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KLM Technology Group #03-12 Block Aronia, Jalan Sri Perkasa 2 Taman Tampoi Utama 81200 Johor Bahru Malaysia	FUNCTIONAL SPECIFICATION FOR SUBMARINE PIPELINE (PROJECT STANDARDS AND SPECIFICATIONS)	

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SCOPE

This Project Standard and Specification describes the technical requirements for the performance of all operations and incidental works related to pre- engineering or pre-construction and post-construction surveys of the submarine pipeline to be laid.

This Project Standard and Specification is not intended to be all inclusive and the use of the guidelines set forth does not relieve the Contractor of his responsibility to collect and furnish survey data capable of providing the requirement inputs for planning, designs, engineering and application.

PREPARATION FOR THE SURVEY WORK

Prior to the beginning of the survey work, responsible for the management and execution of the entire job, shall plan the complete work with the Company/Company's Representative.

A procedural document indicating as a minimum the following shall then be prepared:

- Proposed equipment including vessels with all requisite details
- Sequence/location of profiles
Geodetic controls and horizontal control of survey
- Location of soil samples etc.
- Instrument calibration procedures
- Survey Schedule

Contractor shall ensure incorporation of all Company's comments before submission of final survey.

Schedule

Daily work sheets indicating the length of profiles, type of equipment and/or sampling operations shall be maintained. These records shall be included in the final report submitted to the Company.

Preliminary interpretation of the side-scan, sub-bottom profiler and echo sounder records shall be performed on board to delineate the existing pipeline, and to assess the acceptability of each of the pipeline routes. No delays will be accepted for this reason, as this preliminary interpretation should be performed almost simultaneously with the recording and completed within 24 hours after completion of the surveys.

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The Company shall have the option to designate its engineer(s) to supervise the data collection and interpretation on board. The vessel shall have suitable accommodation for at least 3 Company's Representatives.

POSITIONING SYSTEM AND COMMUNICATION

The Contractor shall install a horizontal positioning system capable of giving the location of the ship with less than 2-meter error. This system shall be able to work continuously 24 hours per day. Vessels shall have a permanent link with the Company's shore base, by means of radio network, to inform the progress of the work at any time. This system shall not cause interference with the above positioning system. Radio communication describing daily work shall be established periodically minimum once every day with the Company's Base.

The layout and UTM/geographical (Everest 1830) co-ordinates of the pipeline terminal points are given in the referenced drawings. Accurate positioning of pipeline terminal points shall be the Contractor's Responsibility.

MARINE SURVEY

The marine survey includes all operations required to obtain the bathymetry, morphology of the sea bottom and shallow geology as described herein.

All works required to install and operate the survey ship positioning system are also included. The width of the corridors to be investigated shall be 700 m which shall comprise new pipeline to be installed and existing pipelines, if any. The survey area includes the platform area from where the pipelines originate/terminate and a corridor along the pipeline routes. The platform area and the pipeline route should be investigated by means of 3 (three) longitudinal profiles run at 200 meter spacings with 700 m long transverse profiles run at a maximum of 500 meter intervals. Additional transverse profiles shall be run wherever necessary for clear delineation of existing pipeline.

At every pipeline crossing, two additional longitudinal profiles at 350 m on either side of the proposed pipeline shall be run for a distance of at least 200 m on either side of the existing pipeline, so that the existing pipeline elevation with respect to seabed is clearly indicated.

The Contractor shall simultaneously analyze the records on board. In case, obstructions are discovered on assigned routes, alternate routes should be selected in the field and survey profiles run/made for the alternate routes subject to Company's approval.

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Shallow Soil Sampling

Piston gravity corer (modified kullenberg) having 6 m barrel fitted with an interval PVC liner and a cutting shoe at the bottom shall be deployed for collecting soil samples. In case of sands, a core catcher shall be provided in side the shoe to assist retention of the sample during retrieval of the sampler. Alternatively a vibro-corer can be employed for collecting soil samples in granular soils.

Based on interpretation of shallow seismic profiles determined by the Contractor, the spacing between sample locations shall be such that different types of strata encountered along the route are covered. However, the spacing between two consecutive sample locations shall not exceed 1 km. Additional soil samples shall be collected at all envisaged pipeline crossing and other such pipeline features.

At location where sand with shale fragments/gravel is encountered and piston gravity corer refuses to penetrate the seafloor on repeated attempts, grab samples shall be collected if the Company Representative is satisfied that piston sample cannot be collected.

All samples shall be extruded in the field and carefully examined and visually classified on board the vessel. Samples shall be tested in the on-board laboratory for classification purposes and for broad assessment of strength. Representative samples shall be properly sealed and carefully packed for transportation to onshore laboratory for additional examination and testing. Testing facilities on board the vessel shall include, but not limited to, the following:

- Natural moisture content
- Dry and bulk density
- Torvane
- Motor vane
- Tricon (unconsolidated un-drained triaxial compression test).

Selected samples transported to onshore laboratory shall be tested to determine the following properties to supplement the information obtained in the field which together shall be used to determine soil parameters for pipeline design and installation:

- Carbonate content
- Specific gravity Grain size distribution
- Atterberg limits
- Indicative shear strength parameters of soils
- Coefficient of friction between pipeline and soils
- Liquefaction potential