FAIR HEAD TIDAL

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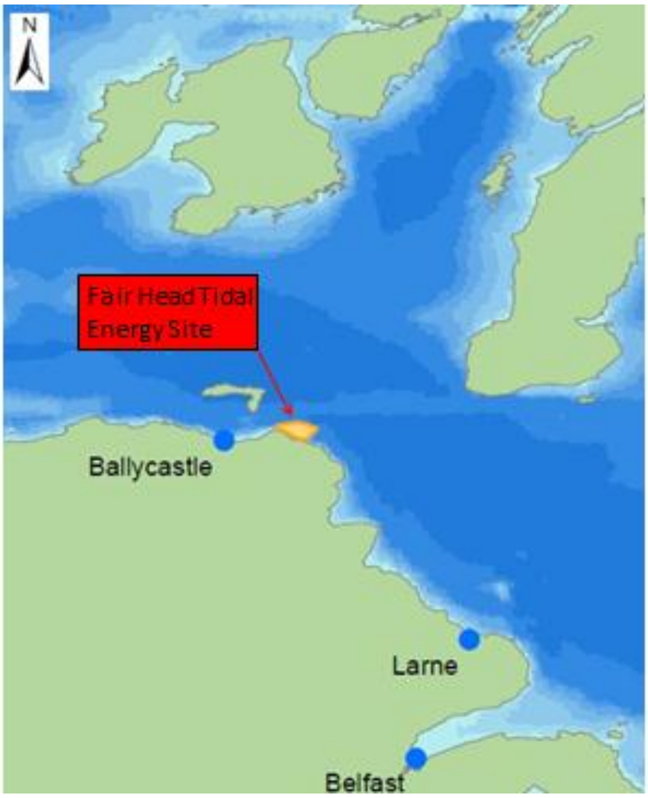

FAIR HEAD TIDAL

Project Description

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1.0 Introduction

In September 2012 a consortium formed by DP Marine Energy Ltd (DPME) and DEME Blue Energy (DBE) was awarded an Agreement for Lease (AfL) from The Crown Estate (TCE). A joint venture company (Fair Head Tidal Energy Park Ltd) has been formed to explore the potential, and develop, subject to permits and consents, a 100MW tidal energy project off the Antrim Coast at Fair Head. If, following consultation and environmental impact assessments, the proposal is consented the build programme will commence around 2016/2017 although this will depend heavily on resolving onshore grid connection issues. The ultimate target is to be in full commercial operation by the end of 2019.

The Crown Estate has also awarded an AfL to Tidal Ventures, a joint venture company between Bord Gáis and the tidal turbine manufacturer Open Hydro. This site located at Torr Head is also of 100MW capacity and lies immediately adjacent to the Fair Head site as illustrated in Figure 1 below. Whilst the two projects are distinct, because of their close proximity the project teams will be working together on a number of key elements of the project assessment including baseline assessments for Marine Mammal and Sea Birds and Cumulative Impact. In fact DP Energy Ireland Ltd (a sister company to DPME) has previously worked on wind energy developments with Bord Gáis in Ireland so an existing co-operative relationship already exists.

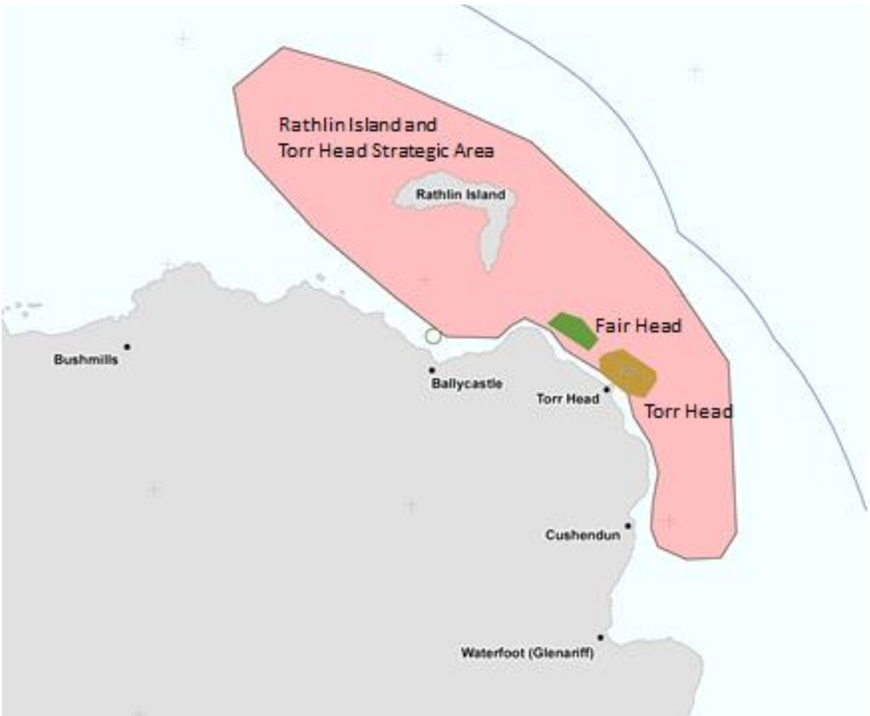


Figure 1: Northern Ireland Tidal Development Areas

2.0 Who We Are

2.1 DP Marine Energy Ltd (DPME)

DPME is one of a number of DP Energy Group companies which have been involved in the development of renewable energy projects in the UK, Ireland and overseas for almost 20 years. The DP Group have a proven track record in delivering renewable energy projects from green field through to operation and has developed over 180MW of operational wind farm projects the first being the Bessy Bell Wind Farm in County Tyrone in 1995 (Figure 2).


Figure 2: Bessy Bell Wind Farm – County Tyrone 1995

The key members of the DPME team have substantial experience in relation to obtaining renewable energy consents for major projects, finance, construction and operation experience for onshore wind, and direct engineering experience in the development, installation and commissioning of utility scale power generation.

Since 2007 DPME has been active in the marine sector and in addition to the Fair Head project is also developing a tidal stream project off the coast of Islay in SW Scotland (Figure 3).

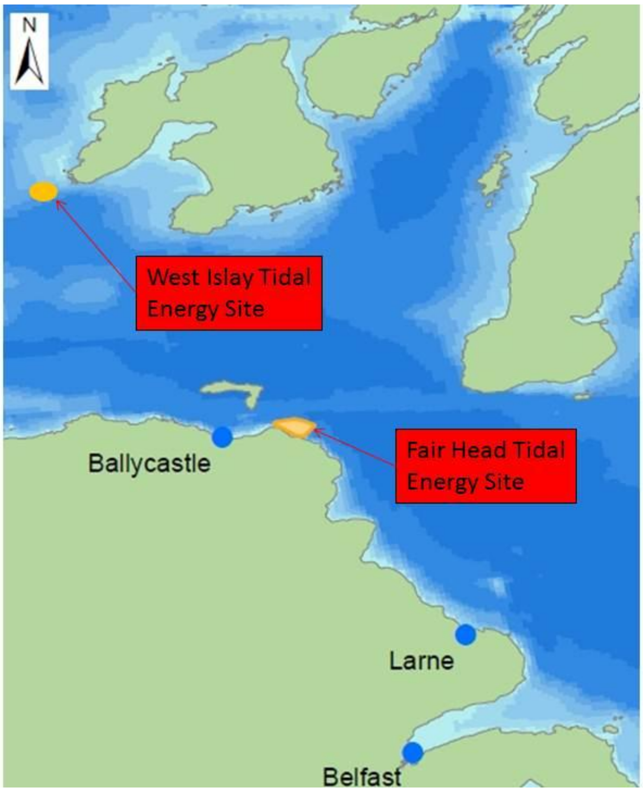


Figure 3: Location of North Channel Tidal Developments

DPME has built up experience in marine energy technical and consenting capability through its work in developing the Islay site from pre-scope through scoping and environmental impact assessment (EIA) implementation and will bring this experience to the Fair Head project. An application for consent for the Islay project will be lodged in early 2013.

2.2 DEME Blue Energy (DBE)

DEME is a Flemish marine construction group with roots going back 150 years and is one of the World's leading contractors in the marine construction sector and a pioneer in the development of offshore wind energy. The DEME group has significant in-house resources for marine construction and installation works including a large specialised fleet and support plant and equipment. In the tidal energy field DEME has direct experience with installing the SeaGen device at Strangford Lough in Northern Ireland utilising one of its heavy lift vessels the Rambiz (Fig 4). DEME Blue Energy (DBE) is a direct subsidiary of the DEME Group and was established specifically to both develop and invest in wave and tidal energy projects.

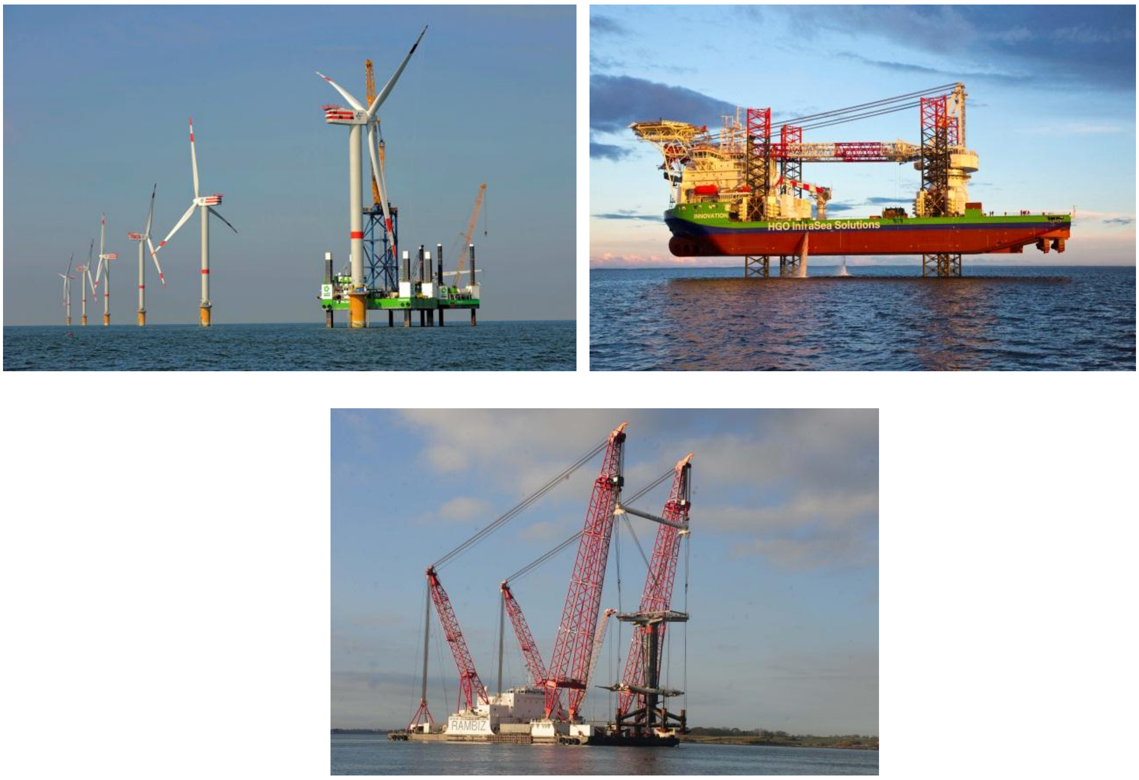


Fig 4 Images of DEME Installation Vessels Including "Rambiz" in Strangford Lough

3.0 Project Location

The development area lies within The Rathlin Island and Torr Head Strategic Area at around 2km to the east of Fair Head off the north Antrim coast and around 1km at its nearest point to land. It occupies an area of approximately 3km^2 is centred on Latitude 55.231 N and Longitude 6.107 W as illustrated in Figure 5 below.

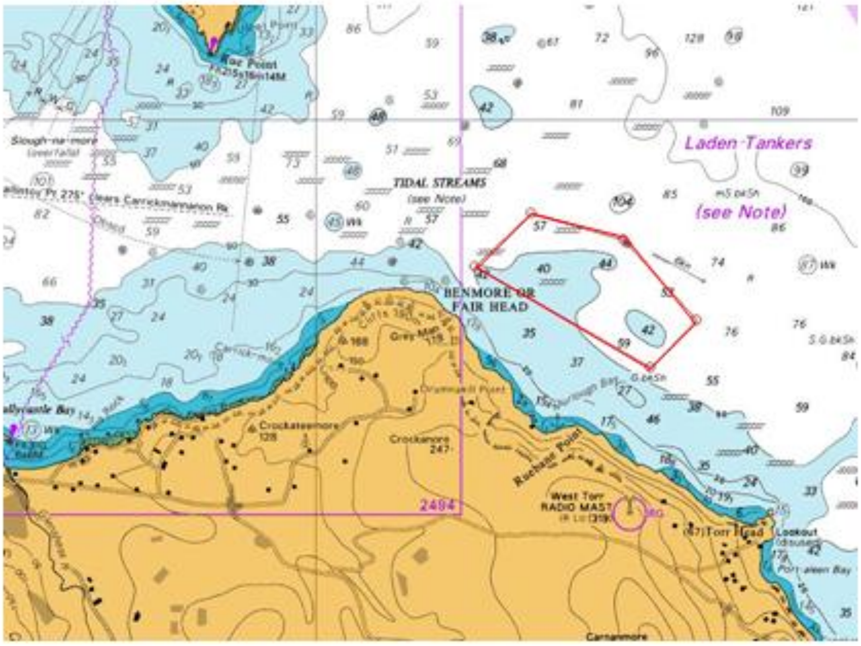


Figure 5: Fair Head Development Area

4.0 Site Description

4.1 Seabed

The British Geological Survey (Malin sheet 55N 08W Sea Bed Sediments and Quaternary) based on grab samples and shallow core indicates that the development area consists of an extensive rock outcrop with gravelly sediments. The majority of the area from Fair Head to Torr Head falls under the category of "Shallow course sediment plains". This description refers to an area of seabed characterised by course sediments with strong currents.

4.2 Navigation

As defined in Notice to Mariners No 17, The North Channel Traffic Separation Scheme (TSS), under the authority of the International Maritime Organisation (IMO) lies within the vicinity of the development site. The Rathlin Island Ferry operated by Rathlin Island Ferry Ltd provides nine daily crossings between Rathlin Island and Ballycastle on the mainland.

There are no Marine Environmental High Risk Areas (MEHRA) within or adjacent to the development site.

4.3 Water Depths

Water depths have been determined from Admiralty data, the British Geological Survey Map Data and detailed bathymetric survey of the waters around the north coast undertaken as part of the Joint Irish Bathymetric Survey (JIBS). Depth varies from 25 to 130m LAT the seabed characterised with a steeply sloping gradient to around 50m from the headlands out to around 1km. The gradient levels off into the North Channel to around 120m out to around 4km.

4.4 Resource

The tidal resource resulting from the flood and ebb tides flowing through the North Channel is largely developed by the flow being accelerated through the narrow passage between the Scottish and Northern Irish landmasses. Local bathymetric effects also act to further accelerate the flow by constraining it in a vertical direction.

A resource assessment has been undertaken utilising acoustic doppler current profilers (ADCP), and a resource model developed and calibrated based on this measured data. The model enables predictions of resource for specific areas and an assessment and prediction of the likely asymmetric flow resulting from the flood and ebb tides. The mean spring peak tidal velocities have been determined to be in excess of 3m/s (msp).

5.0 Proposed Development

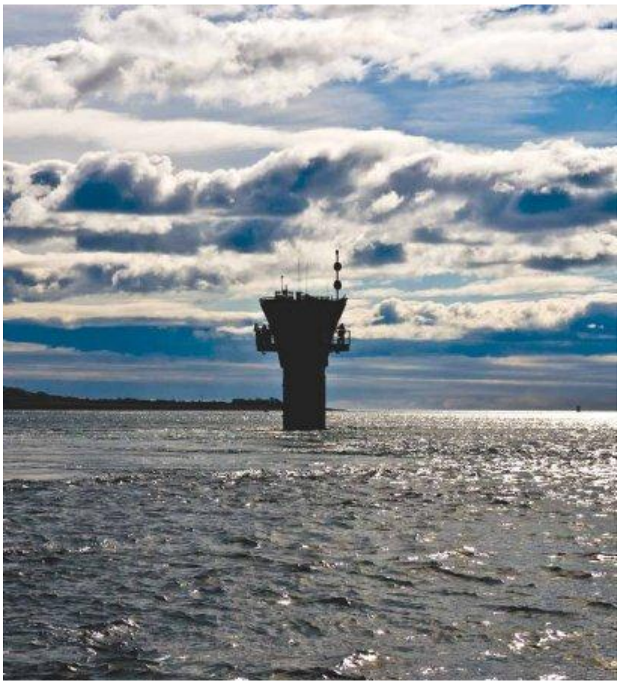
The project will be split into two distinct elements for EIA and consent; the marine works including turbines, subsea cables and associated offshore infrastructure below HMSWL; and the onshore works including landfall, shore cabling, substation, operation and maintenance facility and onward connection to the grid system above LMSWL.

This approach is for two reasons, the first is that the regulators who will deem consent are different bodies for marine and onshore works with DETI advising on marine aspects and The Planning Service for onshore works (plus the local council for infrastructure). The second reason is that currently an onshore grid connection application requires an accompanying planning consent for the development site.

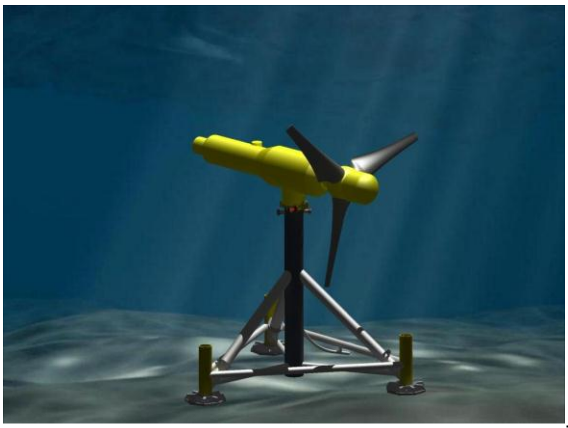
5.1 Marine Works

Turbine Technology
The proposal has been based on a device technology, neutral approach. It is however acknowledged that an entirely neutral approach is not possible and a clear understanding of technology types (and likely candidate machines) is essential to make the EIA process meaningful.

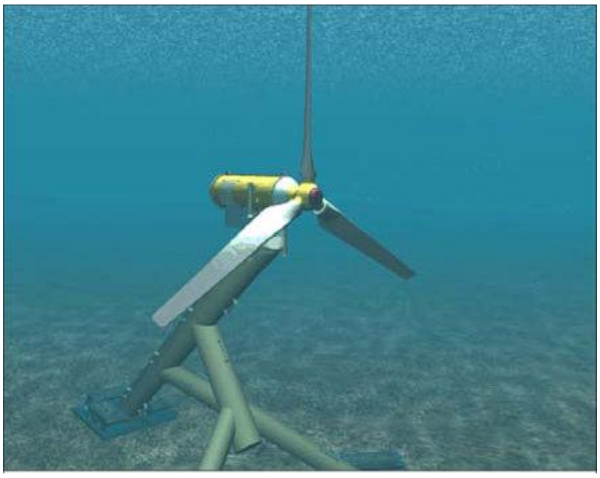
Given the physical constraints and resource of the development site, an envelope has been developed based on a generic design philosophy using Horizontal axis tidal turbines (HATT) with open rotors, and either floating and moored, or sea bed mounted by drilling/piling or gravity mounting. Both surface and non-surface piercing structures are also considered part of the design envelope. Example machines of this type include the Siemens MCT SeaGen S, the Alstom TGL, Voith Hydro and Hammerfest Strom and are illustrated below.



Marine Current Turbines – SeaGen S Mark 2 - (2MW)



Tidal Generation Ltd – 1MW Turbine




HS1000 by Hammerfest Strom – (1MW) Voith Hydro Tidal Turbine

Design Layout – Array Spacing
Whilst analytical models are being developed, at this time there is no practical experience for array spacing definition (the spacing between turbines across and parallel to the flow). However, preliminary indicative layouts are based on a spacing of 500m (25 diameters) downstream by 150m across (7.5 diameters).

Rotor Diameter – Turbulence and Depths
The turbine rotor diameter selected will be limited by the depth of water available. General criteria of a 6m clearance between the blade tip and seabed has been defined and a 5m clearance (at LAT) between blade tip and surface. This, for example, would require a minimum 31m water depth for a 20m rotor diameter. The figure below summarises these typical dimensions / depths outlined above.

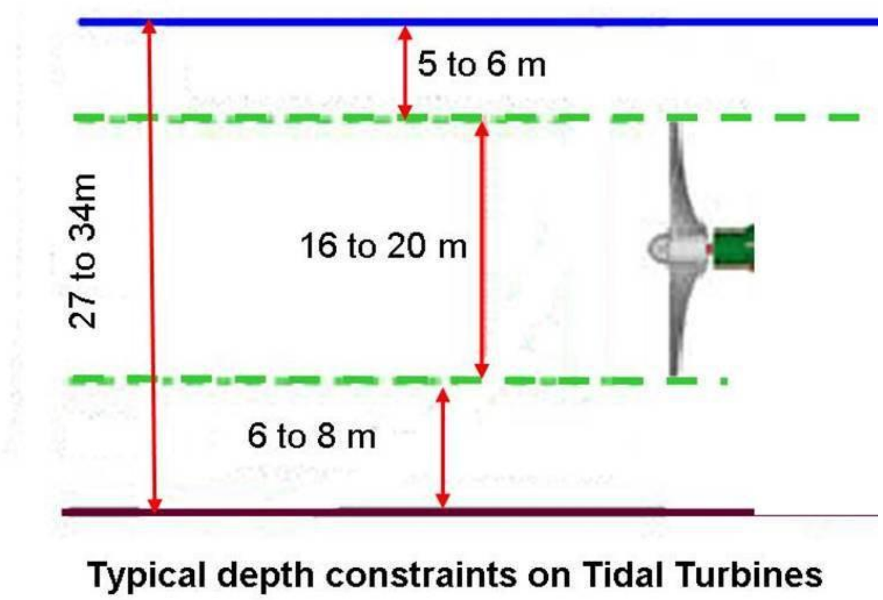


Figure 6: Typical Horizontal Axis Turbine depth parameters

Inter-array Cabling and Marshalling

Individual turbines will be connected to one or more subsea or surface mounted marshalling units containing both power conditioning equipment and transformers in order to increase the generated voltage to 33kV for transmission without significant losses. It is unlikely that a further step up in voltage to 110kV or 132kV will be necessary. Subsea substations at this scale are still unproven, and consequently the project approach is to utilise surface piercing such as the SeaGen S Mark 2 or floating devices to provide the marshalling points for the farm. The advantage of this approach is that principle connections can be undertaken dry with no requirement for underwater connections or the placement of key electrical equipment on the seabed.

Sub-sea Cabling to Shore

The detailed electrical design is yet to be completed but it is likely that multiple 33kV cables will be used to deliver the 100MW capacity to shore. One of the advantages of the Fair Head project is that since it is relatively close to the mainland, lower voltage cables can be utilised with minimal transmission losses without the requirement for a dedicated high voltage and expensive offshore transformer station. As far as possible, cable routes will avoid traversing areas of very high tidal flow and will be either trenched, pinned or protected by rock dumping or mattressing depending on the seabed characteristics. Installation methods and routing will be defined in more detail as part of the EIA to identify the most appropriate subsea and shoreline routing.

A typical subsea electricity cable will have a central core of either aluminium or copper plus some armouring / protective layers. The cable will also accommodate an optic fibre control cable. Typical cable cross section is illustrated below. Overall diameter of cables, rated at 33kv, will be in the range 200 – 250mm.

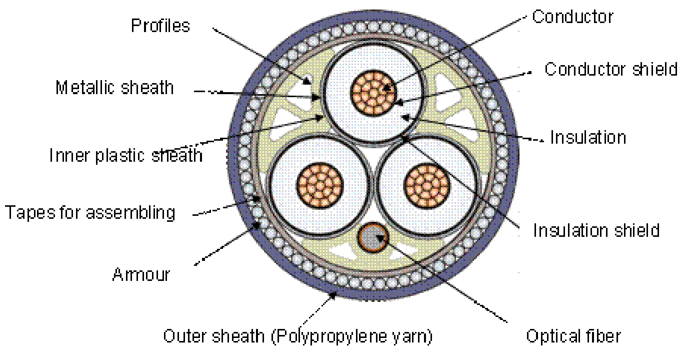


Figure 7: Typical Section of 33kV Subsea Cable

5.2 Onshore Works

Onshore Cable Routing to Sub-station
It will be necessary to underground the subsea cables from landfall to the substation location. This will accomplished by either trenching through the foreshore area or horizontal directional drilling (HDD) depending on the bedrock geology of the proposed landing locations. Detailed assessment of these areas will be required to identify the most appropriate method to use.

Onshore Sub-station and Control Building
The onshore substation location has yet to be defined and will be subject to a detailed assessment of potential landfalls and optimum locations from both EIA and final grid connection perspective. There is potential for both the Fair Head and Torr Head tidal projects to share a common substation and grid connection point but this has yet to be confirmed and the ultimate size and voltage of the station will depend on this decision. If both projects are brought into a common point ashore it is likely that the substation will need to transform the voltage of the incoming subsea cables to 110kV. A typical step up sub-station is shown in Figure 8 below.

Figure 8: Typical 33/132kV Substation Layout

It is expected that connection to the grid system will be by overhead line from the substation to the nearest node point on the grid but there may be sensitive areas where some undergrounding is required. Supports for the overhead line are likely to be wood poles.

6.0 Project Programme

6.1 Project Phases

The project is envisaged to take place in four phases as follows:

- Design / permitting.
- Construction.
- Operation / maintenance.
- Decommissioning.

Phase 1 Design / permitting.
The major elements envisaged are as follows:

- Scoping report and preliminary consultation
- Site surveys to baseline the site, confirm currents and seabed bathymetry.
- Evaluation of tidal technologies and selection of devices for the project.
- Location of individual devices.
- Subsea cabling design and routing
- Preparation of the EIA and submission of the Environmental Statement.
- Consent and permits/licences awarded.

The current target is to submit an application for consent in the first half of 2014.

Phase 2 Construction
The project as currently envisaged will have a total installed capacity of 100MW consisting of individual devices of approximately 1.0 to 2.0MW each. Construction is expected to be phased over a number of years with installation mainly taken place in the months between March and November due to available weather windows and subject to environmental considerations. Construction start dates are heavily dependent on securing an onshore grid connection but it is planned to have the site in full operation by the end of 2019.

Construction methods vary between technologies but generally require foundation units to be transported to the site and deployed at predetermined locations, pinned and grouted into predrilled sockets well in advance of the turbine equipment arrival.

Typically heavy lift jack up barges are used to erect the turbine equipment onto the foundation structure although other methodologies using DP vessels may also used.

Cables are normally loaded on the specialist cable installation vessel at home port and the mobilised direct to site.

In addition to the main installation vessels a number of supply and safety vessels will be required.

Cable landings will also require the use of smaller inshore vessels and cables are typically floated in to the landing location guided by smaller craft at high tide. The cable is then positioned over a prepared trench or horizontally directionally drilled conduit and lowered into position at low tide.

The North Antrim region has several harbours and ports. Large harbours on the east coast include Larne and Belfast which would be the nearest major port to support machine installation. Smaller harbours at Ballycastle, Port-aleen Bay, Cushendun and Cushendall which serve the local fishing and leisure craft industry would be suitable bases for survey, installation support and maintenance craft.

Phase 3 Operation / Maintenance.
The units will be operated remotely via the optic fibre control cable incorporated with the electrical cables. In addition to the inbuilt controls on the units themselves the control cable will control the start and stopping of the units and pitch the blades to maximise the output in harmony with the tidal forces. The cable will also return continuous output and monitoring data on the units themselves.

The units are expected to have a life span of approximately 25 years with major maintenance intervals every 5 years. Exact maintenance sequence will depend on specification and type of units selected. Remotely Operated Vehicle (ROV) will be used periodically, 1 to 3 years, to carry out visual inspection of devices and cabling. Diver inspections will only be used when ROV data is unclear.

The devices will contain oils for lubrication, anti fouling agents and hydraulic fluids. Water is also being considered as a lubricant. Only recognised marine standard materials and substances will be used in the device.

Phase 4 Decommissioning
Decommissioning would normally involve the removal of the turbines and full equipment from site using jackup barges and restoration of the site to as near its natural condition as possible. However, decommissioning may cause significant environmental impact in its own right and it is likely that after 25 years significant colonisation of the support structure will have evolved and an artificial reef formed. Further discussion of decommissioning method and degree will be necessary at the time. A Decommissioning Plan will be drawn up as part of the project and all aspects of the decommissioning will undergo environmental impact assessment which will inform the final decision making process as to the best option.

DOCUMENT END.