor's work description in Appendix 3.2 (Contractor's Survey Description) constitutes a deviation from the requirements in these Survey Specifications.

4.1.3 24/7 operation

The Survey shall be performed as a 24/7 operation.

4.1.4 Characterization of the route

The seabed and sub-bottom conditions along the Segments are characterized by abrupt topographic variations and alternating areas with exposed bedrock and large sedimentary infills. Mud, sand, gravelly sand and sandy gravel, in roughly equal amounts, are the main sediment types. A few small areas of gravel are present, while there are also a number of areas of rock pavement.

4.1.5 Information on slopes

Information on slopes greater than 5° and their direction shall be made available during the Survey to aid route development. Such slope calculations shall be based on cell sizes of 10 meters.

4.1.6 Minimum swathe width

The minimum swathe width shall be three times the water depth. The Contractor shall indicate in Appendix 3.2 (Contractor's Survey Description) the swathe width in function of the actual water depth.

4.1.7 Field charts

The Purchaser requires the production of field charts depicting all data acquired at 24-hour intervals to allow route development.

Geologic conditions of the seafloor such as faults, landslides, mud, volcanoes, gas pockmarks, dramatic topographies and slopes greater than 5° are to be shown on the charts.

4.2 Parts of the Survey

The Survey shall be considered in the following distinct parts for each Segment in Appendix 2.1 (Route Position Lists):

- Deep Water Survey
- Shallow Water Survey
 - Landing Punch Out Survey
 - Near Shore Survey
 - Cable detection Survey (optional)
 - ROV-inspection of two existing cables near Segment 2 (optional)

Overlaps are required between different parts of the Surveys in case adjacent sections of a Segment or 2 adjacent Segments are surveyed at different times. These overlaps shall be:

- 1000 meters between the Shallow Water Survey and Deep Water Survey,
- 500 meters for Shallow Water Survey.

4.3 Deep Water Survey

Contractor shall carry out 2 swathe bathymetry runs using multibeam echosounder.

4.3.1 Survey Corridor

For the Deep Water Survey, i.e. parts of the Survey with water depths deeper than 1600 meters, the width of the surveyed corridor shall be 3 times the water depth up to a maximum of 10 km.

For positions where branching units are planned to be installed, cf. Appendix 2.1 (Route Position Lists) the survey corridor shall be extended to a minimum of 10 km wide on all three legs.

4.4 Shallow Water Survey

4.4.1 Methods

The Work during the Shallow Water Survey shall be focused on collecting complete bathymetry and geophysical data sets for evaluation and finding the most suitable final cable route within the entire 1000m corridor. Special attention shall be paid to seabed features with irregular outline as boulders or outcropping bedrock. The cable corridor shall be chosen to yield the maximum amount of trenchable seabed conditions as well as passages with minimal slope angles. Areas with potential risk for mud flows and turbidity currents in the sub-marine canyons are a potential cable hazard. These areas shall be mapped and evaluated in detail and circumvented to the greatest extent possible.

Additional survey lines to extend the corridor shall be carried out if deemed necessary by Purchaser Representative in order to ensure that sufficient seabed has been surveyed to allow a safe and practicable route to be engineered. All extra work shall be agreed with or instructed by the Purchaser Representative, whose decision shall be final. Overlapping data shall be collected to obtain survey results of adequate resolution in the cable corridor for selection of the optimal cable routes.

The processing and interpretation of results shall be concentrated on illustrating the conditions in the cable corridor.

Based on the evaluation of the collected data sets one final cable route is determined to avoid possible hindrances and obstacles and ensure the most suitable conditions for cable laying. This selected cable route will then be surveyed using sub-bottom profiler, [swathe bathymetry](#) and seabed sampling for each 10 km to determine the cable trenching conditions.

4.4.2 Swathe bathymetry survey

The Contractor shall carry out a swathe bathymetry survey with all soundings and subsequent contours reduced to lowest astronomical tide LAT by prediction. Prediction may not suffice to achieve required data accuracy for swathe bathymetry at depths less than 500 meter. Contractor shall propose a suitable real time tide monitoring or other relevant vertical reference for swathe data reduction to LAT.

During the Survey any changes to swathe bathymetry survey shall be mutually agreed between the Contractor and the Purchaser.

The multibeam echosounder measurements shall produce bathymetry data and also backscatter/reflectivity measurements of the seabed. The backscatter/reflectivity measurements shall in combination with side-scan sonar data be used by Contractor to enhance the evaluation of seabed characteristics and properties.

Contractor shall perform sound velocity profiles at intervals sufficient to ensure uniform data quality.

4.4.3 Side-scan sonar survey

For parts of the Segments with a water depth of less than 1600 m, Contractor shall, except where otherwise stated in Appendix 2.1 (Route Position Lists), carry out full side-scan sonar survey using sea floor mapping to locate and identify all seabed features of 1 m³ or smaller, including both natural and artificial seabed features.

The line spacing shall be sufficient to yield adequate overlap of parallel side-scan tracks to ensure sufficient coverage of the survey corridor with high-resolution bathymetry and seabed classification data.

For obstacle detection and geological interpretation of the seafloor a scan system with dual frequency and digital logging and display system shall be utilised.

The Contractor shall propose a procedure for side-scan surveying with the purpose to achieve optimal images of the seabed topography.

4.4.4 Sub-bottom profiling

The Contractor shall carry out comprehensive sub-bottom profiling with adequate resolution to determine the thickness of the surficial sediments in the top 5 metres of the seabed stratigraphy of the final selected cable route as determined based on the previous survey lines.

4.4.5 Segments excluded from side-scan and sub-bottom survey

Purchaser does not require side-scan sonar survey and sub-bottom profiling of following Segments:

- the entire Segment 2; and
- Subsegments, 1.A.1, 1.A.1.1, 1.A.2, 1.A.4, 1.A.4.1.

If, during the Works, it turns out that side-scan sonar survey and/or sub-bottom profiling of parts of the abovementioned Segment and subsegments is necessary, Contractor shall carry out such Works as additional work as instructed by and at the discretion of Purchaser Representative.

4.4.6 Navigational Accuracy

The Contractor shall use an accurate and repeatable navigation system to give a minimum horizontal positioning accuracy of ± 5 metres at all times which shall be improved upon where practicable.

4.4.7 Survey Corridor

The Survey corridor shall be 3 times the water depth, however, as a minimum the Contractor shall, except where impossible due to the nature of the route, e.g. when surveying in an archipelago, identify and survey a 1 km useable corridor centred on the prime route in order to determine the position and status of any pipelines, cables, obstructions, wrecks and potential obstructions.

For positions where branching units are planned to be installed the Survey corridor shall be extended to a minimum of 2 km on all three legs and centred around the selected position of the branching unit.

4.4.8 Seabed Samples

In order to determine the possibilities of burial of the submarine cable into the seabed the evaluation of its shear strength shall be evaluated based on the results from the sub-bottom profiler.

This evaluation shall be confirmed by seabed samples, preferably using drop core of minimum 3 m length.

The main goal for the seabed sampling is to support and enhance the geophysical evaluations and facilitate the interpretation of trenching possibilities.

In areas of less than 1600 meters water depth, seabed samples using drop core or equivalent shall be carried out by Contractor as necessary to confirm the data interpretations of the sediments. The exact number and location of the samples shall be agreed with the Purchaser Representative, whose decision shall be final. For planning purpose Contractor shall include one sampling position for each 10 km route.

Simple onboard analysis of the samples shall be carried out by Contractor, but this shall not include analysis such as grain size distribution, shear strength, etc.

If the data from the sub-bottom profiler clearly indicates that burial to the expected depth is possible, single seabed sample positions will be omitted if agreed to or instructed by the Purchaser Representative.

In case no sample is recovered when using drop core, the process shall be repeated two times. If these attempts are not successful, the sampling for this position shall be called off, and the seabed shall be determined as hard.

Contractor shall suggest a feasible sampling method in any seabed type/condition along the route.

Purchaser requests Contractor to consider and propose additional methods for data acquisition such as SVP probing, video of seabed, method and equipment of determining currents or other using the bottom sampling equipment as a vehicle.

4.4.9 Event Marks

All geophysical equipment run simultaneously shall have common event marks which shall be annotated in all records.~~All geophysical equipment shall be run simultaneously, and common event marks shall be annotated on all records.~~

4.4.10 Geophysics

Seafloor conditions:

- Backscatter information from the multibeam echosounder shall be used for seafloor analysis.
- The side-scan sonar images shall be used for mapping the seafloor morphology and detection of obstacles. The side-scan sonar shall be used to detect and position obstacles and structures on the seafloor.

Sub-seabed conditions:

- The sub-bottom profiler shall be used for high resolution seismic profiling. This instrument shall be operated to focus on the uppermost 5 m stratigraphy.
- It is proposed to use the latest CHIRP technology or similar.
- Sub-bottom layers of possible hindrances for the cable installation should be assessed and mapped.
- Information from seabed sampling shall support and enhance the geophysical evaluations and facilitate the interpretation of trenching possibilities

4.4.11 Landing Punch-Out Survey and Near Shore Survey

These parts of the Shallow Water Survey shall be carried out by use of multibeam echo sounding only along the coast line and in the full width of the survey corridor between the punch-out position as confirmed or recommended and to water depths of 15 m (LAT).

The objectives of the landing punch-out and near shore surveys are (i) to confirm the tentative punch-out positions as provided by Purchaser for the directional drillings or recommend the best possible punch-out positions based on the seabed conditions (ii) to

survey the route from the punch-out positions as confirmed or recommended to as close to shore as safe operation of the Vessel allows.

Special attention shall be paid to slopes, direction and inclination of the slopes, submarine canyons, obstacles and other seabed and sub-bottom conditions which can affect the directional drilling of the cable landing.

~~The Contractor shall provide detailed seabed information in the vicinity of the punch-out positions. Special attention shall be paid to slopes and obstacles in order to determine if the tentative punch-out position can be determined or if the Contractor shall recommend a more suitable punch-out position.~~

~~The Contractor shall provide detailed seabed information of the route between the punch-out position, as confirmed or recommended, and the starting positions of the directional drilling. Special attention shall be paid to submarine canyons, obstacles and other seabed and sub-bottom conditions which can affect the directional drilling of the cable landing.~~

~~These parts of the Shallow Water Survey shall be carried out between the punch-out positions to as close to shore as safe operation of the Vessel allows.~~

4.4.12 Cable Detection Survey and ROV-inspection (optional)

Contractor can offer to perform cable detection survey using e.g. magnetometer, cable tracker or other equipment with the objective to locate the position and burial depth of known cables.

Contractor can also offer to perform ROV-inspection of two existing cables near Segment 2.

The above services shall be optional for Purchaser.

5. SURVEY VESSEL

5.1 Vessel used by Contractor

Contractor shall provide in Appendix 3.3 (Vessel used by Contractor) the details of the Vessel as required in this section 5.

Purchaser is open to Contractor using more than one Vessel to perform the Works during the Survey. In case more Vessels are used, Contractor shall provide the details of such Vessels in separate appendices to the Contract which shall then be named Appendix 3.3.A, Appendix 3.3.B and so on and so forth.

5.2 General

The Vessel shall be able to manoeuvre in shallow waters, i.e. down to water depths of 15 m. The Vessel shall be able to remain ~~but never closer to shore lines than safe operation of the Vessel allows, as well as~~ in open sea for a minimum of 21 days.

The Contractor shall provide full details on the operating characteristics and capabilities on the Vessel. This description shall include, but not be limited to:

- Bridge navigation and vessel control equipment.
- Operating draught limits.
- Operational weather limitations.

- Cruising and survey speeds.
- Main propulsion unit and auxiliary equipment.
- Communications equipment available on board.
- Accommodation facilities available to the Purchaser Representatives.
- Flag, registry, tonnage and related particulars required for port entries.
- Laboratory space and stabilised 220V AC power supply available for charting, computer operations, and data reduction.

5.3 Operational Performance

The Contractor shall provide a seaworthy Vessel:

- capable of continuous 24 hour a day survey operation;
- capable of performing the specified operations, including the safe deployment and recovery of towed fish and other over side equipment, in the weather and sea conditions to be expected in the survey area;
- sufficiently manoeuvrable to maintain a steady course and speed appropriate for the Work; and
- capable of remaining at sea for long periods of time under the weather conditions normally expected in the Survey Area and for a minimum duration of 21 days in open sea.

5.4 Classification and manning

The Vessel shall be classified and manned for work in the Survey Area.

5.5 Fitness for Purpose Statement

The Contractor shall provide written evidence that the component parts of the Survey Spread, including sea fastenings to the Vessel, have been approved by an independent competent person or vessel classification society, as fit for the intended use in the environmental conditions anticipated, insofar as the seaworthiness of the Vessel, the safety of personnel and the installation of survey and inspection Equipment is concerned.

Items which are identified by the competent person or classification society surveyor as being unfit for the intended use, or otherwise not accepted or approved by the Purchaser Representative, are not to be used for any purpose whatsoever during the work and are to be immobilised and/or clearly labelled or marked accordingly.

5.6 Working Environment

The navigation, survey and towed fish control areas shall each have sufficient space for all personnel and Equipment. These areas shall be designated "No Smoking Zones" and signs should be displayed to that effect.

5.7 Equipment Deployment Area

Sufficient deck space shall be available for the safe conduct of all deck activities, including the deployment and recovery of over-side Equipment. In general, there should always be sufficient space around the Equipment for safe access by personnel together with ready access to safe refuges in the event of hazardous situations developing.

All load-bearing items shall be subject to verification as to their fitness for purpose in accordance with Section 5.5 (Fitness for Purpose Statement).

5.8 Radio, Telephone and Data Communications

The Vessel shall be equipped with radio equipment for communicating with the local shore radio stations, harbour authorities, coast guards and other vessels. The radio equipment outfit shall include marine VHF. As the Survey Area extends out of good reception range of such equipment, satellite communication equipment shall be available.

The Purchaser Representative shall have access to all communications facilities at any time throughout the Survey, including a suitable internet-connection. Communication shall be provided free of charge and access to external communication facilities shall be available at all reasonable times.

5.9 Internal Communications

There shall be a communications system providing a basic level of communications between the bridge and all working areas. The communications system shall be available both safety and operational purposes. This may be achieved by portable VHF equipment.

5.10 Accommodation and Victualling

The Vessel shall be able to accommodate the requisite number of personnel. Single berth cabins shall be available for a maximum of two Purchaser Representatives which shall be of similar standard to that provided for the Vessel's senior officers.

In case an Ice-pilot is requested by Contractor or deemed necessary by Purchaser, a single berth cabin shall be available for the Ice-pilot which shall be of similar standard to that provided for the Vessel's senior officers.

Meal arrangements shall reflect the shift working pattern. There shall be sufficient catering staff to meet this requirement, ensuring the galley is properly manned for the preparation and serving of all meals.

5.11 Facilities for Purchaser Representative

In addition to any accommodation requirements, sufficient space shall be available for the Purchaser Representative to monitor all Survey activities, preferably from a seated position at a desk with space for an "A4" notebook and laptop computer. A stabilised 220-240 volts AC power supply shall be available for Purchaser Representative's computer at a convenient location.

5.12 Electrical Power Supply

A stabilised power supply shall be provided for all survey, positioning and computer Equipment and this shall be independent of the Vessel's own power supply.

5.13 Work Boat

If a work boat is provided for any purpose, it shall only be handled by qualified personnel.

Whenever it is in use, the boat shall be equipped with spare fuel, a basic tool kit, essential spares, a radar reflector, a portable radio, potable water, distress flares and a first aid kit.

5.14 Rubbish Disposal

The Vessel shall be provided with adequate facilities for the storage or disposal of rubbish in compliance with statutory pollution regulations in Greenland.

5.15 First Aid

The Vessel shall have a first aid kit in accordance with current legislation.

5.16 Critical Weather Conditions

The proposal shall to the greatest extent possible specify the specific wind, weather and sea conditions that would force curtailment of the Survey operations. The Beaufort wind scale and sea state codes shall be used for fulfilling this requirement.

6. CONTRACTOR'S STAFF

The Contractor shall provide a CV of each key-person proposed for the Work which shall include:

- professional qualifications;
- previous experience with the equipment to be used; and
- a brief career history.

On the date of signing the Agreement, the Project Manager and Party Chief are to be named. The Project Manager and Party Chief shall be available for discussions with the Purchaser before mobilisation.

The Purchaser reserves the right to reject, or have replaced, any person in Contractor's Staff offered.

The Contractor shall appoint a senior representative during all operations within the scope of this Section who shall either personally or by delegation be in overall charge of the Contractor's Staff and shall be available at all times when Work is in progress.

6.1.1 Qualifications and Experience

Contractor's Staff appointed to the Work shall comply with the experience requirements stipulated below:

| Position | Minimum experience |
|---------------------------------------|--|
| Party Chief | Three years experience of the type of operations being undertaken as either Senior Surveyor or Senior Geophysicist |
| Surveyor | Three years experience of the type of survey operations being undertaken |
| Geophysicist | Three years experience |
| Electronics and Instrument Technician | Three years experience |

Purchaser excepts that the position of Party Chief will be filled by either a surveyor or a geophysicist.

One member of Contractor's Staff in the survey team shall be fully trained in all aspects of the core sampling and testing operations.

The necessity of trainee personnel in the field is recognised and the inclusion of such personnel is encouraged, provided the position and tasks of each trainee is covered by another person, who is qualified and has the relevant experience. Recognising that this policy may be difficult to implement on operations such as these, the requirements of the Survey are paramount.

For the avoidance of doubt, the Party Chief shall be the Contractor Representative onboard the Vessel.

6.1.2 Medical Fitness

All personnel onboard the Vessel, shall have been medically examined and declared fit for offshore duties in accordance with the relevant IMO-regulations.

6.1.3 Safety Policy

No operation shall take place in such a manner as will or may lead to a dangerous situation in respect of life, property or the environment. All personnel have a responsibility for safety. In any situation, where there are reasonable grounds for believing that a hazardous situation exists or is developing, the matter shall be reported to the master or officer of the watch immediately. The Contractor's procedures shall stipulate which personnel have the authority to give orders to cease operations. The Purchaser Representative shall have such authority.

Any Survey operations close to sub-sea pipelines may be subject to work permit controls by the pipeline operator. No survey activities shall take place within 500 metres of any pipeline until any such requirements have been complied with. If the formal authorisation consists of a work permit document, this shall be returned to the issuing authority on completion of the work.

6.1.4 Protective Clothing

All personnel on the Vessel shall be individually equipped with protective clothing for work in arctic waters, including:

- safety helmet;
- safety boots;
- gloves;
- poly-cotton overall; and
- foul weather clothing.

All these items shall be fire-retardant.

Safety helmets and boots shall be worn at all times by personnel on deck.

When working with over side Equipment, survival suit shall additionally be worn.

Personnel involved in small boat operations shall, at all times, wear a survival suit.

7. SURVEY EQUIPMENT AND PROCEDURES

7.1 Survey Equipment

The Purchaser welcomes and encourages the use of the latest survey and positioning technology.

Contractor shall carry out the Survey using Equipment in accordance with the requirements as stated in these Survey Specifications.

7.1.1 Echosounding Equipment

Contractor shall use echosounding equipment capable of maintaining a continuous heave, roll and pitch corrected depth record with a minimum accuracy of 1% of water depth or better. This includes online depths data reduced online to LAT.

7.1.2 Side-Scan Sonar

The side-scan system shall be a dual frequency 100/500 kHz side-scan system capable of covering a 2x~~250+00~~ m wide corridor with fully integrated digital logging and visualization of detailed features in a sea floor mapping system. It is required that the system is cable of detecting and registering objects down to 1 m3 or smaller by use of optimal range setting, frequency settings, ping rate, survey speed, etc.

The system shall be operative down to a water depth of 2000m.

7.1.3 Sub-Bottom Profiling

Contractor shall use sub-bottom profiling Equipment with an adequate resolution to determine the thickness and composition of the surficial sediments in the top 5 meters of the seabed along the whole route.

Contractor shall use a sub-bottom profiling system utilizing a chirped signal working in the frequency range of 1-10 kHz is required.

The system shall be operative down to a water depth of 2000m.

7.1.4 Data Logging Package

All data acquisition shall be logged.

7.1.5 Gyro Compass

Contractor shall use a gyro compass. The gyro compass shall be interfaced to the main navigation computer. The gyro shall be set to True North and the accuracy shall be better than 0.1°. Latitude convergence shall be calculated by the main navigation computer and applied to hull mounted sensors, positioning antennas and towed fishes etc.

7.1.6 Seabed Sampling

It is preferred that Contractor uses drop core of minimum 3 m length for seabed sampling.

Purchaser requests Contractor to consider and propose additional methods for data acquisition such as SVP probing, video of seabed, method and equipment of determining currents or other using the bottom sampling equipment as a vehicle.

7.1.7 Multibeam Echosounder

Contractor shall use a multibeam echosounder system with accurate bathymetry for mapping the seafloor.

The multibeam echosounder shall have a high number of beams and be able to operate down to a water depth of 3500 m.

The multibeam echosounder shall be capable of output data to a grid to produce images of the seafloor with detail and accuracy.

Online processing of data shall account for the Vessel's heave roll and pitch at the time the bathymetric data was acquired.

The swathe bathymetry system shall have a real-time display capable of 50 metre depth resolution or better, and a bathymetric accuracy of 1% of water depth or better.

The multibeam echosounder shall be interfaced to a motion reference system with a resolution of 0.05° or better. Sound velocity profiles shall be recorded using a SVP equivalent to AML SVP16.

7.1.8 Navigational Equipment

The principal positioning equipment shall be Differential GPS.

The Contractor shall provide a suitable computer system and software with the capability of accepting and storing the multi-parameter Survey Data for real-time display, on board processing, and post survey processing.

The positioning accuracy shall be better than ± 5 m utilising differential corrections from satellite and/or radio transmission.

As backup a secondary positioning system utilizing an independent source for differential corrections shall fulfil the same specifications.

Differential corrections shall be updated at a rate not less than 0.1 Hz.

A Super Short Base Line underwater positioning system such as Simrad HPR or equivalent system shall be integrated in the navigation system. The range accuracy shall be better than 1% of the slant range and the angular resolution shall be better than 0.3°.

The system shall be applied to towed fish equipment and bottom sampling Equipment.

7.1.9 Interfacing of Equipment

The computer used for data recording shall be interfaced with the positioning equipment, digital depth recordings, a real time clock and with the gyro compass. A complete time-correlated record of all navigation and survey data acquired shall be maintained throughout the Survey using automatic data logging equipment.

Data acquired during the Survey shall be backed-up as set out in Appendix 3.4 (Contractor's Information on Security Measures)

7.2 Procedures and Dockside Test

All of the Contractor's Equipment, procedures and Contractor's Staff shall be approved by the Purchaser prior to the commencement of the Survey. The actual survey work will be witnessed by the Purchaser Representative.

The Contractor shall utilise surveying Equipment and systems in accordance with Good Industry Practice and shall ensure that no ambiguity will occur in the position of the Vessel, fix points or features to be surveyed and logged.

Prior to completion of Mobilisation, the Contractor shall perform a dockside Acceptance Test on each component of the complete Survey Spread to ensure proper working order.

Contractor shall propose a procedure to document correct function of the HPR system.

The Contractor shall be responsible for all system calibration and re-calibration, including calibration of spare equipment.

7.3 Daily Reporting and Meetings

7.3.1 Daily Reports

The Contractor shall submit to the Purchaser a daily written report ("**Daily Report**") during the operations described in this Survey Specification. The content of the Daily Report shall include:

- Geographical position of the Vessel at the time of the report
- An overview chart showing completed and non-completed sections.
- Summary of the Work performed during the preceding 24 hours,
- Summary of planned Work for the next 24 hours.
- Time spent on effective Work during each 24-hour period and cumulative total.
- Weather downtime during each 24-hour period and the cumulative total.
- Technical Downtime during each 24-hour period and the cumulative total.
- Fishing and shipping activities observed. ~~This shall include vessels at anchor and on passage.~~
- Any other offshore activities observed, including dredging, dumping, drilling, construction, etc.
- Endorsement of the report by the Purchaser Representative.
- Summary of section of the route surveyed.
- Summary of the daily meeting, including decisions made during the meeting.

The Daily Report shall be signed by the Contractor Representative, ships master and co-signed by the Purchaser Representatives.

The exact content and distribution of the Daily Reports will be instructed by the Purchaser.

A daily log sheet (DPR) shall be delivered to the Purchaser Representative. The information in this sheet shall contain a detailed description of the Survey events from the passed 24 hours.

The sheet shall also contain information about the surveyed route conditions (detected hindrances).

7.3.2 Daily Meeting

A daily meeting shall be held every day at 10:00 local time, where the results obtained during the previous 24 hours Survey operations are presented and discussed. The results shall be presented on preliminary charts printed in scale 1:10.000 on format A0 paper.

The Purchaser Representative has the right to reject the results and demand rework of the section in question.

In order not to interrupt an ongoing critical operation the Purchaser Representative and the Contractor Representative can agree to postpone the meeting to a convenient time later on the same day.

Daily progress shall be reported along with any problems or anticipated problems as they come to the attention of the Contractor.

8. EQUIPMENT OPERATION AND MOBILISATION

8.1 Spares

The Contractor shall ensure that adequate spare parts, components and qualified maintenance technicians are available throughout the Survey in order to keep Technical Downtime to a minimum. For the avoidance of doubt Technical Downtime is at the risk and cost of the Contractor. No extension of time for completion shall be granted for delay due to Technical Downtime.

The Contractor shall have a sufficient amount of critical spares such as sonar fish, spare tow cable or the like available either on board the Vessel or in port in Greenland.

All spare Equipment to be carried shall be itemised and the Contractor shall arrange an audit of the stated spares prior to the dockside Acceptance Test.

8.2 Mobilisation and De-mobilisation

Mobilisation shall be deemed completed after the Vessel has arrived on site, as designated by the Purchaser, and all Acceptance Tests have been completed.

De-mobilisation shall be deemed to commence on the completion of data acquisition as determined by the Purchaser Representative.

8.3 Acceptance Documentation

The Purchaser shall accept the Survey Spread prior to the commencement of the Survey. To enable the Purchaser Representative to formally accept the Survey Spread, the following shall be provided:

- The "Fitness for Purpose Statement" as specified in section 5.5
- Documentation demonstrating satisfactory completion of all Acceptance Tests.
- Copies of all Equipment calibration data.
- Copies of medical certificates and survival course certificates of all Contractors' Staff.

Previous calibrations will be acceptable providing the Contractor provides sufficient evidence that such calibrations will remain valid for the duration of the Survey for the Purchaser.

Certification shall be provided to the Purchaser prior to the actual mobilisation, including but not limited to documentation on Contractor's Staff and Equipment calibration certificates.