

Offshore Windfarm Survey on Gunfleet Sands

In recent years an expansion in the telecommunications cable industry led to an increase in the market for cable route landfall surveys incorporating geophysical surveys at sea and topographic surveys of the landing site. In the last two years, however, the economic conditions in the telecommunications industry have been such that there has been a significant decline in the number of surveys being commissioned. Therefore, it was with great interest that the coastal survey industry in the United Kingdom followed the development of the offshore windfarm market. This was given a considerable boost by the announcement of significant UK government funding and the issuing by Crown Estates of eighteen licenses for options to develop offshore windfarms around the UK coastline. Crown Estates own the UK seabed out to the 12 mile limit.

At the time of writing surveys have been conducted at sixteen of the eighteen license areas and studies at a seventeenth, likely in the near future. The UK Government has given approval for the development of the Powergen site at Scroby sands off Norfolk and the National Wind Power North Hoyle site off North Wales with grants of £10 million for each. A further license round is likely to be concluded by August 2003 and consultation is currently underway regarding development further offshore and the legislation required to develop sites beyond the 12 mile limit.

A number of surveys associated with these sites have been conducted during the autumn/winter of 2001 and throughout 2002 with Titan Environmental Surveys Ltd. being associated with geophysical, benthic and oceanographic data acquisition over seven of these license areas, one in Eire and one in Northern Ireland and it is experience gained whilst conducting the first of these surveys over the Gunfleet Sands that is highlighted here.

Why Do a Survey?

The oceanographic, benthic and geophysical surveys are required at an early stage of an offshore windfarm development project as important elements of the Environmental Impact Assessment (EIA). They also feed into many other aspects of the survey/ study programme. The oceanographic survey provides wave and current data to feed into the foundation design process and assists calibration of any model constructed as part of a coastal processes study. The benthic sampling and analysis feeds directly into the EIA and particle size data is used in foundation design and in the coastal processes study. The geophysical data is used in many aspects of the subsequent activities. The shallow geological and bathymetric data can be used in the preparation of a targeted geotechnical workscope whilst the seabed features determined from the side scan sonar data are used in determining the benthic sampling workscope. The bathymetric and seabed features data are used in the coastal processes study, to assess any sites of potential archaeological interest and the interpretation of the shallow geological conditions feeds into the foundation design process.

Survey Background

Geophysical and benthic surveys were conducted for Enron Wind Gunfleet Ltd. (soon to be General Electric Wind Gunfleet Ltd.), who are assessing the development of an offshore wind farm off the south-east coast of England. The site is located 7km south of Clacton-on-sea, Essex. The survey was conducted from Titchmarsh Marina at Walton-on-the-Naze and covered two areas; the proposed wind farm site (5km x 2km); and a proposed cable route (7km x 0.5km). The total line kilometres surveyed was 348.5km over a 10 day period during September and October 2001, with personnel being demobilised from site during prolonged periods of poor weather. In order to maximise good weather periods, Titan conducted 24 hour operations when appropriate as shorter periods of weather standby also occurred whilst on site.

Geophysical Data Acquisition

Data were collected in water depths varying from 20 metres LAT to a minimum of drying height 0.4m LAT in the study area. The survey was performed using: an Odom Hydrotrac single beam echosounder, and TSS DM25 motion sensor; Edgetech DF1000 dual frequency digital sonar; Applied Acoustics surface towed boomer with 8 element hydrophone and CSP1000 bang box; Geometrics GS881 Caesium vapour magnetometer; and positioning was achieved by Trimble RTK GPS systems with a base station on Clacton Pier. A Trimble AG132 receiving differential corrections from the GLA network provided secondary positioning. In addition, vertical control was provided by a tide gauge installed at Clacton Pier.

This extremely shallow water environment, significant transit distances to site, the desire to work 24 hours a day and tidal restrictions on the access to and from Titchmarsh Marina, meant that a specialist vessel and personnel experienced in working in such conditions were extremely valuable in maximising the working potential of the operation. Even slight sea conditions could cause significant swell on the Gunfleet Sands, compounded by the shallow and exposed nature of the site. Some lines were required to be re-run where sea conditions meant that data quality suffered either because of sea surface noise (due to wave effects on the sonar records) or sea surface reflection during very calm weather. In deteriorating and poor sea conditions, data quality was found to be compromised well before the conditions limited safe operation of the survey vessel.

The success of executing geophysical survey operations in shallow waters depends on the skills and knowledge of the survey crews involved. It is critical to design a realistic line plan based on an understanding of the capabilities of the systems in the environment to be surveyed (particularly with regard to sonar ranges in relation to the shallow water depth and deployment of the equipment in such a way as to minimise noise). To obtain optimum data quality from survey instruments requires a thorough understanding of the equipment capabilities in a shallow water environment and how best to mobilise and use it on such survey vessels. The requirements of the client with regard to the sub-surface penetration and a knowledge of the anticipated geology also contributed heavily to the choice of systems to be

used.

Side scan sonar and magnetometer data were gathered to identify seabed hazards and obstructions, of which there were a significant number due to the long history of the sand bank as a hazard to navigation.

Sub-bottom profiling provided sub-surface details to assist engineers in assessing the soil conditions. The seismic data were of high quality, even in the very shallow water depths, as little seabed multiple was noted and penetration in excess of 40m was achieved over much of the site. The sub-bottom profiler data were only hampered by the presence of diffuse shallow gas, which blanked the sub bottom data in places. A surface tow boomer was chosen for use on both the site and the cable route as a compromise between penetration and resolution. Deeper penetration systems had been considered with a view to imaging the top of the Chalk strata but this was deemed too deep to be necessary.

Geophysical Data Processing

Initial data processing on-site ensured quality assurance and complete coverage of the study area. Final reporting and charting were undertaken at Titan's offices in Bridgend, South Wales. Side scan sonar and sub-bottom profiler data were recorded on a CODA DA200 system and then further processed using the CODA Mosaicing and Geokit packages to produce sonar mosaics and interpreted profiles and isopachytes. Navigation and bathymetry were processed through the Trimble Hydro suite of software.

Geophysical Survey Vessel

The vessel used for all operations was a purpose built catamaran, Titan Surveyor, which was towed by long-wheelbase landrover from Titan's base in South Wales to the mobilisation point at Titchmarsh Marina. Commissioned in 1998 and built by Cheetah Marine on the Isle of Wight, she was carefully designed through close collaboration between the two companies, and measures 7.9m loa with a 2.4m beam and a draft of only 0.6m.

Since the vessel's commission, she has been used extensively throughout the UK, mainland Europe, Scandinavia and in the Red Sea. She has operated in many varied sea conditions and has successfully surveyed several thousand kilometres. Titan Surveyor is one of three specialist survey catamarans owned by Titan Environmental Surveys and built by Cheetah Marine. All vessels are easily transported by trailer to site.

Benthic Survey Acquisition

Further survey operations were undertaken, with Titan completing an extensive benthic sampling survey. Detailed discussions with Hydrosearch (scheme consultants) and CEFAS resulted in an extensive sampling programme to collect data on the macrobenthic infauna and epifauna, sediment type and metals and hydrocarbons concentrations, not only in the proposed wind farm site, but also in adjacent areas covering the tidal excursion and nearby estuaries. Day grab samples were taken and retained fauna fixed for later identification at the laboratory, followed by processing to determine the nature of the macrobenthic communities found in the area. A number of beam trawls were conducted to sample the epibenthic fauna and fish.

Oceanographic surveys may also be required at proposed wind farm sites, to provide information on tidal currents, wave height and direction, turbidity and sediment transport. Long term data may be collected over several months from deployed instruments, and used in the construction of coastal process models that will assist in the design of turbine installations and help determine the likely environmental impact of associated construction activities.