

| Item | Report | IMPORTANT NOTE |
|-------------|--------------------------------|--|
| 3305 | Integrated 3D geological model | <p>This task has not pr. this date (2022-01-03) been assigned a supplier. The procurement has neither been initiated.</p> <p>Therefore, the following description of the task requirements is subject to change.</p> |

SCOPE OF SERVICES

| Project | | Energy islands | | | | | |
|-----------------------|-----------------|-----------------------------|------|-------------|------|-------------|------|
| Assignment | | Integrated Geological Model | | | | | |
| Document Title | | Scope of Services | | | | | |
| Document No. | | YY/NNNNN-MM | | | | | |
| Audience | | Tenderers, Consultant | | | | | |
| Version | Document status | Prepared by | | Reviewed by | | Approved by | |
| | | Name | Date | Name | Date | Name | Date |
| 1 | For tender | | | | | | |
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1. Introduction

DESCRIPTION AND DETAILS PENDING ...

The present assignment involve the provision of an *Integrated Geological Model* for the project based on the site investigations.

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2. Scope of Services

2.1 Purpose of assignment

The purpose of the assignment is to establish a Integrated Geological Model for the project to inform Tenderers, that are applying for the licence to develop and construct the OWF, about the geology, the associated geotechnical properties and potential geo-hazards.

The output of the assignment must be applied for

- Sub-selection of specific OWF area within the area of investigation.
- Initial determination of foundation concept and design.
- Assessment of the soil-related risks for installation of foundations.
- Initial planning of the layout for turbines.

These applications are relevant for both the license tender process and the subsequent development performed by the nominated developer.

2.2 Scope of Services

The Scope of Services is to deliver an Integrated Geological Model based on

- An existing ground model from a geophysical survey and
- Preliminary geotechnical investigations.

The Integrated Geological Model must cover the area of investigation as described in section 3.

The Integrated Geological Model must meet the requirements described in section 5.

The Scope of Services must include the following elements:

- Conceptual geological model.
- Spatial geological model.
- Geotechnical characterization of soil units.
- Soil province map

3. Area of investigation

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4. Site investigations

4.1 Geophysical survey 2021

DESCRIPTION AND DETAILS PENDING ...

The described survey data as well as other parts of the geophysical survey will be made available for the Consultant.

4.2 Geotechnical investigations 2022

DESCRIPTION AND DETAILS PENDING ...

The described geotechnical data as well as other parts of the data will be made available for the Consultant as soon as possible and very likely with the timing suggested by the schedule above.

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5. Requirements

The requirements specified in this section apply for the Consultants solution of the present assignment.

5.1 Main parts

The solution include the following main parts:

1. Provision of a conceptual geological model.
2. Provision of a 3D digital and spatial geological model.
3. Provision of a geotechnical characterization of the soil units of the spatial geological model.

5.2 General requirements

4. Items #1 to #3 (section 5.1) establish a description of the geology that is consistent in terms of definition and naming of soil units in terms of lithology, depositional environment and depositional age.
5. The following reference apply for the engineering geological descriptions: *A guide to engineering geological soil description*. G. Larsen et. al. DGF-Bulletin 1. Danish Geotechnical Society.
6. The vertical height system is Mean Sea Level (MSL) via the model DTU18MSL.
7. The coordinate system is ETRS89 UTM zone 32N or 33N.

5.3 Conceptual geological model

8. A conceptual geological model is provided based on a combined analysis and evaluation of the geophysical survey and the geotechnical investigations (see chapter 4).
9. The conceptual geological model is documented as schematic diagrams providing indicative and conceptual illustration of all soil units, their stratigraphic relationships and their variation.
10. The conceptual geological model is supported by a description of all soil units, their lithology and depositional age and environment. The description also include a summary of the regional geological history related to the area of investigation.

5.4 Spatial geological model

11. A 3D digital, spatial geological model is provided based on the geophysical survey and the geotechnical investigations (see chapter 4).
12. The spatial geological model integrates the geophysical and geotechnical results such that optimal consistency is achieved between the geotechnical results (boreholes and CPTs) and the geophysical results (interpreted layer interfaces). The model could potentially be represented by 3D visualisation such as Voxel modelling or other geometric modelling concepts.
13. The spatial geological model cover at least the area of investigation (chapter 3) and has a vertical range from the seabed surface and at least to 100m below seabed.
14. The spatial geological model has a spatial resolution of
 - a. 5m horizontally.
 - b. 0.4m vertically within the depth range 0m to 40m below seabed.
 - c. 1.0m vertically for depths larger than 40m below seabed.
15. In addition to item #4, the spatial geological model also cover geo-hazards, suchs as shallow gas formations, and structural elements such as fault or joints.
16. The documentation of the spatial geological model include
 - a. A description of the modelled soil units and their physical characteristica such as horizontal and vertical extension.
 - b. Representative seismic Imagery examples illustrating the identification of the soil unit horizons.
 - c. A description of the consistency between the model interfaces and the soil interfaces found in the geotechnical results (boreholes and CPTs) supported by example illustrations.

5.5 Geotechnical characterization

17. Geotechnical parameters are summarized for the soil units of the spatial geological model including typical values and variance based on the factual geotechnical report (see chapter 4.2).
18. The geotechnical parameters include classification properties, strength and deformation properties. The Geotechnical parameters should be documented by uncertainties, best estimates or variabilities.

5.6 Soil Province map

19. Calibrated geophysical horizons are used to map geotechnical provinces with similar geotechnical conditions.

5.7 Deliverables

20. All deliverables are provided on an external harddrive in a draft edition for Client review.
21. After Client review, the deliverables are revised by the Consultant based on the Client's comments. All deliverables are re-issued in a revised (final) edition and provided on an external harddrive (two identical copies) to the Client.
22. Language for all deliverables is English.
23. All reports and drawings are provided digitally as PDF files.

5.7.1 Integrated Geological Model Report

24. The report shall include at least the following:
 - a. Executive summary
 - b. Introduction with project summary and scope of services
 - c. Description of area of investigation
 - d. Applied geodetic systems – vertical and horizontal.
 - e. Method description
 - f. Presentation of conceptual geological model (include items #9 and #10)
 - g. Presentation of the spatial geological model (include item #16)
 - h. Images with 3D visualizations from the digital model workspace of key interfaces or key soil units
 - i. Presentation of geotechnical properties of model soil units (include items #17, #18 and #19)
 - j. Overview of drawings and digital deliverables

The Consultant may supplement the report content if deemed relevant.

5.7.2 Drawings

The Integrated Geological Model Report shall enclose at least the following drawings:

25. For all charts the Consultant propose content and layout for Client approval.
26. Overview chart with location plan with at least
 - a. Area of investigation
 - b. 2D UHRS lines and 3D UHRS cubes
 - c. Locations of geotechnical investigations
27. Elevation charts, all soil unit interfaces
28. Isochore charts (vertical layer thickness), all soil units
29. Shallow gas charts, top of horizons
30. Cross-section profiles, 10 to 15 profiles
 - a. Consultant propose profile locations for Client approval
 - b. Profiles provide spatial coverage of the area of investigation.
 - c. Profiles show soil units and geotechnical logs (boreholes and CPTs)

The Consultant may supplement the list if deemed relevant.

5.7.3 Digital deliverables

The Integrated Geological Model Report is supplemented with at least the following digital deliverables:

31. Kingdom project including the spatial geological model
32. All soil unit interfaces are provides as elevation grids in the digital formats ASCII XYZ and GeoTIF.
33. Shallow gas interfaces are provides as elevation grids in the digital formats ASCII XYZ and GeoTIF.
34. All soil units are provides as isochore grids (vertical layer thickness) in the digital formats ASCII XYZ and GeoTIF.

The Consultant may supplement the list if deemed relevant.

6. Time Schedule

DESCRIPTION AND DETAILS PENDING ...

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