Maritime & Coastguard Agency

MARINE GUIDANCE NOTE

MGN 372 Amendment 1 (M+F)

Safety of Navigation: Guidance to Mariners Operating in the Vicinity of UK Offshore Renewable Energy Installations (OREIs).

Notice to other UK Government Departments, Offshore Renewable Energy Installation Developers, Port Authorities, Ship owners, Masters, Ships' Officers, Fishermen, Rescue Organisations, Recreational Sailors/Users.

This notice should be read in conjunction with Marine Guidance Note "Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response", and Marine Guidance Note "Navigation: Safe and Responsible Anchoring and Fishing Practices – Avoiding Damage to Submarine Cables and Pipelines."

Summary

This Marine Guidance Note (MGN) highlights the issues to be considered when planning and undertaking voyages in the vicinity of offshore renewable energy installations (OREIs) in UK waters.

Key Points

- Offshore renewable energy installations present new challenges to safe navigation, but proper voyage planning and access to relevant safety information should ensure that safety is not compromised.
- At present most OREIs are wind farms, though installations using wave or tidal power have been established off the UK coast.
- Information is provided to enable appropriate voyage planning decisions to be made.

1. Introduction

1.1 The number of Offshore Renewable Energy Installations (OREIs) in UK waters is increasing. At present most are wind farms, though tidal and wave energy installations are being developed and some installations have been established which may be close to shipping routes.

1.2 In November 2022, 44 offshore wind farms were operational, and a further 15 were in the post-consent or construction phases. These are mainly located in the East Irish Sea, the southern North Sea (areas off the Humber, the Greater Wash, East Anglia and the Thames Estuary), Firth of Forth and Moray Firth. There are also several sites in the planning stages around the north and east coasts of Scotland and the Celtic Sea. Various industry websites exist that provide updated information on wind farm sites on operation and in planning such as The Crown Estate and Crown Estate Scotland.

1.3 Wind farms can be very large, some approaching 400 square nautical miles. The sites may be irregular in shape and adjacent developments can be in close proximity to each other. In addition, single wind turbines may be established as isolated units, and can include floating turbines.

1.4 Wave and tidal energy devices are currently sited on an ad hoc basis, where wave or tidal stream conditions are optimum but where interference with other marine activities is, as far as practicable, minimised.

1.5 This Guidance Note will enable mariners to make an informed risk assessment for the intended voyage. This should be considered together with the guidance on voyage planning found in other publications, relating to the implementation of SOLAS V Regulation 34 ("Voyage Planning"). Reference should be made to the Marine Guidance Note "Navigation: SOLAS Chapter V - Guidance on the Merchant Shipping (Safety of Navigation) Regulations 2020" which is accessible on the MCA website. MCA and IMO Guidance on Voyage Planning are contained under Regulation 34 of that publication. Further reference to MCA's other MGN entitled: "Offshore Renewable Energy Installations (OREI) – Guidance on UK Navigational Practice, Safety and Emergency Response" is recommended.

1.6 For the purpose of this document, the term 'mariner' is used to include masters, officers, crew, skippers and recreational users on all vessel types and personal watercraft.

1.7 Mariners are reminded of the requirement to navigate safely at all times and this Guidance Note aims to assist mariners in carrying out that obligation. OREIs are a new development, and this guidance is of a general nature, based on the information available to date. It should be noted that specific details of individual sites may vary. As additional information becomes available in the light of experience, the guidance may be reviewed and updated. Notes on United Kingdom Hydrographic Office (UKHO) charts and Sailing Directions should be studied. Details are included in NP100, The Mariner's Handbook.

1.8 Any urgent Maritime Safety Information relating to OREIs will be promulgated by Notices to Mariners and Radio Navigation Warnings.

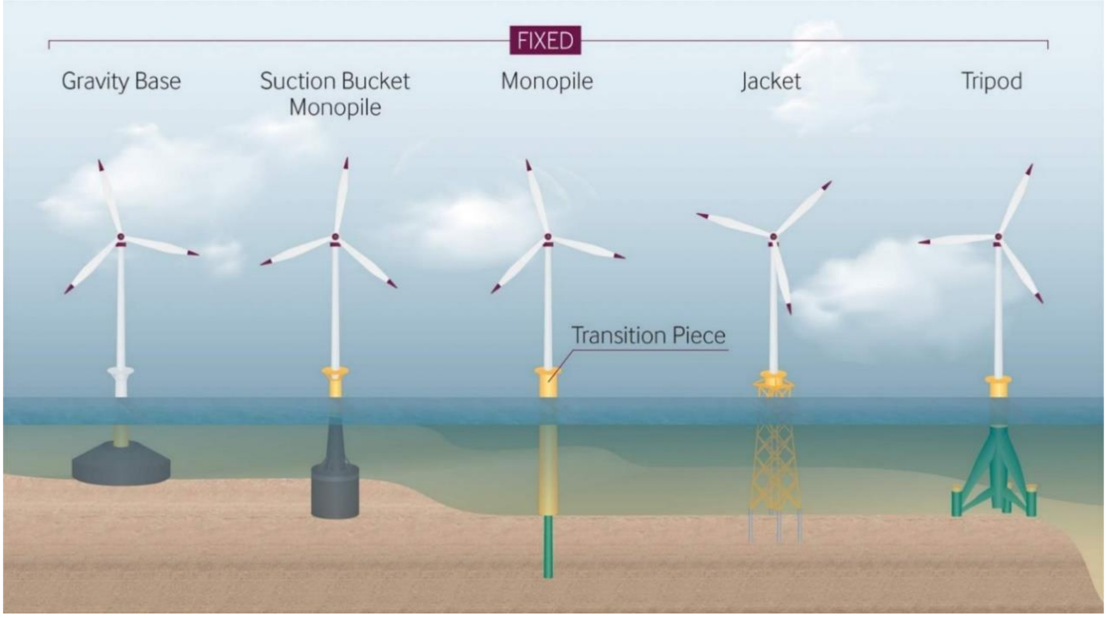
1.9 The ANNEX to this MGN contains illustrations of various OREIs and their markings. Further detailed information on UK wind farms can be found on the Offshore Wind Industry Council - Pathways to Growth e-learning modules and the UKHO's The Mariner's Handbook (NP100). Useful information on specific OREIs can be found on developer websites, their local notifications, KIS-ORCA and Kingfisher bulletins.

2 Wind Farms

2.1 **Visibility and appearance:** Wind farms are readily identifiable both visually and by radar from a considerable distance in good meteorological conditions. The turbines typically comprise of either a fixed or a floating foundation, a yellow transition piece section typically not less than 15 metres high measured above the Highest Astronomical Tide (HAT), above which is a platform forming the base of the turbine tower, which may be up to 200 metres in height from sea level. The structures above the yellow transition piece section are usually painted matt grey (See illustrations in Annex A). At the top of the turbine tower is the nacelle, a box shaped structure housing the generator. The turbine blades are located opposite the nacelle and each turbine blade can be more than 100m in length. The blades tips are coloured red (older wind farms that have smaller turbines may not have painted blade tips) and the blade's leading edges have three red dots for helicopter hover reference points. The total height of a turbine and rotor is currently 250-300 metres. The following table shows the theoretical visibility range of a wind turbine blade tip and nacelle considered from the perspective of different sea users in ideal conditions of visibility:

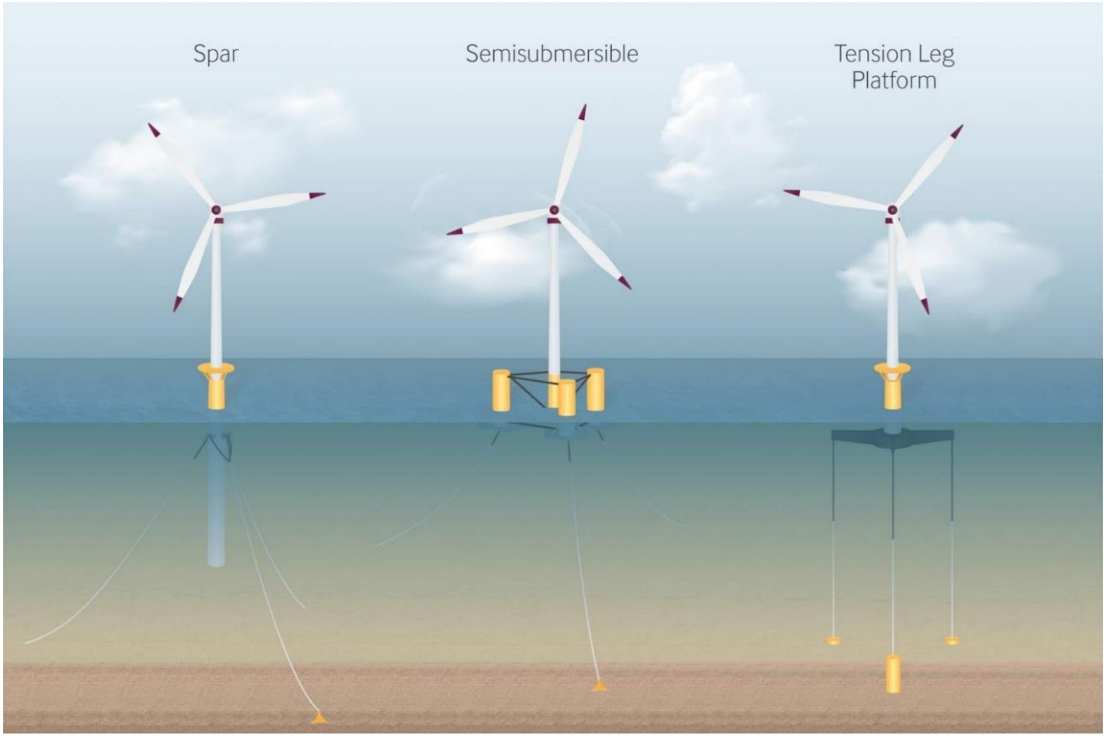
User	Height of Eye	Nacelle Height	Blade Tip	Visibility
Small Craft	3m	150m		28NM
Small Craft	3m		250m	34NM
Handy-size Tanker in Ballast	28m	150m		34NM
Handy-size Tanker in Ballast	28m		250m	40NM

2.1.1 Fixed foundation turbines are found in water depths of less than 60m and are secured to the seabed using one of several available types of foundation (e.g. monopile, gravity base or suction bucket) depending on the characteristics of the seabed and water depth. Scour protection may be added to the base of the foundation. Above the sea surface they appear as either a single structure connecting to the foundation or a jacket structure that has three or four legs.



Examples of fixed turbines and foundations[1]

2.1.2 Floating foundation turbines are found in water depths of more than 50m and consist of either a semi-submersible spar or platform supporting the one or more turbine generators which is secured to the seabed using mooring lines/chains and anchors. The type of mooring systems depends on water depth, seabed conditions and foundation infrastructure, however the main types are catenary, semi-taut and taut.



Examples of floating turbines and moorings[2]

[1] Offshore Wind Industry Council P2G E-learning modules available at: OWIC | Pathways to Growth)
[2] Offshore Wind Industry Council P2G E-learning modules available at: OWIC | Pathways to Growth)

2.2 **Navigational Aids:** Wind farms are marked by aids to navigation as specified by the General Lighthouse Authorities (GLA). The International Association of Lighthouse Authorities (IALA) Guideline *G1162 on the Marking of Offshore Man-Made Structures* requires offshore wind turbines to be marked so as to be conspicuous by day and night, with consideration given to prevailing conditions of visibility and vessel traffic. Cardinal and/or Special Mark buoys may also be permanently placed adjacent to wind farms. During construction cardinal and special marks will be used around the area and mariners should be aware of the likely presence of foundations without a yellow transition piece. These present a significant navigation hazard and will be appropriately marked.

2.2.1 A corner structure, or other significant point on the boundary of the wind farm, is called a Significant Peripheral Structure (SPS). The SPS will be marked with lights visible from all directions in the horizontal plane. These lights should be synchronized to display simultaneously an IALA “special mark” characteristic, flashing yellow, with a range of not less than five (5) nautical miles. Aids to navigation on individual structures are placed below the arc of the rotor blades, typically at the top of the yellow section.

2.2.2 As a minimum, each SPS will show synchronised flashing characteristics (typically yellow with a 1s flash every 5s). In some cases there may be synchronisation of all SPSs. In the case of a large or extended wind farm, the distance between SPSs should not normally exceed three (3) nautical miles.

2.2.3 Selected intermediate peripheral structures (IPS) on the boundary of a wind farm between SPSs may be marked with flashing yellow lights (typically yellow with a 0.5s flash every 2.5s) which are visible from all directions horizontally. The characteristics of these lights areas differ from those displayed on the SPSs and have a range of not less than two (2) nautical miles. The distance between such IPS or the nearest SPS should not exceed two (2) nautical miles. The characteristics of the lights and marks will be shown on the chart.

2.2.4 Single structures, not part of a group of turbines, are marked, according to the *IALA* Guideline *G1162 on the Marking of Offshore Man-Made Structures*, with a white light flashing Morse code “U”.

2.2.5 Temporary short range (2NM) flashing yellow lights may be installed on unfinished foundation structures. These are not required by the IALA guidelines and are installed at the discretion of the developer to aid navigation within the array for designated construction vessels.

2.3 **Other illumination and identification aids:** In addition to the navigational aid lights marking the SPSs and selected IPS of a wind farm, IALA permits:

a. Illuminating of peripheral structures and all structures within the wind farm
b. Racons, (morse character starting with ‘dash’)
c. Radar Reflectors and Radar Target Enhancers; and/or
d. AIS as an Aid to Navigation (as per IALA Recommendation A-126).

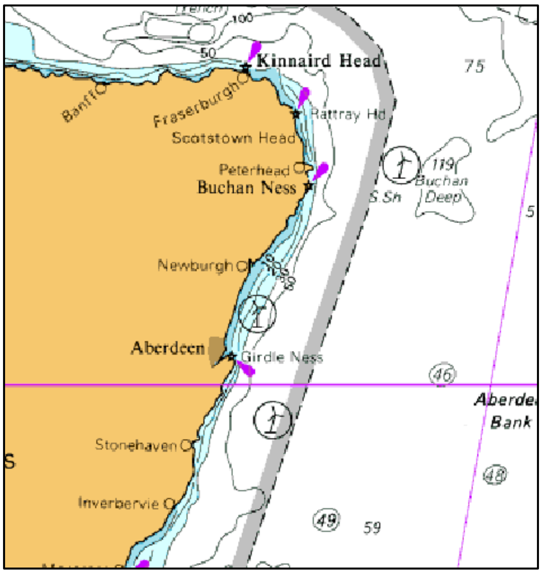
Mariners should consult the largest scale chart available for details.

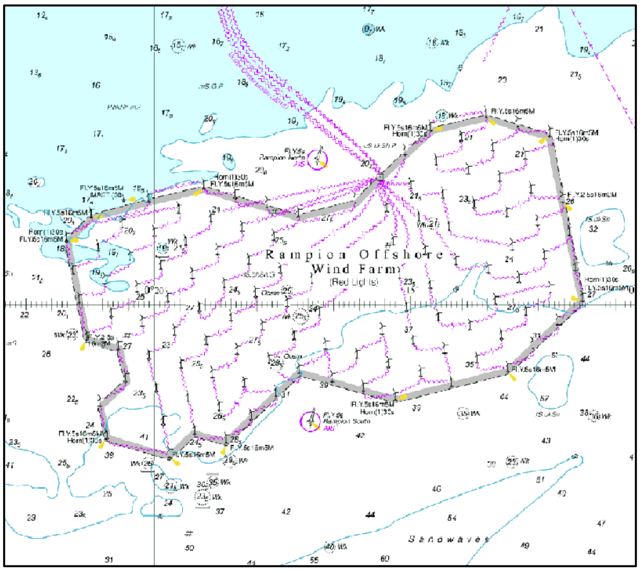
2.4 **Sound signals:** Where required on a wind farm, the typical range of such a sound signal shall not be less than two (2) nautical miles. Details will be given on the chart.

2.5 **Mooring buoys:** For vessels navigating within a wind farm array, mariners should be aware of potential mooring buoys within the boundary. These may be conventional mooring buoys or be electrical charging buoys for vessels with hybrid technology. Vessels that are operationally associated with a wind farm may also moor to an asset for the same reasons.

2.6 **Markings:** Individual turbines will be marked with a unique alphanumeric identifier which should be clearly visible at a range of not less than 150 metres. At night, the identifier will be lit discretely, (e.g. with down lighters), enabling it to be seen at the same range. Wind turbines are therefore readily visible in good conditions; however it should be remembered that they may not be so easily seen at night or in reduced visibility from the wind farm interior. Red aviation lights on the tops of the nacelles may be visible to surface craft (flashing Morse-W), and care must be taken not to confuse these with vessels' sidelights or marine navigational aids, despite the possibility of them appearing to have a flashing characteristic when seen through rotating turbine blades.

2.7 **Charting:** All wind farms off the UK coast, including those under construction, will be included on Admiralty charts by the UKHO either by a group of black wind turbine chart symbols on larger scale charts, or an outer limit with an encircled black wind turbine symbol on smaller scale charts. The outer limit on all scales will be a black dashed line, or a magenta T-shaped dashed line if there are navigational or other restrictions in the area (this may be supplemented by a 3mm stipple band of the appropriate colour); see Admiralty Chart 5011(INT1) - *Symbols and Abbreviations used in Admiralty Charts*. The anchor spread of moorings at floating wind farm sites are charted on the smaller scaled charts.





Examples of offshore wind farm charting.[3]

Similarly, all wind farms in UK waters are shown on ENCs as Offshore Production Areas with standard S57 symbology for turbines and cables. Whether all submarine cables associated with wind farms will be charted depends upon the scale of the chart. As with

[3] © Crown Copyright and/or database rights. Reproduced by permission of The Keeper of Public Records and the UK Hydrographic Office (www.gov.uk/government/organisations/uk-hydrographic-office).

all submarine cables mariners should note the hazards associated with anchoring or trawling near them. Heed should also be taken of any chart notes relating to wind farms.

2.8 Effects of Wind Farms and Wind Turbines on routeing options. When planning a voyage, mariners must assess all hazards and associated risks. The proximity of wind farms and turbines should be included in this assessment. This section provides information on the effects of wind farms and their turbines, which should be considered:

2.8.1 **Spacing:** Turbines within a wind farm are spaced at least 500 metres apart depending on the size of the turbine. In order to make best use of the wind resource, turbine spacing is proportional to the rotor size and the down-wind wake effect created, therefore the larger the rotor diameter the greater the spacing. Smaller craft may be able to navigate safely within the wind farm boundaries, while larger craft will need to keep clear.

2.8.2 **Depth of water:** The majority of wind turbines currently in operation are located in water depths of less than 60m (LAT), where navigable channels in the vicinity may restrict vessels to a particular route passing close to a wind farm boundary. However, floating wind farms, e.g. Hywind Scotland Pilot Park off Peterhead and Kincardine off Aberdeen, can operate in much deeper waters of over 100m and several sites in the Celtic Sea and Scottish waters are in the planning stages.

2.8.3 **Seabed changes:** Wind farm structures could, over time, affect the depth of water in their vicinity. In dynamic seabed areas with strong tidal streams, changes in the scouring of the seabed may occur. This may result in depth information being unreliable. Once a wind farm has existed for a few years there will be a better appreciation of any tidal scour or changes of depth. Wind farm developers are required to assess any potential changes in sedimentation that may occur as a consequence of their plans. Development may be permitted where the assessed effect is considered tolerable. In practice though the actual effect could differ, so mariners should bear this in mind and allow sufficient under-keel clearance with a suitable margin of safety. Some wind turbines have scour protection in the form of boulders and/or concrete mattresses placed around their base.

2.8.4 **Tidal streams:** Wind farm structures may obstruct tidal streams locally, creating eddies nearby. Mariners should be aware of the likelihood of such eddies which are only likely to be significant very close to the structures.

2.8.5 **Vessels:** Smaller high-speed vessels (e.g. Crew Transfer Vessels) or larger vessels involved in construction and maintenance (e.g. jack-up vessels, crane barges and Service Operations Vessels) and safety duties may be encountered within or around a wind farm. Higher traffic densities of windfarm employed vessels can be expected during construction periods or in summer months and construction personnel can travel to and from turbines on a daily basis. Floating turbines will be towed to/from ports during construction and for maintenance. Fishing vessels may also be operating in the area. Mariners should be alert to the likely presence of such vessels and be aware that the structures may occasionally obscure them. This is particularly relevant at night. Large vessels may also become obscured, for example if they are on the opposite side of a wind farm. Smaller and shallow profiled unmanned survey vessels are becoming more prevalent inside the wind farm boundary and along the export cable route.

Whilst they still should be complying with the International Regulations for Preventing Collisions at Sea (COLREGS), a good lookout should be maintained at all times by all available means, as required.

2.8.6 **Shore marks:** In coastal areas shore marks may also become obscured by wind farm structures. Mariners should be particularly alert to this. In particular, the characteristics of lights at night may need careful verification if turbines temporarily mask them. The ship's position should be checked by other means when a wind farm obscures coastal marks.

2.8.7 **Transformer stations:** In or adjacent to larger wind farms offshore electrical transformer-stations may be present. These are of similar appearance to small offshore production platforms and are sometimes referred to as Offshore Sub-Stations (OSS). Submarine cables link turbines to this sub-station from where the generated power is exported to the shore. Whether all submarine cables are charted depends upon the scale of the chart; in some cases only the export cable may be shown. All craft operating within a wind farm should therefore avoid anchoring except in emergencies as the anchor could easily become fouled.

2.8.8 **Degrees of motion:** Floating infrastructure, whether wind turbines or wave or tidal energy devices, will move on its moorings according to metocean conditions and type of equipment. Mariners should give due consideration for the degrees of motion (pitch, roll, yaw, heave, surge and sway) when in close proximity which may affect such hazards as the air clearance of the blades and under-keel clearance of mooring lines.

2.9 Effects on Communications and Navigation systems. In 2004 the MCA and QinetiQ conducted trials at the North Hoyle wind farm to determine any impact of wind turbines on marine communications and navigations systems. The results from the full report, available on the MCA web site, are summarised below.

2.9.1 The trials indicated that there is minimal impact on VHF radio, Global Positioning Systems (GPS) receivers, cellular telephones and AIS. UHF and other microwave systems suffered from the normal masking effect when turbines were in the line of the transmissions.

2.9.2 The turbines produced strong radar echoes giving early warning of their presence. At close range, however, the trials showed that they may produce multiple reflected and side lobe echoes that can mask real targets. These develop at about 1.5 nautical miles, with progressive deterioration in the radar display as the range closes. Where a shipping lane passes within this range considerable interference may be expected along a line of turbines. Target size of the turbine echo increases close to the turbine with a consequent degradation of target definition and bearing discrimination. These effects were encountered on both 3cm and 10cm radars.

2.9.3 Similar effects were found during the BWEA-funded trials undertaken off the Kentish Flats wind farm in 2006. Radar antennae which are sited unfavourably with respect to items of the ship's structure can enhance these effects. Careful adjustment of radar controls can suppress some of these spurious radar returns but mariners are warned that there is a consequent risk of losing targets with a small radar cross section, which may include buoys or small craft, particularly yachts or GRP constructed craft, therefore due care should be taken in making such adjustments.

2.9.4 A more recent study on impacts of wind turbines on marine radar was conducted by *Ocean Studies Board's Division on Earth and Life Studies, USA* in 2021. Desk-top studies were undertaken on impacts of modern solid-state radars and magnetron-based radars. The report published by them *'Wind Turbine Generator Impacts to Marine Vessel Radar'* concluded that wind turbines in the maritime environment affect marine vessel radar in a situation-dependent manner, leading to complications in navigation decision-making. Opportunities exist to reduce wind turbine generator–induced interference on marine vessel radars, such as improved radar signal processing and display logic or signature-enhancing reflectors on small vessels to minimize lost contacts.

2.9.5 If these interfering echoes develop, the requirements of the COLREGS Rule 6 *Safe speed* are particularly applicable and must be observed with due regard to the prevailing circumstance. In restricted visibility Rule 19 *Conduct of vessels in restricted visibility* applies and compliance with Rule 6 becomes especially relevant. In such conditions mariners are required, under Rule 5 *Lookout* to consider information from other sources which may include sound signals and VHF information, for example from a VTS, or AIS. Mariners should bear in mind though that not all vessels are equipped with AIS. Further information can be found in Marine Guidance Note *Navigation: Watchkeeping Safety – Use of VHF Radio and AIS* and subsequent updates.

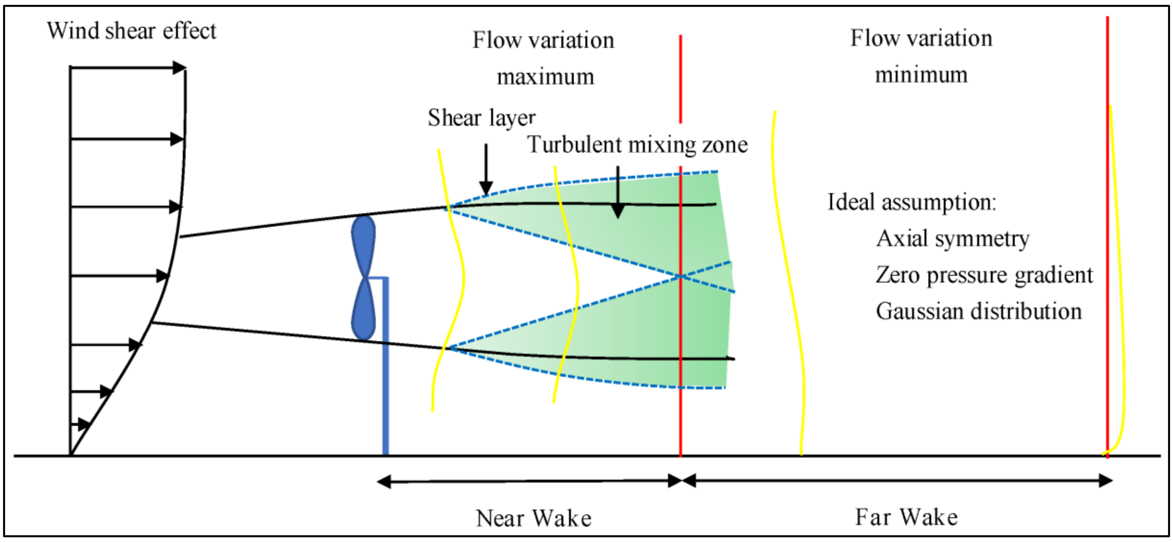
2.9.6 Where adequate safe water exists, it is prudent in planning the voyage of larger vessels to set tracks at least 2NM clear of turbine fields.

2.10 Rotor effects. Offshore wind turbines located around the UK are required to have the lowest point of the rotor sweep at least 22 metres above Mean High Water Springs. This clearance should be sufficient for the majority of small craft. Those with a greater air draught should be aware of this height and take appropriate care. It would, in any case, be imprudent for larger vessels to be this close to a turbine, other than in an emergency.

2.10.1 In harvesting energy turbines "de-power" the wind. Research indicates that a 10% reduction in wind velocity in the lee of a wind turbine may be expected. This wind-shadow effect is predicted to exist within the vertical air column at heights of approximately 15 metres and higher. The impact of the wind-shadow reduces with distance in the lee of a turbine and the inter-turbine spacing affects the impact of rotor wash or wake. The width of the rotor wake is broadly similar to the rotor diameter. As the rotor wake interacts with the sea surface further shadow effects are predicted. The wind, having changed its flow through the rotors, will be expected to recover downwind of the turbine and windshear may occur as the wind back fills.

2.10.2 In simple terms, the effect of a turbine rotor harvesting the wind can be pictured as a horizontal cone, centred on the rotor hub with the approximate diameter of the rotor. The cone extends down-wind, attenuating to a point at a distance proportional to the wind velocity. This down-wind effect will also be dependent upon the azimuth of the rotor. The impact on a vessel will be proportional to its windage area and, for a sailing vessel, the mast height.

2.10.3 Mariners, particularly yachtsmen, need to be aware of these effects. By day, the normal visual clues should be noted and changes in leeway or the balance of tidal stream to wind power anticipated. Extra care should be taken at night when visual clues are not so easily detected.



Wind turbine wakes[4]

2.11 **Promulgation of Information.** Wind farm developers will issue local notifications to publicise the activity associated with the construction and maintenance of a wind farm. The notification should include the marking, location and extent of such areas.

3 Offshore Wave and Tidal Energy Installations

Unlike wind farms, wave or tidal energy installations may not be clearly visible to the mariner.

3.1 **Wave energy convertors** (WECs) capture kinetic energy carried by waves. Wave energy convertors are likely to be located at or near the surface from an attachment or mooring point on the seabed. WECs may be floating or semi-submerged. The following definitions are used:

3.1.1 Attenuator: An attenuator is a floating device which works in parallel to the wave direction and effectively rides the waves. Movements along its length can be selectively constrained to produce energy. One example consists of large linked floating cylinders which are connected by a hydraulic system. Potential energy is stored via hydraulic rams, which operate as the hinged units move in the waves. The generated pressure is used to drive turbine generators inside the cylinders.

3.1.2 Point absorber: A point absorber is a floating structure which absorbs energy in all directions through its movements at/near the water surface

3.1.3 Oscillating Wave Surge Converter: An arm oscillates as a pendulum mounted on a pivoted joint in response to the movement of water in the waves.

[4] Li, Y., Xu, Z., Xing, Z., Zhou, B., Cui, H., Liu, B. & Hu, B. (2020). A Modified Reynolds-Averaged Navier–Stokes-Based Wind Turbine Wake Model Considering Correction Modules. *Energies*. [Online]. 13 (17). p.p. 4430. Available from: https://doi.org/10.3390/en13174430

3.1.4 Oscillating water column: An oscillating water column is a partially submerged, hollow structure. Waves cause the water column to rise and fall allowing trapped air to flow to and from the atmosphere via a turbine. The rotation of the turbine is used to generate electricity.

3.1.5 Overtopping device: This type of device relies on physical capture of water from waves which is held in a reservoir above sea level, before being returned to the sea through conventional low-head turbines which generates power. An overtopping device may use collectors to concentrate the wave energy.

3.1.6 Submerged pressure differential: These devices are typically located near shore and attached to the seabed. The motion of the waves causes the sea level to rise and fall above the device, this pressure differential being used to generate electricity.

Other devices may have unique and very different designs to the more well-established types of technology.

3.2 **Tidal energy convertors** (TECs) capture potential energy from the movement of large bodies of water as the tides ebb and flow. TEC devices may be surface, sub surface or seabed mounted structures, which capture the potential energy present in the moving body of water associated with a tidal stream. Power export is normally via cables to an electrical terminal or directly to shore.

3.2.1 Horizontal axis turbine: This type of device extracts energy from moving water in much the same way as wind turbines extract energy from moving air using a vertical rotor plane.

3.2.2 Horizontal axis turbine (enclosed blade tips): The funnel-like collecting device, usually with Venturi effect to accelerate water column, sits submerged in the tidal current. The flow of water can drive a turbine directly or the induced pressure differential in the system can drive an air-turbine.

3.2.3 Vertical axis turbine: This device extracts energy from moving in a similar fashion to that above, however the turbine is mounted on a vertical axis, i.e. using a horizontal rotor plane

3.2.4 Oscillating Hydrofoil. A hydrofoil attached to an oscillating arm and the motion is caused by the tidal current flowing either side of a wing, which results in lift.

3.3 **Methods for fixing WECs and TECs to the seabed**

From the mariner's perspective it is important to realise that there are various methods by which devices can be fixed to the seabed, which will affect their visibility above the surface.

3.3.1 Seabed Mounted / Gravity Base Devices: physically sit on the seabed by virtue of the weight of the combined device/foundation. In some cases, there may be additional fixing to the seabed.

3.3.2 Pile Mounted: This principle is analogous to that used to mount most large wind turbines, whereby the device is attached to a pile penetrating the ocean floor.

3.3.3 Floating Flexible Mooring: The device is tethered via a cable/chain to the seabed, allowing considerable freedom of movement. This allows a device to swing as the tidal current direction changes with the tide.

3.3.4 Floating Rigid Mooring: The device is secured into position using a fixed mooring system, allowing minimal movement.

3.3.5 Hydrofoil Inducing Down Force: The device uses a number of hydrofoils mounted on a frame to induce a positioning down force from the tidal current flow.

3.4 Transformer Station or Hub – A special structure containing power conversion equipment either within or outside the wave or tidal energy array to which individual generators are connected via a power cable. A submarine cable transfers the power ashore from the hub. A hub may be a separate fixed or floating platform.
Note: *Animated illustrations of current and proposed wave and tidal devices can be seen at: www.emec.org.uk*

3.5 Visibility and Marking of Wave and Tidal Energy Installations:
Visibility will depend on the device type. Some installations are totally submerged while others may only protrude slightly above the sea surface. Marking will be based on IALA *Guidelines G1162 on the marking of offshore wave and tidal energy devices*, which states that:

Wave and Tidal energy extraction devices should be marked as a single unit or as a block or field as follows:

1. *When structures are fixed to the seabed or in the water column and extend above the surface, they shall be marked in accordance with this guidance.*

2. *It is recommended that:*

   a. *Subject to the proper risk assessment, areas containing on surface or sub-surface wave or tidal devices are marked by appropriate AtoN. In addition, radar reflectors, retro-reflecting material, racons and / or AIS transponders should be considered where the level of traffic and degree of risk requires.*
   b. *The AtoN must be visible to the mariner from all relevant directions in the horizontal plane, by day and lighted at night.*
   c. *Taking the results of a risk assessment into account, lights must have an appropriate nominal range and vertical divergence and may be synchronized.*
   d. *Individual wave and tidal energy devices within a site that extends above the surface are painted predominantly yellow above the waterline and have yellow retro-reflective tape as required by the competent authority. If navigation is permitted within site, marking of individual devices may be required.*
   e. *If marked, the individual devices should have flashing yellow lights. The flash character of such lights must be sufficiently different from those displayed on the boundary lights with a nominal range of not less than two Nautical miles.*
   f. *Floating AtoN could be located outside the moorings of the floating structures.*

3. *Based on risk assessment, a single wave or tidal energy extraction structure, standing alone, may be marked as follows:*

   - *Isolated Danger mark; or*
   - *Special mark.*

4. *The AtoN described herein should comply with IALA recommendations and guidelines and have an appropriate availability normally not less than 99.0% (IALA Category 2).*

3.6 **Promulgation of Information.** Wave and tidal energy developers will issue local notifications to publicise the activity associated with the construction and maintenance of a wave or tidal array site. The notification should include the marking, location and extent of such areas.

4 Safety Zones

4.1 Temporary Safety Zones may be established around turbines of up to 500m radius measured from the outer edge of the surface infrastructure. The Energy Act 2004 provides the regulatory framework for safety zones in the UK and they are granted upon successful application to one of the following, depending on location and energy capacity of the site:

a. Department for Business, Energy and Industrial Strategy (BEIS)
b. Marine Scotland
c. Marine Management Organisation [England]
d. Natural Resources Wales
e. Department of Agriculture, Environment and Rural Affairs [Northern Ireland]

4.2 Safety zones are applied during the construction, major maintenance and decommissioning periods of OREIs to reduce risks to vessels navigating in the area, and to personnel and construction vessels working on the infrastructure. In this regard they are similar to safety zones issued around oil and gas infrastructure under the Petroleum Act 1987 which are permanent for their lifetime.

4.3 Safety Zones differ from Exclusion Zones which are established around vessels that are wrecked, damaged or in distress and are made under the Merchant Shipping Act 1995 and Protection of Wrecks Act 1973.

4.4 Such Safety Zones will be promulgated by Notices to Mariners and Radio Navigation Warning broadcasts. Safety Zones will be monitored by support craft which may include fishing vessels employed by developers as guard vessels or by developers' marine coordination centres. Mariners should give such zones a wide berth. Skippers of fishing vessels operating in the area should make themselves aware of any information promulgated by the local OREI Fishing Liaison Officer.

4.5 Where a temporary Safety Zone does not exist around a structure, developers may advise a safe passing distance. This will be promulgated through their local notifications, guard vessel or marine coordination centre.

4.6 Safety Zones are not established around entire wind farm arrays, as compelling risk-assessed arguments would be required for their establishment. However, applications for the establishment of safety zones around single installations during the operational phase of an OREI will be considered on a case-by-case basis, taking site specific conditions into account. An electronic version of the BEIS guidance note on applying for safety zones around an OREI can be found on the BEIS website.

4.7 It may be necessary to limit access for specific activities (such as trawling) where the infrastructure requires restriction of such activity. In such cases the requirements will be promulgated separately. The UKHO will publish information for specific sites on charts and in their publications when the extent of this change is known. It should be noted that the anchors and mooring lines on the seabed of a catenary mooring system will be outside a 500m safety zone.

4.8 With respect to other types of OREI, the establishment of safety zones may be more proscriptive, since wave and tidal devices may not be fixed in position, may extend horizontally for considerable distances on or below the sea surface, and may have potentially dangerous moving parts. Their low profiles may make them difficult to detect visually or by radar. Operational developments will include research and trial units whose positions may vary at short notice.

4.9 **Access to Safety Zones and OREI Infrastructure**

4.9.1 Mariners should remain a safe distance from the OREI and should not enter a safety zone unless it is in the connection with the saving of life/property, owing to stress of weather or if in distress.

4.9.2 Mariners should be aware that there is no right of access to any type of OREI device. They are private property and appropriate warning signs are displayed. In any event access requires skill and is limited by sea state and should only be undertaken in controlled circumstances by trained personnel.

4.10 **Emergencies close to or within an OREI site**

4.10.1 In emergencies such as engine or steering failures close to or within OREI, mariners should immediately inform HM Coastguard and be prepared to use anchors if necessary, being aware of submarine cables and other seabed obstructions.

4.10.2 Mariners may, in extreme emergency, seek refuge on wind turbine towers. Access is via vertical ladders which may be encrusted with marine growth in the inter-tidal zone. Not all turbines may have access ladders, particularly newer generation turbines. Boarding turbines is hazardous and difficult, but the towers can provide refuge if the circumstances require. Very limited shelter from the elements can be obtained pending rescue, as internal access to the turbine tower will not be possible.

4.10.3 If taking refuge on a turbine tower, mariners are warned that the rotors will continue to turn until others become aware of their plight. In such circumstances, mariners should alert HM Coastguard by the best means available, remembering that the turbine tower may obscure line of sight communications, so they may need to adjust their position on the platform.

4.10.4 Once alerted, HM Coastguard can contact the wind farm operations control room which can remotely shut down individual turbines, if necessary. Mariners will not be able to access the internal structure and helicopter rescue from the nacelle will not be possible. In such conditions distressed mariners will have to wait for evacuation by sea when sea conditions permit.

4.10.5 Mariners in emergency are unlikely to be able to use wave or tidal turbines as places of refuge. They are normally located in areas of high significant wave height or strong currents and as such, it may not be safe to approach them, particularly if vessels are already in distress and are not able to safely manoeuvre. They could have several snagging hazards on them which could create more of a hazard than a refuge.

4.10.6 When responding to a distress call or alert from within a wind farm or other OREI mariners should make a careful assessment of the risks associated with entering the area, taking into consideration the guidance outlined above. Large vessels may be unsuitable for requisitioning, but all mariners should initially respond as required by international law and immediately relay the details to the nearest HM Coastguard Maritime Rescue Coordination Centre.

4.10.7 It is recommended that vessels constantly operating in or near the vicinity of offshore wave devices, tidal energy devices or floating wind farms should develop contingency and emergency response plans which address the possibility of individual devices breaking loose and becoming floating hazards.

4.11 Options for Mariners

4.11.1 In taking account of this guidance there are, in simple terms, three options for mariners:

a. Avoid the OREI area completely,
b. Navigate around the edge of the OREI, or
c. Navigate with caution through the OREI.

4.11.2 The choice will be influenced by several factors including the vessel's characteristics (type, tonnage, draught, manoeuvrability etc), OREI type, the weather and sea conditions.

4.11.3 Mariners should be aware that radar targets may be obscured when close to a wind turbine array.

4.11.4 These notes do not provide guidance on specific safe distances at which to pass an OREI for individual vessel types and conditions. However, where there is sufficient sea room it is prudent to avoid the area completely (option (a) above).

4.11.5 When choosing to navigate around or through the OREI, mariners should keep a close look out for hazards as outlined within this document and in all instances, mariners should passage plan accordingly.

5 Way ahead

This guidance may be updated in the future as more experience of offshore wind farms and other OREIs has been gained. Problems of an urgent nature relating to all OREI types should be reported immediately to HM Coastguard. Mariners may wish to report effects or other problems they experience to the UK Technical Services Navigation Branch of the MCA.

6 Conclusion

Although offshore renewable energy installations present challenges to safe navigation around the UK coast, proper voyage planning and gathering all relevant information, should ensure a safe passage for the vessel and safety of life is not compromised.

More information

UK Technical Services Navigation
Maritime and Coastguard Agency
Bay 2/04
Spring Place
105 Commercial Road
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SO15 1EG

Telephone: +44 (0)203 8172554

Email: navigationsafety@mcga.gov.uk

Website: www.gov.uk/mca

Please note that all addresses and telephone numbers are correct at time of publishing.

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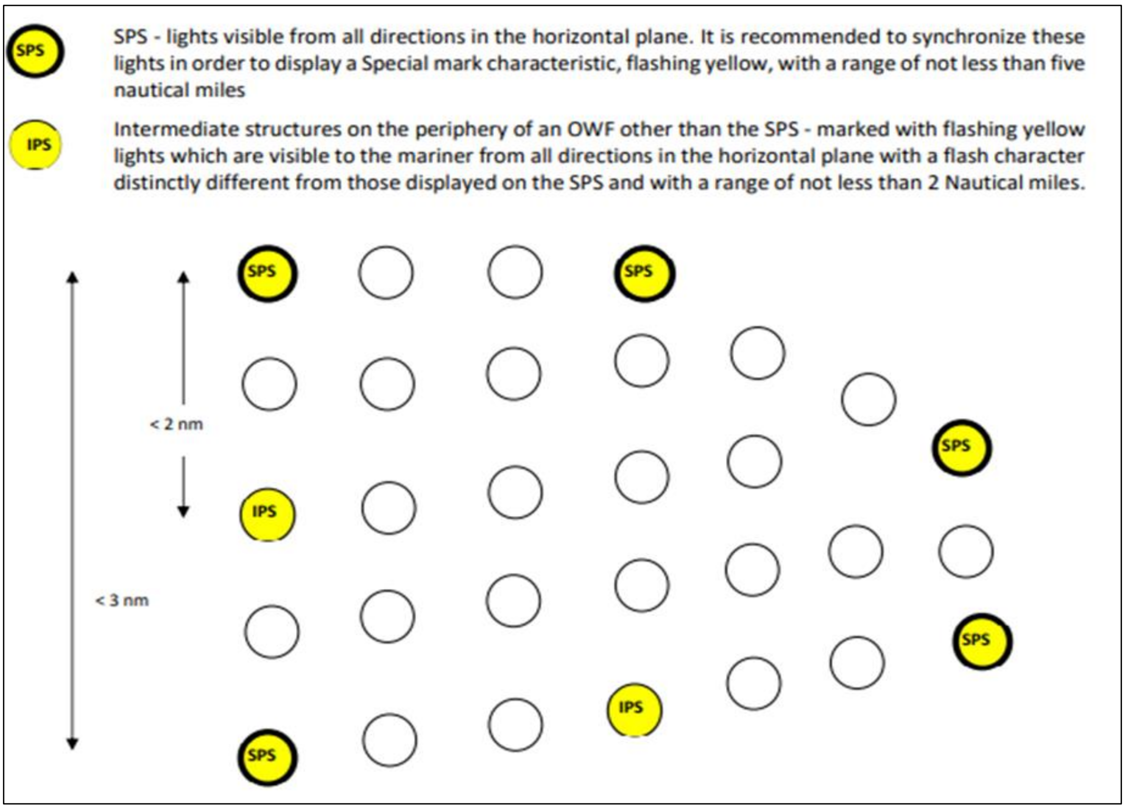
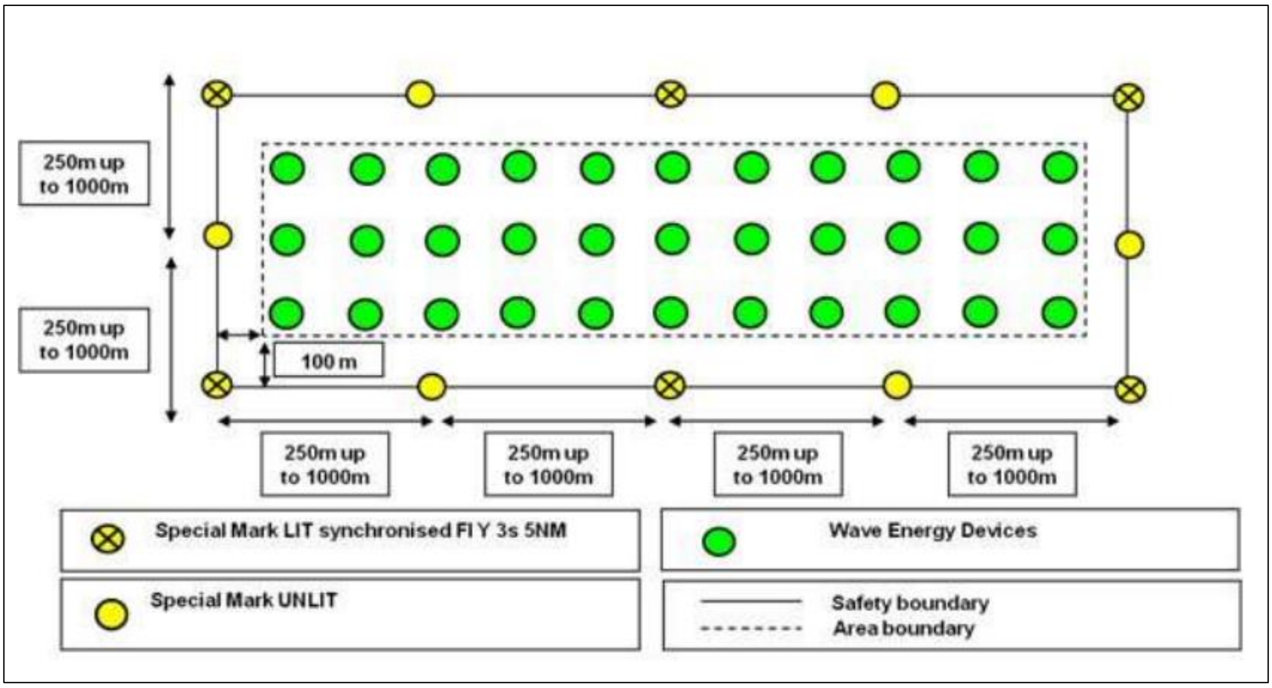
ANNEX

Marking and Appearance of OREIs

1. Examples of OREI Marking





Example of Wave and Tidal Devices Marking (Source: IALA AISM (iala-aism.org)

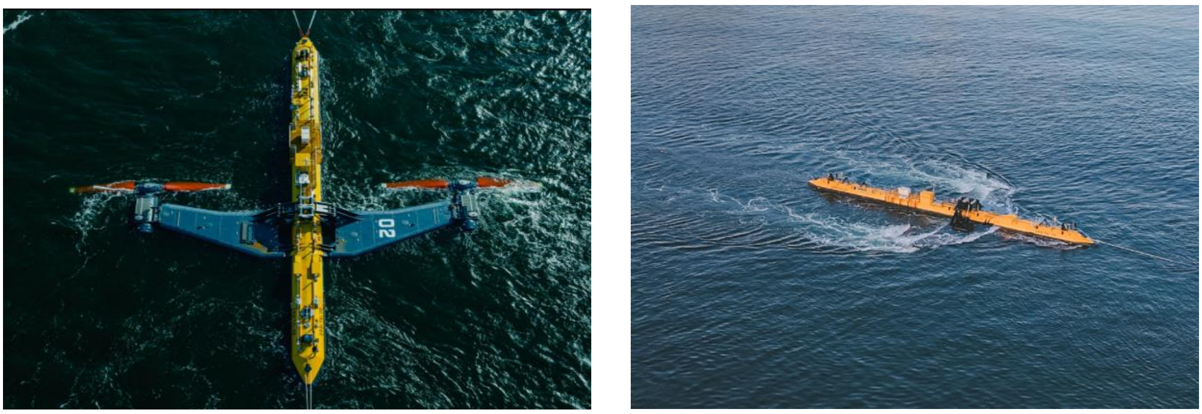
2. Examples of Wind Turbines

Fixed foundation turbine
(Source: The Crown Estate)

Floating foundation turbine
(Source: Principle Power)

3. Examples of Wave and Tidal Devices

Mocean Energy: Blue X- Wave Energy Converter: Prototype testing off Scotland
(Source: Mocean Energy)



Orbital- O2: Tidal Energy Converter situated in the Fall off Warness, Scotland
(Source: Orbital Marine Power)