Navigational Safety Risk Assessment for West Islay Tidal Energy Park

DP Marine Energy Ltd

July 2013

PMSS

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Document Control

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Signatures in this approval box have checked this document in line with the requirements of QP16

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References

1	DECC (DTI) Guidance on the Assessment of the Impact of Offshore Wind Farms	Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms
2	Maritime and Coastguard Agency's (MCA) Marine General Notice MGN 371 (M+F)	Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response Issues
3	31122 PHA Report - Islay Tidal Energy Park – Preliminary Hazard Analysis	DPME Ltd - Islay Tidal Energy Park: Preliminary Hazard Analysis: May 2012
4	Admiralty Sailing Directions NP 66 15th Edition 2004	The West Coast of Scotland Pilot
5	Admiralty Tidal Stream Atlas NP222	Firth of Clyde and Approaches
6	Admiralty Tide Tables NP 201	Vol 1 UK and Ireland
7	Argyll Shipwrecks	By Peter Moir and Ian Crawford 1994
8	Dive West Scotland	By Lawson Wood 2004
9	OTH 89 303	Wave Climate Atlas of The British Isles
10	IHO Special Publication No 44 - IHO Standards for Hydrographic Surveys	5th Edition 2008
11	RYA UK Atlas of Recreational Boating	Recreational Cruising Routes, Sailing and Racing Areas around the UK Coast; 2005
12	International Maritime Organisation (IMO) IRPC 1972	International Regulations for Preventing Collisions at Sea 1972 as amended. The "ColRegs"
13	SI 2007 No 1948	Electricity (Offshore Generating Stations) (Safety Zones) (Application Procedures and Control of Access) Regulations 2007
14	IALA Recommendation O-139	Marking of Man-Made Offshore Structures; Edition 1 December 2008
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16	BWEA /MCA/DTI/PLA Report Dated April 2007	Investigation of Technical and Operational Effects on Marine Radar Close to Kentish Flats Offshore Wind Farm : April 2007
17	Admiralty Publication 5011	Symbols and Abbreviations used on Admiralty Charts
18	IALA Recommendation E-108	On The Surface Colours used as Visual Signals on Aids to Navigation Edition 2 December 2009
19	IALA Recommendation A-126	On the Use of the AIS in Marine Aids to Navigation Edition 1, December 2003
20	The Yachtsman`s Pilot Clyde to Colonsay	Author Martin Lawrence 5th Edition

Abbreviations

ADCP	Acoustic Doppler Current Profiler
AHT	Anchor Handling Tug
AIS	Automatic Identification System.
ALARP	As Low As Reasonably Practicable
Cable (as a measurement of distance)	1/10th of a nautical mile (approx 185 metres) and a standard measure of distance at sea
CalMac	Caledonian MacBrayne (Ferries) Ltd
CGOC	Coast Guard Operations Centre
CHA	Competent Harbour Authority. A statutory authority responsible for a defined area of water in and around a port or harbour
Chart Datum	By international agreement, Chart Datum is a level so low that the tide will not frequently fall below it. In the UK, this is normally approximately the level of LAT
CMAL	Caledonian Maritime Assets Ltd
DP	Dynamic Positioning
DPME	DP Marine Energy Ltd
DfT	Department for Trade
DTI	Department of Trade and Industry
EIA	Environmental Impact Assessment
ES	Environmental Statement
FMEA	Failure Modes and Effects Analysis
GT	Gross Tonnage. The total volume of a vessel, expressed in units of 100 cubic feet (gross ton), with certain open structures, deckhouses, tanks, etc., exempted. Also called Gross Registered Tonnage
HAT	Highest Astronomical Tide. HAT is the highest level which can be predicted to occur in average meteorological conditions and under any combination of astronomical conditions. This level will not occur every year. HAT is not the extreme level as storm surges may cause higher levels to occur. Determined by inspection over a period of years
IMO	International Maritime Organisation
Kn	Knot
kW	Kilowatt
LAT	Lowest Astronomical Tide. LAT is the lowest level which can be predicted to occur in average meteorological conditions and under any combination of astronomical conditions. This level will not occur every year. LAT is not the extreme level as storm surges may cause lower levels to occur. Determined by inspection over a period of years
LOA	Length Overall (of a vessel)
m	Metre
MBS	Maritime Buoyage System
MCA	Maritime and Coastguard Agency
MCT	Marine Current Turbines Ltd
MHWN	Mean High Water Neaps.
MHWS	Mean High Water Springs.
MLWN	Mean Low Water Neaps.
MLWS	Mean Low Water Springs.
MoD DIO	Ministry of Defence - Defence Infrastructure Organisation
MoD RN	Ministry of Defence (Royal Navy)
MRCC	Maritime Rescue Coordination Centre
MSL	Mean Sea Level. The average level of the sea surface over a period (normally 18.6 years)

MV	Motor Vessel
MW	Megawatt
NLB	Northern Lighthouse Board
NM	Notice to mariners
n mile	(International) Nautical Mile (1,852 metres).
NSRA	Navigational Safety Risk Assessment
OREI	Offshore Renewable Energy Installation
PEXA	Practice and Exercise Area
PHA	Preliminary Hazard Analysis
PMSS	Project Management Support Services
RNLI	Royal National Lifeboat Institution
RYA	Royal Yachting Association
ROV	Remotely Operated Vehicle
SCADA	Supervisory, Control and Data Acquisition
SFF	Scottish Fishermen's Federation
SSER	Scottish and Southern Electricity Renewables
t	Tonne (metric)
TCE	The Crown Estate
TEC	Tidal Energy Converter
Tidal Stream	A distinction is drawn between tidal streams, which are astronomical in origin, and currents, which are independent of astronomical conditions and which, in the waters around the British Isles, are mainly of meteorological origin
TSS	Traffic Separation Scheme
VMS	Vessel Monitoring System
WITEP	West of Islay Tidal Energy Park

1. Executive Summary

DP Marine Energy (DPME) has been granted a licence to investigate the use of an area to the west of Islay as a tidal energy farm. A joint venture company called West Islay Tidal Energy Park Ltd (WITEP) has been formed for this project comprising DPME and the Belgian company Dredging, Environmental and Marine Engineering (DEME).

DP Marine Energy (hereafter referred to as DPME) proposes to site an array of tidal turbines off the west coast of Islay in an area obtained under a lease agreement with The Crown Estate (TCE) for the development of an Offshore Renewable Energy Installation (OREI) comprising up to 30MW of Tidal Energy Conversion (TEC) devices.

As part of the consenting process for such an array there is a requirement to undertake an assessment of the navigational safety issues arising from the proposed installation.

This report presents an assessment of the navigational safety issues arising from the proposal to install a 30MW tidal farm consisting of up to 30 individual devices and comprising turbines of different types but falling within a design envelope based on arrays of subsurface only devices and surface piercing devices in both floating and fixed configurations. Two models have been evaluated in order to provide a reference design envelope for the EIA. Whilst these devices are used to inform the detailed baseline for the EIA, and can be considered as the most likely form of TEC solution to be used, other devices are being considered including the potential to mount the turbine units on floating installations similar to that proposed by BlueTEC.

The first of the devices is a surface piercing, pin-piled mounted, twin rotor turbine – the SeaGen 2 developed by Marine Current Turbines (MCT) - and the other is a seabed sited, fully submerged, single rotor device developed by Tidal Generation Limited (TGL). This report aims to demonstrate that all navigational safety risks associated with proposed installation are tolerable and As Low As Reasonably Practicable (ALARP).

The methodology for this assessment follows that for assessing the Marine Navigational Safety Risks of Offshore Wind Farms contained in the DTI/DECC publication - Guidance on the Assessment of the Impact of Offshore Wind Farms (Reference 1) and is required to address the issues raised in the Maritime and Coastguard Agency's (MCA) Marine General Notice MGN 371(M+F) – Proposed Offshore Renewable Energy Installations (OREI) – Guidance on Navigational Safety Issues (Reference 2).

Prior to this NSRA, and in accordance with Reference 1, a Preliminary Hazard Analysis (PHA) has been undertaken to ensure that the risk assessment is appropriate to the nature and scale of the development and employs suitable techniques and methodology which have been agreed with the MCA. Details of the PHA can be found at Reference 3.

The risk assessment has included the conduct of a traffic survey for a total of 28 days undertaken over two periods of 14 days in both winter and summer months in order to assess seasonal variation. Marine users and stakeholders have been involved in the process with particular emphasis placed on the potential impacts on fishing activities in the area. It has also recognised the "in-combination" effects with the offshore wind farm proposed to the west of Islay and being developed by Scottish and Southern Electricity Renewables (SSER).

Appropriate controls and risk mitigation measures have been identified for the hazards presented by the proposed installation and, where appropriate, agreed with the relevant authorities.

The conclusion of this report is that, with the application of the recommended controls, the risk from the proposed installation is "tolerable with monitoring" and ALARP.

2. Introduction

2.1. Background

DP Marine Energy (DPME) has been granted a licence to investigate the use of an area to the west of Islay as a tidal energy farm. DPME is proposing a development consisting of an initial 30MW of capacity with a view to further development of the area in the future.

This submission is intended to support the consent application for a development of Phase 1 of the project consisting of 30MW of capacity to be provided by an array of approximately 30 tidal devices.

As part of the consents process there is a requirement to undertake an assessment of the navigational safety issues arising from the establishment of an Offshore Renewable Energy Installation (OREI). This is required to be conducted in accordance with the Maritime and Coastguard Agency's (MCA) Marine General Notice MGN 371(M+F) - Proposed Offshore Renewable Energy Installations (OREI) – Guidance on Navigational Safety Issues (Reference 2). The methodology for this assessment follows that in the DTI/DECC publication "Marine Navigational Safety Risks of Offshore Wind Farms - Guidance on the Assessment of the Impact of Offshore Wind Farms" (Reference 1).

The assessment will be taken into account in the preparation of the Environmental Impact Assessment (EIA) study report and the resulting Environmental Statement (ES).

The Navigational Safety Risk Assessment (NSRA) methodology requires, in accordance with the DTI/DECC guidance, a Preliminary Hazard Analysis (PHA) to be undertaken prior to the NSRA. That analysis is required to investigate the hazards and propose the methodology and tools to be used in the risk assessment and is required to be submitted to the MCA for agreement in order to ensure that the risk assessment phase is appropriate to the nature and scale of the development and employs suitable tools and techniques and methodology. The PHA report – Islay Tidal Energy Park – Preliminary Hazard Analysis: May 2012 (Reference 3) was submitted to the MCA for comment in May 2012. MCA comments and recommendations were incorporated into the final issue of the PHA.

2.2. Aim

The aim of this report is to demonstrate that a suitable and sufficient assessment of the risks presented to mariners and the emergency services by the installation and operation of the proposed OREI has been undertaken. Where appropriate, this report proposes suitable control and risk mitigation measures to ensure that any remaining risks are either tolerable or can be made tolerable by the application of suitable, agreed controls.

In support of the Navigational Safety Risk Assessment (NSRA), the following safety management activities were undertaken in compliance with DTi/BERR publication - Guidance on the Assessment of the Impact of Offshore Wind Farms and MGN 371 (M+F) Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response Issues:

- Hazard Identification and Risk Assessment for device operations;
- Development of a Hazard Log including a record of risk control measures.

2.3. Scope

The scope of the NSRA covers the risks to navigation presented by the siting of a 30MW tidal turbine array off the west coast of Islay. It takes into account the potential presence of adjacent OREIs. This report presents the arguments and evidence which aim to demonstrate that, with the application of the controls and risk mitigation measures recommended in this report, the risks are tolerable and ALARP.

3. Risk Claim

3.1. Safety Requirements

The principal Safety Requirements for the proposed array are as follows:

- All significant hazards associated with the installation, operation, maintenance and decommissioning of the proposed array shall be identified and the risks assessed as tolerable and ALARP.
- The site will comply with MCA Marine Guidance Note MGN 371 (M+F): Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response Issues (Reference 2);
- The installation shall co-exist safely with other marine users with minimum increase to the baseline level of navigational risk during construction, operation, maintenance and decommissioning. The devices should not cause or contribute to an unacceptable obstruction of, or danger to, navigation or marine emergency services;
- The risks presented by the array devices and their operation will be effectively managed by an appropriate Safety Management System meeting the requirements of the MCA's Guidance (Reference 2).

3.2. Navigational Risk Claim

The navigational risks from the array to marine traffic transiting the area during the installation, operational and decommissioning phases are considered as "Tolerable with Monitoring"[1].

The hazards to shipping during the operational phase are presented by the surface piercing turbines to all vessels and craft and by the subsea turbines to a lesser range of vessels which, in a range of sea-state conditions, could be at risk of collision with the rotors of the turbines. The risk to shipping from the presence of the devices is considered as remaining "Tolerable with Monitoring" provided the risk mitigation measures recommended in this report are applied.

There does, however, remain a level of risk to vessels engaged in creeling activities in the area where, in circumstances where a fishing vessel has stopped in the water to recover a fleet of creels which have become entangled or snagged, the vessel may drift with the tide over the devices in the array causing the gear to become entangled and, potentially, lead to vessel capsize. This represents the worst credible case scenario.

Risk controls necessary to achieve the acceptable level of risk for the array are identified in this report and are required to be implemented prior to installation and operation and will require to be checked periodically. The impact of the siting of the array will be monitored throughout its installation and operations.

3.3. Supporting Reasoned Argument and Evidence

The supporting arguments for the assessment are made in the body of this report and were derived from qualitative analysis based on a number of sources of data including expert opinion (both written and oral) of the marine users of the area and quantitative data regarding vessel movements.

3.4. Tools and Techniques

[1] Risk Tolerability definitions throughout this report are taken from DTi/DECC publication - Guidance on the Assessment of the Impact of Offshore Wind Farms (Reference 2) Table C.4.4. These are also contained at Annex D.

Organisations and individuals who could be affected by the development were identified at the outset for the NSRA and their views were sought on the proposed installation. A list of stakeholders is at Appendix 1.

In order to identify the hazards presented by the proposed array, to make an assessment of the level of risk and to, subsequently, propose appropriate controls to reduce such risks to tolerable level, a Hazard Identification and Risk Assessment (HIRA) technique was used. This is a structured examination of the proposal in order to identify potential navigational hazards to personnel, equipment and the environment. Frequency and criticality of risks have been assessed in compliance with guidance from DTi/BERR publication - Guidance on the Assessment of the Impact of Offshore Wind Farms (Reference 1) Section C4.

This assessment has examined, in particular, the navigational safety aspects of the proposed development and determined whether the proposed controls are appropriate and what operational and emergency procedures are appropriate in the case of an event occurring. This resulted in a hazard log being constructed and actions taken to ensure that all identified risks were reduced to a tolerable level. Stakeholder involvement in the consultation process was an integral part of the data gathering exercise and provided much of the data for the HIRA.

4. Description of the Marine Environment

The general area in which the development is proposed is shown at Figure 1. Included are other potential areas for renewables development.

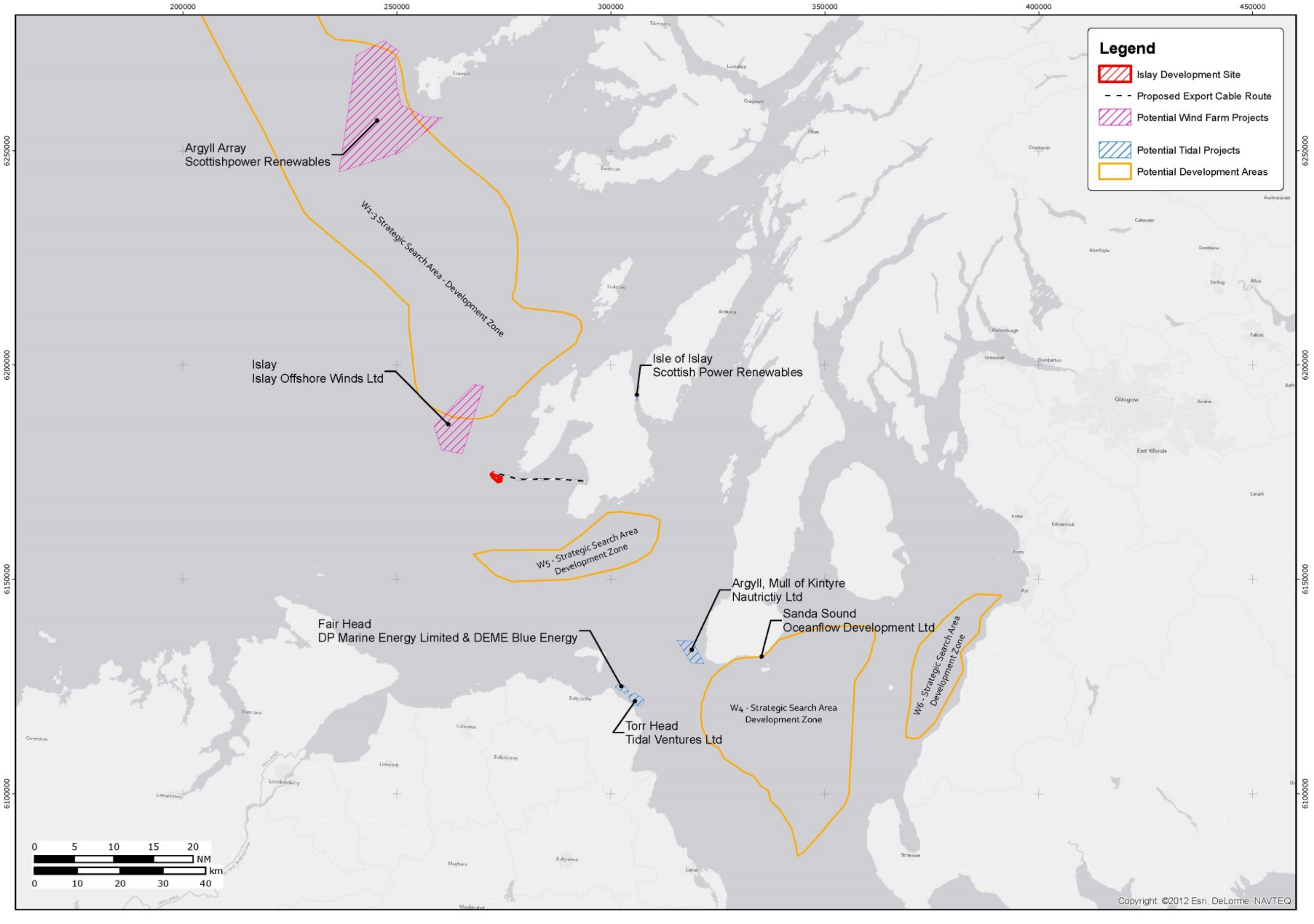

Figure 1: General Overview

4.1. Current Marine Environment

4.1.1. General

The source of much of the data in the following section is derived from:

- Admiralty Charts 2168, 2798 and 1770;
- Admiralty Sailing Directions NP 66 – The West Coast of Scotland Pilot (Reference 4);
- The Admiralty Tidal Stream Atlas NP 222 – Firth of Clyde and Approaches (Reference 5);
- Admiralty Tide Tables NP 201 – Vol 1 UK and Ireland (Reference 6).

4.1.2. Harbours

There are no major harbours in the area though there is one minor harbour of importance, Port Ellen (55° 38'N, 6° 12'W) situated on the SE side of Islay.

Port Ellen is mainly a ferry port for the regular ferry between Kennacraig and Islay. The Port Authority is Caledonian Marine Assets Limited (CMAL). The ferries are operated by a contracted operator, currently Caledonian MacBrayne Ferries Ltd (CalMac). Local authority is vested in a Harbour Master. The normal routes between Port Ellen and other ports do not involve passing to the west of Islay.

Port Charlotte (55 44', 6 23'W), although nominally a port, has no alongside facilities. Small craft can obtain berths at Bruichladdich 1.5 n miles NNE of Port Charlotte and at Bowmore (3 n miles ENE of Port Charlotte).

Bruichladdich Pier provides an alongside berth for small tankers providing oil products to the Gleaner Fuels Depot. The depth alongside is 3.1m and vessels with a maximum LOA of 90m and around 1500GT use the pier on, approximately, 25 occasions per year.

4.1.3. Anchorages

The following anchorages within the Sound are marked on Admiralty Chart 2168 and are described in the Admiralty Sailing Directions:

- Good anchorage can be obtained off Port Charlotte (55 44', 6 23'W) situated within Loch Indaal.
- Small craft can also find anchorage to the NE of Port Charlotte.
- Kilnaughton Bay (Port Ellen)

4.1.4. Search and Rescue

Islay lies within the UK Maritime Search and Rescue operational area currently administered by the Clyde Maritime Rescue Co-ordination Centre (MRCC) based at Greenock. Under the revised proposals (November 2011) for the future coastguard organisation this, however, is scheduled to close in 2013/2014. The new Coastguard organisation will comprise of the Maritime Operations Centre (MOC) based at Southampton as the national strategic centre to manage operations across all UK waters and eight Coast Guard Operational Centres (CGOCs) operating 24hrs a day. The CGOCs in the north-west of the UK are:

- Stornoway
- Belfast
- Shetland
- Holyhead

4.1.5. Ministry of Defence

The area proposed development lies in MOD Practice and Exercise Areas (PEXAs). The proposed site lies in area “Orsay”. The areas in the vicinity of the proposed development are primarily used for surface naval vessel activities. There are no surface vessel live firing areas in the vicinity.

The key MoD activity in the area consists of a major submarine sub-surface transit route through the North Channel between the submarine base at Faslane on the Clyde and the North Atlantic. Whilst not presenting a physical hazard to navigation due to the position of the proposed array close to the coast, there is an issue of noise emitted from the turbines and its potential impact on submarine acoustic sensors.

4.1.6. Wrecks

There are no charted wrecks within the area of interest itself, although the wreck of the SS Norman (sunk May 1900) is reportedly within an area some 6.5 n miles WSW of the Rhinns of Islay Light. There are a number of wrecks present along the coast. One is situated 0.5n miles north east of Frenchman’s Rock (the “Agios Minas”, ran aground 1968) and the other in Kilchiaran Bay (the “Floristan”, ran aground 1942). Both these, along with five others, are identified in “Argyll Shipwrecks by Peter Moir and Ian Crawford (Reference 6 and indicated as dive sites “Dive Islay Wrecks” by Steve Blackburn (Reference 7).

4.1.7. Submarine Cables

There are no charted cables in the development area or in the vicinity of the cable route between the site and landing point at Kintra.

4.1.8. Other OREIs

4.1.8.1. SSER

SSER has plans for the siting of a wind farm in an area some 6 n miles to the north west of the DPME development. Discussions with the SSER project team have elicited the fact that the status of the SSER project is such that results of their traffic survey have not yet been analysed and that they are not in a position to examine the potential interaction at this stage of their project.

4.1.8.2. ScottishPower Renewables

ScottishPower Renewables (SPRL) has consent for the construction of a tidal development with a capacity of 10MW in the Sound of Islay. It has been established in the NSRA conducted for that development, that traffic routes will not be affected to the extent that re-routing would occur such that it would increase numbers and types of traffic passing to the west of Islay.

4.1.9. Tidal Stream

Off the south west coast of Islay the tidal streams are described in Admiralty Sailing Directions (Reference 4) as running in a NW / SE direction with the flood tide setting to the South East and the ebb setting North west. The spring tides attain a rate of 8kn off Orsay, where there is a heavy race with overfalls and eddies. With opposing winds these overfalls are dangerous to small craft.

A detailed resource assessment of the development site has been undertaken utilising both seabed mounted Acoustic Doppler Current Profilers (ADCP) and moving vessel transects. The mean spring peak tidal velocities have been measured in excess of 3m/s, with mean neap peak velocities recorded at around 1.6m/s.

4.1.10. Tidal Height

Tidal height data for, adjacent to the proposed site, for average meteorological conditions, is shown at Table 1.

	LAT	MLWS	MLWN	MSL	MHWN	MHWS	HAT
Standard Port – (Oban)	0.0	+0.7	+1.8	+2.4	+2.9	+4.0	+4.5
Secondary Port Differences (Orsay)		-0.2	-0.5	No Data	-0.6	-1.4	
Heights relative to Chart Datum		**+0.5**	**+1.3**		**+2.3**	**+2.6**	
			Mean Range (Neaps) 1 metre				
		Mean Range (Springs) 2 .1 metres					

Table 1: Tidal Height Data for Orsay

4.1.11. Wave Climate

The project site is subject to strong wave conditions and Atlantic swells. The currents around the Rhinns point are strong both on the ebb and flood tides and this can also result in significant localised wind wave effects in occasions of wind against tide. A detailed metocean study has been undertaken to characterise the wave and wind regime of the site. Further information on site metocean conditions can be found in Chapter 6 of the ES. Table 2 below shows data from the Wave Atlas of the British Isles (Reference 9).

	Significant Wave Height in Metres Exceeded for Stated % of Season				
% of period	Annual	Winter (Jan/Feb/Mar)	Spring (Apr/May/Jun)	Summer (Jul/Aug/Sep)	Autumn Oct/Nov/Dec)
10%	2.5 - 3.0	3.0 – 4.0	2.0 – 2.5	2.0 – 2.5	3.0 – 4.0
25%	2.0 – 2.5	2.5 - 3.0	1.5 – 2.0	1.5 – 2.0	2.5 - 3.0
50%	1.5 – 2.0	2.0 – 2.5	0.5 – 1.0	1.5 – 2.0	2.0 – 2.5
75%	0.5 – 1.0	1.5 – 2.0	0.5 – 1.0	0.5 – 1.0	1.5 – 2.0

Table 2: Significant Wave Height (Hs) for the Area

4.1.12. Weather Data

Weather data for Orsay from Reference 3 compiled over 20 years from 1983 shows that wind direction is predominantly (67%) from between South East and West with mean speeds over the year of 16.5 kn. Data on the number of days with gales and fog from observations over a period of 12 years show that there are 49 and 23 days respectively.

4.1.13. Bathymetry

The bathymetric data on the current editions of the Admiralty chart were obtained from surveys conducted between 1985 -91. More detailed hydrographic survey data has been obtained from Marine Scotland for the area (including sections of the cable route. In addition, further, detailed geophysical surveys of the area have been completed in February 2013. Both comply with the requirements of Order 1a of the International Hydrographic Organisation Standard S-44 Edition 5 (Reference 10).

Examples of the bathymetry data covering the proposed area of deployment are shown at Figures 2 and 3.

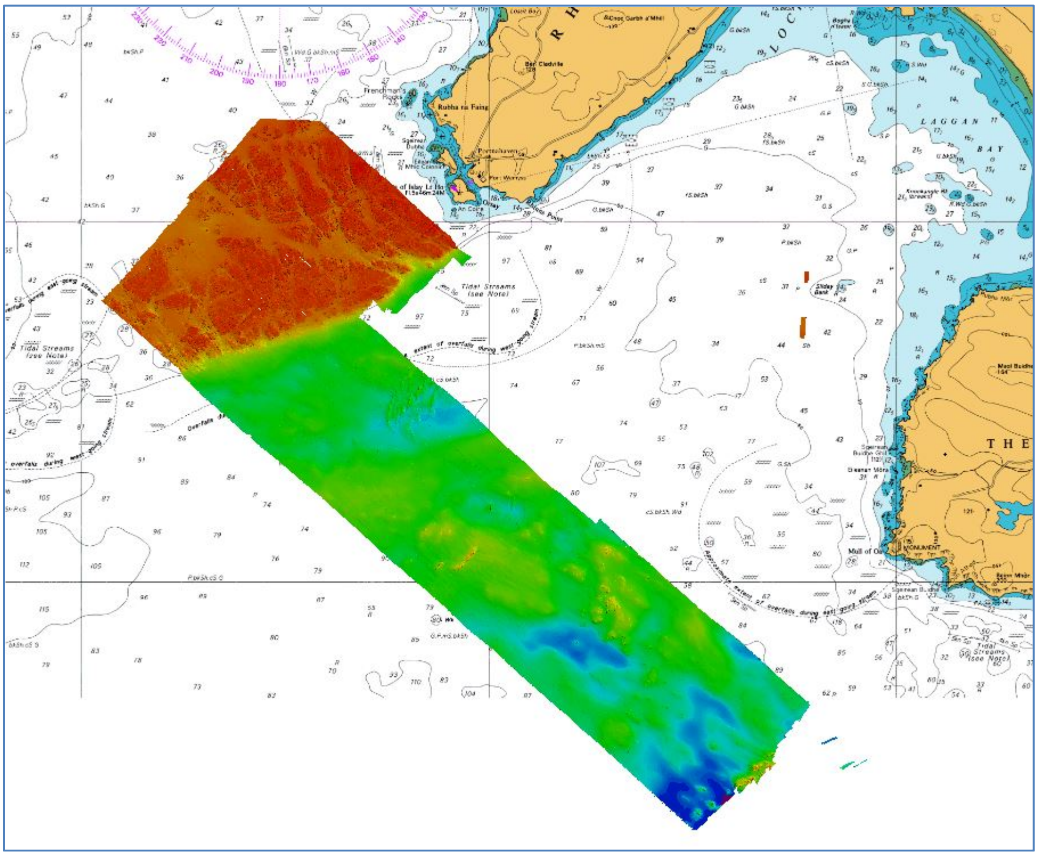

Figure 2: Bathymetric Survey – Development Area

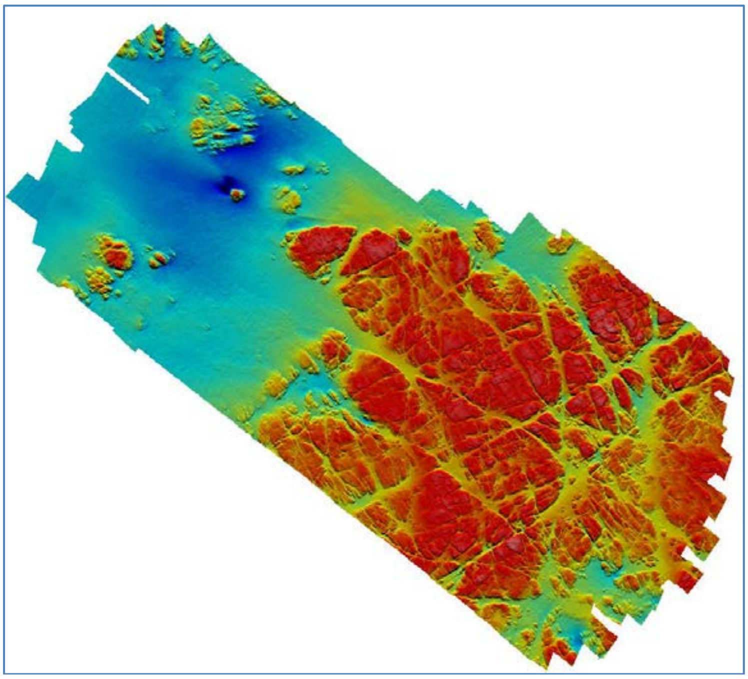

Figure 3: Bathymetric Survey – Detail of Area

4.1.14. Marine Environmental High Risk Zones (MEHRAs)

The proposed development area lies off an area designated as a High Category MEHRA (see Figure 4). There are 32 MEHRAs established around the UK which identify areas of "high environmental sensitivity". This designation of certain areas was a result of the late Lord Donaldson's recommendations in his report *Safer Ships, Cleaner Seas*. The designation was intended to identify areas of the coastline which, taking account ship routing data, size and type of vessel, traffic density and analysis of past accidents, were at "high risk" of pollution.

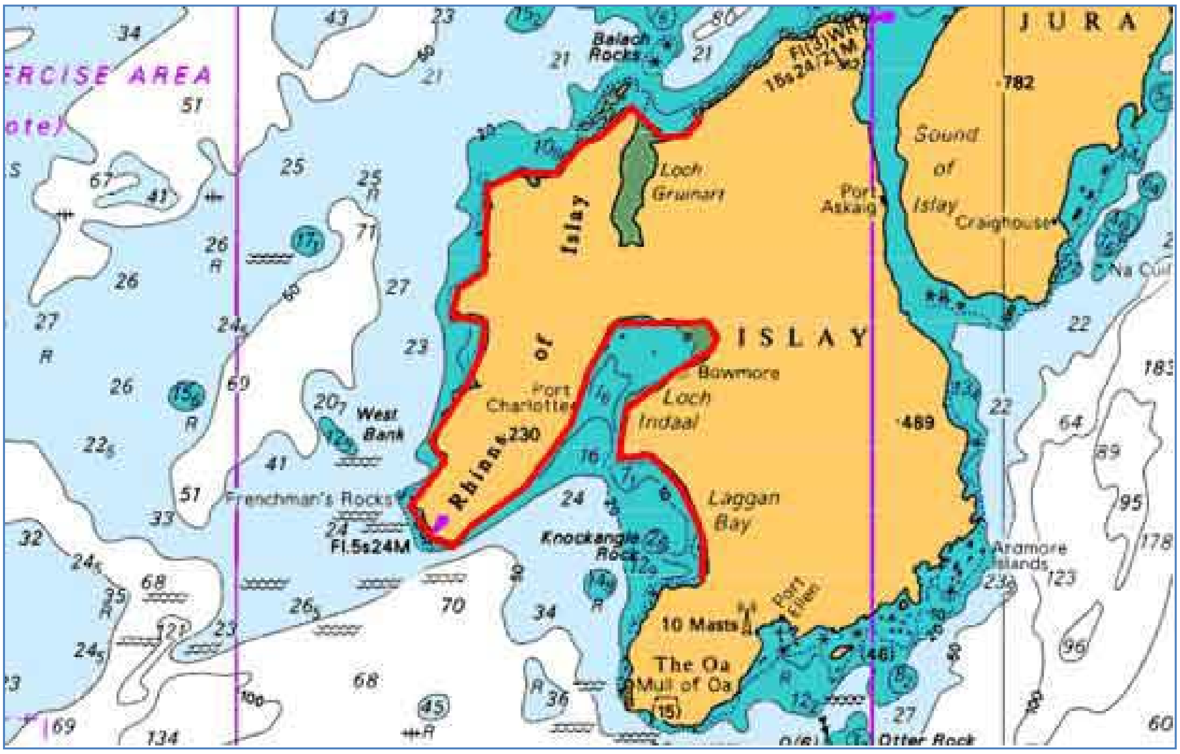

Figure 4: Designated Marine Environmental High Risk Zone (MEHRA)

5. Description of the Proposed Installation and the Impact on the Marine Environment

5.1. Project Description

In order to minimise development and device risks DPME is proposing to develop the tidal farm in three phases. This approach reflects both the relative immaturity of tidal devices in commercial operation, and facilitates the infrastructure upgrades which will be necessary for construction of the large scale project.

5.1.1. Phase 1

The first phase will consist of a 30MW capacity array comprised of up to 30 Tidal Energy Conversion (TEC) devices. This may consist of entirely surface piercing (fixed or floating) devices or entirely subsurface devices or a mix of both. The numbers of devices will depend on the devices chosen and the ratio of those devices within the array.

The initial proposed array will consist of up to 30 turbines arranged as shown in Figure 5. Devices would be interconnected by seabed located inter-array cables with a single, seabed power export cable back to shore and connected to the grid at a shore in the vicinity of Kintra on the west coast of Islay. The proposed cable route is shown at Figure 13 . This NSRA considers the navigational safety implications of this phase of development only.

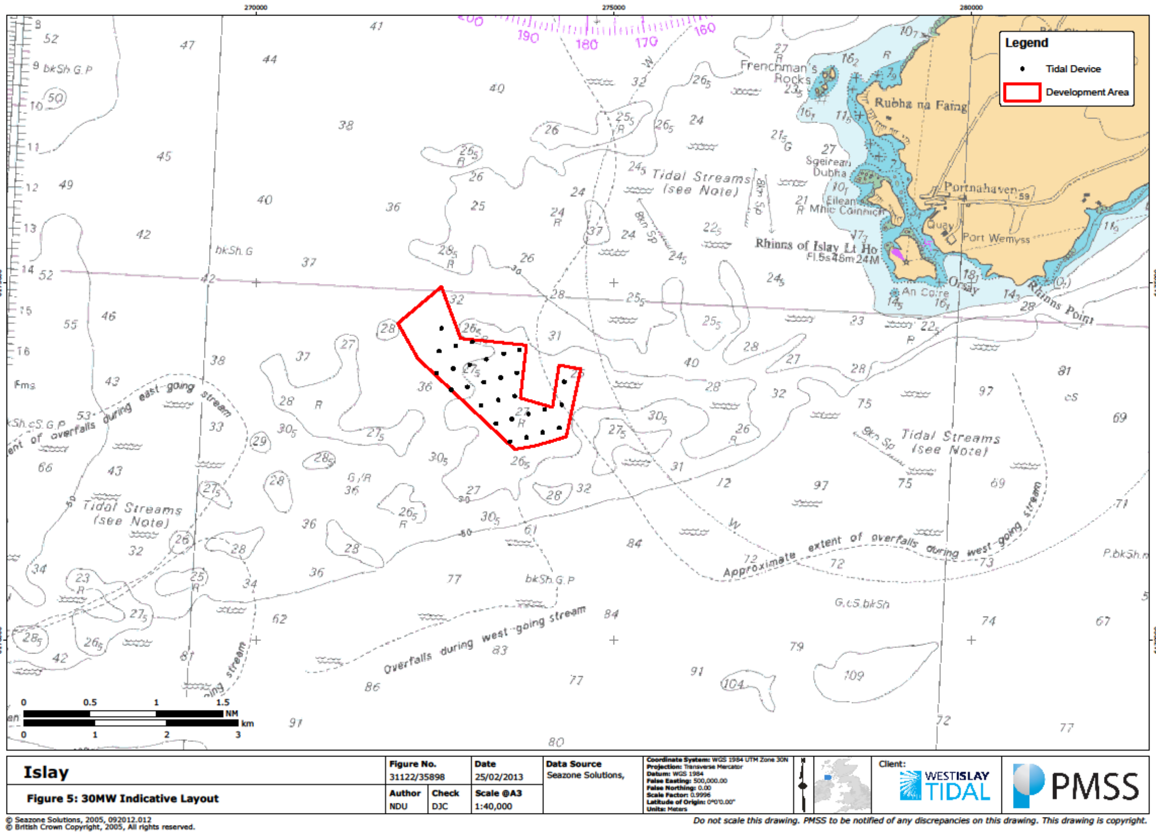

Figure 5: Phase 1 – 30MW Indicative Layout

5.1.2. Phase 2 - Approximately 50MW Installed Capacity – Information Only

This phase featuring additional devices is dependent on progress towards resolving electrical grid access and recognises potential supplier chain issues with respect to the availability of devices and infrastructure to support installation and commissioning. Consent for this phase is not being sought in this submission.

5.1.3. Phase 3 – Approximately 400MW Installed Capacity – Information Only

The intent is to exploit fully the tidal resource in the development area. This could result in a Tidal Farm 400MW of around capacity. Such a development would require significant grid infrastructure improvements. Consent for this phase is not being sought in this submission.

5.2. Site Selection

The site selection process that was undertaken to support the identification of the Islay site as a whole is discussed in more detail in the Chapter 3.0 of the Environmental Statement – Rationale and Site Selection Process. The south west coast of Islay was selected for, amongst others, the following reasons:

- It has a high tidal resource peaking at 3.5m/s (mean peak spring);
- The bathymetry (between 25 and 50m) and sea bed profile matches the general requirements of tidal turbine devices being considered;
- An area large enough to deliver (eventually) in excess of 300MW is present;
- Shipping activity is relatively low in the immediate area.

The criteria for the site include appropriate depths of water to accommodate the potential tidal devices which may be considered for the site. In general, the sub-surface devices being considered require water depths of greater than 25m. A review of existing bathymetric data was undertaken to assist with site selection.

The preferred area for deployment was determined as the area off the west coast of Islay

5.3. Project Location

The initial 30MW phase of the West Islay Tidal Energy project which is the subject of this NSRA is centred within a wider area of a potentially multi hundred MW project. The eastern edge of the project lies at its closest point approximately 2.4 n miles from Orsay off the island of Islay in Argyll and Bute in Scotland. It occupies an area of around 2.28km^2.

5.4. Tidal Energy Convertor Devices

5.4.1. Technology Approach

The development approach taken within the West Islay Tidal EIA is that of being technology/ manufacturer neutral. This is consistent with the projects original scoping document and is also typical of many non-manufacturers led offshore EIA’s where final device selection is only undertaken post consent and subject to a formal commercial tender process. At this point in time there are still a number of different design concepts under development and there has as yet been no consolidation of designs resulting in a common strategy similar to the “Danish Wind Turbine” concept. Therefore, the precise type of TEC device to be used has not yet been settled.

As well as the multitude of designs it is also observed that there is considerable fluidity in manufacturers with major OEM`s taking over smaller technology suppliers and trading between themselves. Siemens has taken a 100% position with Marine Current Turbines as well as developing a technology solution with Voith. Alstom has taken over Tidal Generation Ltd from Rolls-Royce as well as having licensed technology from Clean Current Power Systems. It is very likely that this fluidity will result in some level of design consolidation which will evolve into second and even third generation technologies. This “Rochdale principle”, approach is, therefore, being adopted for this development.

It would be impracticable to define an extremely wide design envelope which could accommodate all of the potential tidal energy options and then attempt to consider a broad range of impacts within an EIA. However, enough flexibility needs to be built into the EIA process that a sufficient range of devices and technologies can be utilised to ensure that the EIA results in a buildable consent with the most up to date technology designs being utilised at the time of build.

In order to ensure this flexibility the key elements of the designs are considered on a realistic “worst case” basis and appraised in relation to the various potential impacts, including those on navigation as well as, for example, visual intrusion.

5.4.2. Generic Device Characteristics

The basic tidal device can be divided into two elements; the energy capture element (hydrodynamic and power take off subsystems) and the mooring and/or foundation structure.

5.4.2.1. Open Rotor Horizontal Axis Turbine

For this EIA although there is as yet no standardised technology solution for extracting tidal energy there is a clear mainstream technology strand developing based on a turbine utilising an un-ducted horizontal axis rotor (two or three bladed) and the EIA and this NSRA have been undertaken on the basis of this design feature. A number of manufacturers have adopted this approach including MCT/Siemens, TGL/ Alstom, Hammerfest Strom and Voith Hydro.

5.4.2.2. Foundation - Support Structures

A number of installation and mounting technologies have been considered for the un-ducted open rotor horizontal axis turbine. MCT have proposed two turbine units attached to a lifting cross arm mounted on a seabed mounted steel tower (the Seagen S). TGL propose their turbine to be clamped on a seabed mounted tripod structure pinned to the sea bed with the turbine winched down to the foundation. Hammerfest Strom propose a similar tripod foundation but with gravity ballast used to keep the structure in place.

Two models of TEC have been evaluated in detail in order to provide a reference design envelope for the EIA. These are the Marine Current Turbines (MCT) SeaGen Mark 2, a twin rotor 2MW machine and the Tidal Generation Ltd (TGL) single rotor 1MW turbine. Whilst these devices are used to inform the detailed baseline for the EIA, and can be considered as the most likely form of TEC solution to be used, alternative support structure systems have also been considered (e.g. Bluewater Bluetec device) and are addressed in this report.

Both the MCT and TGL feature rotor and generator configurations based on horizontal axis, non-ducted, pitch controlled, three bladed rotor but a number of other devices also would fit within this design envelope and would be suitable for deployment (e.g. Voith Hydro, Andritz Hydro Hammerfest etc). The key difference between the MCT and TGL TEC solutions is the foundation design, installation and turbine deployment methodology.

5.4.3. MCT SeaGen S Mark 2 Turbine

The SeaGen S Mark 2 Turbine is a twin rotor, 2MW, surface piercing type device in which the twin rotors and nacelles are attached to a monopile structure which protrudes above sea-level. The Mark 2 is a development of the 1.2MW device trialled in Strangford Loch but with 20m, three bladed rotors. With 20m rotors it can operate in 26.5m minimum depth (3m below and 3.5m above rotor). Figure 6 shows a SeaGen S Mark 1 device.

Figure 6: MCT SeaGen S Tidal Device

The SeaGen S Mk2 is similar to the original SeaGen S. The SeaGen S Mk2 TEC has a maximum capacity of 2.0MW (1MW per turbine) although the power rating can be adjusted according to environmental and technical constraints to between 1.1 and 2.0MW. The device comprises a twin rotor, controlled pitch machine consisting of a central tower with two three-bladed rotor/turbines mounted either side on a cross beam. Each rotor/turbine drives a separate generator via a gearbox. The cross beam is connected to the tower via a sleeve or collar. The complete assembly of collar, cross beam and turbine assemblies can be raised and lowered for maintenance and operation. The total width in the horizontal plane of the device from blade tip to blade tip is approximately 50m based on a rotor diameter of 20m. During operation the central tower is always visible above the surface of the sea as shown in Figure 5.

The turbines start to rotate and generate at a tidal speed of around 1m/s (~2kts) and reach full rated power at 2.4m/s (~5kns). When the tide turns, the turbine blades are rotated 180° to face the oncoming tide and the process is repeated. At full rated power (notional 1MW per turbine) the rotational speed of the turbines is approximately 11.4rpm. With a diameter of 20m and rotational speed of 11.4 rpm, this gives a tip speed of 11.94m/s.

The minimum depth below Chart Datum, i.e. the clearance between the top of the rotor swept arc and the water surface at LAT, will be no less than 3.5m. The clearance between the lowest point of the swept arc and the seabed will be no less than 3m. In all instances these minimum clearance distances will be maintained during micro-siting. Where water depth does not permit this then the rotor diameter may be reduced proportionately on a turbine by turbine basis.

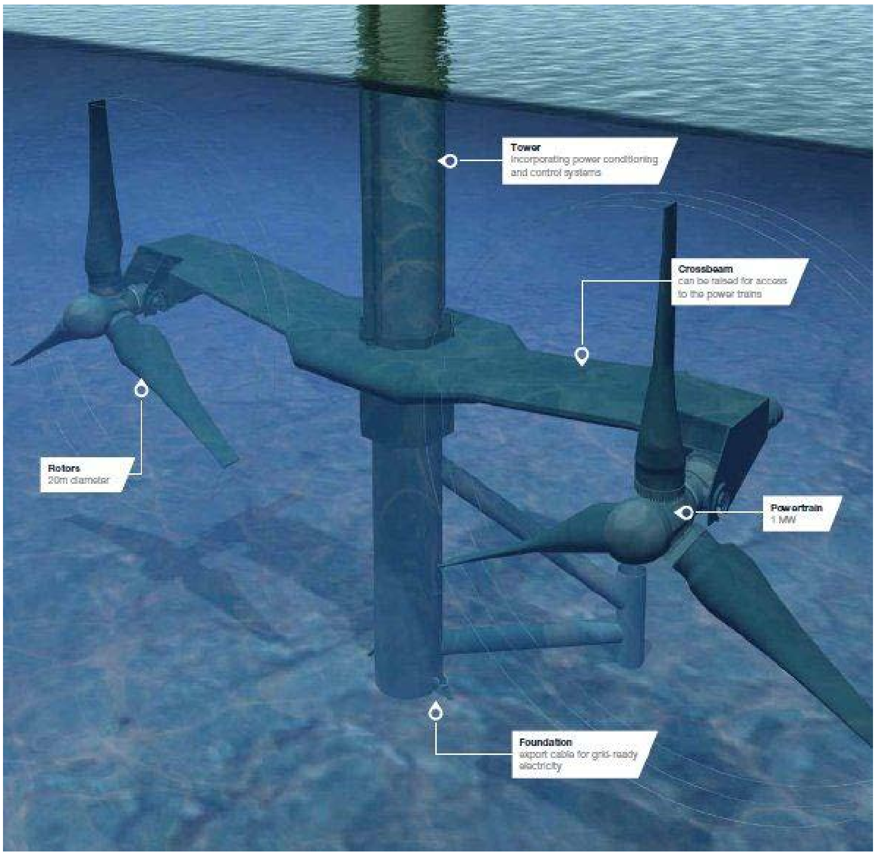

Figure 7: SeaGen S Mk 2 (with monopile foundation)

A transformer and the power conditioning equipment required for exporting power to the grid are housed inside the tower. A pod enclosure on top of the tower houses other electrical and control equipment. The step up voltage transformer will be either cast-resin or oil filled. The pod platform is 7 x 9m in area. The pod enclosure is 3.5m in height and 7m in height at its maximum extent. The maximum height of the structure above LAT (~CD) is nominally 21m.

5.4.4. SeaGen S Structure and Foundation

The detailed design of the Seagen foundation will be subject to ground conditions, metocean conditions, equipment availability, installation and operations philosophy and life-cycle cost. For the purposes of the EIA and this assessment, a quadrapod as opposed to tripod design has been used since it represents the worst case scenario in terms of seabed impacts. Figure 7 illustrates a quadrapod foundation. The foundation structure is secured to the seabed by grouted pin piles. The structure also supports access ladders, J-tubes (to prevent export cable damage), corrosion protection equipment and a boat landing platform.

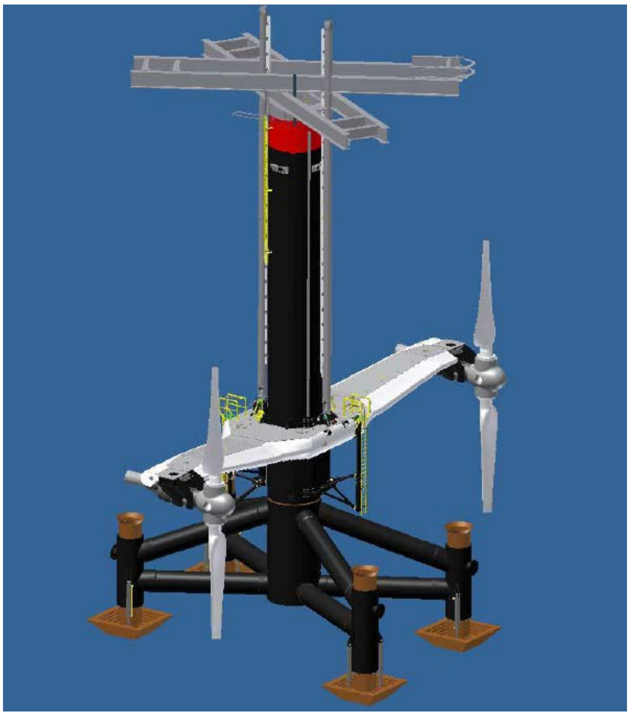

Figure 8 SeaGen S - Example of Quadrapod Foundation

5.4.5. SeaGen S Mk 2 Characteristics

The main parameters and characteristics of the device and support structure are given at Table 3.

Element	
Installed Capacity	2MW
Rotor Diameter	2 x 20m
Width (across stream)	50m
Rotational Speed	11.5m
Swept Area	628m^2 (Total)
Minimum Seabed Clearance below rotor	3m
Minimum Clearance above rotor	3.5m
Height above LAT	21m

Table 3 MCT SeaGen S Mk 2 Characteristics

5.4.6. Alstom-TGL

The Alstom-TGL machine is a scaled version of the 500kW device deployed at EMEC in 2010 and 2011 and will be similar to the 1MW device which has just begun testing at EMEC. The device comprises a single three-bladed open rotor with a maximum capacity of 1.5MW with the specific rating being adjusted according to environmental and technical constraints.

The Alstom-TGL turbine (Figure 9) is similar to the SeaGen S powertrain in that it comprises an un-shrouded, horizontal axis, three-bladed, controlled pitch rotor, with integrated drive-train and power electronics. However, unlike the SeaGen turbine which involves solely blade pitching to accommodate changes of tidal direction, the complete turbine yaws on change of tide 180° to face into the tidal stream. This is accomplished utilising a tunnel thruster mounted on the aft end of the nacelle.

For deployment, the detachable turbine nacelle and rotor assembly is winched down and clamps onto a steel foundation, which is predrilled and pinned to the seabed. A buoyant design of the nacelle allows rapid deployment and retrieval for installation and onshore maintenance.

The Alstom-TGL unit is designed to operate in minimum water depths of 35m. The clearance between the highest arc of the rotor and water surface will depend on the final rotor diameter design selected for the Islay site but based on the 22m currently defined is expected to be no less than 7m at LAT. The clearance between the lowest arc of the rotor and seabed will be no less than 6m. In all instances these minimum clearance distances will be maintained during micro-siting. Where water depth does not permit this then the rotor diameter may be reduced proportionately.

Figure 9: Alstom-TGL Tidal Turbine

5.4.7. Alstom-TGL Structure and Foundation

The Alstom TGL turbine support structure consists of a tubular construction steel tripod, fixed to the seabed through the use of 3 steel pin piles. The tripod is connected to the piles through the use of grouted connections at each of the legs. The detailed design of the TGL foundation will be subject to ground conditions, metocean conditions, barge availability, installation and operations philosophy and life-cycle cost. An illustration of the Alstom-TGL foundation is shown in Figure 10.

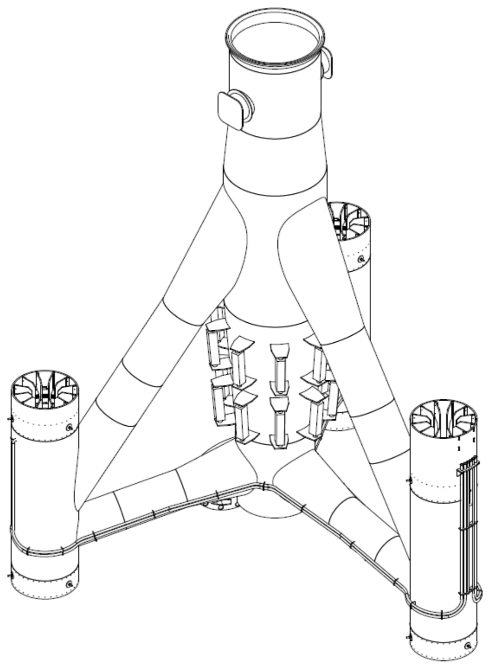

Figure 10: TGL Tripod Foundation

5.4.8. Alstom-TGL Characteristics

The main parameters of the device and are given at Table 4.

Element	
Installed Capacity	1.5MW
Rotor Diameter	22m
Width (across stream)	22m
Rotational Speed	14rpm
Swept Area	380m^2
Minimum Seabed Clearance below rotor	6m
Minimum Clearance above rotor	7m
Height above LAT	N/A

Table 4: Alstom-TGL Characteristics

5.4.9. Bluewater Bluetec Floating Platform Design

5.4.9.1. General Description

The Bluetec is a floating support platform designed to be suitable for all types of tidal turbines whether horizontal or vertical axis. Figure 11 illustrates the platform supporting two MCT turbines. Like the MCT TEC tower, the floating platform solution provides the opportunity to accommodate the most critical equipment above the waterline, where it is dry and protected, allowing for easy access, inspection and repair.

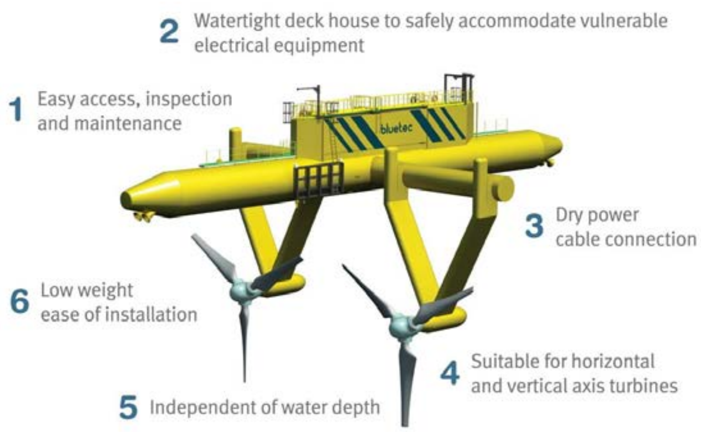

Figure 11: Bluetec Floating Platform

The Bluetec device is secured to the sea bed with a mooring spread consisting of four shared-anchor points to which the devices are connected using a compliant mooring line system as shown in Figure 12. Electricity generated by the individual turbines is brought onboard the platform in a watertight deckhouse and eventually grid-connected via the umbilical power cable.

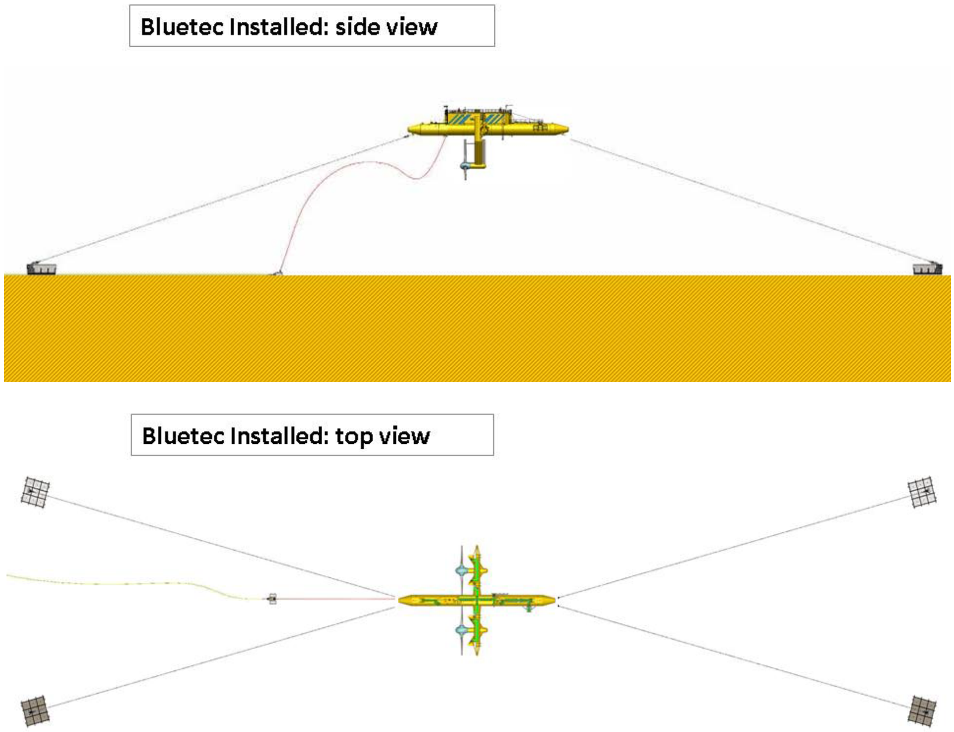

Figure 12: Bluetec Mooring System

The floating platform is constructed from tubular steel sections and has a cross-beam design. Bluetec has a dedicated deckhouse to safely accommodate vulnerable equipment consisting of two parts: a Local Equipment Room (LER) and an Electrical Equipment Container (EEC). The floating structure incorporates vertical bulkheads, creating a number of safe watertight compartments to provide adequate buoyancy for operational and survival conditions. The structure is designed to stay buoyant and stable even during major failures such as a damaged compartment or mooring line.

Including two horizontal axis turbines, the platform will be approximately 60m long and 35m wide and weigh approximately 300 – 400 tonnes. The main structure would protrude around 5m above the water line.

5.4.9.2. Ground Anchors

Two options for the ground anchors are being investigated. For the purpose of this report both options are considered.

Gravity Based Anchors (GBA). These will be made up of steel and concrete elements with overall dimensions of approximately 8x8x3m per anchor.

Drilled pile anchors. Drilled piled anchors involves drilling a shaft into which a steel pile is lowered and sequentially grouted to make solid connection to the surrounding rock. The design of the individual piles will be subject to the geotechnical findings but would be similar to those employed on the MCT or TGL foundation designs, approximately 1m in diameter with a total length of 10m of which 1m will protrude above the seabed.

5.4.9.3. Mooring System

The Bluetec mooring system is a semi-taut system and is designed so that there is no contact between seabed and mooring line. There is therefore no potential for seabed scrub as there is with slack mooring or anchoring systems.

Prior to installation a temporary mooring buoy arrangement will keep the mooring lines and umbilical together and prevent them from touching the sea-floor. When a device is towed away for maintenance/overhaul purposes either a replacement platform or a temporary mooring arrangement will be installed.

Umbilical will have a diameter of approximately 80 – 100 mm and mooring lines will have a diameter depending on the turbines and site conditions.

5.5. Array Details

The approach taken within the array designs of the Islay 30MW proposal outlined below emphasises the need for flexibility and designing an array envelope which encompasses the likely greatest effect. This reflects the technology envelope strategy described above and consequently three potential options are considered:

- All surface piercing - based on 15 surface piercing MCT SeaGen S units (or Bluetec floating devices).
- All non-surface piercing – based on 30 individual 1MW TGL units (combined with a subsea substation).
- A mixed site with both surface piercing and non-surface piercing devices.

The choice of array type will be influenced by a number of factors including seascape visual impact assessment and navigational safety. The above options offer differing degrees of associated effects and consequent risks or environmental impacts which are addressed in the EIA.

5.5.1. Device Spacing

The inter turbine spacing and positioning of the devices is described below but the general alignment is with rows aligned perpendicular to the most energetic ebb and flood currents. For Islay these primary flows are orientated around 160/340 degrees.

The ideal siting principles based on the manufacturers design parameters are defined below in Table 5. It is recognised that the orientation will inevitably be affected by specific seabed conditions localised flow effects. Consequently the final detailed device locations will be confirmed following geotechnical survey of the seabed and confirmation of the resource and location by location turbulence levels.

5.5.2. SeaGen S Array Spacing

Initial studies on the wake effect of the SeaGen S based on modelling and on measured wake decay suggest that a downstream distance of 400m or 20D (where D is the rotor diameter) would be sufficient to ensure that energy production is not adversely affected by interactions between turbines. A minimum staggered downstream spacing of 200m or 10D has also been defined. The Islay layout is based on a 300m or 15D spacing.

The manufacturer's current recommended minimum spacing of the SeaGen TEC, perpendicular to the flow (cross flow) is 61m from tower to tower centreline based on the rotor diameter of 20m and a minimum tip to tip clearance of 10m.

In the example layouts the separation between the centres of each SeaGen TEC has been set at 240m i.e. significantly greater than the manufacturers recommended minimum separation. Whilst wake effects are unlikely to be an issue with these spacings, there are likely to be practical reasons for having increased separation. Such reasons include technical issues e.g. mooring spreads during construction, or environmental issues (e.g. providing evasion corridors to mitigating any potential barrier effect for navigation or marine mammals).

The minimum and maximum spacing and depth parameters for multiple row configurations are set out below in Table 5 below.

Parameter	SeaGen S Mk 2 with 2 x 20m Dia. Rotors
Minimum crossflow spacing	61
Maximum crossflow spacing	300
Minimum separation tip to tip (between devices)	10
Maximum downflow spacing	400
Minimum downflow spacing	200
Minimum water depth of device at project site	29
Maximum water depth of device at project site	40

Table 5: Depth and Spacing Parameters – SeaGen S Mk 2

5.5.3. TGL Array Spacing

The manufacturer's initial studies on the wake effect of the TGL device suggest that a downstream distance of 440m (or 20D with a 22m rotor diameter) would be sufficient to ensure that energy production is not adversely affected by interactions between turbines. It is understood that this is likely to be a maximum downstream requirement and may potentially to be relaxed following evaluation of the results from preliminary array deployments. For the purposes of the West Islay array a minimum staggered downstream spacing of 220m or 10D has been defined whilst the compromise spacing adopted with the example layouts is based on a 330m or 15D spacing.

The manufacturer's minimum recommended cross flow spacing of the TGL device, (i.e. perpendicular to the flow) is 66m or 3D with a rotor diameter of 22m. For the purposes of the array design the maximum cross flow separation between the centres of each TGL device has been taken to be 240m.

The minimum and maximum spacings and depth parameters for multiple row configurations are set out below in Table 6 below.

Parameter	TGL Turbine with 22m Dia. Rotors
Minimum crossflow spacing	66
Maximum crossflow spacing	240
Minimum separation tip to tip (between devices)	44
Maximum downflow spacing	440
Minimum downflow spacing	220
Minimum water depth of device at project site	35
Maximum water depth of device at project site	50

Table 6: Depth and Spacing Parameters – TGL Turbine

5.6. Power Export Cabling

The export cables (up to three) will be medium-voltage, armoured cables laid on the seabed. The cable route being considered under this application is from the site to the landfall point at Kintra (See Figure 13).

The remainder of the offshore route from Kilnaughton Bay to the Kintyre Peninsula and necessary onshore elements will be subject to separate applications for consent.

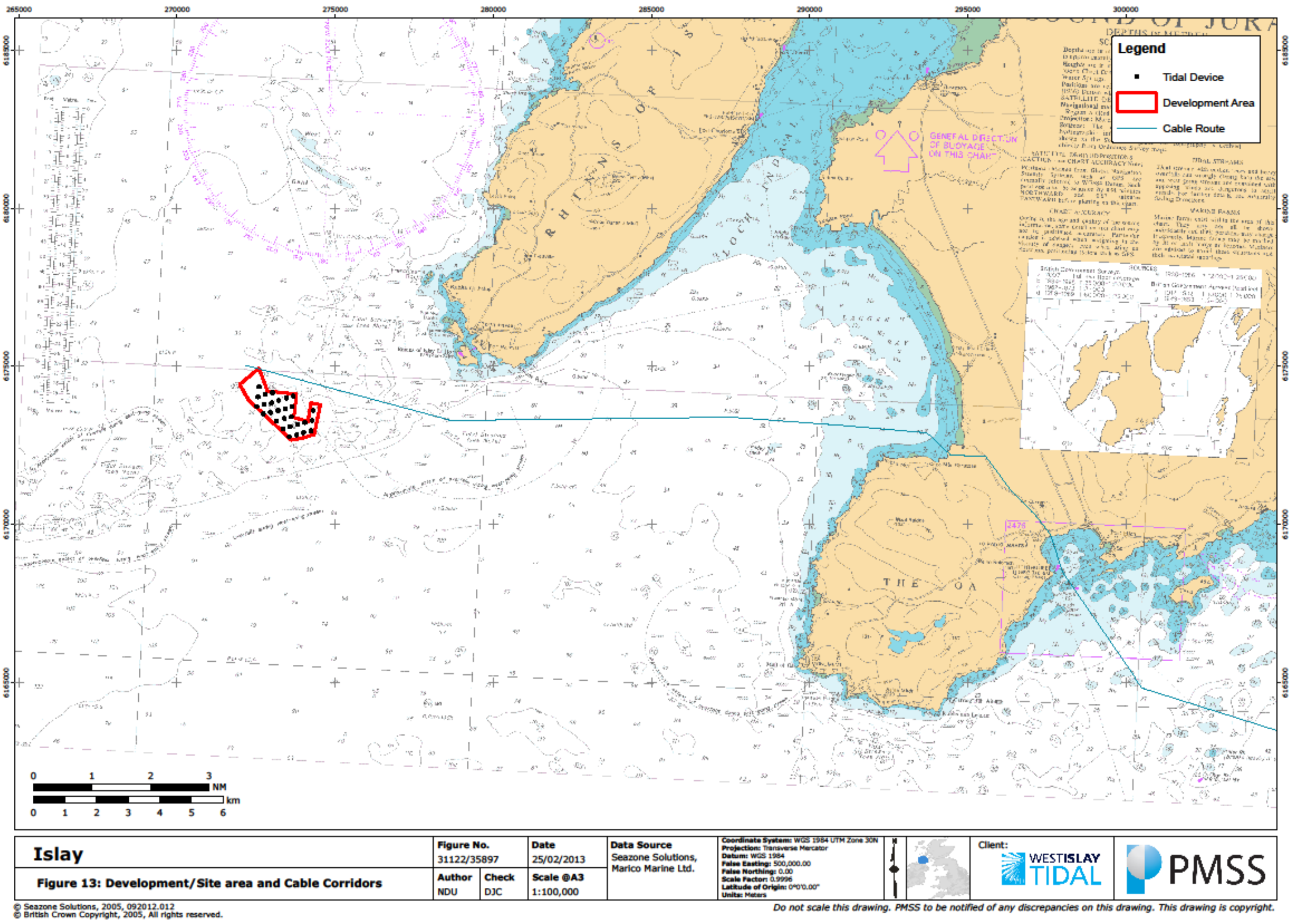

Figure 13 Proposed Export Cable Route

5.7. Lifecycle

It is currently proposed that the array will operate for a period of 25 years. At the end of this period, the array will be decommissioned and the tidal devices removed to a standard meeting industry best practice at the time. Alternatively, a fresh application may be made to extend the life of the array, or to replace the existing turbines.

5.8. Installation Methodology

The installation process methodology has not, at this point, been established as the final design of the array and, indeed, its component parts, have not yet been finalised. However, it is certain that, whatever final design is used, drilling and piling or pinning activities to establish foundations or mooring will be involved as well as heavy lift activities when positioning devices and their sub-sea structures.

The general methodology for the installation process and the tasks will be in the order set out below:

1. Pre-installation activity.
2. Subsea Cable installation.
3. Foundations/moorings installation.
4. Device Installation

5.8.1. Pre-Installation Activity

Pre-installation activity may involve a number of activities ranging from geotechnical investigation using drilling platforms to survey using remote sensors as well as seabed preparation or rock anchor drilling. Some of these activities could require a jack-up platform or Dynamically Positioned (DP) Vessel. None of these activities would present a novel or permanent hazard to shipping.

5.8.2. Subsea Cable Installation

Cable installation would require a medium size specialist cable laying vessel. Once again, this activity would not present a novel or permanent hazard to shipping.

5.8.3. Foundations/Mooring Installation

5.8.3.1. MCT SeaGen

The installation work will most likely be executed by jack-up vessels, DP vessels or Heavy Lift vessels (HLV). A seabed drilling template is used to drill four sockets for piles used to secure the Quadrapod support structure. These piles will protrude slightly above the seabed on completion but will not comprise a hazard to shipping. The support structure and turbines are installed as described in Section 5.9.2 in a single operation.

5.8.3.2. Alstom-TGL

The installation works will most likely be executed by jack-up vessels, DP vessels or Heavy Lift vessels (HLV) A seabed drilling template is used to drill three sockets and the pin-piles grouted in place leaving the piles protruding slightly above the seabed. These will not comprise a hazard to shipping. The support structure (without the turbine) is lowered in place in a separate operation to await later installation of the turbine. The support structures will extend some 12 - 14 m above the seabed providing approximately 16 - 20m clearance above the shallowest structure.

5.8.3.3. Bluewater Bluetec

The Bluewater Bluetec device require the installation of moorings involving large, clump weight type anchors or rock anchors and associated mooring lines with either submerged or surface buoys to enable recovery and connection to the device when it is brought on-site. Such moorings would require a specialist vessel to be on site for a number of days after which the moorings would await the arrival of the devices and may present a hazard to shipping or fishing and which, therefore, would require to be appropriately marked.

5.9. Device Installation

5.9.1. Mobilisation Port

DPME is currently considering the mobilisation port options from where the installation activities would be conducted. At present Clyde Port, Belfast and Mostyn are being considered but a final decision has yet to be taken. Support activities within the port area associated with DPME installation activities would be considered for their impacts on safety of other port operations by the Port Authority in accordance with the requirements of the Port Marine Safety Code. Given the vessel types most likely to be used for installation activities their passage to the site would present no new or novel hazards beyond those expected to be found in the area between the port and the site.

5.9.2. Support Structure and Generator Nacelles

Installation of the seabed sited devices (but not the Bluewater Blutec floating device) would require a vessel capable of heavy lift activities in an area of high tidal rates. A specialist installation vessel would be required such as a jack up vessel, DP vessel or heavy lift barge. Such a vessel will be capable of carrying a number of structures onboard and lifting them into position onto prepared foundation areas on the seabed where they would be pinned and grouted into position. A typical heavy lift vessel (the Rambiz) is illustrated at Figure 14. A jack up vessel is shown at Figure 15.

The MCT SeaGen device would be installed in one operation involving a jack-up vessel, DP vessel or barge lifting the whole structure into place before pinning the quadrapod support structure in place. The Alstom-TGL support structure would be installed in a similar manner but in this case, it is likely the generator nacelles and rotors would be installed as a separate activity possibly involving a different vessel.

It may be the case that the vessel would return to the mobilisation port to embark further devices or a barge may be employed to “feed” the installation vessel on-site.

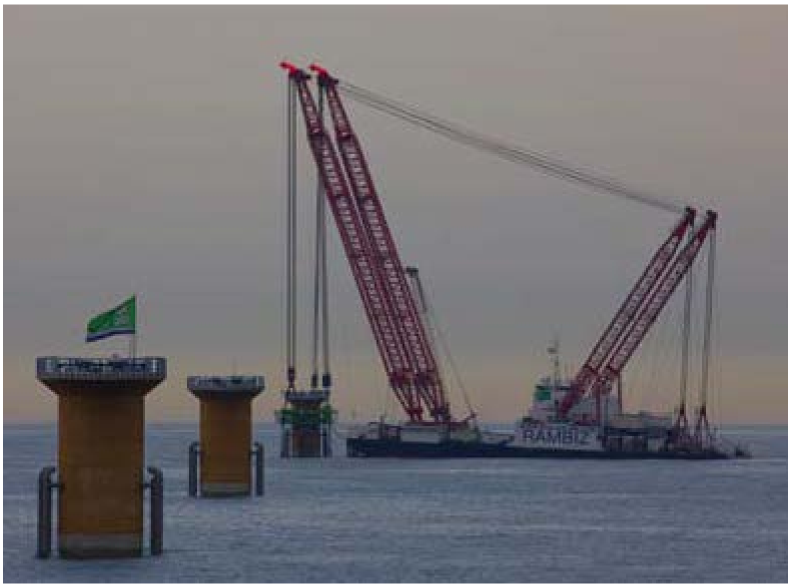

Figure 14 Heavy Lift Vessel “Rambiz”

FACTS

General	
Type of vessel	Heavy-lift jack-up vessel, self-propelled
Main dimensions hull	
Length hull (overall)	147.50 m
Breadth hull	42.00 m
Depth hull	11.00 m
Operational conditions	
Water depth for jacking	Up to 50 m
Significant wave height for jacking and DP	Up to 2.00 m
Wind speed for crane operation	Up to 18 m/s
Operating draft	7.33 m max
DP capability	Vessel complying with DP2 requirements
Dimensions of legs	
Number of legs	4
Leg cross section	Lattice leg
Jacking system	Rack and pinion
Jacking speed	Up to 1 m/min
Accommodation	Up to 100 persons incl. crew. Cabins can be used as single or double cabin. Vessel is pre-fitted for 180 persons on board
Helideck	D = 20.88 m, suitable for Sikorsky S92 with a MTOW of 12.8 t
Thrusters and propulsion	
Vessel speed	Up to 12 knots
Crane	
Category	Crane around the leg
Capacity	SWL 1,500 t @ 31.5 m
Cargo load	
Cargo load	Up to 8,000 t
Sample scenarios	• Up to 7 WTG / 6 MW+ • Up to 12 WTG / 3 MW+ • 2 jackets up to 1,000 t and piles up to 1,300 t • 4 jackets up to 600 t and piles up to 1,600 t • 7 monopiles up to 500 t and 7 transition pieces up to 300 t
Note	**All mentioned conditions depend on a site-specific assessment.**

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Figure 15 Typical Renewables Installation Vessel

Such a vessel would be able to take a number of devices at a time to the site. The number depends on the type being installed. For example, with MCT SeaGen units, it may be possible to take five at a time to the site, drill the sockets, install and commission the turbines over a period of approximately 45 days. It is possible that the TGL units may take a shorter installation period with a total of 30 turbines. It is, however, likely that the operations of drilling and piling and the support structures and turbines will take place in consecutive summers.

5.10. Operation/Maintenance

It is assumed that, once in position, monitoring of the technical performance and function of the device will take place over the life of the device. Planned interventions for inspection or maintenance are currently estimated as requiring recovery of the TGL devices every 5 years. These would be recovered and towed to a port facility by small vessel. The Bluewater Bluetec devices would be recovered in a similar fashion although details of the required intervention periods are not, at this stage known. The MCT devices will be maintained in place and only require occasional major item replacement in the event of major component failure. It is estimated that the average number of interventions requiring a lift vessel will be in the order of 2It is probable that visits to the devices by workboats will also be undertaken for survey and inspection of the devices and for environmental monitoring purposes.

5.11. Decommissioning

At the end of the device/array lifecycle, the devices will be decommissioned. The decommissioning of devices involves a reversal of the installation process and is expected to have a reduced timescale.

6. Other OREI Developments

Seabed lease agreements between The Crown Estate (TCE) and marine renewable energy developers have resulted in several other marine renewable energy installations proposed for the surrounding areas off the Western Isles and Scottish and Northern Ireland coasts (see Figure 1). These, in particular, include the proposed Scottish and Southern Energy Renewables (SSER) Islay Wind Farm, the south east corner of which is approximately 6 n miles to the north west of the DPME proposed development. This will affect traffic levels, as maintenance and support vessels of various types and sizes may be deployed from various local ports/harbours to install or service marine energy projects. Traffic routes and patterns will also be affected by the displacement of traffic from existing shipping routes in the area affected by OREI developments.

The potential for cumulative/in-combination effects of this development on navigational matters has been identified. Discussions initiated by DPME with SSER have not been able to establish sufficient detail of that development and to obtain data from their traffic survey and the impacts on routing that the proposed wind farm will have to enable any detailed analysis of the combined effects to take place as the full scope of the SSER development cannot at this stage be ascertained.

7. Marine Traffic Data Gathering and Analysis

7.1. Sources of Data

The siting of an OREI can, potentially, present a major hazard to shipping during all, or some, of the lifecycle phases. It is, therefore, necessary to have adequate information to enable the impact of the proposed demonstration array on vessel navigation to be fully assessed. Sources of vessel traffic information used in the report are discussed below.

7.2. Radar and AIS Traffic Survey

Marico Marine Ltd were contracted to undertake the marine traffic survey of the area. Two periods of fourteen days, one in March/April 2012 and the other in July/August 2012 were undertaken from a survey site near Portnahaven, Islay. The total duration of the survey periods meets the MCA requirements set out in MGN 371 (M+F) for such surveys and was agreed with the MCA prior to the survey start.

The vessel traffic surveys were undertaken from a suitably equipped temporary onshore Radar/AIS station manned and recording on a 24/7 basis. The vessel track data was collected using Automated Identification System (AIS), Radio Detection and Ranging (RADAR) and direct visual observation. The surveys took into account potential peak seasonal variations in small vessel movements by recording in summer and winter periods. The surveys were conducted against Marico's (internal) Standard for the conduct of such surveys from which assurance can be taken that the data obtained is both suitable and sufficient.

7.2.1. Recording Periods

The main vessel traffic surveys were carried out between the following dates:

- 14 days from 19th March to 4th April 2012 inclusive;
- 14 days from 17th July to 2nd August 2012 inclusive.

PMSS considers that the sample of vessel activity achieved by using the above dates was representative and achieved the overall objective of obtaining sufficient data on which to base the assessment.

7.2.2. Survey Site

The location of the temporary radar surveillance base station for both the winter and summer surveys was determined after visits to a number of potential sites on Islay. It was determined that the best location for outlook onto the tidal turbine site was in the vicinity of the Wavegen Power Station close to Portnahaven.

The site met the criteria necessary for visibility of the site and its buffer boundary by the radar as well as substantial areas of sea on either side of it.

The height of the radar antenna was approximately 30 metres above sea level which gave a theoretical radar horizon of 12.3 nautical miles. See Figure 16.

Figure 16 Approximate extent of Radar Horizon

7.2.3. Survey Station and Equipment

The station – identical in construction for both winter and summer surveys - consisted of a radar tower and aerials, erected together with a cabin for observation equipment and staff.

Figure 17 Radar/AIS Survey Station

The radar software used by Marico provides the ARPA capability for the system and considerably exceeds the minimum requirements for routine plotting. The software will plot up to

500 targets simultaneously. Lost targets will become available after a period of time rather than requiring the operator to clear all lost targets manually as is the case with some other equipment.

7.2.4. Survey Methodology

The survey station was manned by watch-keeping staff throughout the entire survey period and the radar used in manual target acquisition mode rather than leave the radar in auto detect mode as automatic systems may track rain, clutter or other spurious echoes. Also, small vessels often have erratic courses and are frequently lost by auto tracking systems leading to track identification issues and data duplication.

In order to provide accurate data, the observer was required to:

- Manually acquire radar targets;
- Identify targets acquired using AIS and/or visual checks;
- Passively monitor marine VHF radio on working channels to obtain information that can be used to identify targets having due regard for regulatory confidentiality of content;
- When authorised, use Marine VHF radio to call the vessel and instigate an information exchange.
- Record photographically a representative selection of vessels passing through the survey area;
- Maintain a log of vessels tagged on the radar against the tag number with data being recorded on to a spread sheet and/or by hand. In the event of visual targets being not acquired by either the radar or the AIS, visual sighting are to be recorded with sufficient information to identify the vessel type, course, track and speed where possible;

7.3. VMS Data

VMS data is collected from fishing vessels over 15m in length which are required to be fitted with tracking devices to monitor their activities. The VMS data shown at Figure 18 shows the fishing effort in average hours per annum for vessel over 15m over a 4year period 2007-2010 inclusive. This indicates that the area directly to the west of Islay in the vicinity of the proposed development is not subject to any significant level of fishing activity conducted by vessels over 15m in length using trawls or nets.

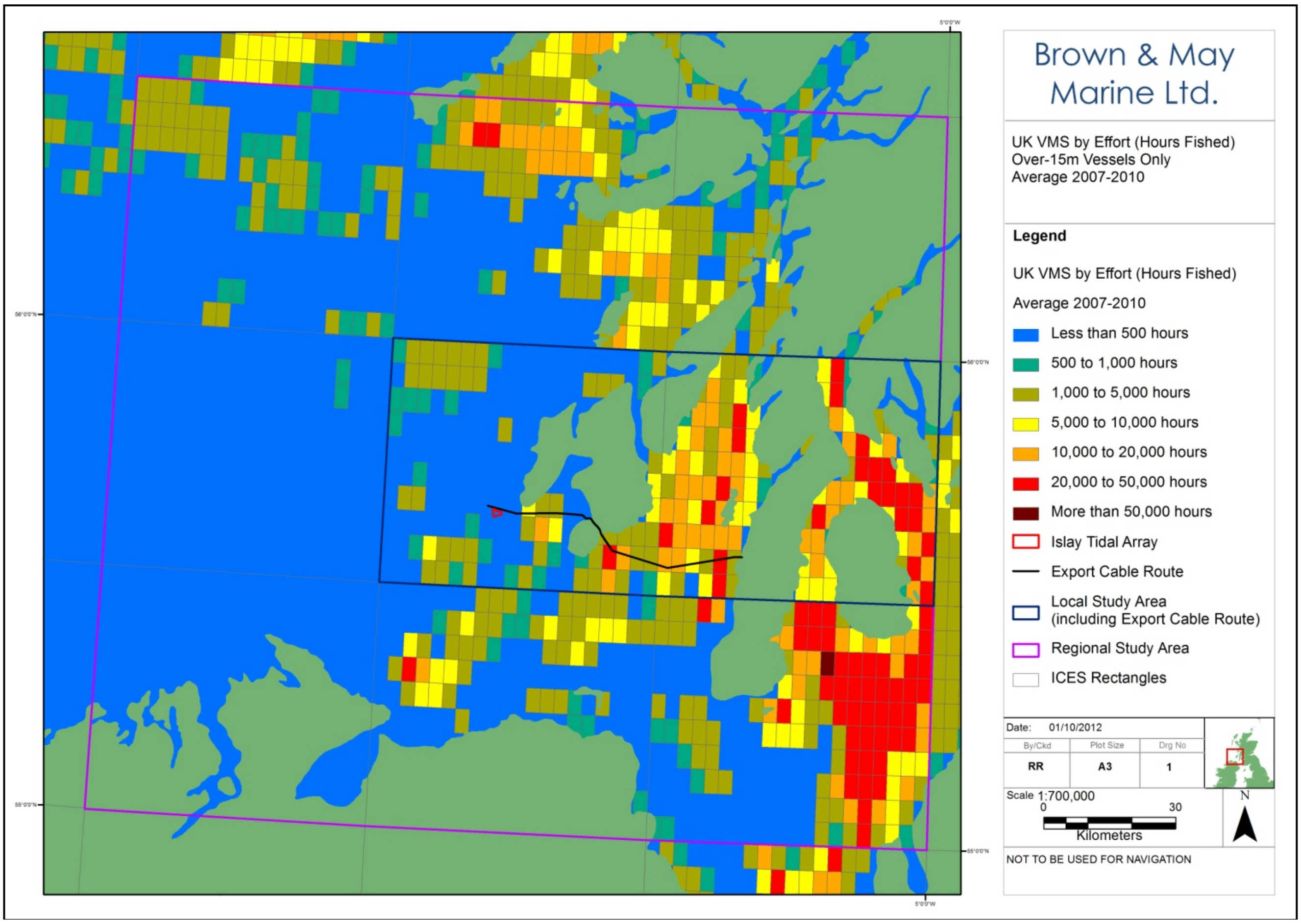

Figure 18 VMS Data – FV >15m: Hours Fished (Average per annum over 4 Years

7.4. Recreational

The RYA Coastal Atlas of Recreational Boating (Reference 11) shows routes around the United Kingdom and provides useful guidance on the general routes between harbours and marinas and an indication of relative levels of traffic. Figure 19 shows the routes for the South West Scotland area.

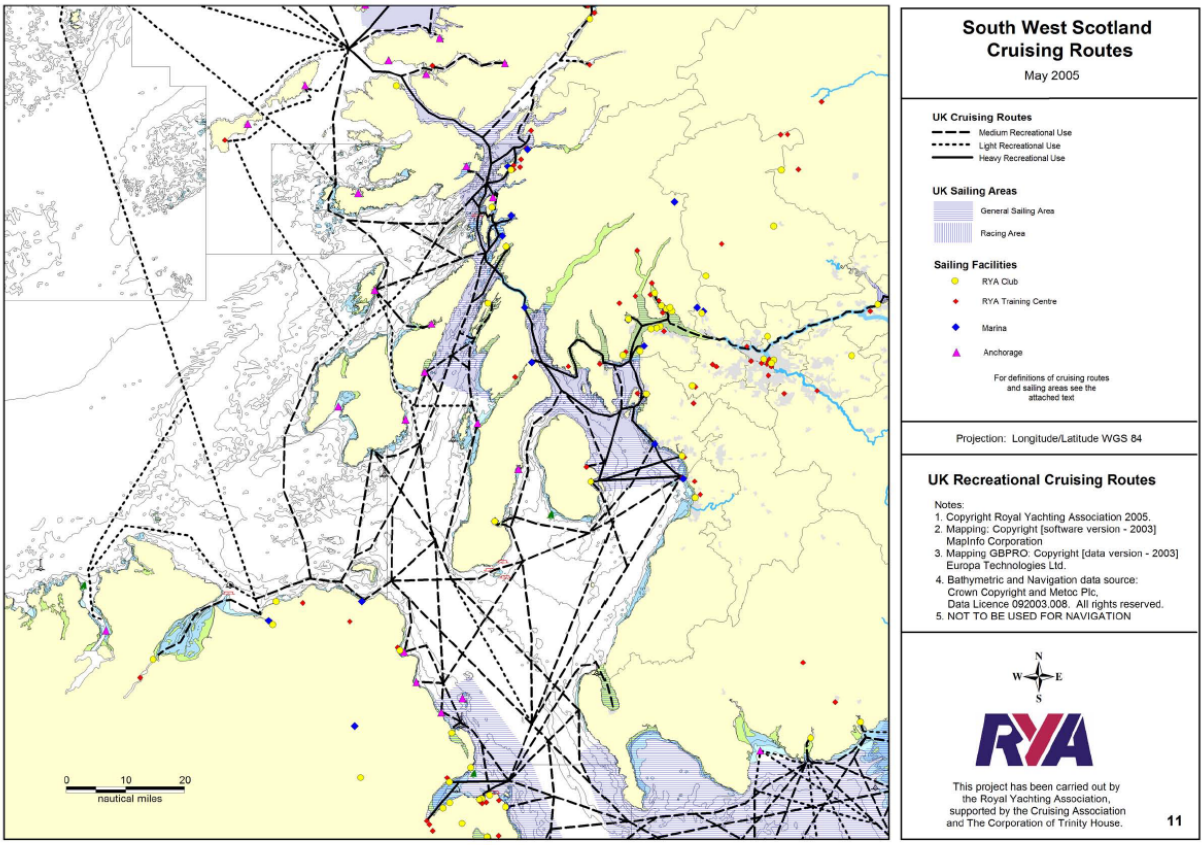

Figure 19 RYA Cruising Routes

7.5. Accident Data

Data regarding casualties and incidents in the general area have been obtained from the RNLI and the Marine Accident Investigation Branch (MAIB). The former shows casualty positions attended by the RNLI's SAR assets whilst the latter shows reported incident data obtained by the MAIB.

7.5.1. RNLI Casualty Data

Data from the RNLI was obtained for the five year period 2007 – 2011 and is shown Figure 20.

7.5.2. MAIB Accident/Incident Data

Casualty data was obtained from the MAIB for the period 1991 to 2011 inclusive and is shown at Figure 20.

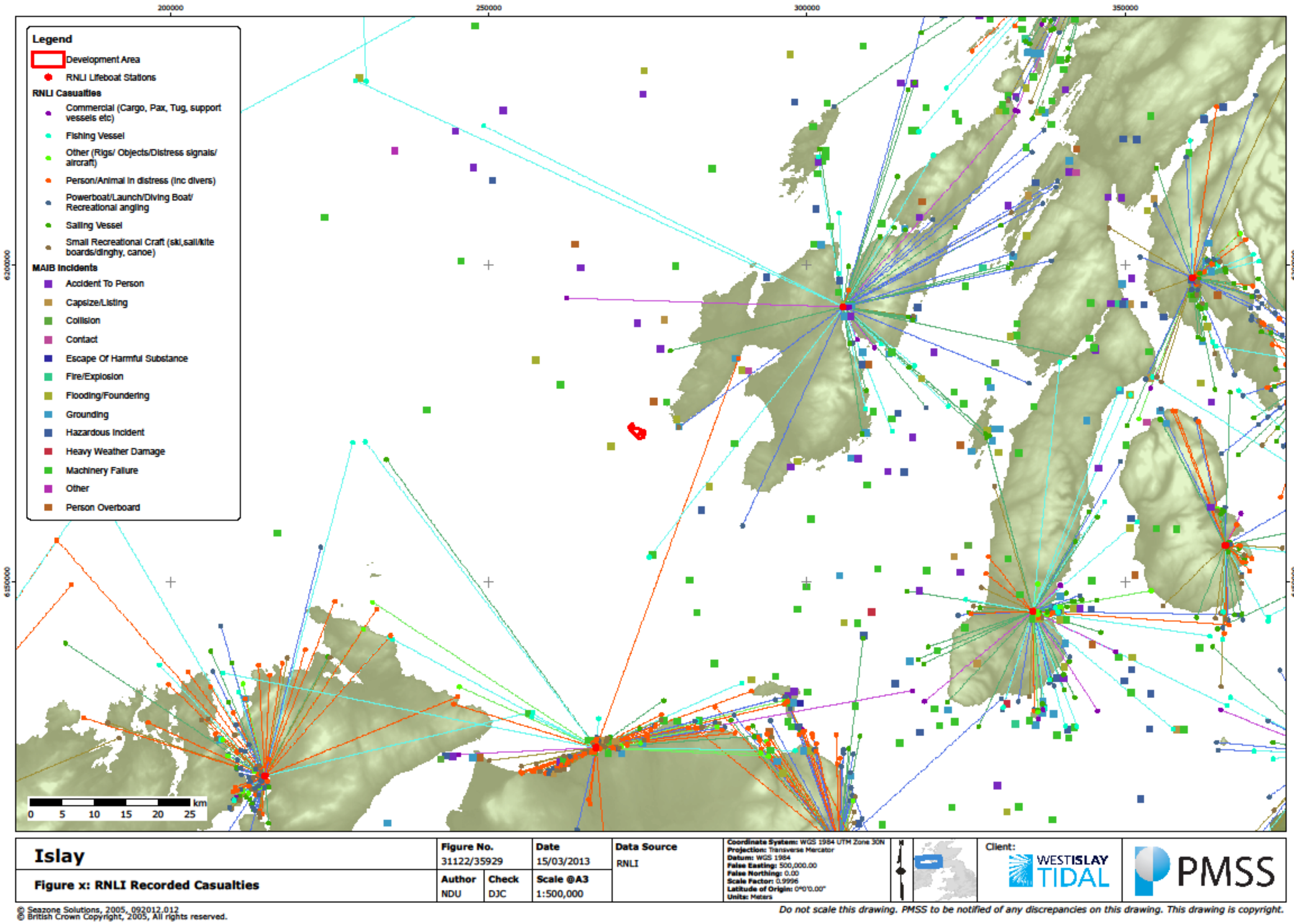

Figure 20 MAIB/RNLI Casualty Data

7.6. Stakeholder Engagement

Issues raised in the Scoping Opinion (2009) have been addressed in this report. As part of the follow-up action, the following stakeholders have been contacted and issues raised have been taken into consideration in the preparation of this report:

- MoD DIO/MoD RN.
- Scottish Fishermen's Federation.
- Clyde Fishermen's Association.
- RYA Scotland.
- Chamber of Shipping.
- Caledonian Maritime Assets Ltd (CMAL).
- Northern Lighthouse Board.
- SSE Renewables.

8. Vessel Traffic Analysis

8.1. Current Traffic Patterns, Densities and Types

The overview of all AIS traffic captured in the two survey periods (march/April and July /August 2012) is shown at Appendix 3, Figure 3-1.. It can be seen that the proposed development area lies in an area where traffic is heading to, or coming from, the North Channel Traffic Separation Scheme (TSS) and routes to the north-west and the Minches.

8.1.1. Traffic Density

Appendix 3, Figure 3-2 shows the traffic density using the criteria of vessels journeys per km^2. "Hot spots" can be seen on the ferry routes into the Sound of Islay and to Port Ellen as well as general traffic 8 n miles south of Islay where the west going traffic emerges from the Traffic Separation Scheme (TSS). In the vicinity of the proposed development there is a concentration of traffic of routes between the Minches/Oban and the North Channel or the Sound of Jura. This concentration shows densities of between less than 10 and up to 40 vessel journeys per square kilometre over the total survey period. This is equivalent to 0.5 – 2 vessels per day per km^2. The data further shows that there is, on average, some 10 transits per day within 10 n miles of the area or ~1.5 transits per day through the proposed area.

Figures showing traffic data for the whole survey period within 10 n miles and 500m of the site as well as single day examples for both winter and summer are shown at Appendix 3, Figures 3-3 to 3.8.

8.1.2. Military Vessels

Military usage of the area to the west of Islay consists of Practice and Exercise Areas (PEXAs) mainly used for surface vessel activities. Discussions with Ministry of Defence (Royal Navy) (MoD RN) staff responsible for water-space management have established that the site presents no significant concerns with regard to surface navigation in the area. The specific area of the site is not used for exercise activities and vessels transiting to and from the PEXAs will, generally, keep to routes further offshore. Hence, any hazard presented by the development would be treated as a normal navigational hazard when route planning.

Concerns have been raised by MoD RN and Defence Infrastructure Organisation (MoD DIO) – the body responsible for safeguarding Defence interests – concerning underwater noise and its potential impact on submarine navigation. This issue requires further understanding of the noise outputs and signatures of the tidal devices in order to be resolved. Discussions between MoD DIO, facilitated by The Crown Estate (TCE) are on-going.

8.1.3. Commercial Vessels

Commercial traffic within 10 n miles of the area consists of a mix of all vessel types including oil, gas and product tankers; general cargo vessels, passenger (cruise) vessels and support vessels. See Appendix 3, Figures 3-9 and 3-10.. Figure 21 below shows the breakdown of vessels over each day of the survey periods by type.

The cargo vessels consist mainly of range of different size[2] vessels plying between Northern Ireland/Irish Sea Ports and East coast of UK and Scandinavian/Russian destinations. Those small to medium size general cargo vessels generally draw around 6m draught whilst large cargo vessels (e.g. MV Red Queen, 40,040gt) can draw up to13.8m according to AIS message data.

[2] Vessel categories (as used in Admiralty Sailing Directions) are not considered as standard, internationally accepted definitions but the following provides a rough guide to vessels sizes. Tonnage used here is displacement tonnage (in metric tons). "Small" = <2000t, "Medium" = 2000 – 20,000t, "Large" = > 20,000t.

There is also a significant number of large cruise vessels drawing, in the case of the MV Saga Ruby, up to 8.6m. These vessels are sailing between Irish Sea ports (Liverpool, Dublin) and the Hebrides or Scandinavia.

Oil, gas and product tankers comprise a significant proportion of the traffic by type. These range from medium size product tankers, drawing 5 – 7m, operating around UK ports to larger tankers drawing up to 13m plying between major UK and foreign terminals.

8.1.4. Draught

Figure 22 below shows the breakdown by draught of vessels passing within 500m of the site over the totality of the survey period. Those vessels listed with zero draught were those tracked by radar but not identified.

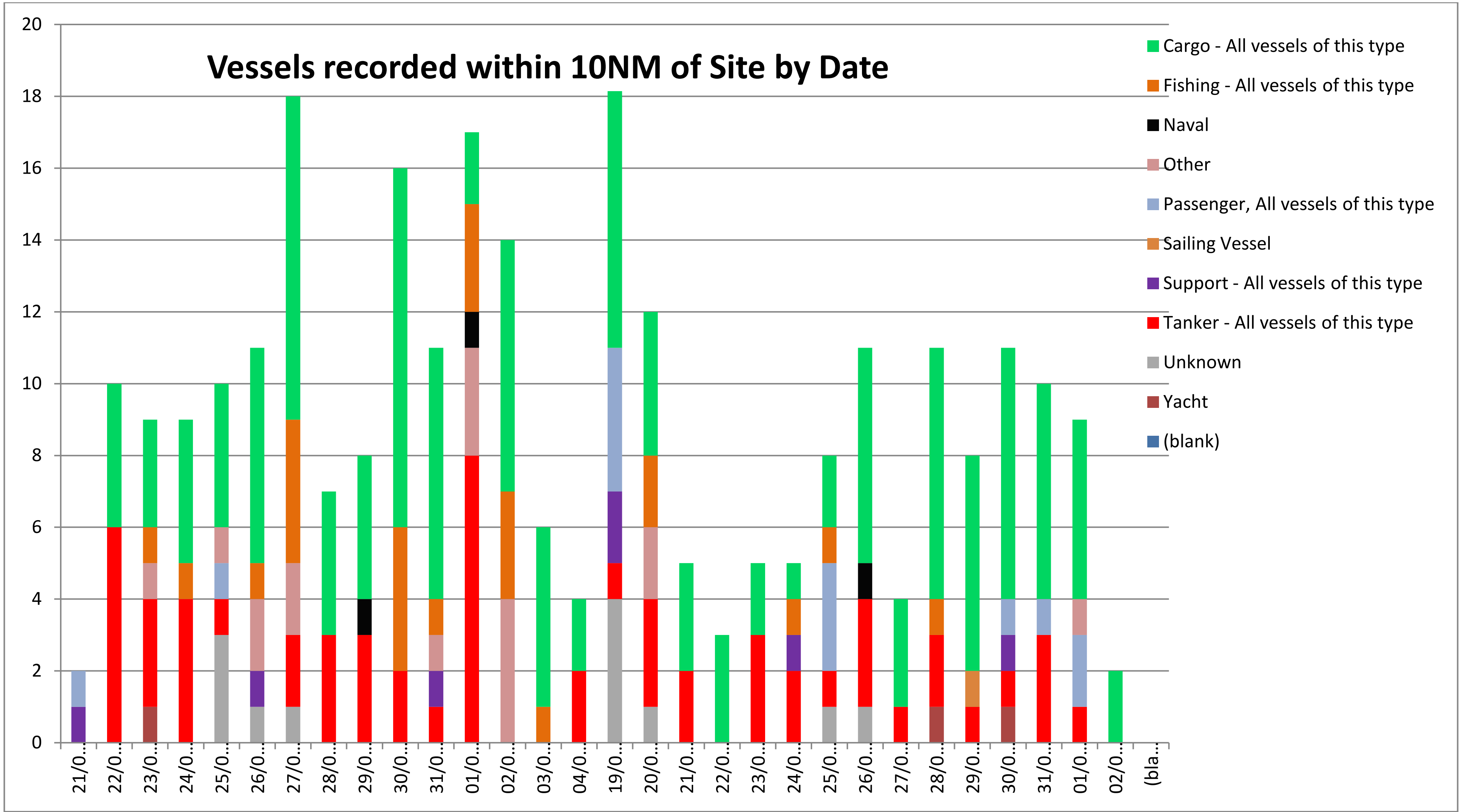

Figure 21 Vessels within 10 n miles of Site by Type and Date

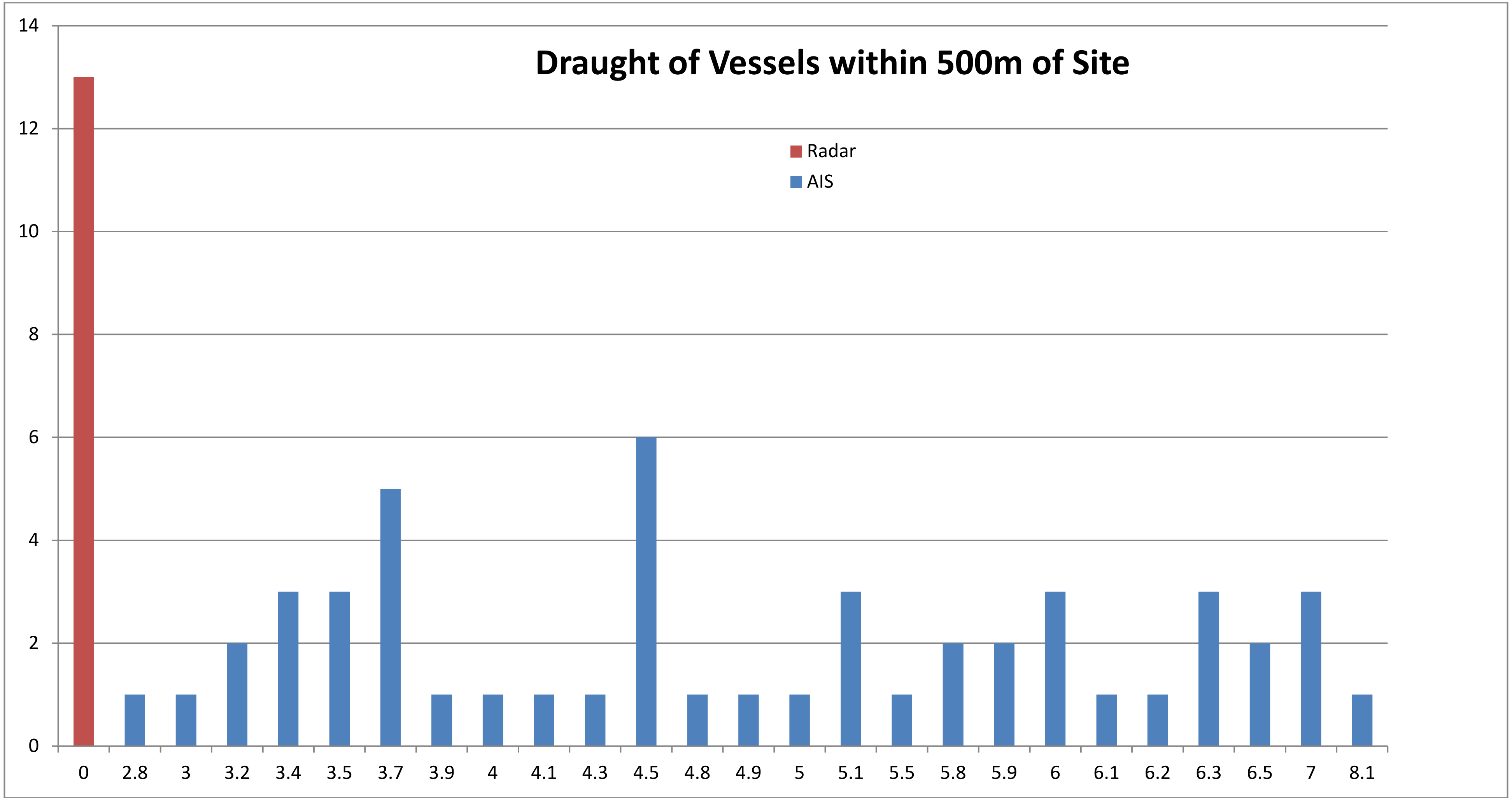

Figure 22 Draught of Vessels within 500m of Site

(Note: Vessels listed as zero draught are those tracked by radar and not visually identified.)

8.1.5. Ferries

There are no scheduled ferry routes to the west of Islay and, hence, no potential for interaction between ferries and devices / vessels during the construction, operation and decommissioning phases including for the cable route to Kintra..

8.1.6. Fishing Vessels

In the general area to the west of Islay, fishing activity by vessels greater than 15m in length would appear to be confined to an area to the southwest of the current proposed development area where the overfalls and tidal rates are less and there is an area of shallow banks. The radar and AIS survey showed little if any fishing activity beyond that which correlated with the VMS data. Figures 3-11 and 3-12 in Appendix 3 show the total fishing vessel traffic for the two periods. All fishing vessels in both survey periods within 10 n miles of the site were in transit (an assumption based on their speed being greater than 6kn) with the exception of one vessel during the summer period which appeared to be engaged in fishing activity on the Rhinns Bank to the south west of the proposed development area. A total of twelve fishing vessels were observed during the winter period and three during the summer period.

Discussions with representatives from the fishing industry (27th Sep 2012) indicated static fishing was the major activity which takes place off the Rhinns with some scalloping activity to the south west mainly between March to November. Whilst there is considerable crabbing activity to the north-west this does not directly affect the proposed development area except so far as fishing vessels in transit to the grounds may pass through the area from the south east.

8.2. Recreational Activities

8.2.1. Recreational Boating

The RYA have, in their initial response to the scoping opinion request opined that the *"site appeared well suited to purpose"* as " *It is not heavily frequented by shipping or recreational craft"* and *"It appears to be in quite deep water and is not in a major shipping or small craft route"*.
However, they did raise concerns over the lack of information regarding the exact position and extent of the proposed tidal energy park.

More recent discussions with RYA Scotland after provision of further data on the location and extent of the site have verified this position.

The RYA Coastal Atlas of Recreational Boating (Reference 11) show a route passing some 5 n miles to the west of the Rhinns of Islay light between the ports of Northern Ireland and the Firth of Lorne leading to the Sound of Mull/Loch Linnhe/Oban. This route would appear to reflect the guidance provided in Admiralty Sailing Directions for the area in that "*heavy overfalls, dangerous to small vessels occur off the Rhinns and on the bank NW of Islay as shown on the relevant charts*".

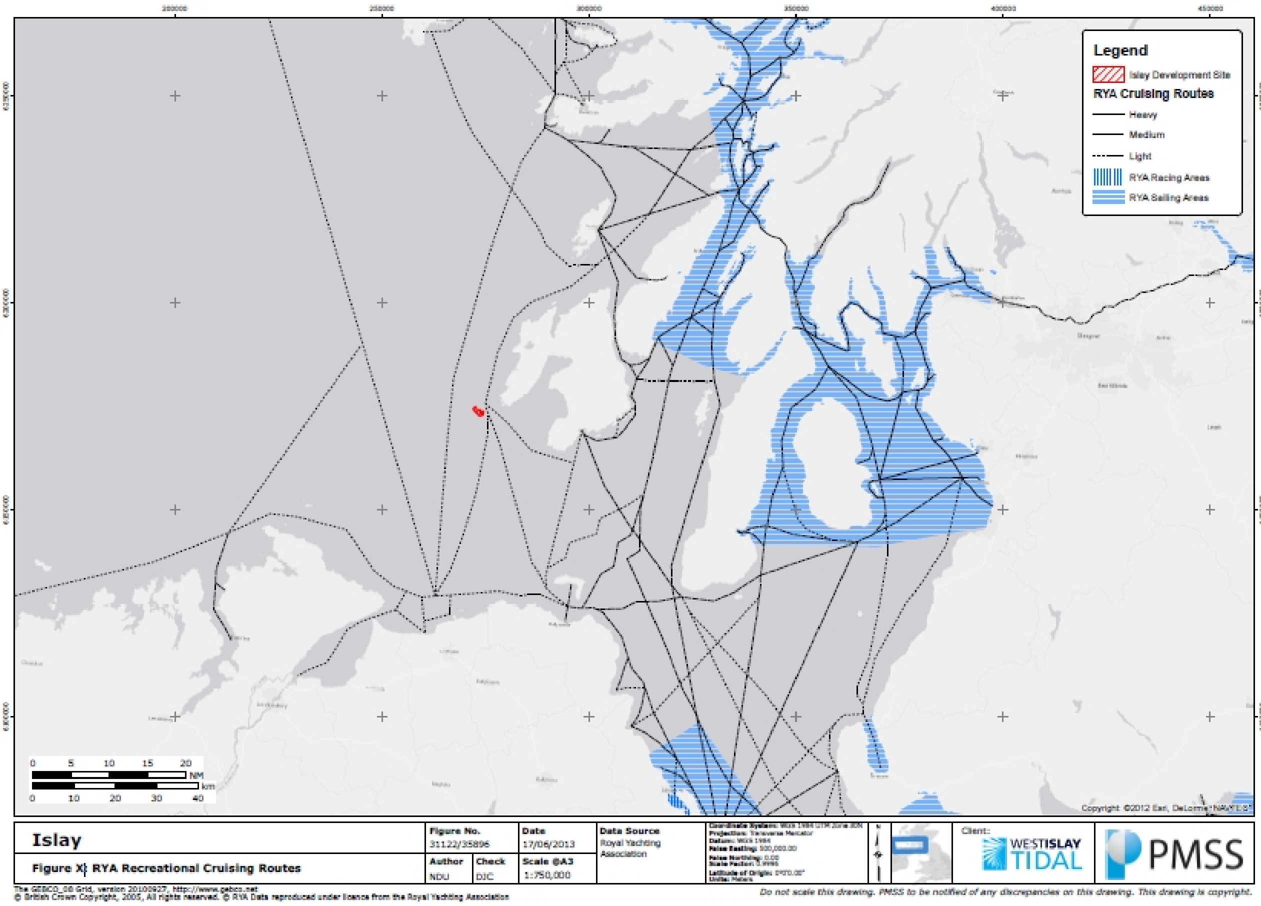

Figure 23 RYA Cruising Routes off Islay

Discussions with RYA Scotland representatives[3] established that the “Sail West Project” (operating under the name of Malin Waters and led by Donegal County Council but including partners such as Visit Scotland and south west Scottish Councils) were promoting sailing in the general area between Northern Ireland and western Scotland. They have a number of recommended itineraries (passages) including one which goes from Northern Ireland to Oban. It does, however, recommend use of the Sound of Islay and does not involve passage to the west of Islay.

Recreational craft activity is shown at Figures 3-11 and 3-12 in Appendix 3. It is noted that, for both winter and summer survey periods, one recreational craft per period were recorded, one of which loiters in the area of the proposed development.

8.2.2. Diving

Diving guides for the area show no dive sites in the vicinity of the proposed tidal park area.

8.3. Future Traffic Patterns, Densities and Types

There are no indications from stakeholders that there are any planned, significant changes to the level and types of traffic currently experienced with the exception of the promotion of recreational traffic between Northern Ireland and the West Coast of Scotland under the Malin Waters initiative. As stated in Section 8.2.1, this, however, is unlikely to have a significant effect on recreational traffic levels given that the recommended routes do not pass west of Islay.

[3] Dr G Russell FRMetS MIEEM: RYA Scotland Planning and Environment Officer.

8.4. Effects of Proposed Array on Current Traffic Densities

The effects of the proposed development on the traffic densities and types are considered to be the following:

- Additional construction/decommissioning vessel traffic including a cable laying vessel, a deployment barge and tugs, installation mooring over a period of, approximately 6 months over two consecutive years;
- The presence of a work boat for inspections and maintenance activities over the life of the array;
- The occasional presence of a specialist barge and tugs for maintenance and unplanned repair interventions.

Such activities will, when present, both add to the current traffic levels, and cause vessels using the area off the Rhinns of Islay to deviate to the either side of the development when transiting the area. Whether they take the inshore route or stand off further offshore would depend on a number of factors including the vessel's size and draught as well as the conditions at the time. The risks from this potential effect are addressed in Section 9.

8.5. Effects of Proposed Array on Future Traffic Densities

Given that the future traffic patterns and densities are considered not to show significant change, any effects are considered to be insignificant in terms of changes in risk levels.

The extent to which operational, maintenance and decommissioning activities impact on marine traffic and the subsequent potential increase in risk is briefly considered below, and examined in more detail in Section 9.

8.5.1. Operations

The operation of the array will involve little or no activity that may present a hazard to marine users with the exception of the presence of the turbines themselves. However, there may also be some "funnelling" effect on traffic during the life of the array caused by vessels wishing to avoid the area of the turbines. (See Section 9.) Given the current traffic density this effect is not considered to be significant.

8.5.2. Maintenance

The associated maintenance activities will not constrain the traffic using the routes to any greater extent than the presence of the turbines. This would include occasions when a range of support vessels are involved in, for example, routine surveys or inspections.

8.5.3. Decommissioning

It is expected that the impact of decommissioning activities will be similar to those arising from the construction and installation phases.

8.5.4. Other OREIs

The other developments being proposed for the area will, to an extent, affect traffic routing and density to a greater extent than the DPME West of Islay Tidal Energy Park due to their more extensive nature and their position further offshore.

9. Navigational Risk Assessment

9.1. Hazard Identification, Risk Assessment and Controls

In order to identify the impacts of the hazards that may be presented by the proposed demonstration array, discussions were held with the key local stakeholders who use the area to the west of Islay. These discussions aimed to identify the perceived hazards presented by the siting of the array. Those included in the discussions were representatives from:-

- Caledonian MacBrayne (CalMac) Ferries.
- Caledonian Marine Assets Limited.
- RNLI.
- Scottish Fishermen's Federation (SFF).
- Clyde Fishermen's Association/Local fishermen.
- RYA Scotland.
- Northern Lighthouse Board.

9.2. Hazard Identification Methodology

The hazard identification process was conducted against the key issues identified in MGN 371 (Reference 2) and using the guidance contained in DTI/DECC publication - Guidance on the Assessment of the Impact of Offshore Wind Farms (Reference 1). These issues were used to generate keywords for assessing each activity phase (construction, operations & maintenance and de-commissioning) associated with the array or individual devices. The hazards associated with the array were then assessed for the risk that they presented to other mariners. The outcome of the assessment is tabulated in Appendix 1.

The following sections summarise the findings.

9.3. Construction/Installation

The navigational hazards and consequent risks arising from the construction/installation phase are considered below.

9.3.1. Pre-Installation Activities

Pre-installation activity may present specific hazards arising from the activities such as geotechnical investigation using drilling platforms or survey vessels or, possible a jack-up platform. Whilst none of these activities would present a novel or permanent hazard to shipping, there is a risk to shipping if such activities do not comply with standard practice for notification of marine activities using the Maritime Safety Information (MSI) system (e.g. Notices to Mariners (NMs), radio navigation warnings, Kingfisher etc). Vessels involved would comply with the International Regulations for Preventing Collisions at Sea, 1972 (COLREGS) (Reference 12)
.

9.3.2. Foundation/ Mooring Installation

The drilling and piling operations associated with all the proposed technologies involve the presence on site for periods of time of drilling platforms/vessel. As with the pre-installation activities these do not present a novel or permanent hazard to shipping and the risk can be considered acceptable if similar risk mitigation actions are taken. However, the presence of seabed obstructions such as exposed pin piles or, in the case of the TGL device, the support structure, introduces a hazard which may be there for some period of time before the complete devices are installed. In the case of the moorings for the Bluewater Bluetec it would result in the introduction of a new hazard from the mooring lines, clump anchors and the any buoys (surface or sub-surface) used to mark or aid recovery of the mooring.

It would be necessary to ensure that all such hazards that are presented to marine users are notified through the Maritime Safety Information (MSI) system but, in particular the Kingfisher system for alerting fishermen to the hazard. The area should also be charted as an area under construction before the commencement of any drilling or mooring installation activity.

9.3.3. Subsea Cable Installation

Subsea cable installation between the site and Kintra will be carried out by a suitably equipped cable laying vessel. The vessel would present a hazard to shipping when engaged in cable operations when its ability to manoeuvre would be compromised. However, the vessel would be required to comply with the COLREGS (Reference 12) and would show the appropriate signals and lights for such an activity. The marine contractor responsible for the cable lay activity would notify the UK Hydrographic Office (UKHO) of the activity using the MSI system for promulgation to all vessels by Notices to Mariners (NMs) and radio navigational warnings. This would also include the promulgation of the information regarding the installation activities over the marine VHF radio by the Maritime & Coastguard Agency. Given the low traffic density in the area and the fact that the cable laying operation would be planned to be undertaken in the most favourable conditions of tide and weather, it is considered that with the risk control measure mentioned above, the risks from the cable installation activity would remain tolerable with monitoring.

9.3.4. Array/Device Installation

The installation vessel would require to be on site for the duration of each phase of installation. Each phase may include the installation of five or so devices over a period in the order of 45 – 60 days.

Notice of the works would be promulgated through the UKHO MSI system (i.e. Notices to Mariners (NMs) and Radio Navigational Warnings (NavWarns/WZs)). The installation vessels would comply with the COLREGS (Reference 12) in that they would display the appropriate lights and marks for vessels engaged in such activities.

Vessels may be at risk of collision if they either violate, or incorrectly apply, the COLREGs when passing close off Orsay in the vicinity of the installation spread. However, the conspicuous nature of the (stationary) vessels involved is considered as being unlikely to lead to any ambiguity about the construction vessels activities which could result in the violation or incorrect application of the manoeuvring rules.

Vessels could also be put at risk if they were to suffer propulsion failure such that they were set down onto the construction vessel. However, for vessels passing the spread, the dwell time in the “window” whereby failure of propulsion would cause them to be set down (by wind or tide) onto the spread, is small due to the limited extent of the spread and the fact that the prevailing tides are likely to set vessels “not under command” (NUC) along the line of their planned route (i.e. north west /south east) and not towards the vessel. The traffic density is such that the likelihood of such an occurrence can be considered as remote.

9.3.5. Safety Zones

The establishment of a Safety Zone, in accordance with the Energy Act 2004 and Electricity (Offshore Generating Stations) (Safety Zones) (Application Procedures and Control of Access) Regulations 2007 (Reference 13), has been considered as a potential control for the reduction of such risks as arise from the installation and de-commissioning phases. The size of the “standard” zone for construction (500m) would leave adequate room for passage inshore of the activity.

However, it is considered that, with the promulgation of Maritime Safety Information through the normal means (i.e. NMs and NavWarns) and the indication of the construction vessels activities provided by compliance with the COLREGs with regard to visual signals, and the presence on site of manned vessels capable of monitoring and advising the other marine traffic in the vicinity, the establishment of a Safety Zone in accordance with Reference 13 is not appropriate in that it provides little or no additional reduction in risk beyond the normal measures that will be employed in the circumstances.

9.3.6. Safety Vessels

The requirement for a dedicated safety vessel has also been considered for this operation. Such a vessel can, in certain circumstances and if properly manned and briefed, help reduce risk to other vessels by monitoring traffic and providing warning of the activities occurring in the area. The following factors need to be considered:

- The levels of traffic in the area;
- The time on task of the installation vessel;
- The size, bridge manning levels and capability of the vessel involved in the installation works which enables it to conduct the duties of safety vessel;
- The provision of adequate notice of such activity through the Maritime Safety Information services;
- Appropriate compliance with the COLREGS by the installation vessel;
- Application of appropriate environmental limits (sea state, visibility) such that installation activities will not proceed during adverse weather.

Taking the above into account, it is considered that a dedicated safety vessel would not be required as the installation vessel's onboard monitoring and warning capabilities are such that a safety vessel would not provide any additional risk reduction.

9.3.7. Emergency Response Cooperation Plan

In the event of any incident occurring, DPME is required to have in place an Emergency Response Cooperation Plan (ERCoP), covering the construction, operations & maintenance and decommissioning phases of the array. It requires to be agreed with the MCA and the appropriate Maritime Rescue Coordination Centre (MRCC)/Coast Guard Operations Centre (CGOC). The plan is required to address (amongst other things) such issues as:

- Details of companies involved (i.e. marine contractors, client etc)
- Responsibilities
- Points of contact (e.g. names, posts).
- Communication plan (e.g. VHF IMM Channels, MF Radio, mobile phone)

9.3.8. Risk Assessment and Controls

The risks from the pre-installation and device installation phases are, therefore, considered to be "tolerable with monitoring" provided the following risk control measures are put in place.

Risk Control Measures for Cable/Device/Array Installation:

- ❑ Environmental limits for the installation process are developed and implemented.
- ❑ Submission of adequate information to the UKHO and other authorities in adequate time to enable promulgation of national and local NMs/Radio Navigational Warnings/Kingfisher alerts.
- ❑ Charting of the development area as an area under construction.
- ❑ Installation vessels marked and lit in accordance with COLREGS.
- ❑ Emergency Response Cooperation Plan (ERCoP) in place covering construction phase (including cable laying).

9.4. Operational Phase

The operational phase presents several potential hazards to other marine users. These are discussed in this section.

9.4.1. Collision with Tidal Device

9.4.1.1. Collision with Surface Structures

The array is likely to consist of a mix of up to 30 devices as outlined at Section 5.5. Given that the array may consist of all surface piercing/floating or all seabed sited or a mix of device types and that the spacing of the devices has not been decided and could vary between 61 and 300m, it is not possible at this stage to determine any probability of impact for a vessel drifting through the array. The surface piercing MCT device will, of course, present a hazard to all vessel types and in all conditions as would a floating device such as the Bluewater Bluetec. However, the Bluetec device presents a larger hazardous area due to its taut mooring design where the mooring lines themselves present a hazard, the extent of which would depend on the angle from the horizontal of the mooring lines.

9.4.1.2. Collision with Sub-Surface Structures

MCT SeaGen 2
The extent of the hazard does, however, extend beyond just the tower structure of the MCT SeaGen device as the turbine rotors, with a proposed clearance above the rotor swept arc of 3.5m (at Chart Datum), will present an additional hazard to hulls of vessels which, by accident or by design, find themselves within the array. With the top of the rotor swept arc 15m either side of the tower centre line, the vessel would be required to pass within 15m of the tower in order to strike the rotor.

The 3.5m clearance does not include any height of tide which is generally of a positive value (MLWS +0.5 to MHWS +2.6m) and which, thereby, increases the clearance depth over the normal tidal range from 4m to 6.1m. However, it does not allow or any wave/swell or for vessel movement induced by that motion. As shown in Section 4.1.11, for 50% of the year, the Significant Wave Height (Hs) exceeds 1.5 – 2.0m. Even in summer (when shallow draught recreational vessels are most likely to attempt to passage to the west of Islay), Hs exceeds 1.0 – 1.5m for 50% of the time.

The range of vessels draughts for vessels passing within 500m of the development area over the two periods of traffic survey is shown at Figure 28.

The MCA draft guidance on under-keel clearance (UKC) when siting sub-sea renewable devices recommends that allowance should be made for the dynamic draught of a vessel (allowing for all motions induced by sea, swell and vessel movement) plus a 30% safety margin. The recommended clearances should be measured from Chart Datum which is generally the equivalent of Lowest Astronomical Tide (LAT).

Whilst the guidance could not be complied with in the case of the MCT SeaGen device, the hazard presented by the rotors needs to be considered along with that presented by the tower as vessels would not be freely navigating over the top of the turbines due to the presence of the tower structures themselves. Therefore the hazard presented by the rotors should be considered as part of the collision hazard presented by the turbine structure as a whole.

TGL Turbine
It is proposed that the TGL turbines would have a clearance depth (relative to Chart Datum) of 7.5m. As this still-water clearance would also be reduced by the sea/swell conditions, these devices would not comply with the MCA guidance criteria for a significant proportion of the vessels identified in Figure 28 and could present a hazard to a small proportion of the vessels in certain conditions.

9.4.2. Probability of Collision

9.4.2.1. Vessel Not Under Command and Drifting

Whilst the theoretical possibility of collision between certain vessels and turbine rotors may exist in specific circumstances, the likelihood of such an occurrence requires to be considered. MAIB and RNLI data, as shown in Section 7.5, demonstrates that the incident rate over the 20 years of MAIB data and five years of RNLI data shown is relatively low. The breakdown of incidents within 10n miles of the area is shown at Table 8. It should be noted that four of the incidents were noted by both the RNLI and MAIB. Taken together and allowing for the shorter data collection period for the RNLI data period, the average number of incidents is in the order of one per annum within 10 n miles of the area. The incidents include a number of casualty types including, for example, a small craft fire/explosion alongside or at anchor at one of the small piers in Islay, or collision during berthing/anchoring. The types and position of incident which could lead to unintentional entry into the development area and possible collision with any part of a device (i.e. flooding/foundering, machinery failure or other disabling incident) amount to approximately 11 over the period of record taking.

Source	No of Recorded Casualties (All Types)	Period of Data (yrs)	Average per Year
RNLI	6	5	1.2
MAIB	16	20	0.8

Table 7 Marine Casualties within 10NM – MAIB and RNLI Figures

Due to the low incidence of figures and the relatively low traffic levels in this area it is considered that any probabilistic analysis would not, at this stage, provide meaningful risk figures for vessels suffering a loss of propulsion and drifting unintentionally into the Energy Park. Also, given that the spacing of devices has not been determined between the worst case (61m) and the best case (300m), it is not possible to make an assessment of the probability of collision if a drifting vessel were to enter the area.

The risk of collision to NUC vessels has to be assessed against the background risk faced by any vessel which finds itself adrift off the west coast of Islay. As witnessed by the wrecks on the west coast in the vicinity of the Rhinns, vessels have been driven ashore here in the past. Small (e.g. recreational craft) are at risk from the races and overfalls at certain stages of the tide if they were to get driven into them. Almost inevitably, any vessel adrift and in a position whereby tide and wind were to set it into the Energy Park would end up driven ashore or, for small craft, foundering in the overfalls.

9.4.2.2. Vessels Under Command – Human Error

Vessels using the routes to the west of Islay could also, through human error, be at risk of collision with the devices within the Energy Park. Such error could be caused by a number of reasons including poor lookout or failing to plan a passage using all information available from in-date charts and publication corrections and updates.

It should be noted that the hazard to small craft in this area of overfalls and races is well documented and understood especially by recreational craft owners resulting in recommended routes standing further off the coast and avoiding the Rhinns “ledge” which, to a great extent, gives rise to the dangerous conditions. However, there are a significant number of vessels which pass close by the area on routes between the Minches/west coast of Scotland harbours and Lochs. The siting of the Energy Park in an area of relatively (for the area) “high” traffic density (between less than 10 and up to 40 vessel journeys per km^2 – See Section 8.1.1 Figure

21]) means that there is a finite probability of human error not allowing for the presence of the Energy Park.

Given that the Energy Park and the devices within will, in general, comprise a hazard to shipping risk controls will require to be applied which mitigate, so far as is reasonably practicable, the risks arising

The site would, therefore have to be suitably marked and lit. The recommended scheme for the proposed layout is discussed in Section 10 and will be subject to final agreement with the Northern Lighthouse Board (NLB) when final layouts and device types are decided. The guidance on marking and lighting is contained in International Association of Lighthouse Authorities (IALA) Recommendation O-139 On the Marking of Man Made Offshore Structures (Reference 14). That document also recommends that consideration be given to other Aids to Navigation (AtN) such as AIS, RACONS, foghorns etc. Recommendations for appropriate AtN are discussed at Section 10.

As with the construction phase, the establishment of a Safety Zone has been considered as a potential control for the reduction of risks during the operational phase. It is considered that no particular benefits would be conferred by the application of such an instrument beyond that which would be provided by standard means of marking navigational hazards discussed above. There are also issues associated with the application, monitoring and enforcing of such measures particularly where these pertain to sub-sea devices. Therefore, the application of Safety Zones for the operational phase is not recommended for use in these circumstances.

9.4.3. Fishing Gear Entanglement

The fishing activities conducted off the Rhinns of Islay in the proposed area of development consists entirely of creeling. This is undertaken by small craft (usually under 10m in length) using fleets of creels up to 1000 metres in length. The cable route to Kintra is subject to scallop dredging by similar sized vessels

The main safety concern is that the presence of the devices in the development area presents a significant hazard to the creel fishermen if they were to have a problem when recovering their gear. In normal circumstances they would drift with the tide whilst they cleared the snag with the gear. Drifting with gear over the side into the array area presents a possibility of entanglement leading to vessel capsize given the tidal rates experienced in the area and the rotating blades of the devices.

With regard to general entanglement with the device, the fishermen would be required to treat the structures as they would other hazards with which fishing gear could become entangled. That is, to cut their gear if there was a perceived danger to their vessels from the turbines. In order to avoid such a hazard, the designation of the area around the array as a “No Fishing” area is addressed in Section 10.

Subsea cables provide a potential snagging hazard for scallop fishing gear and entanglement with them could cause fishing vessels to capsize when hauling in. If the subsea cables were not in full contact with the seabed (bridging) the potential for snagging is greater. Cable movement (caused by the force of the tidal stream) could endanger fishing gear when laid. The cable will be sited such that bridging is avoided so far as is possible. This will be achieved by careful sea bed survey and accurate positioning of the cable. Movement of the cable (particularly where it will be at an oblique angle to the direction of the tidal stream) will be assessed for likelihood of movement and the requirement for cable protection (e.g. mattressing, ductile iron protectors).

9.4.4. Diving

There are no designated diving sites within significant distance of the development area or the cable route which would present a risk to recreational divers.

9.4.5. Device Failure

9.4.5.1. MCT SeaGen

The design of the turbine and support structure will be subject to third party verification by an appropriate authority. Any failure of the device, either whole or in part, would be indicated by the device Supervisory Control And Data Acquisition (SCADA) systems. Responses to such failure would include the shutting down of the individual device (or the array as a whole, where appropriate) by the application of the shaft brakes thus stopping the rotor and, hence, power generation.

In the unlikely event of a catastrophic failure of the device, any parts which become detached are unlikely to become a hazard to shipping as no component is positively buoyant. Any debris will sink to the seabed and be subject to the effects of the tide.

9.4.5.2. TGL

With the exception of the nacelle and rotor assembly, the structural components of the TGL device are not buoyant. Failure of the support structure would result in the structure remaining on the seabed. As the blades themselves are not buoyant, detachment of the blade, either whole or in part, would not present a hazard to shipping. Blade failure would be detected by the monitoring and lead to the device being shut down automatically by the control system.

Failure of the clamp retaining the nacelle and rotor assembly, whilst conceivable, is considered a remote risk. The two possible scenarios that could, conceivably, result are:

1. The nacelle breaks away from the foundation and floats away on the surface;
2. The nacelle breaks out of the latches but does not rise to the surface and remains tethered to the tripod but floating mid-water with reduced surface clearance.

The restraining clamp which prevents both of the two scenarios above from occurring has undergone load testing and independent design assessment. The clamp is fitted with two mechanical locks that are operated by an ROV once the nacelle has been deployed onto the tripod. These locks are passive devices which physically prevent the clamp from opening to a position where it could detach from the tripod. In addition, the tether used to winch the nacelle down onto the tripod remains in place after the clamp has been operated, and thereby provides a redundant means of securing the nacelle. The clamp is capable of withstanding the worst case storm and operational loads on the structure.

In addition to the high integrity of the design, accidental release of the nacelle from the latches will trigger an alarm in the monitoring system, which will be relayed to the operator’s control centre and appropriate action would be taken in accordance with the operator’s Emergency Response Procedures. In addition, the nacelle will be equipped with a tracking and monitoring device in order that its position can be established in case of such an event.

9.4.5.3. Bluewater Bluetec

The Bluewater Bluetec device most likely failure mode which could lead to a hazard to shipping would be a complete mooring failure. A partial mooring failure whereby a failure of one or more legs, but not all, may result in the device being retained within the site. However, complete mooring failure – perhaps originating in a single line failure leading to a cascade effect – would result in the entire device drifting with the tide beyond the development area where it would become a hazard to shipping. If the device were to be unlit and semi-submerged it would present a significant hazard to all shipping.

The design would, therefore, have to show that due consideration was given to design “withstand” i.e. that the design can withstand the forces expected to be experienced from extreme events that may be expected over the life of the device on site, particular where these occur in conjunction with each other. i.e. Extreme storm wave events combined with equinoctial tides. Consideration should be given in the design to ensuring that a single point of failure cannot lead to domino failure of other components. The mooring system will be subject to third party design verification.

Further risk mitigation may be required such as monitoring of mooring loads indication of mooring failures through a Supervisory Control and Data Acquisition (SCADA) system.

Consideration would be given to incorporation of position indicating systems which activate when the device is offsite and lighting systems, different to any lighting required when within the site, which would make mariners aware of the risk of collision with an object adrift.

9.4.6. Anchorages

There are no anchorages in the vicinity of the development site or of the cable route between the site and the cable landing point at Kintra which would be affected by its presence. Therefore, the likelihood of an incident involving a vessel dragging its anchor through the development site or across the export cable (cf "Young Lady" incident 25 June 2007) is considered negligible.

9.4.7. EMI

The devices generate alternating current and with the nacelle and the cable sited below water or on the seabed, there is not expected to be any adverse EMI effects on navigational equipment (i.e. magnetic compasses from the devices or the cable.

9.4.8. Acoustic Interference

The acoustic emissions from the Tidal devices would comprise a mixture of broadband noise with narrow band components. The sources of such noise include the blades of the rotors and rotating machinery (gears, pumps etc). The issues associated with this issue and the impacts on Ministry of Defence (MoD) assets have been raised with MoD Defence Infrastructure Organisation (MoD DIO) as well as MoD Royal Navy (MoD RN) personnel. The MoD's position on this issue is one of "grave concern" with regard to the potential to "inhibit or degrade national defence capabilities".

Discussions are, at present, ongoing to attempt to resolve this issue by establishing what information the MoD would require to enable them to assess the impact of acoustic emissions on MoD assets.

9.4.9. Effects on Communication, Radar and Positioning Systems

The potential effects on communication, radar and positioning systems have been addressed in two studies:

a. MCA/QinetiQ Report - Results of the electromagnetic investigations and assessments of marine radar, communications and positioning systems undertaken at the North Hoyle wind farm by QinetiQ and the Maritime and Coastguard Agency 2004 (Reference 15)
b. BWEA /MCA/DTI/PLA Report - Investigation of Technical and Operational Effects on Marine Radar Close to Kentish Flats Offshore Wind Farm 2007 (Reference 16)

The general conclusions are that there is no significant impacts on such systems from wind farms except with regard to radar where the issues associated with identifying small contacts within an array and side-lobe echoes can, when within 1-1.5 n miles of the towers, result in missing (or misidentifying) small contacts and cause significant interference on the radar screen.

The surface piercing devices (MCT SeaGen, Bluewater Bluetec) will both present a radar reflective surface and show as contacts on a radar screen. The MCT SeaGen towers will present a strong signal similar to a wind turbine tower. The Bluewater Bluetec device would, being smaller and lower than the MCT structure, provide a less conspicuous and reliable echo and may, at times, be lost in sea clutter.

The sub-surface TGL devices are not considered to present any hazard to communication, radar and positioning systems during operations.

Overall, it is consider that the effects of proposed array would not present a significant hazard to navigation due to the relatively small extent and number of surface devices intended and the distance offshore used by the majority of the traffic. Given the low density of traffic, a vessel passing within 1-1.5 n miles of array would not have significant (if any) numbers of other vessels close by with which the presence of the array devices would cause confusion or interference.

9.5. Decommissioning Phase

It is intended that when the lifecycle of the array is complete, the devices and associated cables will be removed. The decommissioning phase is, therefore, a reversal of the installation process. The risks from the decommissioning activity are expected to be the same as for the installation process. Hence, similar control measures would be implemented.

Risk Control Measures for Operational Phase:

- ❑ The Energy Park would be appropriately charted indicating that the area contained hazards to shipping and including, where appropriate, the least depth of hazards within the area. (See Section 10).
- ❑ The individual surface piercing devices would be lit and marked. (See Section 10).
- ❑ Where the extent of the sub-surface devices was not encompassed and made clear by the AtNs on the surface piercing devices, buoyage meeting the requirements of the Northern Lighthouse Board and complying with the IALA Maritime Buoyage System (MBS) would be used to indicate the presence of sub-surface devices. (See Section 10)
- ❑ An area designated as “No Fishing” to be established encompassing the Energy Park.
- ❑ Appropriate information would be submitted to the UKHO and other authorities such that the Energy Park and individual devices would be included in publications e.g. Sailing Directions.
- ❑ Ensure that the design of devices, particularly of those elements the failure of which would cause, or lead to, further hazard to shipping (e.g. moorings) is subject to appropriate design review and scrutiny in order that the risk is ALARP.
- ❑ Implement an ERCoP as part of an SMS.

10. Charting, Marking and Lighting

10.1. Charting

The generally accepted philosophy is that the chart should provide mariners with the appropriate information on the position and nature of the hazards and to allow them to make the decision on the appropriate distances and clearances required to ensure the safety of their vessels. The following recommendations are based on that philosophy.

The scale of the largest scale current Standard Nautical Chart (SNC) (Admiralty Chart 2168) covering the area is 1:75000. Given the extent of the proposed array, this presents issues regarding the amount of data that can be shown within the area on the chart encompassing the array and the potential obscuration of detail necessary for the mariner. For Electronic Navigational Charts (ENCs), these issues are, to an extent, overcome.

10.1.1. Charting the Array Area

The area in which construction is to take place should be marked as such immediately prior to construction activities starting. On completion of construction, the area containing the devices should be charted as a "*Marine limit in general, usually implying physical obstructions*" with a standard international symbol of a black pecked line (International Symbol N1.1 - Admiralty Publication 5011, Symbols and Abbreviations used on Admiralty Charts (Reference 17)). This would indicate to the marine users that potential hazards exist within the area. This proposal is subject to agreement with the UKHO and further consideration of the issues of obscuring data on the chart given the scale.

An explanatory note is also recommended to be added to the chart explaining that subsea obstructions in the form of tidal turbines are sited within the area. The area would also be supplemented by the charting of the device positions (see below) or by insertion of the least depth. Such an area and note will require to be clear in identifying the nature of hazards present.

Given the potential hazard to creel fishing activities adjacent to the proposed Energy Park, it is considered that the area is designated as a "No Fishing" (International Symbol N21) area. The designation of an area to exclude specific activity requires Scottish Government approval.

10.1.2. Charting the Devices

It is recommended that, if practicable (given the scale of the chart covering area and the practicalities of marking individual devices) all devices, whether surface piercing or sub-surface should be marked using an appropriate symbol (e.g. in the case of the Alstom-TGL device as an underwater obstruction (e.g. Symbol L21 or 24 from Admiralty Publication 5011 (Reference 17). The symbol could, if possible, be annotated by text alongside indicating that it was a Tidal Turbine. The symbols for sub-sea devices should show a single depth within the symbol indicating the least depth of the device. If displaying individual devices is not possible due to the scale of the chart, then such information on least depth could be included as a notation in the array area or in the note mentioned above.

In order that fishing vessels are provided with accurate information on the position of the individual devices such that the device locations can be entered into their plotters with sufficient accuracy, it is further recommended that the individual device positions are provided to the Kingfisher Information Service which provides fishermen with information on subsea cables and other "introduced" hazards in the marine fishing environment.

10.2. Marking and Lighting

The issues surrounding the requirements for marking and lighting the proposed demonstration array have been discussed with the Northern Lighthouse Board (NLB). The guidance on marking and lighting of offshore wave and tidal energy devices is laid down in the International Association of Lighthouse Authorities Recommendation O-139 "The Marking of Man-Made Offshore Structures" (Reference 17).

The IALA recommendation states that "*Areas containing surface or sub-surface energy extraction devices (wave and/or tidal) should be marked by appropriate navigation buoys in accordance with the IALA Maritime Buoyage System, fitted with the corresponding top-marks and lights. In addition, active or passive radar reflectors, retro reflecting material, Racons and/or AIS transponders should be fitted as the level of traffic and degree of risk requires*."

It further states that "*The boundaries of the wave and tidal energy extraction field should be marked by lighted navigational buoys, so as to be visible to the Mariner from all relevant directions in the horizontal plane, by day and by night. Taking the results of a risk assessment* *into account, lights should have a nominal range of at least 5 (five) nautical miles. The Northerly, Easterly, Southerly and Westerly boundaries should normally be marked with the appropriate IALA Cardinal mark. However, depending on the shape and size of the field, there may be a need to deploy lateral or special marks*."

10.2.1. Lighting and Marking of MCT SeaGen Devices

Initial discussions with the Northern Lighthouse Board (NLB) suggested that all the MCT turbines would probably be required to be lit. Those on the "corners" (i.e. major changes of direction between rows) with a flashing yellow light (with a characteristic different from cardinal marks) having a nominal range of not less than 5 n miles, whilst the other/intermediate turbines would have lights flashing yellow with a nominal range not less than 2 n miles, with a different characteristic again. The height of the light would be around 20m (if on top of the turbine tower). The lights would possibly be required to be synchronised. The MCT structures would be required to be painted yellow – from the level of HAT to ~15m (around platform level). Alternative schemes could be horizontal yellow bands not less than 2m in height. The yellow colour should conform to IALA Recommendation E-108 (Reference 18).

The individual tower structure would also require to be marked with unique alpha-numeric identifiers lit with down lighters such that they are visible at a range of 150m by both day and night.

10.2.2. Lighting and Marking of Bluewater Bluetec Floating Devices

If such moored floating devices were to be used these shall be painted yellow above the water line. The guidance states that dependent of the boundary marking, individual devices need not be marked but, if they are it should be an all-round flashing yellow light with a range of not less than 2 n miles and of a characteristic different from the boundary lights. In this case, it is recommended that such devices shall be individually lit as described.

Floating devices would require to be marked with a unique identifier visible at a range of 150m by both day and night.

10.3. Boundary Marking

The discussions with the NLB suggested that, if the extent of the presence of the sub-surface devices is not fully indicated by the MCT turbine lighting, then there will probably be a requirement for the use of buoyage. The extent of the area would be required to either be marked as "Special Marks" (Flashing yellow) or as Cardinal Buoys either with nominal range not less than 5 n miles. Such buoys would have a height of light of around 3m, limiting their visibility to an extent. NLB stated that whilst they would aim to minimise the use of buoys (recognising that the use of buoys in such waters is problematic). However, as the precise mix and layout of devices has not yet been defined, it is not possible to state exactly what that the buoy requirement / layout would look like. The precise scheme will be determined after further consultation with the NLB.

10.4. Sound Signals

Sufficient sound signals (foghorn) shall be provided to ensure that the presence of the Energy Park is made known to vessels in poor visibility.

10.5. AIS

IALA O-139 recommends that consideration is given to the use of AIS as an aid to navigation and IALA Recommendation A-126 - On the Use of the AIS in Marine Aids to Navigation (Reference 19 provides details of the use of AIS in such modes. Given the fact that the Energy Park is at the western extremity of Islay at a key routing point, it is strongly recommended that an AIS transponder is installed on one of the MCT devices at the western extremity of the Park. This would complement the visual AtN (i.e. light) as a means of positively identifying the western extremity of the Park and can, by the enabling of specific AIS messages, provide additional information e.g. an area to be avoided. Whilst AIS AtNs can only be received by vessels with appropriate receivers, it is considered it is a significant risk control in view of the shipping using the area.

Risk Control Measures:

- The construction area should be charted warning of construction activities taking place prior to construction taking place.
- The Energy Park Area to be charted in accordance with Admiralty Chart 5011 as “Marine limit in general, usually implying physical obstructions” with a standard international symbol of a black pecked line (International Symbol N1.1).
- Surface piercing devices to be charted as offshore installations in accordance with Admiralty Chart 5011.
- Sub-sea devices to be charted as “Underwater Installations” (e.g. Symbol L21 or L24) and providing limiting depths.
- An explanatory note provided on the chart explaining the hazard.
- Where the full extent of the sub-sea devices is not encompassed by the lighting provided for the surface piercing devices, buoyage, complying with the IALA MBS shall be provided to delineate the full extent of the hazardous area.
- Surface piercing structures or devices to be marked with a unique alpha numeric identifier, visible from 150m distance and lit by down lighters.
- Fog horn to be fitted to one (or more, depending on the mix of devices) of the MCT devices.
- An AIS transponder to be fitted to the western most MCT device.
- Positional information on the devices and cables to be provided to Kingfisher information service.

11. Search and Rescue Overview and Assessment

11.1. Coast Guard

The proposed site is situated in the area of the UK Maritime Search and Rescue currently administered by Clyde Maritime Rescue Co-ordination Centre (MRCC) at Greenock. The restructuring of the UK MCA organisation will result in the shutting down of the Clyde MRCC and the areas administered from a single Maritime Operations Centre with eight Coast Guard Operations Centres (CGOC) around the country being delegated local control when and as appropriate.

The developer will be responsible for providing an Emergency Response Cooperation Plan (ERCoP) for agreement by MCA HQ at Southampton. The outline requirements of the ERCoP are addressed at Section 12.

11.2. RNLI

The RNLI maintain a number of stations within operating distance of the proposed development area equipped with All-Weather Lifeboats (ALB). These include:

- Port Askaig
- Portrush NI

These stations have, in the past responded to incidents to the west of Islay. The Port Askaig RNLI station is some 35 n miles (1.5 – 2hrs) from the proposed Energy Park whilst Portrush is approximately 25 n miles (1 – 1.5hrs) distant. Given the RNLI craft used at these stations, it is considered that the capability of the assets used in any response is appropriate for the vessel types known to use the area. The RNLI assets would be suitable for operating within the Energy Park in most conditions given their draught and the clearance over the rotors for the devices.

12. Through Life Safety Management

The operating company will put in place as part of normal Safety Management System arrangements, specific arrangements for dealing with normal and emergency operating activities. These will include appropriate Emergency Response Plans for incidents occurring both on and offshore. The ERCoP will be an integral element of the SMS dealing with the liaison and cooperation required with the MCA and other SAR agencies in the event of incidents requiring their assistance or where other marine users are, or could be, affected.
The SMS will be subject to appropriate review and update.

12.1. Emergency Response Cooperation Plan

MGN 371 (M+F) Annex 4 (Reference 2) requires that an Emergency Response Co-ordination Plan (ERCoP) is established as part of the risk mitigation process for any OREI. The ERCoP is required to be in place for the construction, operation and decommissioning phases of the demonstration array.

The plan is required to address a number of issues depending on the type and characteristics of the array and devices.

The requirements for such a plan require to be discussed with the MCA SAR Staff Officer and will be incorporated into an agreed ERCoP prior to the commencement of installation operations.

Risk Control Measure:
• Develop and implement an ERCoP covering the construction, operation and decommissioning phases of the demonstration array in cooperation with the MCA/MRCC Clyde.

13. Status of Hazard and Risk Control Log

The hazard and control log is at Appendix 1. The controls identified in the Log will be addressed by DPME as part of the project risk management process. The controls recommended in this report have been allocated to specific organisations and will be reviewed during the design and installation process.

14. Major Hazards Summary

The major hazards are contained within the Hazard and Risk Control Log at Appendix 1. The top level risks for the proposed West Islay Tidal Energy Park development are considered as the following:

- Vessels entering the Energy Park due to human error.
- Collision between transiting vessel and the installation "spread".
- Creel fishing boats gear snagging on the devices or foundations.
- Scallop dredgers snagging on export cable.
- Mooring failure of moored devices (if such were to be used) resulting in the device becoming a hazard to shipping outside of the Energy Park area.

The major hazard and consequent risks are considered to arise from the surface piercing turbines presenting a collision hazard to all traffic and the sub-surface turbines presenting a hazard to vessels of a certain draught in specific sea-states. Vessels entering the area due to human error are considered to be more likely than vessels Not Under Command (i.e. "drifting") due to the low levels of traffic and the low incidence of recorded incidents involving vessel adrift in the area.

The risk of collision can, it is believed, be adequately mitigated to an As Low As Reasonably Practicable (ALARP) level by the application of appropriate controls as described in Section 9 and derived from the Hazard and Control Log.

The risks arising from the installation activities are not considered novel and can be mitigated by the application of standard controls for offshore construction work being undertaken by specialist vessels.

Cable laying activities are, in the main, well understood and can be controlled through normal practice (i.e. compliance with the ColRegs, Notices to mariners etc

The risk to vessels engaged in creeling is a considered to be an issue in that that creel fishing would take place as close to the area as would be allowed by whatever means is used to chart the hazard. It is quite probable that the array area would, to an extent, act as a nursery for the target species thus encouraging fishing activities close to the area. In the event of a gear malfunction, there is a possibility of the fishing vessel drifting into the array with gear deployed over the side leading to entanglement and capsize. Whilst it is recommended that the charted area showing the hazard is of a size that just encompasses the hazards (devices), it is considered that a "No Fishing" area should be considered that provides a greater "buffer" area around the array such that the risk of entanglement is reduced. The exact size of the area would require to be agreed with the fishermen and their representatives. It is understood that such an area would require Scottish Government assent.

15. Conclusions

The following conclusions are drawn from the study:

1. That the risks to navigation from the cable laying and device installation operations are considered to be "Tolerable with monitoring" subject to the application of such risk controls as are identified in this report.;

2. The risk to navigation arising from the proposed clearance depths over the rotors of the MCT SeaGen and Alstom-TGL turbines (which present a hazard to shipping in a range of tidal and sea-state conditions to a significant proportion of vessels currently operating in the immediate vicinity of the proposed area if they were to enter the Energy Park) can be considered as "Tolerable with Monitoring" subject to the application of such risk controls as are identified in this report;

3. The risk from vessels drifting into the site is considered as sufficiently low as to be considered "Tolerable with Monitoring" given the vessel traffic levels and the numbers of recorded incidents from RNLI and MAIB data;

4. That the Energy Park area should be charted appropriately as a "Marine Limit in General, implying physical obstructions". This does not exclude navigation but, along with appropriate annotation showing that limiting depths apply (either against the individual devices or as a chart note), provides the mariner with adequate information on the hazards presented by the Park.

5. Whilst pelagic and demersal fishing activities do not take place in the area or its immediate vicinity, creeling vessels do operate off the Rhinns in the local area. As such there is a risk to such small vessels due to the potential for gear entanglement when recovering or laying static gear. This would require the imposition of a "No Fishing" area coincident with the charting of the area as a "Marine Limit in General containing hazards";

6. The export cable presents a hazard to scallop dredging activities between the site and Kintra.

7. That the individual devices/sub arrays require to be charted appropriately subject to the limitations of the scale of the chart and the need to avoid congestion of information;

8. That the extent of the sub-sea devices may not be adequately indicated by the lighting and marking applied to any surface devices in the array and will, therefore, require to be marked with buoys or other devices;

9. The in-combination effects from the SSER have not been able to be established fully due to the lack of appropriate data on vessel traffic for the windfarm area.

10. That the scale and nature of the risks requires the development of a Safety Management System of which an ERCoP is an integral part.

16. Recommendations

The following is recommended:

1. That the risk controls as are identified in this report with regard to preventing vessels from entering the Energy Park area are implemented in order to ensure that the risk is reduced to a level considered as "Tolerable with Monitoring";

2. That the Energy Park area should be charted as a "Marine Limit in General, implying physical obstructions" along appropriate annotation showing that limiting depths apply (either against the individual devices or as a chart note);

3. That a "No Fishing" area coincident with the charting of the area as a "Marine Limit in General containing hazards" is imposed;

4. That the cable is charted and information on its position provided to Kingfisher;

5. That the individual devices/sub arrays are charted appropriately subject to the limitations of the scale of the chart and the need to avoid congestion of information;

6. That where the extent of the sub-sea devices is not adequately indicated by the lighting and marking applied to any surface devices in the array, the area shall be marked with buoys meeting the requirements of the IALA MBS;

7. The in-combination effects from the SSER propose wind farm site require to be examined in conjunction with SSER when they have sufficient data with regard to vessel traffic data for the windfarm area.

8. That an appropriate Safety Management System is put in place prior to the start of construction operations. This shall include an ERCoP.

17. Statement of Limitations

The risks arising from the proposed Tidal Energy Park off the West Coast of Islay have been assessed as “Tolerable with Monitoring” and ALARP. However, this assessment is only valid under the following assumptions/limitations:

- Any major deviation in the technologies or installation methodology which differs significantly from those described in this document must be assessed for risk and the NSRA and Hazard Log must be revised accordingly;
- All charts are updated with the proposed symbology and notation recommended within this document in order to mark hazards adequately and appropriately;
- The position and type of lighting and marking (including buoyage) to be installed are as described in this document. Any proposed deviation to this must be presented to the appropriate marine authorities and reassessed for adequacy of navigational safety.

Appendix 1. Hazard and Control Log

Risk Tolerability and Criticality Matrices used in the Hazard and Control Log

Hazard Identification Risk Assessment (HIRA)					
HIRA Risk Matrix					
	Consequence	Insignificant	Minor	Major	Catastrophic
Frequency	Definition	No significant harm to people	Injury to vessel crew Injury to OREI installation crew Injury on the shore	Loss of vessel crew members (1-3) Loss of OREI installation or maintenance crew members (1-3) Fatalities on shore (1-3)	Total loss of vessel crew Total loss of OREI installation or maintenance crew Multiple fatalities onshore
Frequent	Likely to happen annually or more frequently	Tolerable with Additional Controls	Tolerable with Modifications	Unacceptable	Unacceptable
Reasonably Probable	Likely to happen duting the license period of an OREI (nominally 20 years)	Tolerable with monitoring	Tolerable with Additional Controls	Tolerable with Modifications	Unacceptable
Remote	Unlikely (but not exceptional) to happen during the licence period	Broadly Acceptable	Tolerable with monitoring	Tolerable with Additional Controls	Tolerable with Modifications
Extremely Remote	Only likely to happen in exceptional circumstances	Broadly Acceptable	Broadly Acceptable	Tolerable with monitoring	Tolerable with Additional Controls

Risk Criticality	Condition	Explanation
Broadly Acceptable	None	Technical review is required to confirm the risk assessment is reasonable. No further action is required
Broadly Acceptable	None	Technical review is required to confirm the risk assessment is reasonable. No further action is required
Tolerable with monitoring	With a commitment to risk monitoring and reduction during operation	Risk must be mitigated with engineering and/or administrative controls. Must verify that procedures and controls cited are in place and periodically checked
Tolerable with Additional Controls	With a commitment to further risk reduction before operation	Risk should be mitigated with design modification, engineering and/or administrative control to a Risk Class of 4 or below before construction
Tolerable with Modifications	With a commitment to further risk reduction before construction	Risk must be mitigated with design modification and/or engineering control to a Risk Class of 5 or lower before consent
Unacceptable	None	Risk must be mitigated with design modification and/or engineering control to a Risk Class of 5 or lower before consent
Unacceptable	None	Risk must be mitigated with design modification and/or engineering control to a Risk Class of 5 or lower before consent

West of Islay Energy Park - Hazard & Control Log

Element	Phase	Guide word	Hazard	Consequence	Initial Risk			Controls / Mitigation	Residual Risk		
					Frequency	Consequence	Risk		Frequency	Consequence	Risk
Subsea Cables	**Installation & Commissioning**	Shipping routes	Cable installation vessel Restricted in Ability to Manoeuvre (RAM). (Port Ellen approaches is a particular hazardous area)	Vessel in transit collides with cable installation vessel(s).	Reasonably Probable	Major	**Tolerable with Modifications**	Installation vessel compliant with COLREGs. Issue NMs/Radio Navigation Warnings. ERCoP SMS – Emergency Response Procedures	Extremely Remote	Major	**Tolerable with monitoring**
	Operation	Vessel engaged in fishing	Cable	Vessel capsize due to snagging	Remote	Major	**Tolerable with Additional Controls**	Cable to be charted. Cable position to be provided to “Kingfisher” System Avoid “bridging”. Mattress protection at vulnerable points. ERCoP SMS – Emergency Response Procedures	Extremely Remote	Major	**Tolerable with monitoring**
		Anchorage	Cable	Vessel anchor snags on cable	Remote	Major	**Tolerable with Additional Controls**	Cable route to avoid anchorage areas Cable to be charted. Avoid “bridging”. Consideration of providing “mattress” protection at vulnerable points. ERCoP SMS – Emergency Response Procedures	Extremely Remote	Major	**Tolerable with monitoring**
Devices (Structures and Nacelle)	**Installation and Commissioning**	Shipping routes	Jack-up vessel/barge and vessels (Construction spread) conducting installation	Vessel (ferries/fishing vessels) collision with installation spread	Remote	Major	**Tolerable with Additional Controls**	Installation vessels compliant with COLREGs. Issue NMs/Radio Navigation Warnings. MRCC/CGOC broadcasts radio navigation warnings Warn frequent users e.g. / fishermen. ERCoP SMS – Emergency Response Procedures	Extremely Remote	Major	**Tolerable with monitoring**
		Shipping routes	Vessel not under command (NUC)/ construction spread	Collision between NUC vessel and installation vessel(s) leading to damage to vessel damage/injury /loss of life	Remote	Major	**Tolerable with Additional Controls**	Notice to Mariners (NTM)/ Navigation Warning(NavWarns) Monitoring of traffic by installation vessel Emergency breakaway procedure Vessel Lighting and marking ERCoP – MRCC/CGOC provides warning of vessel NUC to installation vessel. SMS – Emergency Response Procedures	Extremely remote	Major	**Tolerable with monitoring**
		Violation/ Mistakes/ Slips/ Lapses	Installation spread conducting installation	Vessel transiting area makes navigational error leading to collision with installation vessels and damage to vessel/injury /loss of life	Remote	Major	**Tolerable with Additional Controls**	Installation vessels marked and lit appropriately. Monitoring of traffic by installation vessel Emergency breakaway / evacuation procedure ERCoP SMS – Emergency Response Procedures	Extremely remote	Major	**Tolerable with monitoring**

West of Islay Energy Park - Hazard & Control Log

Element	Phase	Guide word	Hazard	Consequence	Initial Risk			Controls / Mitigation	Residual Risk		
					Frequency	Consequence	Risk		Frequency	Consequence	Risk
		Radio Interference	Use of incorrect IMM VHF channels	Interference with IMM VHF ship/shore and ship/ship communications	Reasonably Probable	Minor	**Tolerable with Additional Controls**	Installation vessel(s) to agree working channels with local operators/MCA	Remote	Minor	**Tolerable with monitoring**
Devices Structures and Nacelle	**Operation**	Vessel NUC	Vessel not under command (NUC)	Vessel enters array area and collides with device	Reasonably Probable	Insignificant	**Tolerable with Monitoring**	ERCoP - MRCC/CGOC warns operator of NUC vessel – systems shutdown. Devices/ array area appropriately charted	Reasonably Probable	Insignificant	**Tolerable with monitoring**
		Violation/ Mistakes/ Slips/ Lapses	Vessel enters array area	Vessel enters array area and collides with device	Frequent	Insignificant	**Tolerable with Additional Controls**	Devices marked and lit appropriately. Use of AIS / RACON AtN recommended Devices/ array area appropriately charted	Reasonably Probable	Insignificant	**Tolerable with monitoring**
		EMI	EMI Interference with navigational equipment	Potential for navigational error due to effects on navigation equipment e.g. .magnetic compass	Extremely remote	Insignificant	**Broadly Acceptable**	No evidence of EMI effects seen from other similar sub-sea cables in area.	Extremely remote	Insignificant	**Broadly Acceptable**
		Maintenance	Maintenance vessels restricted in their ability to manoeuvre (RAM)	Collision between transiting vessels and vessel conducting maintenance.	Remote	Major	**Tolerable with additional controls**	Maintenance vessel marking and lighting. Compliance with COLREGs ERCoP SMS – Emergency Response Procedures	Extremely remote	Major	**Tolerable with Monitoring**
		Acoustic noise	Interference with military/civil SONAR	Potential for navigational error due to inaccurate depth readings due to the effects on SONAR	Extremely remote	Insignificant	**Broadly Acceptable**	Acoustic output likely to be mainly low frequency broadband and unlikely to interfere with civilian HF, narrowband navigational/depth finder sonars. * Issue of interference with MoD Assets to be determined.	Extremely remote	Insignificant	**Broadly Acceptable**
		Device /mooring Failure	Loss of device or significant components	Surface vessel collision with floating objects	Reasonably Probable	Major	**Tolerable with Modifications**	Device (and mooring where appropriate) subject to third party design verification against appropriate codes. MCT device components are not positively buoyant. Device provides indication of failure through SCADA system. Bluewater Device to be lit appropriately and to indicate position in case of total mooring failure. ERCoP – Operator to inform MRCC/CGOC SMS – Emergency Response Procedures	Extremely Remote	Major	**Tolerable with Monitoring**
		Mooring Failure	Loss of AtN buoy or significant components	Surface vessel collision with floating objects	Remote	Major	**Tolerable with Modifications**	Buoy designed to meet conditions. Buoy & Mooring subject to periodic Examination, Maintenance, Inspection and Test.(EMIT) ERCoP SMS – Emergency Response Procedures	Extremely Remote	Major	**Tolerable with Monitoring**
		Device Failure	Loss of AtN (Lights/buoys etc	Vessel enters array area and collides with device	Remote	Major	**Tolerable with additional controls**	AtN comply with IALA Cat 2availability requirements (99%) Mix of AtN and number of devices lit.	Extremely Remote	Major	**Tolerable with Monitoring**

West of Islay Energy Park - Hazard & Control Log

Element	Phase	Guide word	Hazard	Consequence	Initial Risk			Controls / Mitigation	Residual Risk		
					Frequency	Consequence	Risk		Frequency	Consequence	Risk
Devices Structures and Nacelle	**Operation**	Anchorage	Device moorings/subsea cables	Vessels anchors snagging on device	Reasonably Probable	Minor	**Tolerable with Additional Controls**	Cables routes to avoid anchorages where possible. Cable to be charted	Extremely remote	Insignificant	**Broadly Acceptable**
		Fishing	Devices present snagging hazard to fishing gear	Fishing vessel enters area by accident or design and fishing gear snags on devices causing vessel to capsize	Remote	Major	**Tolerable with Additional Controls**	Only creeling takes place in area. Devices / area charted. Device positions provided to Kingfisher system. Designation of the area as “No Fishing”	Extremely remote	Major	**Tolerable with Monitoring**
		Diving	Turbines present a hazard to recreational divers	Fatality following collision with turbine	Extremely Remote	Major	**Tolerable with Monitoring**	No diving takes place offshore in the area	Extremely remote	Major	**Tolerable with Monitoring**
		Diving	Turbines present a hazard to commercial divers undertaking dives in array area	Fatality following collision with turbine	Remote	Major	**Tolerable with Additional Controls**	Diving activities controlled by operator. Turbines made safe	Extremely remote	Major	**Tolerable with Monitoring**
	De-commissioning	Vessel NUC	Vessel not under command	Collision between NUC vessel and de-commissioning vessel(s) leading to damage to vessel damage/injury /loss of life	Remote	Major	**Tolerable with Additional Controls**	Notice to Mariners (NTM)/ Navigation Warning(NavWarns) Vessel Lighting and marking ERCoP SMS – Emergency Response Procedures	Extremely remote	Major	**Tolerable with Monitoring**
		Violation/ Mistakes/ Slips/ Lapses	Vessel collides with decommissioning vessel	Collision between vessel and de-commissioning vessel(s) leading to damage to vessel damage/injury /loss of life	Remote	Major	**Tolerable with Additional Controls**	Vessel marked and lit appropriately. Monitoring of traffic by de- commissioning vessels ERCoP SMS – Emergency Response Procedures	Extremely remote	Major	**Tolerable with Monitoring**

Appendix 2. Stakeholder List

Argyll & Bute Council
British Chamber of Shipping
British Marine Aggregate Producers Association
Caledonian Maritime Assets Ltd (CMAL)
Caledonian MacBrayne Ferries (CalMac)
Clyde Fishermen's Association (CFA)
Clyde Yacht Clubs Association (CYCA)
Diving - BSAC
Local Fishermen - Port Ellen
Inshore Fisheries Group (IFG) - Small Isles and Mull IFG
Islay Dive Centre
Islay Marine Charter
Marine Scotland
Mallaig & Northwest Fishermen's' Association (MNWFA)
MCA
MoD Defence Estates (Safeguarding)
MoD RN FOSNNI
MoD RN QHM Clyde
Northern Lighthouse Board
RNLI Islay Lifeboat Station
RNLI Scotland
RYA Scotland
Scottish Fishermen's Federation
Scottish Canoe Associations
West Highland Anchorages and Moorings Association
Gleaner Oils Limited

Appendix 3. Figures

See Separate Document

Appendix 4. MGN 371 Compliance Checklist

See Separate Document

Record of Changes

Rev #	Date	Description	Approved
A	2013-03-22	Draft for Internal Review	D CANTELLO
B	2013-04-26	Draft for DPME initial review	D CANTELLO
C	2013-06-18	Draft for DPME “Gatecheck” Process	D CANTELLO
D			
E			
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G			
0	2013-07-24	Issue	N CHIVERS
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Distribution List

#	Function Title	Company	Name (optional)
1	Project Manager	DPME	B Marnie
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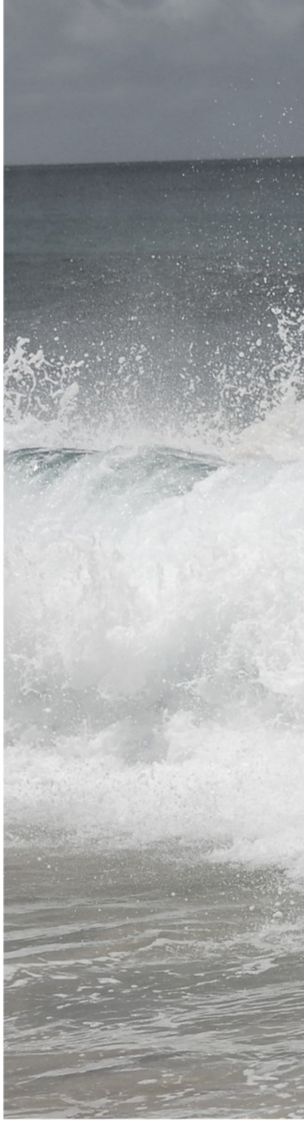

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