

# Managing the UXO threat for offshore wind

Two world wars and years of munitions dumping have left behind a unique and substantial risk legacy on the European seabed. For developers in Europe seeking to build offshore energy infrastructure projects, negotiating the obstacle of thousands of tonnes of unexploded ordnance (UXO) has posed a considerable and often unanticipated challenge. High-profile contractor disputes and costly project delays have been the result.

Simon Cooke, Managing Director of 6 Alpha Associates, a specialist risk company with particular expertise in the assessment and management of offshore UXO, describes the scale of the threat to energy projects in European and global waters and how this explosive risk can be diffused.

Today's UXO threat in European waters is entirely man-made. It is the result of war

fighting and other activities over the last century, including mine laying, naval battles and bombing during the two world wars and dumping of expired munitions by a number of European nations that continued until the 1980s.

The scale of the risk is substantial but difficult to quantify. We know, for example, that up to 30% of the sea mines laid in the period between 1914 and 1945 remain unaccounted for, whilst the nature of post-war dumping operations means that it is hard to gain an accurate figure for the number of tonnes of expired munitions currently sitting on the seabed, although best estimates suggest that this amounts to hundreds of thousands of tonnes.

A cocktail of explosive weaponry is on the ocean floor in the North Sea and English Channel, ranging from sea mines, which have since lost buoyancy, to bombs, shells and torpedoes that missed their intended



targets, and, most worryingly perhaps, chemical weapons and mustard gas of the sort disposed of in German waters after WW1. Some of those munitions are buried sub-surface and others move with tides and current – an issue we'll look at later on.

The result, in more stark terms, is that, while offshore workers in the North Sea discover a WW1 sea mine only once a decade, WWII mines are found on an annual basis and iron bombs of varying size and provenance turn up regularly. UXO therefore presents a tangible and calculable risk to any intrusive activity taking place on the seabed, ranging from dredging to the construction of offshore energy infrastructure, including drilling, cable laying and driving of monopile foundations for offshore wind turbines.

The latter is of particular concern to UXO risk management practitioners. While offshore oil and gas platforms are typically towed into place and located in deep water far from shore, away from the highest risk areas, offshore wind developments are currently restricted to sites nearer the coast where UXO is generally more prevalent.

As offshore wind projects proliferate in European waters, and new markets consider the technology, it is increasingly important that developers are aware of the threat posed by UXO in the marine environment. Any high impact disturbance to the seabed is capable of causing unintended detonation of surface or buried ordnance, an event that, at the very least, will cause substantial damage, delay and associated costs and, in the very worst case scenario, may result in worker injury or loss of life.

Subject to the size of the high explosive charge and the depth of water (amongst other factors), the underwater detonation of UXO will often generate a series of shock waves, which will be sufficiently powerful to damage and possibly sink vessels at some distance from the seat of the explosion. Clearly any UXO that might inadvertently be brought back to the vessel (e.g. if it is trapped or entangled in equipment) might cause much more damage if it initiates in close proximity to the hull and/or personnel on board.

One of 6 Alpha's greatest challenges lies in educating developers, financiers, project managers and construction professionals not only that UXO is a tangible, widespread threat that will, more often than not, be present on their site but also that it might severely impair project delivery. Clearly Developers and their Principal Contractors are legally responsible for the safe management of all risks to sub-contractors and installers.



Even in cases where detonation does not occur and UXO is unexpectedly discovered on site during the construction phase of an offshore wind farm or marine cabling project, the developer is at significant risk of project delay, which is always much more expensive to manage once the project is underway.

6 Alpha estimates that it is approximately ten times more expensive to ameliorate UXO risk once the project is underway, as compared with managing the risk proactively before the installation phase begins.

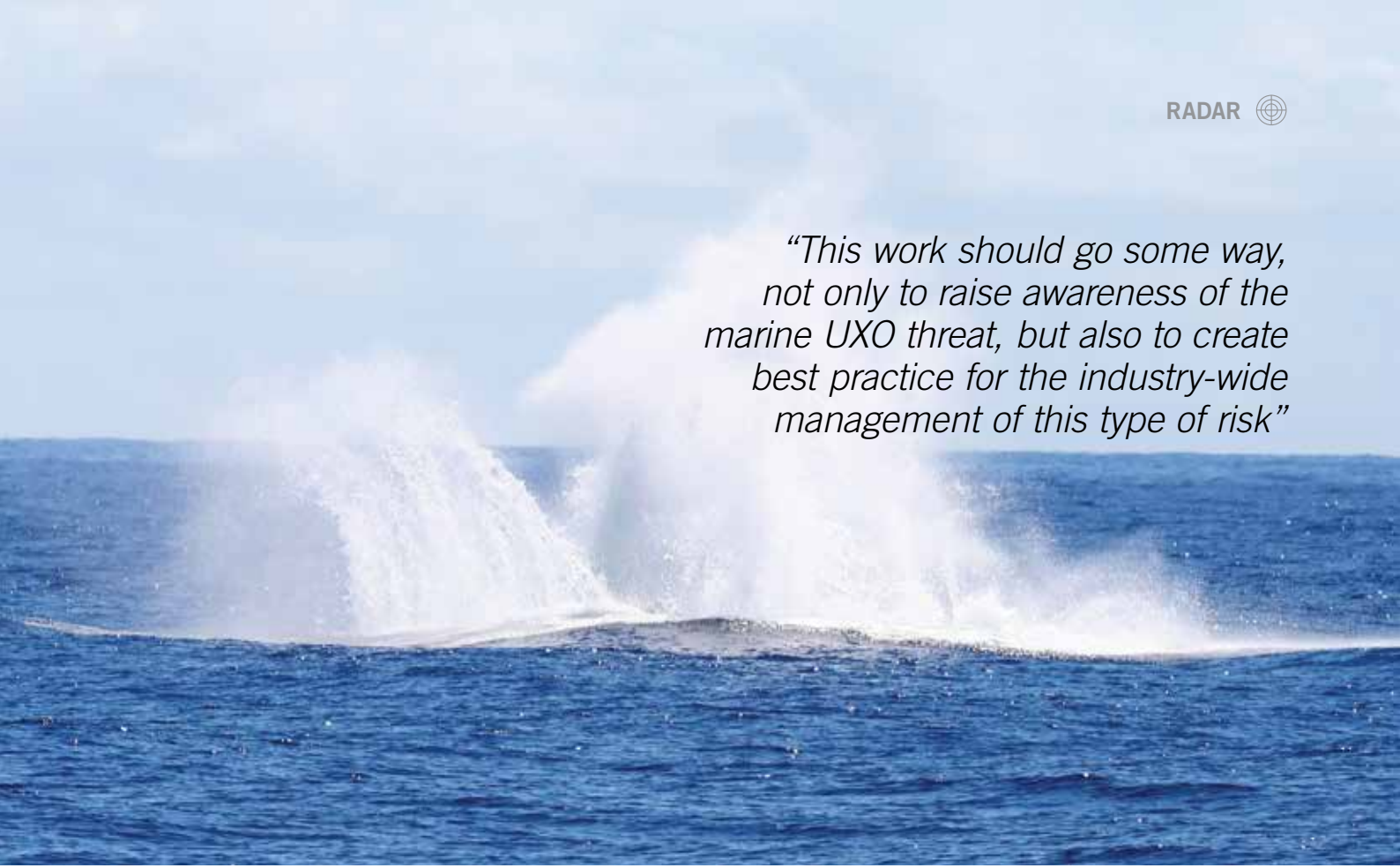
On offshore wind sites, for example, the cost of hiring a large jack-up vessel for turbine installation can be as much as £200,000 per day, meaning that long periods of inactivity will begin to quickly erode contingency sums.

Recent project setbacks have served to illustrate this point. A dispute over UXO ensued between German grid generator

TenneT and the developer of the Riffgat Offshore Windfarm, concerning the responsibility for UXO along the export cable route. TenneT estimated that it had spent €100m because the amount of UXO along the route significantly exceeded initial estimates. TenneT claimed it had spent €47m on clearing munitions and €43m on compensation caused by delays.

More recently at RWE's Gwynt-y-Môr offshore wind site, work was initially suspended when three WWII bombs were discovered. Following the imposition of exclusion zones around the bombs, permission was sought from the authorities for their detonation. Once permission had been granted, a process that can take weeks, vessels were again excluded from the site as the bombs were detonated in a series of controlled explosions.

While the probability of inadvertent UXO discovery and detonation might be considered low, the risk of delays engendered by UXO discovery and



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consequential contractual dispute is all too apparent and such a risk might be mitigated easily and early in the project-planning phase.

This mitigation is achieved through a range of measures including a detailed threat and risk assessment, geophysical surveying, and if UXO is discovered, removal.

And although some UXO removal contractors will seek to employ an expensive 100% clearance approach to a site, 6 Alpha determines what kind of action is appropriate – often it makes far greater economical sense to simply avoid geophysical survey anomalies that model as UXO (but may in fact be scrap), rather than attempt complex and often unnecessary investigative procedures.

So far, so good. Many developers at this stage, having minimised the UXO risk for construction, believe that the issue has been dealt with for the duration of the project lifecycle.

This, however, is not the case. In mitigating UXO risks in the construction phase to as low as reasonably practicable – the legal benchmark for risk management - the most cost effective route is to leave anomalies found on the seabed, which are not verified as UXO, in the survey phase and will not impede on construction, in situ.

Whilst such practices enable the installation of infrastructure in safety and at best value for money, inevitably a significant number of anomalies with known UXO signatures (but which have not been verified as such through investigation) remain on site, often within engineering working space and

sometimes in quite close proximity of installed infrastructure.

Over time, these anomalies, which in some cases could be UXO, will move along the seabed, either through natural marine processes, or disturbance from fishing activity.

The natural danger is that these items may come into close proximity of offshore wind turbine or platform foundations and cables, that may themselves be the subject of on-going Operations and Maintenance (O&M) activities.

In the short term this presents a demonstrable risk to the safety of personnel, vessels and the installed infrastructure that is in close proximity of such prospective hazards, while in the medium to long term, verification of such anomalies as UXO can lead at best to expensive operational downtime and the possibility of long delays, and at worst to an accident.

However, through the use of specialist geophysical survey techniques, enhanced UXO munitions mapping and appropriately applied UXO risk management procedures, it is increasingly possible to accurately plot the approximate UXO drift direction and distance likely to be travelled with time, typically on a per annum basis.

This specialist work, which has been successfully undertaken by 6 Alpha Associates for a number of developer clients, not only enhances the longevity of UXO safety sign-off certificates, but also enables operations and management teams to better understand and quantify the true scale and costs associated with managing long-term offshore UXO risks.

To date, development cycles have enabled offshore wind farm construction teams to better understand the first three years of a typical 25-year project. As the focus for offshore wind moves towards cutting the cost of electricity generation, enhancing the understanding of Munitions Migration is imperative for future project success.

While the threat of UXO to marine infrastructure projects has been well-publicised of late, the young offshore wind sector is still coming to terms with the nature of the UXO risk posed to its projects. Likewise, the marine construction industry as a whole currently lacks centralised formal guidelines for the management of this risk.

In a reflection of this, 6 Alpha has recently been commissioned, alongside Royal Haskoning DHV, to co-author the upcoming CIRIA guidance for the Assessment and Management of Unexploded Ordnance (UXO) Risk in the Marine Environment.

This work should go some way, not only to raise awareness of the marine UXO threat, but also to create best practice for the industry-wide management of this type of risk. In the meantime, offshore wind developers, marine cabling firms and all of those involved in marine construction should take note of the potential obstacle that these unexploded munitions pose to the safe and timely completion of their projects and learn how to manage it in a proactive, strategic and appropriate manner. ■

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