

## 1. Metocean

General subject	Summarized question	Answer
Metocean Scope	We prefer the comprehensive scope as it gives the possibility of a more detailed loss analysis (Yield) and thus a lower uncertainty in the results.	Most bidders indicate that the default scope is sufficient; especially if on-site Lidar measurements are conducted We believe that the default option in combination with on-site Lidar measurements will deliver adequate data for the bidding process. Furthermore, most bidders prefer to do their own detailed assessment of both Wind Recourse and Oceanic conditions. The majority prefers access to data instead of the comprehensive scope.
Metocean Scope	It is preferred that detailed design level metocean and wind studies are provided. This will enable the most competitive tenders due to an increased level of accuracy in design and reduced additional conservatism.	Most bidders indicate that the default scope is sufficient; especially if on-site Lidar measurements are conducted We believe that the default option in combination with on-site Lidar measurements will deliver adequate data for the bidding process. Furthermore, most bidders prefer to do their own detailed assessment of both Wind Recourse and Oceanic conditions. The majority prefers access to data instead of the comprehensive scope.
Metocean general	The proposed workstream follows the Industry practice for obtaining Metocean conditions (in this area).	The proposed option is the Default option.
Metocean comment to proposed process	The default scope of delivery is concluded to be sufficient of our needs. We will assess these data further in-house.	No answer needed
Metocean comment to proposed process	The comprehensive scope is required to be able to submit an optimized bid. Otherwise all bidders would have to conduct the additional analyses in the bidding phase This is time-consuming and not optimal from a socio-economic point of view. In case the bidders must conduct the additional analyses it will be reflected in the bid price. We therefore recommend that DEA conduct the "Comprehensive Scope"	Most bidders indicate that the default scope is sufficient; especially if on-site Lidar measurements are conducted We believe that the default option in combination with on-site Lidar measurements will deliver adequate data for the bidding process. Furthermore, most bidders prefer to do their own detailed assessment of both Wind Recourse and Oceanic conditions. The majority prefers access to data instead of the comprehensive scope.
Metocean process	In terms of WRA perspective , default scope is sufficient	Choice between options (Default/Comprehensive) will be published
Metocean Wind Resource Assessment	We would prefer a WRA to be delivered additionally, for comparison purposes. However, most important is the approach outlined in the overall strategy, so that we can prepare the WRA / EYA on our own.	All Available data will be published and made available to the bidders
Metocean Comments to measurement data	1a) they are all either quite far away, or near-shore and thus affected by the continent. No, none of it should be left out, the more data the better. An on-site measurement would be of help, nonetheless (measured parallel to the data to be provided). 1b) is strongly appreciated	We will deploy Floating Lidars, possible with measurements for waves, currents and tide.
Metocean Request for measurement on-site	Advice on WRA: deployment of a floating Lidar on site to have one year of measurements before the bid. This will lead to a lower uncertainty than the use of onshore data or offshore data rather far from the Thor site.	We will deploy Floating Lidars, possible with measurements for waves, currents and tide.
Metocean Request for measurement on-site	Will there be a plan to put out a floating Lidar on site?	We will deploy Floating Lidars, possible with measurements for waves, currents and tide.
Metocean Comments to measurement data	Based on previous experience we expect high quality of the database to be delivered. Location specific associated wave and current data of particular interest.	All available data will be published together with information of location of measurement
Metocean Oceanic measurements	Not aware of what all measurements available at Danish part of North Sea. But would it be possible to get access to wind measurements from RUNE project ( link of project is as below) <a href="https://www.vindenergi.dtu.dk/nyheder/nyhed?id=%7B177BF4B6-CFB4-49D4-B25ED570314FE8DE%7D">https://www.vindenergi.dtu.dk/nyheder/nyhed?id=%7B177BF4B6-CFB4-49D4-B25ED570314FE8DE%7D</a>	We will investigate the availability of these measurement data

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Metocean On-site measurements	Also are there any proposed measurement campaign or ongoing (if any) at site or near to site? E.g. similar to Dutch offshore tender (floating LiDAR at site). This would be preferred option for having wind data at site.	We will deploy Floating Lidars, possible with measurements for waves, currents and tide.
Metocean On-site measurements	The measurements mentioned in Page 8 of <a href="https://ens.dk/sites/ens.dk/files/Vindenergi/3_metocean_input.pdf">https://ens.dk/sites/ens.dk/files/Vindenergi/3_metocean_input.pdf</a> are either a large distance from the site or not of ISO/IEC 17025 quality as the IEC61400-22/IECRE-OD-502 dictates. It is preferred that an on-site measurement campaign covering both wind and metocean is conducted for a minimum of one full year (one met mast in the center of the site or two floating lidars, plus metocean array). This will enable the most accurate assessment of site conditions, avoiding additional conservatism and reducing developer risk regarding wind resource (thus lowering price).	We will deploy Floating Lidars, possible with measurements for waves, currents and tide.
Metocean On-site measurements	Deploy a lidar at the western perimeter of the site for at least a year of wind measurement, e.g. throughout 2020. The wind data should be continuously published. This will allow for more precise estimation of the wind resource for the bidders.	On-site measurements will include both Floating Lidar and measurements of Marine Conditions.
Metocean Comments on modelling	Wave and wind data is generally well established by existing models (that can be adapted to the actual site).	No answer needed
Metocean Weather windows	We got the impression that the weather data will not include data on weather windows/weather downtime in relation to season, waves and wind. Information on the weather windows are essential for the conduction of the geophysical and geotechnical surveys, where many different types of vessels are used. As the weather downtime over the survey period is considerable and can be even longer than the actual survey time, it is of vital importance for the total cost of the survey. We are therefore convinced that consistent and correctly assessed weather data around the weather windows are important for all parties	We will publish a metocean desk study with weather windows.
Metocean WRA report comments	It would be useful if independent WRA ( Wind Resource Assessment) study report of the site can be delivered containing the details ( as below ) along with providing wind data: <ul style="list-style-type: none"> <li>• Basically explaining which data set has been used for the purpose of wind resource at site.</li> <li>• Description of wind resource at site</li> <li>• Description of methodology used for wind resource</li> <li>• Description of long term climate at site and methodology used to derive it.</li> <li>• Other site parameters like air density , wind shear, turbulence</li> </ul>	All the requested parameters are planned to be part of the report.
Metocean WRA report comments	Basically in line with report to what has been provided for Dutch offshore tender ( HKZ , Borssele) <ul style="list-style-type: none"> <li>• Would it be possible to provide processed long term data at site?</li> </ul>	All the requested parameters are planned to be part of the report.
Metocean WRA report comments	As understood that Mesoscale data would be provided to bidders, for how many locations it will be provided, 2 or more?	The number of locations will be decided at a later stage
Metocean WRA report comments	Default scope is fine, but it would be useful to get some information on the icing statistics ( if any) of the proposed site	We do not plan to include icing statics presently

## 2. Seabed site investigations

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Geophysical survey Seismic investigations	What technical device do you foresee for using for the high-resolution (HR) seismic profiling and medium-resolution (MR) seismic profiling surveys? Please note that the penetration capacity is depend on the soil density and the seismic sources used.	The specific instrument models for seismic mapping are not yet determined - tender for survey is still ongoing. It is likely that the HR system would be an EdgeTech 2000. The UHRS system could be a Sparker based system with a 48 channel streamer or similar.
	Baseline plan was to carry out UHRS survey with 500m line spacing and target penetration of 60m bsb. Please decrease line spacing for UHRS survey and increase seismic penetration. b	Requirements to UHRS survey will be modified to provide UHRS survey with ca. 250m line spacing operated to provide penetration depths to 100m bsb.
	Carry out seismic survey as an 3D seismic investigation	This not possible with the present time frame.
Geophysical survey Magnetometer / UXO	The magnetometer reconnaissance does not replace an UXO survey but can deliver some indicants of potential existing UXO object. Hence it is very helpful when the measured magnetic anomalies can select into natural and anthropogenous origin, respectively.	Requested approach part of survey specifications.
	More information is required on the uxo survey. The value of largely spaced MAG lines are limited, at the same time MAG lines are required for the pre-geotechnical locations.	There will be two survey activities using magnetometer: Geophysical site survey using MAG for reconnaissance. And UXO box survey for reducing the UXO risk prior to intrusive work with the preliminary site investigations. The latter will use line spacing suitable for this purpose.
Geophysical survey	The horizontal positioning uncertainty for the towed equipment should be reduced to < 1,0 - 1,5m.	The proposed accuracy may be achievable for parts of the survey - but in general it is difficult to request the proposed accuracy for the entire site.
	The data processing and evaluation of the geophysical survey shall be carried out by qualified geophysicists.	Requested approach is part of survey specifications.
	Geographical format:  Deliverables of geographic information shall be in vector or raster format. For vector data, Environmental Systems Research Institute (ESRI) geodatabase or shape file format shall be used. Attribute tables and metadata for each dataset shall be included. In additions, for general studies and maps, ArcGIS map project files (.mxr files) would be extremely useful if available.  For raster data (georeferenced images and grids), the data shall be delivered as Geographic Tagged Image File Format (GeoTIFF)Digital terrain and elevation models (DTMs / DEMs) shall be delivered in 32 bit floating point pixel data. DWG or DXF format files and shall be delivered with true/world coordinates. In cases where drawings consist of several reference files, all referenced files shall be delivered separately with true/world coordinates. Each feature must be on separate layers and layer naming shall reflect feature type. Complete attribute data shall be delivered in separate ASCII files.	SH propose specific digital delivery format of GIS deliverables. The survey deliverables are already requested to be delivered in various GIS formats, that to a large extent accommodate the requests made by the SH. Exceptions are that no deliverables are requested in AutoCad format and that the ESRI file-geodatabase is structured with another structure than SSDM.

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	For all seabed and geotechnical survey data, the IOGP Seabed Survey Data Model (SSDM) shall be used. Refer to IOGP/ SSDM Seabed Survey Data Model.	
Geophysical survey	Soundings data: Soundings are all measured and quality controlled depth values from a swath system. Soundings data shall be delivered in ASCII XYZ format. Field delimiter shall be <space> Z values shall be negative values below the vertical datum.	Requested approach is part of survey specifications.
	Side Scan Sonar: Side Scan Sonar data shall be delivered as one band georeferenced raster data files in PNG, JPG, or TIFF format. The georeferencing information shall be embedded into the raster.	Requested approach is part of survey specifications.
	Sub Bottom Profiler: Sub Bottom Profiler (SBP) data shall be delivered as raster data files in TIFF. SBP shall be delivered in SEG Y format as specified in SEG Y revision 1 –Attributes and chart formats.	Requested approach is part of survey specifications.
	Impose adequate and timely reporting. Argumentation: foresee delivery of raw data, QAQC'd raw data, draft reports and final reports in due time. + consider to allow stakeholders to contribute to the review process to increase usefulness of final report.	This not possible with the present time frame. Project team will ensure a QC process applied for the reports, charts and data.
	Include bathymetrical THU/TVU grids in delivery package.	Requested approach is part of survey specifications.
	Record backscatter during bathymetrical survey.	Requested approach is part of survey specifications.
	It is recommended that all the relevant geophysical data (Seismic (single- channel; multi-channel), MBES) and geotechnical data and the interpretations hereof will be included in the same geological model.	Requested approach is part of survey specifications.
Preliminary geotechnical investigations	The determination of the CPT/BH locations should be based on the result of the geophysical site investigation.	Requested approach is part of plan.
	The layout of the geotechnical investigation campaign shall cover both kind of areas and provide sufficient soil parameter for creating an optimal OWF layout and sufficient detailed design assumptions for the foundation design.	This appears inconsistent with the BSH standard that require the preliminary geotechnical investigations to be " <i>rudiments for the ... preliminary design</i> ". This is in particular a challenge since turbine locations are not yet determined.
Preliminary geotechnical investigations	Boreholes should be performed with continuous sampling of undisturbed samples to target depth of 70 m bsb. Borhole locations should be supplemented with a nearby (e.g. 5m) CPT performed in a separate borehole.	Proposed requirements to target depths and continuity for BHs and CPTs understood. Requested approach for VC / CPT sampling already part of survey specifications.
	Increase geotechnical scope for boreholes from 10-15 locations to e.g. 15-30 locations. Increase geotechnical scope for CPTs from 50-70 up to 100 locations.	The project team has decided to increase the planned scope to 15-20 boreholes and 60 to 80 CPTs. The plans are subject to the market conditions.

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	Include PS-logging for a number of the CPT positions in scope.	The project team has decided to include PS-logging for a limited number of locations. The plans are subject to the market conditions.
	Foresee dialogue on intended scope with typical detailed designers of OWF foundations (key market players). Argumentation: most recent design methodologies might require other focus/ more attention for specific tests.	Requested approach is part of plans.
	Sample storage: Argumentation: safeguard good quality storage of sufficient samples, allowing kick start of more lab testing should any tests have been overlooked, or as an input to the winning party.	Requested approach is part of plans.
Preliminary geotechnical investigations Laboratory program	Add some advanced laboratory tests: Triaxial and shear tests, over-consolidation ratio, thermal resistivity, pore pressure dissipation.	The project team will include a number of advanced laboratory tests in the planned scope.
Onshore program	Are soil investigations of the locations for the onshore substations (to be built by the developer) also part of the surveys?	No
Export Cable Route	Minimize length (straight line) and consider reach of in-field cables (strings) in the planning of substation location(s) and routing options. Consider to perform a high level preferred location scenario before finalizing the cable route.	The cable routes have been amended to be as straight lines as possible from wind farm site to the two landfall alternatives. All routes will be investigated.
	Include geotechnical boreholes for landfall investigations	A number of onshore geotechnical boreholes will be performed on the beach area to map soil conditions relevant for the landfall.
	Foresee sufficient thermal conductivity tests. Argumentations: relative low cost and will allow bidders to more accurately assess cable design and cable burial and related risk to account for in the offers.	Requested approach is part of survey specifications for cable route survey.
	VC and CPT for export cable route should be carried out pairwise with little distance of any meter to each other. Scope should be planned based on an preliminary interpretation of geophysical data.	Requested approach is part of plans.
Export Cable Route	Include termal resistivity tests on soils samples from VCs.	Requested approach is part of plans.
	It is also highly recommended to include survey of the bathymetry/topography in the nearshore/surf zone unto the beach (0 – 10m).	Requested approach is part of plans.
	Repeat hydrographical survey for landfall after one year and potentially at a few more intervals. The sea-floor in this area on the Danish West Coast is highly dynamic and information on the variation will minimize risks at the landfall.	Requested approach is part of plans.
	For the alignment charts is it recommended to include an isopach of the top layer as well as a longitudinal profile that highlights the thickness of the top mobile sediment, this will enable a first approximation of the seabed mobility and the corresponding risk of exposure for the export cables	Requested approach is part of plans.