OFFSHORE RENEWABLE ENERGY DEVELOPMENTS

Proposals for offshore renewable energy development are increasing. This briefing note, describes some of the different devices that are currently being proposed around our coastline, what they will look like and how to identify them when you are out at sea.

BACKGROUND

In 1998, following the signing of the Kyoto Protocol, the UK Government started to work towards developing renewable energy technologies with the aim to generate 10% of all UK electricity from renewable sources by 2010. Over the last 8 years the renewable industry has grown considerably and as a result so have the generators, sites required and expected out put of the developments. This has led to increased opposition to onshore projects and with the 2010 deadline looming, technology has now moved offshore where there is increased space and potential for renewable energy developments in the form of wind, wave and tidal energy generators.

OFFSHORE WIND FARMS

- UK offshore wind farms will be developed in three areas: the Thames Estuary, Greater Wash and Liverpool Bay, a total of 33 sites have been proposed
- Round 1 sites: 18 sites are within 12 nautical miles of the coast and are limited to 30 turbines
- Round 2 sites: 15 sites are beyond 12 nautical miles with up to 120 larger turbines
- To date there are three fully operational Round 1 wind farms: North Hoyle, Scroby Sand and Kentish Flats.

Constructing a wind farm

Before a site can be constructed there is a lengthy consents process in which stakeholders (interested parties) including the RYA are consulted and can comment.

The first stage of construction involves large piles being driven into the seabed to form a solid foundation for the turbine. This is followed by additional protection, such as large boulders and rocks, being placed at the base to ensure the substrate surrounding the pile is not washed away, causing subsidence.

The turbine structure is then assembled and consists of a tower, three blades and the nacelle (see figure 1). For the unit to work, sensors on the turbine detect the wind direction and turn the nacelle to face the wind which consequently turns the blades to generate electricity.

During this phase, there will be a temporary safety zone keeping all navigation 500 m from the construction activity.

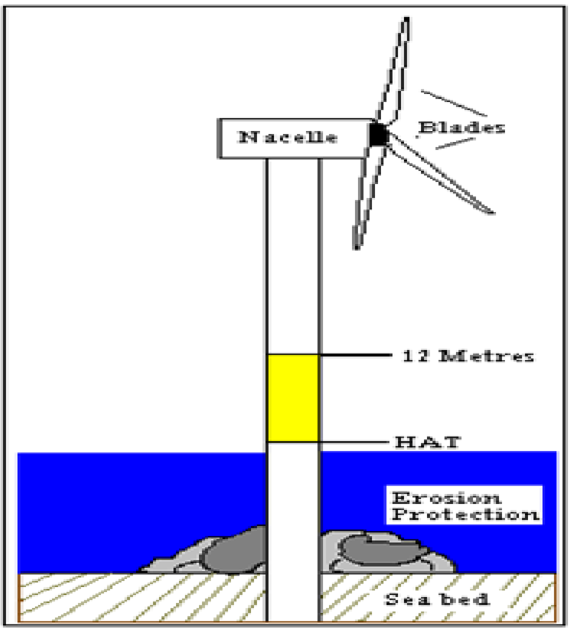


Figure 1 Components of a wind turbine

Wind farm operation

The turbine is now in the operational phase and will start generating electricity at wind speeds of around 3-4 metres per second (8 miles per hour). They will generate maximum power at around 15 m/s (30mph) and shut down to prevent damage at 25 m/s or above (50mph).

Sub-sea cables run from each individual turbine and take the power to an offshore transformer station which converts the electricity to a high voltage, before running it back to connect to the national grid at a substation on land.

Navigating within Wind Farms

The RYA has secured a minimum rotor clearance height of 22 m above MHWS to ensure the safety of the majority of small recreational craft. At present there are no safety zones excluding small craft navigating close to the turbines but you are advised to stay a safe distance from the turbines. Your decision on navigating through these arrays should of course account for the wind, wave and tidal conditions, your vessels clearance height and the existence of underwater scour protection and cabling around each turbine.

The turbines are generally constructed with a minimum of 300 metres between each structure, generally more, leaving plenty of space for safe in favourable conditions navigation through an array.

You should not tie up to or land on the turbine structures except in emergency situations where there is provision to take refuge on the maintenance platform that is generally around 12 metres above sea level. Likewise anchoring is prohibited in many cases, except in emergency situations.

Marking and lighting

Trinity House set the requirements for marking and lighting of the turbines which are in turn guided by IALA recommendations.

- During construction, buoys may be laid to mark the predominant corners of the site.
- The lower tower of each turbine will be painted high visibility yellow from Highest Astronomical Tide (HAT) to 12 metres or more above the waterline.
- Each turbine will be numbered and lit with low level lighting just above this level which is the level of the maintenance access platform.
- Any lights on the turbine will be seen no less than 6 metres and no more than 15 metres above HAT.
- The "corner" turbines and any other significant points on the periphery of the array will be marked by an IALA "Special mark" characterised by a flashing yellow light, with no less than a 5 nm range.
- The distance between special marks should not normally exceed 3 nm.
- Larger wind farms where the corners are further than 3 nm apart, additional turbines located on the boundary will be lit with yellow lights flashing as a sequence different from the corners and visible to the mariner from all directions with a range of 2 nm or more. The distance between these turbines or the nearest corner will not exceed 2 nautical miles.
- In areas where fog is a regular occurrence wind farms will have fog horns fitted that will cover a range of no less than 2 nautical miles.
- Notices to Mariners and Radio Navigational Warnings will be published to inform mariners of construction, establishment and decommissioning of any wind farm.
- The relevant Hydrographic Office will be informed of the development of any wind farm and it will then be charted appropriately.

WAVE POWER

The UK has some of the most powerful wave resource in Europe, focused along the west coast. The accessible UK wave resource is estimated at exceeding the current electricity consumption of the country. Wave technology is considerably less developed than that of wind power and there are currently only a few fully functional wave energy generators up and running world wide, of which two are off the UK coast.

Wave energy devices

Pelamis, from Ocean Power Delivery (OPD) is flexibly moored which allows it to swing head-on to the incoming waves and therefore

cover successive wave crests.

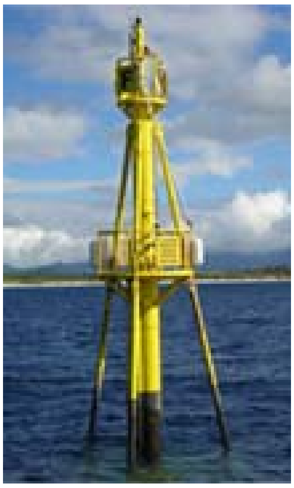
The structure is semi-submerged, made up of cylindrical sections and linked together with hinged joints. The motion of the waves creates movement in the joints, which through hydraulic rams is subsequently resisted. The rams then pump high-pressure oil through hydraulic motors via smoothing accumulators. The hydraulic motors are connected to and drive electrical generators to produce electricity. The power produced from all the joints is fed down a single cable to a junction on the sea bed. A number of Pelamis devices can be connected together and linked to shore through a single seabed cable.

There is one Pelamis structure currently in operation at the European Marine Energy Centre off the Orkney coast. It is about the size of four train carriages, measuring 120m in length and 3.5m in width and weighing 750 tonnes fully ballasted. It is a 750kW machine and was connected to the UK grid in August 2004. Pelamis produced the first offshore wave energy to be exported into the UK electricity system.

LIMPET from Wavegen (Land Installed Marine Powered Energy Transformer) is the

world's first commercial scale wave energy converter, located on the coast of Islay in the Highlands of Scotland. It is the smallest of Wavegen's shoreline energy modules, and generates 0.5MW of power for local communities. There are now plans for Wavegen to install a LIMPET style generator on the Faeroe Islands.

Powerbuoy from Ocean Power Technologies (OPT) involves capturing the wave energy using large specialised buoys anchored to the sea bed. These buoys convert the wave energy into electricity via a number of ‘power take-off systems’. Offshore trials were first conducted off the coast of New Jersey,



USA from 1997, and the company are currently moving towards the commercial application of these buoys. The first 50kW ‘PowerBuoy’ has recently been installed in Hawaii.

Wave Dragon is made up of three main components:

1. Two wave reflectors which channel waves towards the ramp and are linked to the main structure.
2. The main structure which holds a double curved ramp where the channelled waves overtop entering a water storage reservoir.
3. A set of hydro turbines which convert the hydraulic head in the reservoir into electricity.

The Wave Dragon structure is stationary set up to face the predominant wave conditions. The turbines are the only moving parts.

TIDAL POWER

It has been predicted that 3000GW of tidal energy is theoretically available in the UK, but of that less than 3% is situated in areas suitable for power generation. Tidal current energy is very site specific, and only where tidal ranges are amplified by features such as shelving of the sea bottom and funnelling in estuaries can the energy be harnessed and utilised.

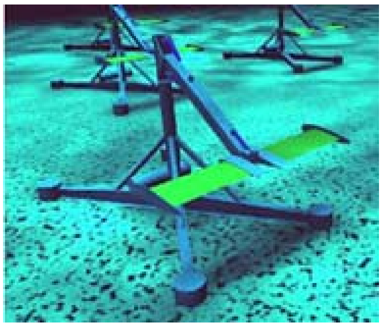
In 2001, 42 sites around the UK were listed as suitable for tidal stream generation and it has been estimated that at least 34% of the UK's electricity demand could be generated from the tide. The attraction of tidal power is that it is highly predictable, compared with other forms of renewable energy such a wind and wave.

Tidal energy devices

The Seaflow Project from Marine Current Turbines (MCT) has developed a tidal turbine that consists of rotors mounted on solid steel piles set in a socket drilled into the seabed. The rotors of the turbine are driven by the flow of water over the blades. Due to the dense properties of water, even relatively slow moving currents generate significant amounts of power. The first offshore device was installed May 2003 and is located 1 km off Foreland Point, on the north coast of Devon. It was the first large scale marine renewable energy system to be installed offshore world wide.

Stingray from The Engineering Business (EB) harnesses the flow of a tidal stream over the seabed to create an oscillating motion of the structures panels. This movement initiates the operation of hydraulic cylinders to drive a motor that, in turn, drives an electrical generator. This device is a seabed mounted machine, and can be situated in any water depth up to 100m.

In September 2002 the Stingray generator was tested offshore in the Yell Sound off the Shetland Islands. The machine installed was 180 tonnes, and capable of producing 150 kW of power. This was then removed and data collected for analysis to aid the further development of commercial units. The unit is now back in Yell Sound and future plans include a 5MW pre-commercial Stingray farm to be connected to a local power distribution system.



TidEL, from SMD Hydrovision will consist of a pair of counter-rotating 500kW turbines. These turbines are mounted together on a single connecting beam. The TidEL unit is buoyant and will be anchored to the seabed by a series of mooring chains. The flexible mooring system allows the turbines to turn with the tidal flow into a position down stream of the prevailing tide, and in doing so facing the blades towards the oncoming water flow. These structures can be moored in any reasonable coastal water depth but there is still work to be done before structures are assembled for true energy production.

Navigating around wave and tidal energy generators

The diversity of the devices being proposed for wave and tidal energy generation means that there is no clear advice that can be formulated regarding the navigation through these devices.

There are no safety zones excluding navigation around the existing installations although as with the wind farm arrays, you are advised to proceed with caution taking account the devices features, which should be promulgated in notices to mariners, and the current wave, tidal and weather conditions. In the future, safety zones may be established for certain craft on the basis of a risk assessment.

Marking and Lighting of Wave and Tidal Energy Generators

Trinity House is responsible for lighting and marking requirements of offshore wave and tidal generators.

Marking a wave or tidal array

- Prior to construction buoys may be laid to mark out the predominant corners of the site and will remain in place throughout all phases of the project.

- The boundaries of the wave and tidal energy extraction field will be marked by lit buoys, and will be visible from all directions during the day and at night and the lights will have a minimum range of 5 nm.
- The North, South, East, and West boundaries of the energy field will be marked with appropriate IALA Cardinal Marks.
- Individual devices within the field will generally not be marked or lit, but if they are it will be with a flashing yellow light with a range of 2 nautical miles or less.
- There may be active or passive radar reflectors, reflective material, or racons present depending on the area in question and the level of regular traffic.
- Devices within an array that extend above the waterline will be painted yellow, like the base of wind turbines.
- Boundaries and corners will be marked and lit like wind farm sites.

Marking individual devices

- A single wave and tidal device which is not visible above the surface, but has the potential to be a hazard to surface navigation, will be marked by an IALA 'Special mark' yellow buoy with a 5 nm range flashing yellow light.
- A single wave and tidal generator that extends above the surface will be painted black, with red horizontal bands. It will also be fitted with lights and top marks representative of an IALA Isolated Danger mark.

Promulgating information

- Notices to Mariners and Radio Navigational Warnings will be published to inform mariners of construction, establishment and decommissioning of any wind farm.
- The relevant Hydrographic Office will be informed of the development of any wind farm and it will then be charted appropriately.

MORE INFORMATION

RYA Website
www.rya.org.uk/KnowledgeBase/Environment

Contact the Environment Team at the RYA:
environment@rya.org.uk

British Wind Energy Association
www.bwea.org.uk

Department of Trade and Industry
http://www.dti.gov.uk/renewables/

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