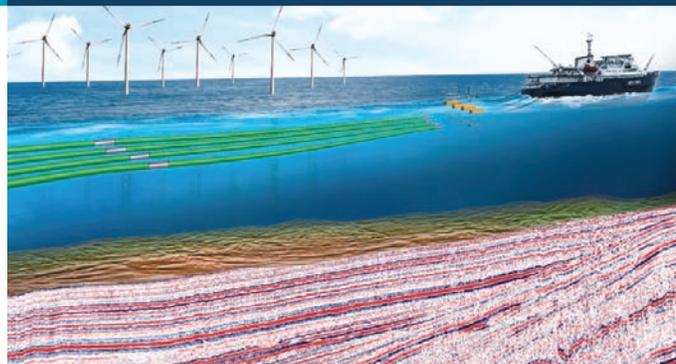


# Offshore Wind Farm Site Surveys

NCS  
SubSea



Offshore Wind Farms (OWF) are a vital and rapidly growing component of the global move towards a renewable energy future. NCS SubSea, working in collaboration with industry-leading geophysical and geotechnical partners, is playing a leading role in defining that future.



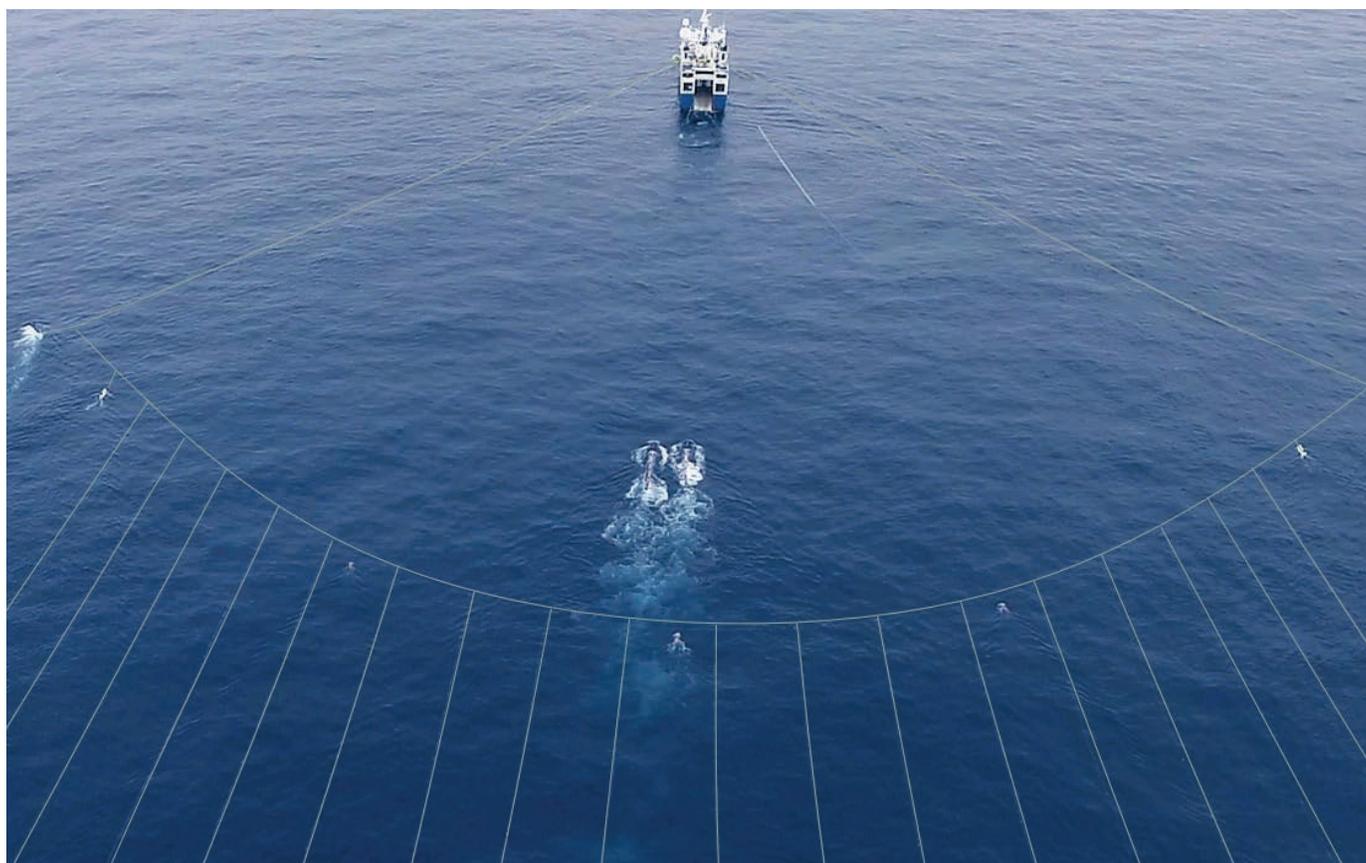
# Offshore Wind Farm Site Surveys

## Site Evaluation to Installation in Record Time

Our accelerated cycle time methodology to OWF site evaluation sets a new standard by providing offshore wind farm developers an opportunity to substantially shorten the overall time frame from initial site evaluation to the installation of turbines, while simultaneously reducing project risk and increasing the quality and reliability of pre-construction engineering decisions. This accelerated project cycle time in turn dramatically reduces overall site development costs and eliminates the need for costly rework and refinement of reconnaissance grade surveys that are ill-suited to address the challenges offshore wind operators face.

We achieve these outcomes using an integrated, holistic approach to OWF projects, collecting multiple datasets in parallel, rather than sequentially:

- We cover the entire survey area at the outset with dense, ultrahigh resolution 3D(UHR3D) seismic data using our revolutionary P-Cable technology
- Working with our partners, we collect rich, multiphysics data, investigating the seafloor and shallow subsurface geology using a carefully chosen suite of best-in-class geophysical tools
- Working as a team we consolidate this data within the 3D structural framework developed from the 3D seismic data to provide a living ground model that delivers actionable knowledge built upon an integrated interpretation of the multiphysics data

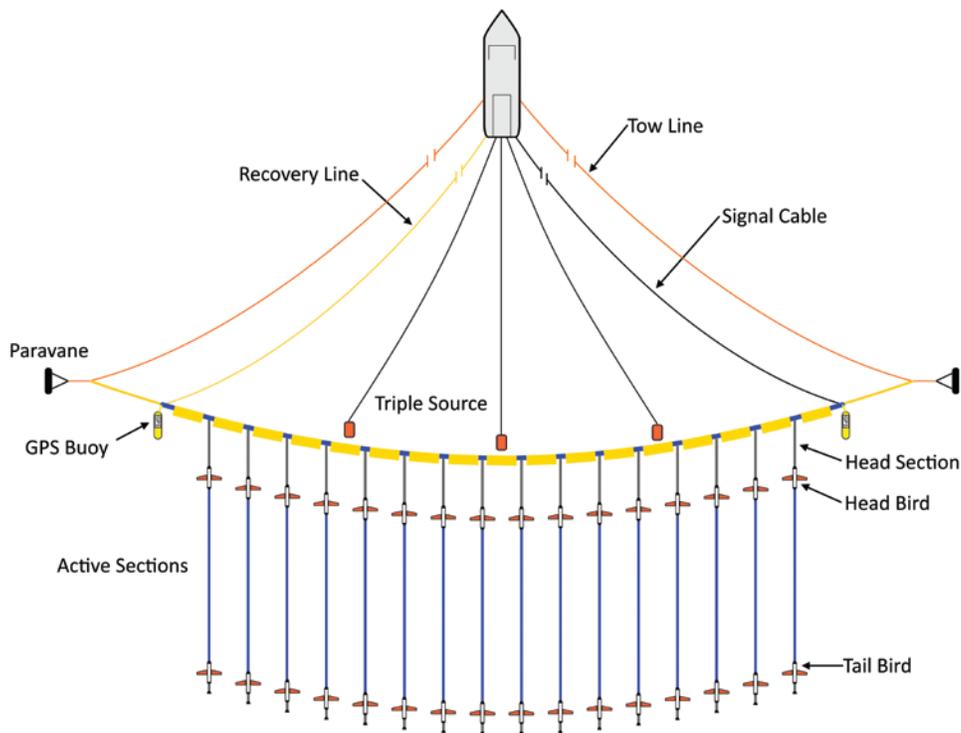


## P-Cable UHR3D Seismic Data: The Structural Foundation for OWF Project Success

Due to its unrivaled spatial and vertical resolution, the P-Cable Ultrahigh Resolution (UHR) 3D marine seismic system is an ideal technology for evaluating the seafloor and shallow subsurface geology at OWF sites. Of particular importance is the ability of the P-Cable UHR3D system to capture the full 3D wavefield which can then be processed to accurately locate and image small-scale features such as boulders and cobbles that can interfere with the installation of foundations and seafloor anchors. These data are the foundational element of the 3D structural model used to develop the living ground model for the OWF site.

The P-Cable UHR3D seismic system is a unique, streamer-based 3D seismic data acquisition technology. P-Cable is designed to provide full 3D seismic imaging of the subsurface with a much higher temporal and spatial resolution than conventional marine 3D seismic systems. The advantage of this approach lies in the comprehensive three-dimensional structural framework in which all ancillary datasets can be integrated while providing ultrahigh resolution imaging for interpreting sub-surface geology.

The P-Cable UHR3D seismic system is comprised of many closely spaced, short-offset multichannel streamer cables with small receiver group intervals. NCS SubSea’s field-proven receiver spread is engineered to be configurable to meet various binning requirements. The versatility of the P-Cable system allows for tailor-made solutions with industry-leading acquisition efficiency and turnaround time. A typical P-Cable system configuration for OWF surveying is shown in Figure 1.



P-Cable Ultrahigh Resolution 3D (UHR3D) Seismic System Diagram.

# Offshore Wind Farm Site Surveys

## Multiphysics Data:

### The Key to Minimizing Risk and Improving Pre-Construction Engineering Decisions

Despite its unparalleled resolution and structural integrity, UHR3D seismic data still only measures a few physical parameters of the subsurface geology. To develop a comprehensive understanding of the seafloor and shallow subsurface geology, it is essential to complement this structural information with a broad range of geophysical measurements including:

- Multibeam echosounder (MBES)
- Synthetic aperture sonar / side scan sonar (SAS/SSS)
- Sub-bottom profiler (SBP)
- Magnetometer / magnetic gradiometer (MAG)
- Controlled source electromagnetic (CSEM)

### For geotechnical measurements we work with our partners to provide:

- Cone Penetration Testing (CPT) and Piezo-Cone Penetration Testing (PCPT)
- Borehole sampling and logging
- Soil Sample Analysis

### Advantages of our Accelerated Cycle Time Methodology

Our integrated, holistic approach to OWF site characterization offers significant advantages over the traditional sequential, piecemeal approach to pre-construction site investigation, including:

- Data for the entire development area is available from the outset, eliminating the need for expensive and time-consuming repeat or refinement geophysical surveys
- The dense, ultrahigh resolution 3D geophysical data are used to optimize the location and reduce the overall number of geotechnical evaluation sites, reducing the need for multiple redundant or unnecessary CPTs or boreholes
- A multiphysics approach allows the data to be combined in an integrated interpretational framework that facilitates the construction of robust and reliable ground models that are not dependent on any single measurement type
- Construction of the living ground model begins at the start of the project with data added continuously to ensure the most up to date ground model is always available to guide business decisions

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For more information about our revolutionary approach to OWF site investigation please contact us at [info@ncs-subsea.com](mailto:info@ncs-subsea.com)