Photograph reproduced from
The Yachtsman's Pilot Clyde to Colonsay by Martin Lawrence and Imray Laurie Norie and Wilson Ltd.

WESTISLAY TIDAL

ENERGY PARK

volume 2

environmental statement

1 of 4

DP ENERGY MARINE

DBE DEME Blue Energy

WEST ISLAY TIDAL ENERGY PARK

VOLUME 2 ENVIRONMENTAL STATEMENT

CONTENTS

Preface

This Environmental Statement (ES) is prepared, by DP Marine Energy Ltd (DPME), in support of an application for statutory consents for West Islay Tidal Energy Park (the Project).

The Project is being developed jointly by DPME and DEME Blue Energy (DBE) on the behalf of West Islay Tidal Energy Park Limited a special purpose Scottish Company which has been incorporated to build and operate the Project.

The Project consists of the installation of 30MW of Tidal Energy Converters and associated infrastructure including the export cables to landfall on Islay

The proposed array of tidal energy devices will be located approximately 6km (at its closest point) from the south west tip of the island of Islay in Argyll and Bute, Scotland. The proposed landfall for the associated electricity export cable will be located adjacent to Kintra Farm on the west coast of Islay.

The Regulatory Authority responsible for assessing the application for consent is Marine Scotland. They will be supported in the assessment process by a number of environmental bodies including Scottish Natural Heritage (SNH).

The Environmental Statement can be viewed during the statutory consultation period at the following locations:

Islay Energy Trust, Custom House, Bowmore, Isle of Islay, PA43 7JJ Tel: 01496 810873	Portnahaven Post Office Portnahaven Isle of Islay PA47 7SH Tel: 01496 860264	Bowmore Post Office, Main Street, Bowmore, Isle of Islay, PA43 7JH Tel: 01496 810366
Port Ellen Post Office, 66 Fredrick Crescent Port Ellen, Isle of Islay, PA42 7BD Tel: 01496 30238	DP Marine Energy Ltd Mill House Buttevant County Cork Tel: +353 22 23955	Scottish Government Library, Victoria Quay, Edinburgh, EH6 6QQ

During the consultation period copies of the Environmental Statement can be purchased from DPME either on CD for a charge of £15 or in hard copy form for £400. Copies of the Non-Technical Summary are available free of charge and a downloadable version is also be available on the West Islay Tidal website: www.westislaytidal.com. Requests for CD and or hard copies of the ES can be made to the DPME address above or by email islay@dpenergy.com

Responsibility	Job Title	Name	Date	Signature
EIA Chapters	EIA Manager	Clodagh McGrath	Monday, 22nd July 2013	[redacted]
Non EIA Chapters	Project Manager	Blair Marnie	Monday, 22nd July 2013	[redacted]
Checked	Project Development Engineer	Damian Bettles	Monday, 22nd July 2013	[redacted]
Approved	Director (DPME)	Simon De Pietro	Monday, 22nd July 2013	[redacted]
Copyright:	DPME ©	Document Reference:	West Islay Tidal Energy Park Environmental Statement	

It should be noted that the NTS and ES has been prepared by DPME supported by DBE with significant input from external sub-consultants on specialist chapters. A review process for Quality Assurance was conducted on all chapters, whether produced by external consultants or internally by DPME.

The ES has been prepared by DPME with all reasonable skill and care and whilst every effort has been made to ensure the accuracy of the material published in this and associated documents, West Islay Tidal Energy Park Ltd, DPME or DBE will not be liable for any inaccuracies.

DPME would like to acknowledge the technical support provided by Siemens/MCT, Alstom/TGL and Bluewater/BlueTEC for their considerable assistance in enabling the design envelope to be defined.

The licence numbers for proprietary data referenced in diagrams and maps can be found on individual figures.

Glossary of Terms:

Agreement for Lease	Agreement entered into between West Islay Tidal Ltd and The Crown Estate for the rights to development on the seabed, named as West Islay Tidal, shown in Figure 5.1.
Dynamic positioning vessel	A Dynamic Positioning Vessel (DP) can safely maintain its position and heading in a tidal flow using a system of thrusters. DP vessels are able to work safely and efficiently in waters deeper than vessels using anchors.
Export cables	Cables used to export power generated by the tidal turbines to the onshore infrastructure.
Gravity based structure (GBS)	A structure which uses ballast to sit securely on the seabed without needing to be stabilized by piles or anchors. The GBS is used to support a tidal turbine.
Monopile	A single large diameter steel tube that is grouted into a hole bored into the seabed. The monopile is used to support a tidal turbine.
Nacelle	The enclosure of the tidal turbine's mechanical and electrical equipment.
Pin pile	The use of multiple small diameter steel tubes that are grouted into a hole bored into the seabed. The pin piles are used to support a tidal turbine.
Project	For the purpose of this ES, the Project refers to the West Islay Tidal Energy Project.
Remotely operated vehicle (ROV)	A Remotely Operated Vehicle (ROV) is an underwater vehicle able to undertake multiple subsea operations. ROVs are highly manoeuvrable and are controlled by operators on-board the DP vessel.
Tidal turbine	A device that converts hydrodynamic energy in the tidal flow into electrical energy.
Tidal turbine array	Term used to describe a group of tidal turbines.
Turbine support structure (TSS)	A turbine support structure is the structure placed on the seabed onto which a tidal turbine is installed.
Wet mate connector	A device used to connect electrical and data cables underwater.

List of Acronyms

AA Appropriate Assessment
AADT Annual Average Daily Traffic
ABRA Argyll & Bute Renewables Alliance
AC Alternating Current
AD Anno Domini
ADCP Acoustic Doppler Current Profiler
AfL Agreement for Lease
AFT Argyll Fisheries Trust
AGLV Areas of Great Landscape Value
AHC Active Heave Compensation
AIS Automatic Identification System
ALARP As Low as Reasonably Practicable
AMAA Ancient Monuments & Archaeological Areas Act
AOD Above Ordnance Datum
AR4 Forth Assessment Report
ASCOBANS Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish & North Seas
ASFB Association of Salmon Fisheries Board
AST Atlantic Salmon Trust
AWAC Acoustic Wave and Current
BADC British Atmospheric Data Centre
BAP Biodiversity Action Plan
BAT Best Available Technique
BERR Department of Business, Enterprise & Regulatory Reform
BGS British Geological Survey
BOCC Birds of Conservation Concern
BODC British Oceanographic Data Centre
BS British Standard
BSI British Standards Institution
CAA Civil Aviation Authority
CEFAS Centre for Environment, Fisheries & Aquaculture Science
CFA Clyde Fishermen's Association
CD Chart Datum
CIA Cumulative Impact Assessment
CIRIA Construction Industry Research & Information Association
CMACS Centre for Marine and Coastal Studies
CMS Construction Method Statement
COWRIE Collaborative Offshore Wind Research into the Environment.
CPA Coast Protection Act
CPT Core Penetration Tests.
CRM Collision Risk Modelling
dB Decibel
DBE DEME Blue Energy
DDV Drop Down Video
DECC Department of Energy & Climate Change
DEFRA Department for Environment, Food & Rural Affairs
DEME Dredging, Environmental & Marine Engineering
DFO District Fisheries Office
dGPS Differentially corrected GPS
DOE MD Department of Environment, Marine Division
DP Dynamic Positioning
DP Decommissioning Programme
DPME DP Marine Energy
DSFB District Salmon Fisheries Boards
EC European Commission
EcIA Ecological Impact Assessment
EEC European Economic Community
EIA Environmental Impact Assessment
EMEC European Marine Energy Centre
EMF Electro Magnetic Field
EMaP Environmental Management Plan
EMP Environmental Monitoring Programme
ENVID Environmental Issue Identification
EPS European Protected Species
ERCoP Emergency Response Cooperation Plan
ES Environmental Statement
ESAS European Seabirds at Sea
ETA Estimated Time of Arrival
EU European Union
EUNIS European Nature Information System
FAO Food and Agriculture Organisation
FCS Favourable Conservation Status
FEPA Food and Environment Protection Act
FLO Fisheries Liaison Officer
FREDS Forum for Renewable Energy Development in Scotland
FRS Fisheries Research Services
FSA Formal Safety Assessment
FTE Full Time Equivilents
GDP Gross Domestic Product
GHG Greenhouse Gas Emissions
GIS Geographical Information Systems
GPS Global Positioning System
HATT Horizontal Axis Turbine
HLV Heavy Lift Shearleg Vessels
HIAL Highlands & Islands Airports Ltd
HIRA Hazard Identification & Risk Assessment
HRA Habitat Regulations Appraisal
HS Historic Scotland
HSE Health and Safety Executive
ICES International Council for the Exploration of the Sea
ICOMOS International Council on Monuments and Sites.
IFA Institute for Archaeologists
IEMA Institute of Environmental Management
IMO International Maritime Organisation
IPCC Intergovernmental Panel on Climate Change
ISA Immediate Study Area
IUCN International Union for Conservation of Nature
JCP Joint Cetacean Protocol
JNAPC Joint Nautical Archaeology Policy Committee.
JNCC Joint Nature Conservation Committee
kg Kilogram
km Kilometre
km2 Square kilometre
Km/h Kilometre per hour
kV Kilovolts
LAT Lowest Astronomical Tide
LBAP Local Biodiversity Action Plan
LCA Landscape Character Assessment
LDP Local Development Plan
LLA Local Lighthouse Authority
LSCA Landscape Seascape Character Assessment
LSE Likely Significant Effect
m Metre
MarLIN Marine Life Information Network
MAIB Marine Accident Investigation Branch
MARPOL International Convention for the Prevention of Pollution from Ships
MS Marine Scotland
MBES Multibeam Echo Sounder
MCA Maritime and Coastguard Agency
MCS Marine Conservation Society
MCT Marine Current Turbines Limited
MESH Marine European Seabed Habitats
MFA Marine and Fisheries Agency
MGN Marine Guidance Note
MHWS Mean High Water Springs
MLWS Mean Low Water Springs
MLURI Macaulay Land Use Research Institute
mm Millimetre
MMO Marine Management Organisation
MNCR Marine Nature Conservation Review
MNNS Marine Non Native Species
MoD Ministry of Defence
MP Member of Parliament
MPA Marine Protected Area
MPS Marine Policy Statement
MS Marine Scotland
MSFD Marine Strategy Framework Directive
MSFD Marine Strategy Framework Directive
MSL Mean Sea Level
MSP Mean Spring Peak
MSS Marine Scotland Science
ms Metres per second
MSW Multi Sea Winter (adult salmon)
MW Megawatts
NATS National Air Traffic Service
NMRS National Monuments Records of Scotland
NBN National Biodiversity Network
NCI Nature Conservation Importance
NGR National Grid Reference
NIEA Northern Ireland Environment Agency
NLB Northern Lighthouse Board
Nm Nautical miles
NPF National Planning Framework
NSA National Scenic Area
NSRA Navigational Safety Risk Assessment
OCFA Offshore Cable Feasibility Assessment
OSPAR Oslo & Paris Conventions for the protection of the marine environment
OREI Offshore Renewable Energy Installation
OS Ordnance Survey
PAD Protocol for Archaeological Discoveries
PAM Passive Acoustic Monitoring
PAN Planning Advice Note
PBR Potential Biological Removal
PEXA Practice and Exercise Area
PPG Pollution Prevention Guidelines
PHA Preliminary Hazard Analysis
PMF Priority Marine Feature
PSD Power Spectral Density
RCAHMS Royal Commission for Ancient and Historical Monuments for Scotland
ReDAPT Reliable Data Acquisition Platform Tidal
RES Renewable Energy Strategy
REZ Renewable Energy Zone
RNLI Royal National Lifeboat Institution
ROCs Renewables Obligation Certificates
ROS Renewable Obligation Order for Scotland
ROV Remotely Operated Vehicle
ROW Receiver of Wreck, wreck administration department within the UK Maritime Coastguard Agency.
RPM Revolutions per Minute
RSPB Royal Society for the Protection of Birds
RTP Roger Tym and Partners
RYA Royal Yachting Association
SAAR Standard Annual Average Rainfall
SAC Special Area of Conservation
SAM Scheduled Ancient Monument
SAMS Scottish Association for Marine Science
SAR Search and Rescue
SBL Scottish Biodiversity List
SCANS Small Cetacean Abundance in the North Sea
SCADA Supervisory Control and Data Acquisition
SCOS Special Committee on Seals
SEPA Scottish Environment Protection Agency
SEA Strategic Environmental Assessment

SFF Scottish Fishermen's Federation
SHEP (Historic Scotland's) Scottish Historic Environment Policy
SHETL Scottish Hydro Electric Transmission Ltd
SHEPD Scottish Hydro Electric Power Distribution Ltd
SIFAG Scottish Inshore Fisheries and Advisory Group
SLA Scenic Landscape Area
SLVIA Seascape & Landscape Visual Impact Assessment
SMA Seal Management Area
SMRU Seal and Mammal Research Unit
SMP Survey Monitoring Plan
SNH Scottish Natural Heritage
SNMP Scotland's National Marine Plan
SOLAS International Convention for the Safety of Life at Sea
SOS Secretary of State
SPA Special Protection Area
SPG Supplementary Planning Guidance
SPL Sound Pressure Level
SPP Scottish Planning Policy
SRSL SAMS Research Services Limited
SSA Setting Study Area
SSE Scottish and Southern Energy
SSER Scottish and Southern Energy Renewables
SSSI Special Site of Scientific Interest
TCE The Crown Estate
TAC Total Allowable Catch
TEC Tidal Energy Converter
TGL Tidal Generation Limited
THLS Trinity House Lighthouse Service
TOC Total Organic Carbon
TSS Turbine Support Structure
TSS Traffic Separation Scheme
TTS Temporary Threshold Shift
UK United Kingdom
UKBAP UK Biodiversity Action Plan
UKC Under Keel Clearance
UKHO UK Hydrographic Office
UKRES UK Renewable Energy Strategy
UNCLOS United Nations Convention of the Law of the Sea
UNESCO United Nations Educational, Scientific & Cultural Organisation.
VATT Vertical Axis Turbine
V Volts
VERs Valued Ecological Receptors
VHF Very High Frequency
VP Vantage Point
VMS Vessel Monitoring System
VTS Vessel Traffic Services
WANE The Wildlife & Natural Environment (Scotland) Act (2011)
WEWS Water Environment & Water Services Act
WITEP West Islay Tidal Energy Park
WGNAS Working Group on North Atlantic Salmon
WHO World Health Organisation
WFD Water Framework Directive
WSA Wider study area
ZAV Zone of Actual Visibility
ZTV Zone of Theoretical Visibility

List of Tables:

List of Figures:

List of Technical Appendices:

5.1 Fluids Tables - MCT
5.2 Materials Data Sheets - MCT
5.3 Materials Data Sheets – TGL
5.4 Fluids Tables - TGL
5.5 Rock Bag Specification
6.1 Metocean Tables
7.1 Baseline Report West Islay Tidal Energy Project
7.2 Baseline Condition Survey
7.3 Encounter Modelling
7.4 Acoustic Modelling Report 1 MCT
7.5 Acoustic Modelling Report 2 TGL
7.6 DP Energy Deal Telemetry Report
7.7 Summary of SMRU Seal Counts and Telemetry Tracks in the Islay Area
7.8 Baseline Noise Assessment SRSL
7.9 HRA Report
8.1 Islay Benthic Video Survey Report
8.2 Islay Tidal Benthic Baseline
10.1 Summary of Bird Surveys Technical Report.
10.2 HRA Ornithology Screening Report
11.1 DPE Natural Fish Baseline Report
12.1 DP Tidal Energy Comm Fish Baseline
12.2 DPE Salmon and Sea Trout Baseline
13.1 Archaeology - Baseline Report
14.1 Preliminary Hazard Analysis
15.1 SLVIA Baseline Report
17.1 SocioEconomic and Recreation and Amenity Baseline Report
17.2 Consultations and Issues Raised
18.1 Consultations and Issues Raised

WEST ISLAY TIDAL

ENERGY PARK

volume 2 // chapter 1 // introduction

1.0 Introduction

This Environmental Statement (ES) has been prepared on behalf of West Islay Tidal Energy Park Ltd by DP Marine Energy Ireland Ltd (DPME), who together with DEME Blue Energy NV form the joint venture partnership for the West Islay Tidal Energy Park (WITEP) project.

The ES is submitted in support of an application for consent for the WITEP project (the "Project"), a proposed development of a tidal energy park covering an area of approximately 2.28 km^2 around 6km off the south-west coast of the island of Islay in Argyll and Bute in Scotland.

1.1 The Development

The proposed Project comprises of between 15 and 30 tidal energy convertors (TECs) delivering a maximum installed capacity of 30MW together with the associated infrastructure required to export the generated energy to the shore on Islay.

The TECs will be horizontal axis open rotor devices, each with an output of between 1.0 and 2.0MW. The infrastructure will include the inter-array cabling, marshalling hub and up to three subsea export cables to mean high water springs (MHWS) mark on Islay.

The site location and subsea export cable route to Islay is shown in Figure 1.1.

1.2 The Application

The consent application is for the development described in 1.1 above, together with the associated installation and enabling works.

Pending final selection of turbine manufacturer(s), and the resultant influence this will have on the exact location of the individual TECs, a project design envelope has been considered. The environmental impact assessment (EIA) of this project design envelope is intended to facilitate subsequent selection of horizontal axis open rotor TEC`s within the parameters of the project envelope considered. Further information is provided in Chapter 5: Project Description.

The electrical connection beyond the export cables initial landing point on Islay is not considered in this ES and will be the subject of a separate application for consent under Section 37 of the Electricity Act by the Scottish Government Consents Unit and under The Town and Country Planning Act by Argyll and Bute Council Planning Department. Outline details of these elements are included within this ES for information only to add context to the project.

Therefore, the following elements are not included in the ES:

- Any onshore cabling beyond MHWS mark;

- The jointing bay at landfall on Islay;
- Any metering or control room buildings;
- Metering/Control room buildings on Kintyre;
- Electrical substations; and
- Any operational support or maintenance facilities.

The predicted life of the tidal farm is approximately twenty-five years after which time the equipment will either be decommissioned and the site reinstated or potentially the site may be refurbished with new TEC`s subject to a further planning application at that time.

1.3 Site Lease

In October 2011, DPME, having successfully participated in the Saltire Prize Leasing round, entered into an Agreement for Lease (AfL) from The Crown Estate (TCE) for a 30MW Saltire Prize lease which is effective for 25 years. The AfL provides DPME with the security required to develop the project whilst seeking the required consents for the installation and operation of the project from the regulatory authorities.

1.4 Background to Applicant and Developer

This application is submitted on behalf of WITEP Ltd, a joint venture company established for the Project by DP Marine Energy Ltd and DEME Blue Energy NV. Background information about the two companies is given below.

1.4.1 DP Marine Energy Ltd (DPME)

The name DP Energy encompasses a number of companies which operate in the field of renewable energy and sustainable development. Each DP Energy company is a private limited company with the controlling shareholdings being held by Maureen De Pietro and Simon De Pietro.

With a common core of key team members working on projects across the group of companies, there is extensive experience of more than 15 years of developing a range renewable energy projects. Together they have developed over 180MW of built wind energy projects comprising seven projects and 114 turbines. It currently has a further 109MW in build/ready to build, and 100MW in Ireland, Canada and Australia with grid connection offers in permitting and a further 130MW at various stages of consent.

The team’s key strengths and capabilities encompass managing the site assessments, identifying key environmental and other development issues, stakeholder engagement, risk mitigation and consenting. The result being the delivery of viable, consented projects.

DPME is a member of the DP Energy group of companies and was established in 2007 specifically to develop marine energy projects. Together with its development partners, DPME currently holds AfL's for 130MW of tidal energy projects.

Since its identification of the west coast of Islay site as a potential tidal energy park, DPME has been progressing the development: gathering site specific data, carrying out resource modelling and undertaking environmental assessment in conjunction with our specialist assessors and statutory consultees.

1.4.2 DEME Blue Energy NV (DBE)

DEME is a marine construction group with roots going back 150 years. DEME is one of the leading contractors in the marine construction sector and one of the pioneers in the development of offshore wind energy. The DEME group has significant in-house resources for marine construction and installation works including a large specialised fleet and support plant and equipment. DBE was established to invest in Blue Energy (wave and tidal energy) projects. DEME's direct experience with installing the SeaGen device at Strangford Lough in Northern Ireland attributes them a unique position to assess and minimise the risks for future installation of similar devices.

1.5 Structure and Purpose of the ES

The ES reports the findings of the Environmental Impact Assessment (EIA) conducted for the 30MW tidal site and subsea cable corridor from the tidal site to landfall at Kintra on Islay in line with EIA regulations and following guidance from Marine Scotland's Consenting manual[(1)]. The document will form part of the Project consent application to Marine Scotland and is structured as follows:

- Volume 1: Non-Technical Summary
- Volume 2: Full ES comprising the following chapters which are listed below in Table 1.1.
- Volume 3: Figures
- Volume 4: Technical Appendices

Section	Chapter	Description
Introduction	1	Introduction
	2	Legislative & Policy Context
	3	Site Selection & Alternatives
	4	EIA/ES & Consultation
	5	Project Description
	6	Physical Environment
Biological Environment	7	Mammals
	8	Benthic
	9	Otters
	10	Birds
	11	Natural Fish
Human Environment	12	Commercial Fisheries
Human Environment	13	Archaeology

Section	Chapter	Description
	14	Shipping & Navigation
	15	Landscape & Seascape Visual
	16	Traffic & Transport
	17	Recreation & Amenity
	18	Socio-Economic
	19	Noise
	20	EMF
Summary & Conclusions	21	Summary, Mitigation & Monitor

Table 1.1: Structure of Environmental Statement (Volume 2)

1.6 List of EIA Contributors

The ES has been compiled by DPME and incorporates the results of the EIA works undertaken by specialist environmental assessors. Details of the assessors and their contributions are shown below in Table 1.2.

ES Chapter	Assessors	Experience
1 - 6	DPME	See 1.4.1 above
7: Mammals	SAMS Research Services Ltd (SRSL)	To date, SRSL has delivered consultancy services and field surveys for 8 renewable energy developments in Scotland, to facilitate sustainable development of the marine renewable energy industry in these waters
8: Benthic	Natural Power Ltd	Natural Power have provided services on numerous proposed wave and tidal energy projects providing consultancy expertise ranging from site selection, data collection, hydrodynamic modelling, site design, environmental impact assessment and consenting services.
9: Otters	Caledonian Conservation	Caledonian Conservation Ltd provides a range of ecology and ornithology services for development and conservation in Scotland.
10: Birds	Natural Research Projects Ltd	The majority of NRP`s marine consultancy work is for the renewable energy sector in connection with offshore wind, tidal and wave power developments. Current projects include baseline surveys of seabirds and associated impact assessments for one offshore windfarm and three tidal array developments.
11: Natural Fish	SRSL	See above
12: Commercial Fisheries	Brown & May Marine (BMM)	BMM have been undertaking studies and services relating to various potential impacts on commercial fishing since 1982. These have included assessing the impacts of loss of fishing area resulting from offshore oil and gas and windfarm installations. Offshore clients include: BP, Shell, Total, Medgaz, Enagas, Bord Gais, Centrica and Dong Energy.
13: Archaeology	Headland Archaeology (UK)	Headlands maritime and marine department has recently undertaken a number of marine cultural

ES Chapter	Assessors	Experience
	Ltd	heritage EIAs for Round 3 Offshore. In addition they are working on 5 offshore windfarm projects, 3 interconnectors including the Western HVDC Link, a wave project and harbour development
14: Shipping & Navigation	PMSS Ltd & DPME	PMSS works exclusively in the Renewables Industry and has been providing technical consultancy support to wave and tidal projects for over a decade. Clients and projects include: Alderney Renewable Energy; Aquamarine Power; Atlantis Resource Corporation; Oyster 1; SeaGen Strangford Lough; Skerries SeaGen Array;
15: Landscape & Seascape Visual	Stephenson Halliday Ltd (SH)	SH have a substantial client list. With respect to marine development, SH have contributed to the LVA for MCT`s Kyle Rhea Tidal Energy Project.
16: Traffic & Transport	DPME	See 1.4.1 above
17: Recreation & Amenity & Socio-Economic	Roger Tym & Partners	Roger Tym & Partners have undertaken a number of major infrastructure projects including the initial preparatory assessments for the Argyll Array Offshore Wind Farm, and the Tiree Growth Plan Costing Study; and previously detailed assessments of the Beauly to Denny 400kv Transmission Line Upgrading, the EIA for the scheme, the local public inquiry sessions; for the Northern Link transmission line from Beauly to the Western Isles; for the fixed links assessments between the island communities of Bute-Colintraive, Coll-Tiree, and Seil-Luing; the replacement Rassay Ferry Terminal; and for the Eisgein wind farm on Lewis, amongst others.
18: Socio-economic	Roger Tym & Partners	See above
19: Noise	DPME	See 1.4.1 above
20: EMF	DPME	See 1.4.1 above
21: Summary of Impacts	DPME	See 1.4.1 above

Table 1.2: List of EIA Assessors

1.7 Data Gaps and Uncertainties

Since the project's inception in 2008 when there was limited site data and limited guidance for survey methodologies available, DPME engaged with key stakeholders especially Scottish Natural Heritage (SNH). As an example, the Mammal and Birds survey methodologies[2&3] were developed from best available offshore wind experience and modified to accommodate the application to a tidal development. This work was carried out in close association with SNH and an "open EIA approach" evolved. Following the first years survey work a major review was undertaken and SNH and RSPB confirmed that the survey methodologies were delivering credible results.

Following exhaustive site survey works, which despite on occasion being hampered by adverse weather conditions were substantially completed, DPME are of the view that an acceptable level of survey work has been undertaken to properly characterise the environment in and around the proposed development and as such consider that there are no significant data gaps in this ES.

Due to the emerging nature of the tidal energy industry there is little or no experience in operating arrays of turbines in a commercial development. There is a growing database of knowledge acquired from test sites such as EMEC and Strangford Lough for single turbines and it is recognised by the Scottish Government that the step from single test sites to multi-turbine arrays is required. Marine Scotland has produced guidance for Survey, Deploy and Monitor strategies(4) and in combination with the mitigation proposals identified in this ES, DPME will continue to work with Marine Scotland and stakeholders to develop appropriate environmental monitoring strategies.

1.8 Future Aspirations for the Site

1.8.1 Larger Commercial Development – 400MW

In May 2009 DPME submitted a request for a scoping opinion(5) for a 400MW tidal energy development. The current AfL forming the application site lies within the scoping area. DPME have already undertaken baseline assessments and surveys over the 400MW area in anticipation that there will be the opportunity to develop additional phases following the successful delivery of the current Project.

1.8.2 Electricity Export

The project currently has a 30MW connection agreement for a connection at the Carradale sub-station on the Kintyre Peninsular and the project is proceeding on this basis. However, since project inception, DPME has been aware of the potential of providing the electricity generated by the tidal turbines to Islay users such as the Distilleries to replace their current dependence on heavy fuel oil as well as their existing electrical requirements.

Under review are a number of technical solutions for converting the electricity generated by the Project to the heat energy required by the distilleries, including the use of electric steam boilers and steam accumulators. This would expedite the project and provide cost benefits, as well as substantially reduce the carbon footprint of the distilleries.

When constructed, the mainland grid connection to Carradale would provide both export and import capability, thereby improving the energy security for the island of Islay as a second connection route for the island.

This work is currently ongoing in association with the Islay Distilleries, HIE and the Scottish Government but is not a part of this application.

1.9 References

1. Marine Scotland Licensing and Consents Manual Covering Marine Renewables and Offshore Wind Energy Development: Report R.1957 – October 2012

2. Islay Tidal Energy Project Marine Mammals and Basking Sharks Scope and Methods Proposal: Dr Ben Wilson – February 2010.

3. Islay Tidal Energy Project Bird Scope and Methods Proposal – December 2009.

4. Survey, Deploy & Monitor Licensing Policy Guidance: Marine Scotland – September 2012 DRAFT

5. Request for Scoping Opinion by DP Marine Energy Ltd in respect of Islay Tidal Energy Project Environmental Impact Assessment Scoping Report – May 2009.

WESTISLAY TIDAL

ENERGY PARK

volume 2 // chapter 2 // legislative & policy context

2.0 Legislative and Policy Context

2.1 Introduction

This chapter provides a summary and overview of the international, UK, Scottish, regional and local policy, guidance and associated legislation which are directly relevant to the Project and the assessment of potential likely environmental impacts.

2.2 Governmental Policy and Context

2.2.1 Global Energy Context and EU Policy

Global climate change resulting from the release of greenhouse gases is now believed to be the most serious environmental threat facing the planet. A continuation of global emissions, including greenhouse gases like carbon dioxide, at current levels could lead to an average global temperature rise of up to 6°C by the end of this century as reported in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report: Climate Change 2007 (AR4)(1).

The implications of the predicted effects are profound. According to the Department of Energy and Climate Change (DECC) it would result in a considerable increase in heat wave, drought, and flood event occurrences. The potential secondary effects include increased levels of public health related illness and a level of people migration not previously experienced.

The economic implications of climate change are also acutely significant with The Stern Review(2) concluding that with no action, the overall cost and risk of climate change will be equivalent to losing a minimum of 5% of the global Gross Domestic Product (GDP) each year. Taking the full range of risks and impacts into account, the global GDP could be 20% lower than it might otherwise be.

Following the UN Framework Convention on Climate Change ("The Earth Summit") in Rio de Janeiro in 1992, the Kyoto Protocol set binding targets to reduce greenhouse gas emissions. In 2005, targets were set for 37 industrialised countries including the EU for reducing overall greenhouse gas emissions by 5% compared to 1990 levels during the five-year period from 2008 to 2012. In Doha, Qatar, on 8th December 2012, the "Doha Amendment to the Kyoto Protocol" was adopted. At the second commitment, Parties pledged to reduce Greenhouse Gas (GHG) emissions by at least 18% compared to 1990 levels during the eight-year period from 2013 to 2020.

Directive 2001/77/EC titled "Promotion of Electricity Produced from Renewable Energy Sources in the Internal Electricity Market" was adopted in 2001, which together with subsequent amendments, set national targets for gross inland energy consumption from renewables.

Through the EU Climate and Energy Package enacted in 2009, the European Union committed to what is known as the "20-20-20" targets for delivery by 2020:

- A 20% reduction in EU greenhouse gas emissions from 1990 levels;
- Raising the share of EU energy consumption produced from renewable resources to 20%; and
- A 20% improvement in the EU's energy efficiency.

Directive 2009/28/EC "On the Promotion of the Use of Energy from Renewable Sources and Amending and Subsequently Repealing Directives 2001/77/EC and 2003/30/EC" established a common framework for the production and promotion of energy from renewable sources. Each Member State has adopted a target calculated according to the share of energy from renewable sources in its gross final consumption for 2020. This target is in line with the overall '20-20-20' goal for the Community.

The EU is focussed on energy security issues, as identified in the "EU Energy Policy: Engaging with Partners beyond Our Borders" published in 2011, with the security and diversity of supply key threads. Renewable energy is one of a number of potential contributors to diversity of supply.

2.2.2 UK Government Context and Policy

Together with its legal obligation under Kyoto, targets committed to under its EU obligations and the conclusions from Stern Review on the Economics of Climate Change, the need to tackle climate change has considerable implications for the UK.

Energy production has declined since 1999, to the extent that the UK became a net importer of energy in 2004. In 2009, 26.7% of the UK's energy needs were imported. This reliance on imported energy combined with the scheduled loss of 25% of our existing energy generating capacity by 2018 through power station closure is considered to be an unsustainable energy model.

In 2009, the UK Government released the Low Carbon Transition Plan White Paper(3) which plots how the UK will meet its cut in emissions targets on 1990 levels by 2020. Developing a low carbon energy sector for the longer term can deliver both increased energy security for the UK and ensure that it meets international targets for the reduction of greenhouse gas emissions.

Recognising the need for new energy infrastructure, there are five key points:

- Currently three quarters of UK electricity comes from coal and gas. To meet climate change targets by 2050, virtually all electricity will need to come from zero carbon energy generation such as renewable sources, nuclear or fossil fuel coupled with carbon capture and storage techniques;

- There will be an increased emphasis on electricity as the source for supporting the heat and transport sectors. This could see the UK's demand for electricity in 2050 increasing by 50% from where it stands today. This would mean that electricity would account for approximately half of the UK's overall energy use;

- As the UK moves to low carbon energy sources it is acknowledged that there will be a need to improve the electricity supply infrastructure to accommodate changes in the nature and location of generating capacity. It is estimated there will be a net requirement of 43GW of new capacity by 2020 and about 60GW by 2025;

- This rise in electricity demand will coincide with the closure of around sixteen power stations scheduled through to 2018. The closures represent a 25% (18GW) decline in current generation capacity. The decline of North Sea oil and gas reserves(3) (4) is also a key issue; and

- In the UK, at least 22GW of existing electricity generating capacity will need to be replaced prior to 2020. This is as a result of a combination of tightening environmental regulation and ageing power stations.

Whilst acknowledging the findings of The Stern Review(2), it must be noted that by being at the forefront of the renewable energy sector, there are substantial economic opportunities as recognised by the UK Government. In 2009, the energy industries contributed 3.7% of the UK GDP and directly employed over 150,000 people (5% of industrial employment)(4). The low carbon and environment sector currently employs around 880,000 people and is worth £106 billion per year. It is estimated that employment levels could rise to more than a million people by 2020, if the UK is able to maximise the opportunity presented by being a world leader in low carbon technologies.

The Climate Change Act 2008 introduces into UK law a legal requirement on the UK Government to cut emissions by 80% compared to 1990 levels by 2050, with targeted steps towards this. The first target was to reach 10% of supply being generated by renewable sources by 2010, increasing to 15% in 2015 and then 20% in 2020.

The Renewable Obligation (Scotland) Order (ROS) came into effect in 2002. The Order placed an obligation on licensed electricity suppliers to source an increasing proportion of electricity supply from renewable sources. The current proportion of electricity that must be sourced from renewable sources is 10.4%, and this will rise to 15.4% by 2015. The ROS has recently been amended to provide a legal guarantee that the ROS will continue to apply to accredited schemes until 2037.

The Renewables Obligation (Scotland) Amendment Order 2013 came into force on 1st April 2013. It underpins the Governments long term support for marine renewables by increasing the support level from 2 to 5 Renewables Obligation Certificates (ROCs) for both tidal stream and wave energy.

2.2.2.1 Marine Policy Statement – UK

The UK Marine Policy Statement (MPS) applies to all UK waters and has been adopted by the UK Government, the Scottish Government, the Welsh Assembly Government and the Northern Ireland Executive.

The function of the MPS is to provide the framework for preparing Marine Plans and taking decisions affecting the marine environment. All national and regional marine plans must conform to the MPS. The objectives of the MPS are given as:

- Promote sustainable economic development;
- Enable the UK's move towards a low-carbon economy, in order to mitigate the causes of climate change and ocean acidification and adapt to their effects;
- Ensure a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species and our heritage assets; and
- Contribute to the societal benefits of the marine area, including the sustainable use of marine resources to address local social and economic issues.

The MPS emphasises the importance of renewable energy and recognises the importance of considering marine based renewable energy projects in marine planning, stating in paragraph 3.3.1 that "Contributing to securing the UK's energy objectives, while protecting the environment, will be a priority for marine planning".

2.2.3 Scottish Government Context and Policy

The Scottish Government has signalled its commitment to tackling climate change and strong support for renewable energy development through both legislation and policy. The Scottish Government estimates that by achieving the 2020 electricity target alone, 40,000 new jobs and £30bn of investment in Scotland(5) will be created. The Climate Change (Scotland) Act 2009 imposes a legal commitment on the Scottish Government to reduce emissions by 42% from 1990 levels by 2020 and by 80% by 2050.

In July 2011, the Scottish Government published the 2020 Routemap(5) for Renewable Energy in Scotland, which is an update and extension to the Scottish Renewables Action Plan 2009. This updated and expanded Routemap reflects the challenge of the Government's new target of achieving an equivalent of 100% demand for electricity from renewable energy by 2020, as well as the target of 11% renewable heat.

The 2020 Routemap is complemented by the draft Electricity Generation Policy Statement(6), which sets out the Scottish Government's position on the role of renewable electricity and fossil fuel thermal generation (coal, gas, oil) in Scotland's future energy mix. The draft statement gives a clear view on the need for rapid expansion of renewable electricity across Scotland.

The 100% target does not mean Scotland will be 100% dependent on renewables generation: renewable energy is part of a wider electricity mix and the underlying aim to export as much as it consumes.

The Marine Energy Roadmap[7] highlights the key role marine renewables will play in meeting these targets and objectives.

2.3 Planning Framework and Guidance

2.3.1 Marine Planning Framework

The Marine Strategy Framework Directive (MSFD) (2008/56/EC) was transposed into Scottish law in 2010 through the Marine (Scotland) Act. The objective of the MSFD is to "promote the integration of environmental considerations into all relevant policy areas and deliver the environmental pillar of the future maritime policy for the European Union". The Directive follows a similar approach to the WFD (Water Framework Directive) establishing a framework within which Member States shall take the necessary measures to achieve or maintain a good environmental status in the marine environment by 2020". To do this Member States have to make an initial assessment of their marine waters, establish environmental targets and associated indicators to guide progress to a good environmental status along with a co-ordinated monitoring programme and identify and deliver a programme of suitable measures. The National Marine Policy Statement and Marine Plans will be the delivery mechanism for the MSFD in Scotland and Marine Scotland's Licensing Operations Team (MS-LOT) is responsible for ensuring that applications allow for compliance with the Directive.

2.3.2 National and Regional Marine Plans

Under the Marine (Scotland) Act 2010 and Marine and Coastal Access Act 2009 the Scottish Government must prepare a National Marine Plan for Scottish Territorial Waters and the offshore zone. The Scottish Government may also choose to prepare Regional Marine Plans. Section 15(1) of the Marine (Scotland) Act 2010 states that "a public authority must take any authorisation or enforcement decision in accordance with the appropriate marine plans, unless relevant considerations indicate otherwise". This includes consents and licences. However, there are currently no adopted marine plans in place.

The National Marine Plan is being developed to clarify the overall objectives that provide the basis for managing Scotland's marine environment. A pre-consultation draft of the National Marine Plan was published in March 2011 and the responses to the consultation were published in a document in July 2011. The timeframe for revising the pre-consultation draft and issuing a final version for consultation is by the summer of 2013.

2.3.3 Marine Renewable Energy Sectoral Plan

In 2007, the Scottish Government published a Strategic Environmental Assessment (SEA) for Marine Renewables covering Scottish Territorial Waters. The report concluded that there is significant resource within Scottish territorial waters for wave and tidal energy development. Work is progressing on the Sectoral Plans for Wave and Tidal Energy which require a Sustainability Appraisal in line with the requirements of the current marine legislation. This work will refresh the 2007 SEA and increase the geographic scope to include Scotland's renewable energy zone (out to 200 nm). The Sustainability Appraisal includes SEA, strategic Habitats Regulation Appraisal (HRA), Socio-economic Impact Assessment and consultation.

Initial Plan Frameworks will be produced which will draw upon the original SEA, Scoping and Regional Locational Guidance for The Saltire Prize and Regional Locational Guidance for the Pentland Firth Strategic Area. Additional scoping work is being undertaken using the MaRS model to map resource and constraint areas covering the Scottish renewable energy zone to develop further Plan options. Regional Locational Guidance review and application will be applied to the areas identified to produce refined Plan options and these will be reported within Initial Plan Frameworks.

The Sustainability Appraisal will be applied to produce Draft Plans and will be subject to statutory public consultation. The Plans will provide clear guidance to Industry on where to focus investment and pursue development opportunities.

2.3.4 Marine Protected Areas

Marine Protected Areas (MPAs) are a requirement of the Marine (Scotland) Act 2010. The purpose of MPAs is to afford protection to particular features of the marine environment. There are three categories of MPA, namely Nature Conservation MPAs, Demonstration and Research MPAs and Historic MPAs. The Scottish Government is currently consulting on suitable areas for Nature Conservation MPAs. This has resulted in 30 locations identified for possible designation as MPAs. None of these include, or are adjacent to the Project.

2.3.5 Additional Guidance

In addition, there is a need to develop schemes within the national and regional planning context and guidance including:

- The relevant offshore renewable strategies and associated Strategic Environmental Assessments (SEA) and plan level HRA (Marine Scotland);
- Regional Locational Guidance (Marine Scotland);
- Marine Spatial Plans (being developed by Marine Scotland);
- the Scottish Government's National Planning Framework and associated Scottish Planning Policy; and
- Structure and local Development Plans (local planning authorities).

The following strategic guidance in the form of planning application notes and marine guidance is also important:

- PAN 3 Community Engagement;
- PAN 42: Archaeology–Planning Process and Scheduled Monument Procedures;
- PAN 45: 2002 Renewable Energy Technologies;
- PAN 50: Controlling the Environmental Effects of Surface Mineral Workings;
- PAN 51: Planning, Environmental Protection and Regulation;
- PAN 56: Planning and Noise;
- PAN 58: Environmental Impact Assessment;
- PAN 60: Planning for Natural Heritage;
- PAN 62: Radio Telecommunications;
- PAN 68: Design Statements
- PAN 69: Planning and Building Standards Advice on Flooding;

- PAN 75: Planning for Transport;
- PAN 79: Water and Drainage; and
- Marine Guidance Note 371 (M).

2.4 Legislative Context

2.4.1 Marine Licence (ML) Under the Marine (Scotland) Act 2010 and Marine and Coastal Access Act 2009.

The Marine (Scotland) Act 2010 received Royal Assent on 10 March 2010 and it creates a new legislative and management framework for the marine environment within Scottish Territorial Waters (0 to 12 nautical miles). This follows the UK Marine and Coastal Access Act 2009 under which Scottish Ministers have devolved authority for marine planning and conservation powers in the offshore region (12 to 200 nautical miles). These provide a framework for the sustainable management of Scotland's seas and one of its key aims is to streamline and simplify the licensing and consenting process for offshore renewable projects.

Projects had historically been required to seek licences and planning consent under several pieces of legislation before development could proceed. With the introduction of the Marine (Scotland) Act, co-ordinated applications for planning consent and associated licenses (including a Marine Licence under the Marine (Scotland) Act and Section 36 Consent under the Electricity Act) can now be made via a single point of access, Marine Scotland's Licensing Operations Team (MS-LOT), as part of a unified licensing and consenting process.

2.4.2 The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000

These Regulations implement the European Environmental Impact Assessment (EIA) Directive 1985 (as amended, 2009), and outline the requirement for assessment of the effects of certain public and private projects on the environment. Such projects include the construction, extension and operation of a power station or overhead electricity lines under Sections 36 and 37 of the Electricity Act. As the Project is over 1MW and so requires Section 36 consent, it is considered to be a Schedule 2 development under The Electricity Works (EIA)(Scotland) Regulations 2000; defined as "a generating station, the construction of which (or the operation of which) will require a section 36 consent but which is not Schedule 1 development"

2.4.3 The Marine Works (Environmental Impact Assessment) Regulations (as amended)

These regulations are relevant to those elements of the project that require a marine licence under the Marine Scotland Act 2010.

2.4.4 Energy Act 2004

The UK Government has a responsibility to ensure navigational safety measures are implemented in order to honour its commitments under Article 60(7) of the United Nations Convention on the Law of the Sea (UNCLOS) relating to provisions for 'Artificial islands, installations and structures in the exclusive economic zone'. This is addressed in a number of specific Acts.

DECC is responsible under Section 95 of the Energy Act 2004 for considering applications for safety zones for offshore renewable energy projects in English, Welsh and Scottish waters and in the Renewable Energy Zone (REZ), except for those with a generating capacity of 100MW or less in English and Welsh waters which are dealt with by the Marine Management Organisation (MMO).

The Energy Act 2004 (and subsequent commencement orders, the latest issued in 2010) establishes a regulatory regime for UK waters, with extension to the UK's REZ. Section 99 of the Act deals specifically with navigation and in combination with Section 36b 'duties in relation to navigation' of the Electricity Act (1989), stipulates that a consent cannot be granted for an offshore renewable energy installation (OREI) which is likely to interfere with the use of 'recognised sea lanes essential to international navigation'. This term is married at 36b (7) to Article 60(7) of the United Nations Convention on the Law of the Sea, 36b (2) of the Electricity Act consolidates the provisions of Section 34 of the Coast Protection Act 1949 (now superseded by the Marine and Coastal Access Act 2009) (MCA, 2008). Within UK water, the Maritime and Coastguard Agency (MCA) is a statutory consultee on all developments.

If marks or lights are required in respect of marine developments, a project specific assessment must be made with Statutory Sanction applied for from the General Lighthouse Authority, which in Scottish Waters is the Northern Lighthouse Board (NLB). This provides compliance with the Government's commitment to the International Convention for the Safety of Life at Sea (SOLAS) 1974, and as directed by the Merchant Shipping Act 1995.

NLB are also responsible for the inspection and audit of all Aids to Navigation within their area of jurisdiction, including Local Lighthouse Authority (LLA), offshore installations and aquaculture aids. Once Aids to Navigation are established as part of the design and build of marine developments, any alteration or removal within Scottish Waters requires the prior Statutory Sanction of the Commissioners of Northern Lighthouses.

Sections 105 to 114 of the Energy Act 2004 introduced a statutory decommissioning scheme for offshore renewable energy installations in English, Welsh and Scottish territorial waters and in the REZ. Under the statutory scheme, the Secretary of State for Energy and Climate Change may require those persons with an interest in such installations to produce a fully costed Decommissioning Programme (DP) detailing how they intend to remove the installation when it comes to the end of its useful life and how the costs of doing so will be funded. Unlike development consents/licences which have been devolved, responsibility for decommissioning remains with the UK Government and is administered by DECC and must be agreed by the Secretary of State (SoS).

2.4.5 Water Environment & Water Services Act (WEWS)

The Water Framework Directive (WFD) was transposed into Scottish law in 2003 by the Water Environment and Water Services (Scotland) Act 2003. The Act sets out the role of Scottish Ministers and the Scottish Environment Protection Agency (SEPA) in relation to achieving the overall aims of the WFD. In order to deliver its WFD obligations, the Scottish Government has introduced controls over activities likely to have an adverse impact on the water environment. This is embodied within the Water Environment (Controlled Activities) (Scotland) Regulations 2005, referred to as the Controlled Activity Regulations (CAR), which came fully into force on 01 April 2006. CAR enables SEPA to control activities which may have an impact on the water environment; and is one of the key tools enabling the Scottish Government to achieve objectives identified within the WFD. The key aspects of the WFD of relevance to offshore renewables (for engineering and dredging works) are water quality, ecology and morphology.

2.4.6 Habitat Regulations

During the EIA process consideration will also be given to the following environmental related legislation with regard to potential effects on protected sites, habitats and species:

- EC Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna (the 'Habitats Directive'), implemented by:
    - Conservation (Natural Habitats &c.) Regulations 1994 (as amended).
    - Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007.
- Directive 2009/147/EC of the European Parliament and of the Council on the Conservation of Wild Birds (the 'Birds Directive')
    - Article 4 of the Birds Directive requires measures to be taken outside of SPAs to "strive to avoid pollution or deterioration of habitats" for all wild birds including "regularly occurring migratory species". This applies to both the onshore and offshore aspects of the development.
- Wildlife and Countryside Act 1981.
- Nature Conservation (Scotland) Act 2004.
- Conservation of Seals Act 1970.

2.4.7 Habitats Directive 1994

The Habitats Directive is the short name for 'Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora'. This 'Habitats Directive' is transposed into Scots law through the Conservation (Natural Habitats, & c.) Regulations 1994 (as amended in Scotland) and Offshore Marine Conservation (Natural Habitats & c.) Regulations 2007. These Regulations are commonly referred to as the 'Habitats Regulations'. Amongst other measures, the Habitats Regulations afford protection to certain species identified in the Habitats Directive, including those requiring strict protection (European Protected Species).

2.5 Consents and Licensing

In order to permit the construction and operation of all components of the Project, the following consents and agreements will be required for the offshore elements of the project:

- An application to Marine Scotland under Section 36 of the Electricity Act, 1989; and,

- A Marine Licence from Marine Scotland under Section 20 of the Marine (Scotland) Act 2010 (replacing Section 5 Part II of the Food and Environment Protection Act (FEPA), 1985 and Section 34 of Coast Protection Act, 1949).

The offshore elements of the Project will require a decommissioning programme to be developed under the Energy Act 2004.

In addition to the above, further consents, which may also be required, include:

- European Protected Species licence for cetaceans and otters under The Conservation (Natural Habitats, & c.) Regulations 1994; and

- A licence for disturbance to basking sharks under the Wildlife and Countryside Act, 1981 (as amended) and the Nature Conservation (Scotland) Act 2004.

2.5.1 Electricity Act 1989 (S36 Consent)

Applicants are required to apply for and obtain the consent of the Scottish Ministers (which like marine licences can be granted with conditions to ensure full compliance with all relevant legislation) under Section 36 of the Electricity Act 1989 before an electricity generating station with the capacity of over 1 megawatt can be constructed or operated in the Scottish marine area. The Electricity Act 1989 (Requirement of Consent for Offshore Generating Stations) (Scotland) Order 2002 modifies Section 36(2) of the 1989 Act to specify that such generating stations with a permitted capacity of 1 MW require consent (for onshore generators the capacity is 50MW). Offshore developments with a capacity of 1MW or under are exempt from S36 requirements.

Applications for S36 consent can be made at the same time as applications for Marine Licences. Section 35 of the Marine (Scotland) Act 2010 Act allows for s36 electricity consents and marine licence to be considered together.

2.5.2 Marine Licence

From April 2011, under the Marine (Scotland) Act 2010 a single Marine Licence has replaced the previously separate FEPA and CPA licences required under the Food and Environment Protection Act 1985 (FEPA) the Coastal Protection Act 1949 (CPA). A Marine Licence will be required for the Project due to the installation of the support structures, devices and associated cabling being considered as a deposit by construction activity both in the sea and or under the seabed as described within the legislation.

2.6 Conservation Regulations

2.6.1 Habitats Regulations Appraisal (HRA) and Appropriate Assessment (AA)

It is noted that HRA is a separate process from EIA. However, the HRA process has been followed for the Project and the findings of this have been used to inform specific topic sections of this ES. The HRA process relates specifically to the consideration of effects on Natura sites designated for their importance for

European protected habitats and species. The process considers the potential effects of the development on internationally important habitats and/or species for which the sites are or will be designated. The assessment includes consideration of direct and indirect effects on these interests and must also consider cumulative effects from other proposed plans or projects.

Appropriate Assessment is one stage of this process. A competent authority shall make an Appropriate Assessment of the implications for a site in view of that site's conservation objectives, before deciding to undertake or give any consent, permission or other authorisation for, a plan or project which:

- Is likely to have a significant effect on a European site in the UK (either alone or in combination with other plans or projects); and
- Is not directly connected with or necessary to the management of the site.

The AA must ascertain that the proposed project will not adversely affect the integrity of the site. In all other circumstances, including cases where there is doubt about the absence of adverse effects, the proposal may not proceed unless there are no alternative solutions and imperative reasons of over-riding public interest apply.

2.6.2 European Protected Species Licence (EPS)

Certain species are listed in Annex IV of the Habitats Directive as species of European Community interest and in need of strict protection. The protective measures required are outlined in Articles 12 to 16 of the Directive and are transposed into Scottish law through the following:

- Regulation 39 (1) and (2) and 43 of the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended): (Scottish inshore waters within 12nm);
- Regulation 39 (1) and 43 of the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 applies (Offshore Marine Regulations); and
- The Wildlife and Natural Environment (Scotland) Act (2011) (WANE).

The Regulations make it an offence to deliberately or recklessly capture, kill, injure, harass or disturb any such animal. It is also an offence to deliberately or recklessly obstruct access to a breeding site or resting place of any such animal, or otherwise to deny the animal use of the breeding site or resting place. In addition, it is an offence to disturb such an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs. For cetaceans (dolphins, porpoises and whales) only, there is a more general offence deliberately or recklessly to disturb these creatures. The damage or destruction of a breeding site or resting place of any EPS of animal is an offence of strict liability. An EPS Licence is required for any activity that might result in disturbance to an EPS

2.7 References

1 IPCC Fourth Assessment Report: Climate Change 2007 (AR4)

2 The Stern Review on the Economics of Climate Change – Oct 2006.

3 The UK Low Carbon Transition Plan: National Strategy for Climate and Energy – 2009.

4 UK Energy Sector Indicators 2010: DECC – 2010.

5 2020 Routemap for Renewable Energy in Scotland: The Scottish Government -2011.

6 Draft Electricity Generation Policy Statement 2010: Scotland – A Low Carbon Society: The Scottish Government -2010

7 Forum for Renewable Energy in Scotland (FREDS) Marine Energy Group (MEG) – Marine Energy Roadmap: 2010.

WESTISLAY TIDAL

ENERGY PARK

volume 2 // chapter 3 // site selection & alternatives

3.0 Site Selection Process and Alternatives Considered

3.1 Introduction

This chapter describes the site selection process undertaken to identify the most suitable location for the development. It details the criteria for the selection process as well as the alternative locations and technologies considered.

3.2 Site Selection Process

3.2.1 Strategy Design Criteria

Islay is one of a number of potential tidal energy sites which have been assessed against the following principal criteria:

- Available Resource;
- Resource Constraints;
- Social and Environmental Considerations;
- Installation, Maintenance and Operation Considerations; and
- Grid Connection Feasibility.

These are described in more detail in their respective sections below.

3.2.2 Available Resource

For a site to be considered for selection it was required to have the potential for a full scale commercial development. This was defined as a minimum of 100MW of potential generating capacity, with a preference for in excess of 200MW of potential generating capacity.

In order to achieve this, the tidal flow was required to have a velocity of at least 2.5m/s mean spring peak flow (msp) over a sufficient area within a viable depth range of between 25 and 50m.

Considering the above, a desk based study was undertaken to identify potential sites in United Kingdom waters out to 12Nm. This was done using the Atlas of UK Marine Renewable Energy Resources (1) which provides semi-empirical data on wave and tidal resource in UK territorial waters. In addition, the bathymetry of coastal areas is provided. A model forms the basis of the Atlas which enables detailed information to be assessed down to a resolution of 1/60° latitude x 1/40° longitude (1 nautical mile (approximately 1.8km)).

In addition, the Highland Renewable Energy Strategy (2) contains a similar model which can be interrogated for detailed sea and bathymetric states down to 1km^2. The model was run using the parameters of water depth between 25 and 50m LAT and 2, 3 and 4m/s (msp) current. The areas meeting these criteria are identified in Figure 3.1. In order to focus on locations with the best resource, sites with a tidal velocity of less than 2.5m/s were discounted.

3.2.3 Site and Resource Constraints

Admiralty charts and navigation Pilot Notes were reviewed to gain a better understanding of the areas identified in terms of a more detailed bathymetric characterisation and of potential constraints including Traffic Separation Schemes, military zones, disposal sites, pipelines and cables.

3.2.4 Social and Environmental Considerations

The social and environmental factors of potential sites were considered in terms of the impact of a commercial scale tidal energy park. For potential Scottish sites, this activity was aided by referring to the Scottish Marine Renewables Strategic Environmental Assessment (SEA) - 2007 (3) and the Highland Renewable Energy Strategy (2) that provide comprehensive top level information on the potential sensitivity of the seas around Scotland.

Sites designated for their nature conservation importance (SACs and SPAs), important fish spawning areas or important habitat sites for cetaceans were avoided. Sites without significant value in terms of fishing or recreational use were prioritised.

3.2.5 Installation, Maintenance and Operation Considerations

Water depth was a key consideration in terms of site viability. Turbine technology selection is currently limited by water depth, which also has general implications on installation and maintenance procedures. In order not to limit turbine choice to a subset of manufacturers and maintenance regimes, water depths considered were limited to between 25 and 50m.

3.2.6 Grid Connection Feasibility

The locations of many of the high tidal resource areas are remote from the electrical grid infrastructure required to transport the power to its users. This is certainly the case on the west and north coasts of Scotland. Grid infrastructure maps of the UK down to 132kV were surveyed to determine proximity and therefore level of deep reinforcement likely to be attributable to a project. In Scotland, infrastructure maps down to 33kV were reviewed.

3.3 Islay Site

A number of Scottish sites were initially identified upon application of the above criteria. The individual merits of each site were subsequently examined in more detail and the project site was finally selected as the preferred option based on the following attributes:

- The potential installed capacity is in excess of 300MW;
- The tidal flow velocity has a magnitude around 3.0m/s (msp) and is behaviourally compliant;
- The bathymetry (between 25m and 50m) and sea bed profile match the requirements of leading tidal flow devices;
- There is no major shipping activity across the site;

- There are no areas designated for their nature conservation importance (SACs and SPAs), important fish spawning areas or important habitat sites for cetaceans within or in the immediate vicinity of the site; and
- There are no significant fishing or recreational activities on the site.

The most significant development risk identified at the preliminary review stage after technology is that of electrical grid availability although this is something the Islay site has in common with most of the tidal energy park site alternatives.

Following identification of the area off the coast of Islay, a detailed desktop constraints assessment was undertaken by ABPmer titled "Extended Tidal Technology Constraints Assessment – South West Islay, July 2008 [(4)]. This confirmed the findings of the initial site selection process and that the site was a suitable candidate for further evaluation.

3.4 Alternatives Considered

3.4.1 Introduction

It is a requirement of The Marine Works (Environmental Impact Assessment) Regulations 2007 under Schedule 3 section 6 that the Environmental Statement should include "An outline of the main alternatives studied by the applicant and an indication of the main reasons for the applicant's choice, taking into account the environmental effects of those alternatives and the project as proposed."

This has been interpreted to mean not only alternative sites, but also the alternative TEC technologies being considered. Hence this EIA will outline the decision making process for both site and technology selection.

3.4.2 Tidal Energy Compared to Other Energy Sources

3.4.2.1 Scottish Government Policy and Aspirations

Based on the 2020 Route map [(5)] The Scottish Government's stated objective is for the equivalent of 100% of Scotland's electricity demand to be generated from renewable sources by 2020, with an aim of Scotland generating twice as much electricity as it needs (50% from renewables and 50% from conventional sources) and exporting as much as it consumes.

In stating this objective The Marine Energy Roadmap [(6)] highlights the key role marine renewables will play in meeting these targets and objectives.

3.4.2.2 Why Tidal Energy?

There are many different forms of renewable energy generation that can contribute to meeting the challenge of reducing our reliance on fossil fuels. Potentially, all of these renewable energy options have a place in the overall "energy mix". In respect of the choice of generation technology, it is a question of the availability of resource in a given location or region, the appropriateness of the solution and the contribution to the energy mix.

Scotland has a significant wind energy resource and this continues to be developed both on and offshore. Wind energy is a mature technology and almost certainly offers the quickest and lowest risk route to market for generating large quantities of renewable power. However, it also has a significant tidal and wave resource which is currently underdeveloped due to a number of reasons. The rapid propagation of wind farms across Scotland means that within regions there are significant generation peaks based on the available wind resource. Similarly wave energy will be dependent upon the same resource, wind.

Conversely, tidal energy generation has an availability cycle that is both regular and predictable based on the lunar cycle. Thus tidal energy generation has the ability to provide added stability to the renewable energy mix. It should be seen as complimentary to wind-reliant renewables rather than as an alternative.

Due to the fact that tidal energy generation can be predicted years in advance, a grid operator can schedule operation of other conventional generation plant accordingly, thus leading to more efficient operation of the power grid.

3.4.2.3 Alternative Marine Energy Sources

Offshore wind has been grouped in with this discussion of Alternative Marine Energy sources on the basis of geography and land take (competition for the seabed area).

Offshore Wind Farms

In recent years there has been a significant increase in the development of offshore wind farms in UK waters.

On the 16th February 2009 The Crown Estate (TCE) announced the results of the allocation of offshore wind farm sites in Scottish territorial waters. Ten sites were awarded to nine consortia and companies with the potential to generate an estimated 6GW of power. The sites are distributed around the east and west coasts of Scotland.

An opportunity exists to develop an inclusive marine renewable energy infrastructure incorporating the technologies of offshore wind, wave and tidal energy which when distributed around the coast have a greater capability to smooth the potential peaks and troughs of renewable energy generation.

Wave Power

There is huge potential for wave development on the exposed north and west coasts of Scotland and Ireland. Islay itself already has a small onshore wave energy facility named the Limpet (7) and there is certainly scope for wave capture off the coast of Islay.

Wave energy is developed by the action of the ocean winds on the surface of the water and thus is essentially wind energy derived. Consequently although wave action tends to rise more slowly and decrease less quickly (as we see on beaches with heavy surf long after a storm has blown through) it still has a similar problem to wind in that it is not predictable.

The weather systems which create these waves are many times larger than the localised site geographic features which create tidal resource hotspots and consequently wave devices (at the utility scale) have more scope for site location than tidal devices. On this basis it is arguable that utilising a potential tidal site (of which there are few) for exclusive wave energy development would be an inappropriate use of resource.

In the future there may well be scope for combined wave and tidal devices in the region of the Islay site. However, in respect of technology development status, Tidal Energy Convertors are clearly more advanced than Wave Energy Convertors which still faces significant challenges, especially on the more exposed west coast of Scotland.

3.4.3 Alternative Tidal Energy Development Sites

3.4.3.1 Introduction

Based on tidal energy resource data presented in the Atlas of UK Marine Energy Resources [(1)], there are a number of potential development areas with a significant tidal flow around the United Kingdom. Inevitably, application of physical and environmental constraints reduces the number of potential development areas significantly. A number of these sites are currently also leased subject to proposals for future tidal energy park development. From the initial resource mapping, a set of prospective sites were identified of which Islay was selected as the preferred option based on the assessment criteria described above.

3.4.4 Technologies – Alternatives

3.4.4.1 Introduction

Although the consideration of technology alternatives will be more fully explored within the EIA, the rationale for the application of a design envelope proposal as the basis of the EIA is set out below.

It should be noted that this is not an exhaustive review of technologies but a high-level assessment of the various technologies, to aid understanding of design envelope rationale. It should also be made clear that the site has not been selected for its suitability as a demonstration site for a particular technology operation.

The site has been chosen as a platform on which to develop a substantial, commercially viable tidal energy park. For this reason, the technology selection process has, in part, been driven by those technologies able to operate in the environment of the selected site.

In previous sections this document has described a technology neutral approach being adopted. The purpose of this is to minimise development risk by deferring final device selection until manufactures have been able to prove the reliable operation of their devices in environments similar to the project site. Therefore, final manufacturer selection and detailed design information will not be available until after the consenting process has been completed. However, suitable details on precise location and device selection will form part of the Construction Methods Statement (CMS) which will be submitted for approval to Marine Scotland prior to construction commencing.

3.4.4.2 Overview of TEC Technologies

There are essentially two ways of harnessing power from tidal flows either through tidally impounded water (tidal range) utilising naturally occurring basins, manmade barrages or offshore lagoons or by extracting the energy from the tidal movement of water (tidal streams).

These two fundamentally different approaches may then sub-characterised by differentiating on turbine design, submerged or surface piercing devices, anchoring methods etc.

The rationale defining selection of technology subsets which dictate the parameters of the design envelope is outlined below.

Barrages and Lagoons.

The tidal barrage has been actively developed since the 1960`s with the construction of La Rance barrage near St Malo in France. At 740m long it features 24 two-way pump turbines operating at 10MW each. The tidal range is around 12m with a typical head of 5m. There are two other commercial schemes: a 25MW scheme installed at the Bay of Fundy (Canada) in 1982 and a 100MW scheme in China which has been in operation since 1987. However, suitable sites for tidal barrage applications are limited.

In the UK the most feasible are on the Severn and Bristol Channel. The most notable potential scheme is the Severn Tidal Barrage (STB) proposal which, with an 11m tidal range, is estimated to be capable of supplying 17,000 GWh/yr (or around 5% of demand in England and Wales). Other potential locations include Conwy (33MW), Loughor (5MW), Milford Haven (96MW) and Dyfi (20MW).

Tidal lagoons operate on the same principle as the barrage but are constructed offshore and feature a self-contained lagoon which captures and converts tidal energy using low head turbines. Optimum locations for these devices are near low tide level close to the shore.

There are a number of capital and strategic issues with barrage and lagoon systems:

- Extremely high capital investment costs;
- Construction requires significant quantities of raw material import; and
- Development lead time to commercial operation is considerable.

For barrage schemes, such as the STB, there have been significant concerns voiced in relation to the potential environmental impacts resulting from changes to tidal regimes.

In the case of the STB, the Severn estuary provides nationally and internationally significant feeding areas for wildfowl, and it is a concern that substantial changes to the ebb and flow of the estuary might have a dramatic effect on a number of important avian species. It is perhaps pertinent to note that the potential development of the Severn Barrage has been a subject of debate for some 30 years or more.

Tidal lagoons schemes minimise some of the environmental concerns since they do not directly affect the exposure or otherwise of intertidal mudflats. They do, however, have potentially higher associated costs since a full lagoon must be constructed rather than a partial barrier.

In general terms whilst this category of tidal energy conversion has the potential for considerable generation, the associated scale, costs, lead times to construction and potential environmental impacts are pose a daunting challenge.

Tidal Energy Converters (TECs)
Unlike barrage or lagoon systems which rely on enclosing a body of water in order to build a hydrostatic head which is then used to generate energy, TEC output is proportional to the velocity of the tidal flow across them. This results in a trade-off between the energy transferred from the flow to generate electricity and the impedance to the flow from the TEC devices. This has implications not only on the design of the TEC devices themselves, but also the number of devices that can be installed within a flow stream.

Since the tidal flow regime remains relatively unaffected by the TEC array, the resultant environmental impacts are significantly lower than a barrage or lagoon scheme.

Currently there are many variants of TEC designs that are being developed by multiple manufactures, they can be grouped into three categories as follows:

Reciprocating Hydrofoils
Reciprocating Hydrofoils place a series of hydrofoils into the tidal stream which generate vertical motion by means of pitch control. Reciprocating devices therefore either need to have a means of translating this oscillatory energy into rotational power to drive a conventional generator or adopt a linear generator technology which has yet to be fully marine environment. Translation of linear energy into rotational can be achieved either by use of a ram and working fluid to generate pressure or by use of some form of mechanical cam action. In both cases there is an additional level of complexity added to the system as well as a reduction in efficiency due to a second stage of energy conversion.

Hydrofoils offer some advantages in potential exploitation of shallower waters, and in areas where fish or mammal collision pose greater risks since the slow speed of the reciprocating action is likely to be easily avoided by most species.

However, the energy conversion efficiency, mechanical integrity and potential for fouling of current devices mean that reciprocating hydrofoil based technologies were excluded from selection.

Vertical Axis Turbines

Vertical axis machines currently being developed either operate by generating lift or drag, although the lift devices are more likely to progress to commercial viability due to the relatively low energy capture of drag devices.

Vertical axis machines can be used in a number of different scenarios:

- In free stream, where the fluid action on the different elements of the device create rotational forces around its circumference; or
- In an enclosed structure known as a "Tidal Fence".

Free stream turbines maybe completely open or ducted to improve machine energy capture. They may be seabed mounted or slack moored.

Many of the features of the vertical axis marine turbines can be compared with those of the equivalent Darrieus vertical axis wind turbines and although the change of working fluid (water not air) potentially alleviates some of the problems experienced with the Darrieus wind turbines, some issues still remain.

There are advantages to installing vertical axis turbines within a tidal fence, whereby the turbines effectively form "turnstiles" that stretch across a channel. The mounting and access to generators and gearboxes becomes easier, and the tidal fence itself enhances energy capture by effectively increasing stream velocities through blockage.

Suitable locations require a tidal regime of around 1.75m/s (3.5knots). Developments are proposed for a 100MW scheme in San Francisco Bay and an 1100MW base installation in the Philippines. The Severn Estuary is also under consideration as a potential location, as an alternative to the Severn Tidal Barrage project.

Although they are likely to have a lesser impact on flow regimes than a barrage or lagoon project, there are a number of commonalities. Like barrage schemes tidal fences create navigational issues, problems with migratory fish passage a high capital cost and a requirement for significant quantities of raw material import for construction.

Horizontal Axis Turbines

Horizontal axis tidal turbines are those in which the rotational axis is parallel to the flow velocity direction. Both open and closed (ducted) versions are currently at various stages of commercial scale development.

Open rotor designs are most analogous to the existing conventional wind turbines, visually and operationally very similar. The axial turbine is placed in a tidal stream, in the same manner a wind turbine is positioned across a high wind speed ridgeline, and the blades pitch to generate lift, thereby inducing rotation as the water flows across them.

Closed rotor designs enclose the rotor blades in a duct in an attempt to increase the energy transfer efficiency.

Both types of horizontal axis turbines have their merits, although at the time of writing there appears to be an industry convergence towards open rotor devices.

3.4.5 Export Power & Grid Connections – Options

3.4.5.1 Introduction

One of the biggest challenges facing the marine energy industry is how to connect projects which are, for the most part, in remote locations where previously there has not been a requirement for substantial power export. In this respect Islay is no different and several options have been, and continue to be, reviewed. Since there are a number of potential connection options for the project, it should be noted that this application is not made for the grid connection beyond the high water mark at the cable landing at Kintra. Any information provided in this document for the grid connection beyond this point is provided as contextual background information only.

Exporting 30 MW of power can usually be accommodated over a 33kV line over short distances. As the grid connection point for the project is likely to be a significant distance away, it is probable that the voltage will be stepped up to 132 kV at an onshore substation located on Islay, although this aspect of the project is yet to be defined.

3.4.5.2 Route Options to Islay

In identifying the optimal cable routes it was important to identify not only the locations of the nearest 132kV substations on the mainland but also available capacity for 30MW to be exported. As shown in Figure 3.2 Port Anne and Carradale substations were identified on the Kintyre peninsular. Due to onshore wind farm activity, neither substation currently has capacity but current reinforcement work being undertaken by Scottish Hydro Electric Transmission Ltd (SHETL) between Crossaig and Hunterston will provide capacity in the timeframe of the project.

As shown on Figure 3.2, the route to Port Anne (effectively shadowing the existing 33kV line to Islay) which runs from the substation at Bowmore and crosses at Port Askaig to Jura and beyond, runs through several designated landscapes that would provide significant consenting challenges. Had this route been more viable, the logical cable export route would be a landfall north of Portnahaven, or through Loch Indaal direct to the Bowmore sub-station (options 1 and 2 respectively).

Having selected Carradale, a connection agreement has been signed with SHEPB, and an indicative route has been identified. The rational for the Kintra landfall selection is the recognised ecological designations in the vicinity, a potential corridor through to Port Ellen where a substation installation is viable and the direct subsea route from Port Ellen to landfall on Kintyre.

3.4.5.3 Utilisation of Tidal Energy on Islay

Whilst an agreement is in place for the 30MW connection at Carradale, there is clearly scope to utilise the electricity generated directly on Islay. Electrical load on the island currently peaks at around 5MW, however discussions with the distilleries are at an early stage to assess the feasibility of supplementing the use of imported heavy fuel oil for steam generation with electric steam boilers.

Providing the heat demand from renewably generated electricity would result in a substantial direct carbon saving. Heat demand modelling and feasibility studies are currently ongoing.

3.5 Selected Design Envelope and Effect on EIA

The rationale for the design envelope starts with the objective of minimum technology risk, and is based on devices that have the greatest potential for uninterrupted performance and maintenance accessibility in the chosen site environment.

The design envelope has been chosen to define the limits of the physical and operational parameters of the device that might be employed. The key choices within this envelope which may affect the environmental impact of the device are listed below.

3.5.1 Open or Closed Rotor

The selection of an open or closed rotor device is essentially an engineering, and operability choice. At this point, there is little evidence to point to any significant difference between the two on the potential impact on marine life.

3.5.2 Surface Piercing or Submerged Structure

There are significant and obvious advantages to the use of surface piercing devices in which the structure provides a platform for access and field maintenance. It is highly likely that early commercial devices will require a significant servicing and maintenance regime and the marine environment in general requires greater servicing diligence. A device which can be raised to the surface on its own structure will assist servicing and maintenance in a greater range of weather conditions and is likely to achieve higher availability than one which requires more extensive subsurface or crane lifting activity to maintain or recover.

The obvious disadvantages of a surface penetration device are its visual effect on seascape and its effect on navigation. However, the extent of surface penetration is less imposing than many other offshore structures and the navigation risk of submerged devices may be shown to be similar.

Both types of design have advantages and disadvantages and will be considered further within the EIA.

3.5.3 Foundations

The EIA will consider the potential foundation solutions including the use of drilling, piling and floating moored. These alternative solutions for anchoring the devices to the seabed each have their advantages and disadvantages from an engineering, cost and ecological perspective. Intrusive foundations for example may result in short term release of sediment, and higher noise levels.

A detailed assessment of the potential impacts of the alternative solutions will be carried out as part of the EIA process.

3.6 References

1 Atlas of UK Marine Renewable Energy Resources: Technical Report R1342 – May 2008.
2 Highland Renewable Energy Strategy: The Highland Council (May 2006)
3 Scottish Marine Renewables Strategic Environmental Assessment (SEA) – 2007
4 Extended Tidal Technology Constraints Assessment – South West Islay, July 2008
5 2020 Routemap for Renewable Energy in Scotland – July 2011
6 The Marine Energy Roadmap 2010 FREDS
7 Limpet – www.wavegen.co.uk

WESTISLAY TIDAL

ENERGY PARK

volume 2 // chapter 4 // EIA/ES & consultation

4.0 The Environmental Impact Assessment, Environmental Statement and Consultation

4.1 Introduction

The Environmental Impact Assessment (EIA) is defined as "a process which identifies the environmental effects (both negative and positive) of development proposals".

The EIA is a procedure that must be followed for certain types of project before they can be given development consent. The procedure is a means of drawing together, in a systematic way, an assessment of a project's likely significant environmental effects. This helps ensure that the importance of predicted effects and the scope for reducing negative effects are properly understood by the public and regulatory bodies before a decision on the outcome of the planning consent application is made.

The purpose of the EIA process is to:

- Identify likely significant effects to be taken into account by the relevant decision maker;
- Integrate environmental considerations into the project planning and design activities in order to achieve a high standard of environmental performance for the Project; and
- Consult with stakeholders and address their concerns.

The scope of this EIA is to assess the impact of the following:

- The installation, operation and maintenance of a 30 MW tidal energy park development off the coast of Islay;
- The installation and maintenance of sub-sea inter-array cabling between the Tidal Energy Converters (TECs) and a sub-sea export cable to the landfall location at Kintra on Islay; and
- Decommissioning of the above listed installations.

The Environmental Statement (ES) details the findings of the EIA process and provides an explanation on how conclusions were reached. A detailed description of the Project, recommendations for an appropriate Environmental Management Plan (EMaP) and a proposed Environmental Monitoring Programme (EMP) are also included.

4.2 Design Definition

4.2.1 Project Design Envelope

Marine energy encompasses a rapidly advancing group of technologies designed to harness the renewable energy resource in the marine environment. Significant technology developments are ongoing in the general field of marine energy, but specific to this application in the field of Tidal Energy Convertor (TEC) technology. Current and planned trials of TEC devices are providing a feedback loop into ongoing product and installation methodology development. In order to take advantage of this continuous, and at times stepped, improvement of the technology available it is beneficial to retain a degree of flexibility in decision process for final device selection.

Similarly, as the EIA and ES are completed before a detailed technical assessment of the site has been undertaken, there remains a degree of uncertainty relating to installation techniques, foundation types, turbine size and specific technology viability.

As a result, a "Project Design Envelope" or "Rochdale Envelope" (1), as it has become known, has been defined. The adoption of the Project Design Envelope approach allows a meaningful EIA to be undertaken by defining a set of "worst-case" parameters that decision makers can consider in determining the acceptability, or otherwise, of the environmental impacts of a project.

As long as a project's technical and engineering parameters fall within the limits of the envelope and the EIA process has considered the impacts of that envelope and provides robust and justifiable conclusions, then flexibility within those parameters is deemed to be permissible within the terms of any consent granted, i.e., if consent is granted on the assessed maximum parameters of a development, any parameters equal to or less than those assessed is permitted to be constructed.

The principle of the Project Design Envelope permits the developer or applicant to provide broad or alternative project engineering and construction parameters, of which one or a subset of the scenarios or parameters will ultimately be constructed.

The 'realistic worst-case' scenario assumes that one or other of the parameters will have a more significant adverse effect than the alternative. Where a range is provided, for example turbine outputs or blade tip heights, the most detrimental is assessed in each case.

The design that could result in the most significant impact may be different for different environmental receptor types. Understanding the cause and effect specific to each receptor leads to the definition of the appropriate "Project Design Criteria" for that receptor and, therefore, identifies the 'realistic worst case'. Taking the 'realistic worst case' scenario, it can be assumed if no significant impact is demonstrated at the 'realistic worst case', then no significant impact is likely for any scenario. The Project Design Criteria are presented in Table 4.1 below.

Identical potential impact - Common EIA
Greater potential impact
Device specific impact - EIA both

Section	Element	Characteristic	Turbine		Justification
			MCT	TGL	
Technical Appendices	Turbine	Materials	Mild Steel, Composite Blades	Mild Steel, Composite Blades	Common component materials, same potential impact for both devices
		Installed Capacity	2MW	1.5MW	Not applicable
Noise		Number of Rotors	2	1	Noise signature variable between both devices requiring both turbines to be evaluated
Mammal, birds, fish		Width (across stream)	50m	22m	Encounter risk model (ERM) to be device specific due to substantial variation in geometry, swept area and tip clearance
Mammal, birds, fish		Rotor Diameter	20m	22m (worst case)	Included as part of ERM
Mammal, birds, fish, noise		Rotational Speed (Rated Power)	11.5rpm	14rpm at 18m rotor diameter	Included as part of ERM
Mammal, birds, fish		Swept Area	628m2 (both rotors)	380m2	Included as part of ERM
Mammal, birds, fish		Cut in speed	1m/s	1m/s	Included as part of ERM
Mammal, birds, fish		Rated Speed	2.4m/s	2.7m/s	Included as part of ERM
Mammal, birds, fish		Seabed Clearance	3m	6m	Included as part of ERM
Mammal, birds, fish		Surface Clearance (LAT)	3.5m	7m	Included as part of ERM
Landscape & Visual, birds		Protrusion Height (LAT)	21m	n/a	Only applicable to the SeaGen turbine
Landscape & Visual, birds		Area of Pod Platform	7x9m	n/a	Only applicable to the SeaGen turbine
Landscape & Visual, birds		Maximum Protrusion	40m	n/a	Only applicable to the SeaGen turbine

Section	Element	Characteristic	Turbine		Justification
			MCT	TGL	
		Weight	460 tonnes (both drive trains)	150 tonnes	The weights of the equipment do not have an environmental impact
Ecology		Anti-corrosion	Impressed Current System (ICS)	Norsok Standard M-501 System (e.g.: Interzone 505) plus Anodic Protection	Both systems commonly used in marine environment therefore no EIA requirement
Ecology		Anti-foul	Non leaching anti foul coating (e.g.: Intersleek 737)	Non leaching anti foul coating (e.g.: Intersleek 737)	Both systems commonly used in marine environment therefore no EIA requirement
Ecology		Gearbox	Planetary	Planetary	Oil lubricated & seawater cooled potential pollution event
Ecology		Hub & drive train	Pitch control & bearings	Pitch control & bearings	Oil lubricated potential pollution event
Ecology	Electrical Conversion	Generator	Asynchronous	Asynchronous	Oil lubricated & seawater cooled potential pollution event
Ecology		Output Voltage	33kV	6.6kV	Oil cooled potential pollution event
Technical Appendices	Foundation	Materials	S355 Steel	S355 Steel	Common component materials, same potential impact for both devices
Ecology		Maximum area covered	260m2	154m2	SeaGen loss of habitat area greater
Ecology		Footprint of piles (4off)	4m2	4m2	Same loss of habitat area
		Height	12m	16m	Not applicable as impact is CRA which is dealt with by tip clearance
Noise, ecology		Pin pile Diameter	1.5m	1.3m	Affects size and period of drilling SeaGen has over-riding envelope
Noise, ecology		Pin pile Depth	11m	5m	Affects size and period of drilling SeaGen has over-riding envelope
		Weight (dry)	460 tonnes (all components)	120 tonnes	The weights of the foundations do not have an environmental impact

Section	Element	Characteristic	Turbine		Justification
			MCT	TGL	
Ecology		Anti-corrosion	Class 3 Offshore Coating- TBA	Class 3 Offshore Coating- TBA	Both systems commonly used in marine environment therefore no EIA requirement
Install & Commission					
Ecology	Turbine	Power Requirement (external)	100kW	100kW	Insignificant power on import not considered to have an impact
	Foundation	Seabed Preparation	Not Applicable	Not Applicable	None
Ecology		Depth of Excavation	12m	6m	Affects size and period of drilling SeaGen has over-riding envelope
Ecology		Drill Fluids	None	None	Refer to TGL materials data sheets
Ecology		Discharge (drill cuttings)	80m3 of (typically) 30mm stone chips	20m3 of (typically) 30mm stone chips	Greater quantity of cutting from SeaGen S
Ecology		Grout	Approx. 30m3 of OPC grout	Approx15m3 of OPC grout	Greater quantity of Grout from SeaGen S
Ecology		Noise	Approx. 160dB at 1m, 140dB at 100m & falls below background (EMEC) within 500m	Approx. 160dB at 1m, 140dB at 100m & falls below background (EMEC) within 500m	Same noise but over a longer period for SeaGen S
	Vessel	Type, GRT, Length, Draft, Noise, Fuel Usage, Waste/Litter	See vessel spec details section 5.23	Vessel capable of lifting & handling a 120 tonne foundation of 14m x 14m x 16m	Both turbine foundations will require a similar type and size of vessel. See section 5.23 for detail
	Moorings	Type	Gravity based anchors (GBA), steel and concrete, OR Drilled, piled steel anchors grouted into drilled holes		Drilled, piled steel anchors considered to have larger envelope due to the potential for contamination from drill cuttings, hydraulic oil from the cutter and grout overburden plus noise from

Section	Element	Characteristic	Turbine		Justification
			MCT	TGL	
					cutting operation
		Dimensions	GBA: 8x8x3m each OR Drilled pile 1m diameter x 10m depth		Gravity base has higher area of coverage but considered to have lower potential impact
		Attachment	TBA		Method of attachment unlikely to have an environmental impact
	Marker Buoys	Type	Consult with statutory authorities		
		Dimensions	Consult with statutory authorities		
		Attachment	Consult with statutory authorities		
Operation & Maintain					
	Turbine	Noise	See section 9	Part of ReDAPT	Noise signature variable between both devices requiring both turbines to be evaluated
		Water Abstraction or Discharge	Not applicable	Not applicable	
		Chemical Requirements	Not applicable	Not applicable	
		Potential Discharge to Sea	Not applicable	Not applicable	
		Potential Discharge to Air	Not applicable	Not applicable	
	Vessel	Type, GRT, Length, Draft, Noise, Fuel Usage, Waste/Litter	See vessel spec details section 5.23	A suitable workboat greater than 30m length capable of towing the floating turbine & of the deck transportation & lifting of 4 tonne floating winch unit of dimensions 2.5m x 2.5m x 2.5m	Both turbine foundations will require a similar type and size of vessel. See section 5.23 for detail
Decommission					

Section	Element	Characteristic	Turbine		Justification
			MCT	TGL	
	Turbine		Removal will generally be reverse of installation method	Removal as per standard O&M procedure	SeaGen S will require large vessel for a longer period to remove turbine and additional steelwork. TGL will only require large vessel for foundation removal
	Foundation		Use pile cutter to cut through piles close to seabed	Use pile cutter to cut through piles close to seabed	Both turbine foundations will require a similar type and size of vessel. See section 5.23 for detail
	Vessels		Similar vessels to those used for installation	Use O&M vessel & installation vessel with subsea cutter for pile removal close to seabed	Both turbine foundations will require a similar type and size of vessel. See section 5.23 for detail

Table 4.1: Project Design Criteria

4.3 The EIA Methodology

4.3.1 EIA Procedure Overview

The principal steps undertaken when developing a project under EIA regulations are broken down into a series of stages as summarised in Figure 4.1 (2) below.

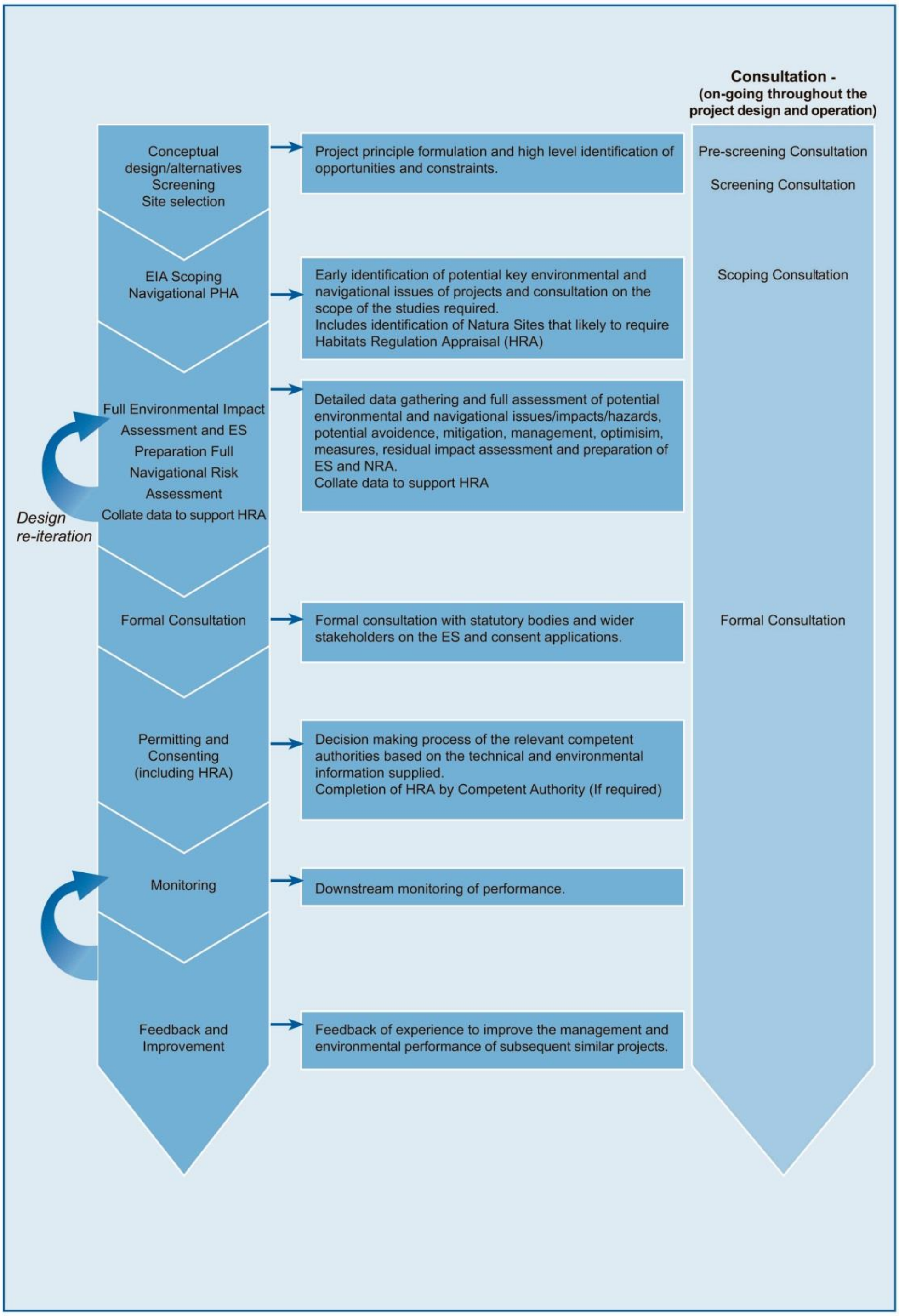


Figure 4.1: Overview of EIA and HRA Main Steps

As this project was conceived in 2008 when the regulatory body for all section 36 applications was The Consents Unit of The Scottish Government, several of the early steps in the process were administered by them including the provision of the Scoping Opinion[3] on which the fundamental EIA guidance for the site was defined.

4.3.1.1 Conceptual Design/Alternatives, Screening and Site Selection

This aspect of the project is defined in more detail in Chapter 3: Site Selection Process & Alternatives Considered. Available existing baseline information was gathered to produce a constraint assessment [4] during preliminary evaluation of the site. This assessment together with some preliminary site surveys and informal discussions with The Consents Unit, Argyll and Bute Council, SNH, The Crown Estate, Highlands & Islands Enterprise and SSE led to the production of a concept design specification. A list of statutory and non-statutory consultees was defined by The Consents Unit. In this case it was agreed with the regulator that a screening exercise was not necessary as, given the nature of the project, the developer acknowledged that an EIA was required.

4.3.1.2. EIA Scoping & Navigational Preliminary Hazard Analysis (PHA)

EIA Scoping – Tidal Energy Site

Based on a detailed desk top study and feedback from the pre-scoping consultation, a scoping proposal titled "Request for Scoping Opinion by DP Marine Energy Ltd in respect of Islay Tidal Energy Project Environmental Impact Assessment Scoping Report May 2009"[5] was submitted to The Consents Unit for a 400MW proposal. Given the unfamiliar nature of the project a series of clarification meetings were held to enable questions to be raised by consultees prior to scoping opinions being defined. Clarification meetings were held with the following groups:

- Argyll and Bute Council;
- Clyde Fisherman's Association;
- Royal Society for the Protection of Birds (RSPB);
- SNH; and
- The Consents Unit.

The formal scoping opinion [3] was issued by The Consents Unit in September 2009, the content of which formed the scope and methodology by which the project EIA was to be undertaken. Table 4.2 summarises the content of the response and a reference to where specific comments have been addressed in this ES. The complete scoping opinion can be found on the Marine Scotland website.

Item	**Description**	**ES Chapter**
1 - 5	Information from The Consents Unit	Not applicable
6.	General Issues	
Economic Benefit	The application should include relevant economic information connected with the project, including the potential number of jobs, and economic activity associated with the procurement, construction, operation and decommissioning of the development.	17 & 18
7.	Contents of the Environmental Statement (ES)	
Format	Developers should be aware that the ES should also be submitted in a user friendly PDF	All

Item	Description	ES Chapter
	format which can be placed on the Scottish Government website. It is considered good practice to set out within the ES the qualifications and experience of all those involved in collating, assessing or presenting technical information	1 1
NTS	… . Within an ES it is important that all mitigating measures should be: • clearly stated; • fully described with accuracy; • assessed for their environmental effects; • assessed for their effectiveness; • their implementation should be fully described; • how commitments will be monitored; and • if necessary, how they relate to any consents or conditions.	NTS
The Crown Estate	….The Crown Estate will not be granting a seabed lease for the development proposed as it currently stands.	1
Site Select & Alternatives		
Argyll & Bute Council	The design & siting of these (onshore) elements should be considered in the light of their impact upon the qualifying features of the Rinns of Islay SSSI and SPA designations …. In addition, given the level of offshore activity off the West Coast of Scotland, it would perhaps be appropriate to have some consideration as to whether a more strategic approach is warranted to the location and provision of a major facility which would serve the needs of all potential developments in the area. The Council would welcome the inclusion within the ES of further clarification in respect of the likely scale and nature of shore based maintenance facilities to serve the various phases of the proposed development and, the likelihood of these being based on Islay. The likely consequences of reduced tidal flow velocities as a consequence of the operation of the installed equipment should be identified along with any expected changes to hydrodynamics and coastal processes, and likely consequences for benthic ecology. The extent of the potential collision risk posed to marine species should also be evaluated along with any consequences presented to navigation/fishing interests. Safety zones should be considered in relation to competition for space with other activities such as fishing and aquaculture. Whilst surface penetrating devices remain within the considered “design envelope” consideration should be given to the landscape/seascape visual impact of the proposal.	Not applicable Not applicable 5 6 7 NSRA 15
Royal Yachting Association	This site appears to be well suited to purpose. It is not heavily frequented by shipping or recreational craft. …. It appears to be in quite deep water and is not in a major shipping or small craft route>	NSRA
Maritime and Coastguard Agency	Page 8: As a 400MW installed capacity this would be considered as a High Risk or Large Scale Development within the context of the DECC/DfT/MCA Guidelines on the Assessment of the Impacts of Offshore Wind Farms publication. Page 47: No mention is made of the West Islay Argyll and Bute Marine Environmentally High Risk Areas (MEHRA). Page 102: This section requires enhancement to reflect the increasing importance of strategic pipelines and cables following the “Young Lady” incident. Page 110: ….. . MGN 275 had now been replaced by MGN`s 371 and 372 which should be followed as appropriate to the project.	NSRA NSRA NSRA NSRA
Description of		

Item	Description	ES Chapter
the Development		
SEPA	Plans should be provided showing the site boundary and the locations of the devices, cable routes and onshore supporting infrastructure.	5
	Details of the device design and footprint on the seabed should also be provided.	5
Royal Yachting Association	Tidal developments of this type must be a welcome development provided they do not create a hazard to navigation.	NSRA
Decommission		
Royal Yachting Association	Obstructions on the seabed will have to be removed on decommissioning	5
Grid Connection Details		
SNH	… . This may well lie within the Rinns of Islay SSSI/SPA and the EIA should consider the impacts of the proposed development on the notified interests of the sites outlined above.	Not applicable
8.	Baseline Assessment and Mitigation	
Design Landscape & the Built Environment		
SNH	… EIA process will follow recognised guidance for landscape/seascape and visual assessment. Key elements for consideration in landscape and visual assessment are the ancillary onshore infrastructure, marker buoys/lighting and the possibility of a single surface breaking seabed mounted foundation to house hub connections although SNH feels strongly that submerged hubs would be a preferable option in terms of visual impact.	15
Construction		
SEPA	The ES should provide a description of the construction activities i.e. installation of foundations, moorings and other subsea structures, cable laying and cable protection. The ES should describe mitigation measures to avoid or minimise impacts to a level where they are not significant e.g. reduce seabed scour from moorings. Options and methodologies for cable installation should be described in the ES.	5
Argyll & Bute Council	The Environmental Statement should address construction and decommissioning activities, identifying likely effects upon marine and terrestrial ecology, mammals, marine fauna and birds. Potential effects upon water quality and coastal processes should be identified along with measures to control pollution and minimise waste. Regard should be paid to the consequences of turbidity and sedimentation arising from seabed construction activities. Construction noise should be identified along with likely consequences for marine life and human receptors. If piling is required, consideration should be given to the use of a 'soft-start' procedure to allow marine mammals to move away from the area as the noise levels are slowly increased. A construction method statement should be produced for approval which draws upon the environmental considerations identified and proposes appropriate avoidance and mitigation measures.	Several +Construction Method Statement
Chamber of Shipping	Construction Phase - Information about the construction and related activities including mitigation measures is sought with the EIA at a later date. We would like to highlight that the provisions should include detailed arrangements to ensure minimum disruption for the existing vessels using Port Ellen. The construction and support activities will also need to be properly coordinated	Con-struction Plan
Royal Yachting Association	During construction NLB will no doubt specify how the work should be marked. Furthermore appropriate Notices to mariners will need to be issued as required	NSRA
SNH	In the absence of a clear location for each phase of deployment SNH recommend that monitoring for the initial phase (7.5MW deployment) should cover the entire deployment area (for full 400MW phase) plus buffer area of between 500m-1KM in order that DP Energy can locate the first phase within the development search area. However if DP Energy can be more specific in their location of each phase, and timescales involved, then we recommend that each phase of installation requires 2 years	21

Item	**Description**	**ES Chapter**
	of baseline survey. Installation periods for the initial 7.5 MW deployment and subsequent second phase 50MW deployment should not be included in the baseline survey work for the third phase (400MW) deployment as these installation periods are likely to cause disturbance/displacement of monitored species and could skew background data.	
	The installation periods should however be monitored. Mitigation measures to prevent or minimise damage, displacement of disturbance of habitats and species should be included within the ES and assessed as to their suitability, bearing in mind that certain mitigation methods may impact on other species or habitats. We recommend that DP Energy agree an appropriate monitoring programme with SNH which must consider specific issues/interactions that may be a concern of the designated sites listed above in Section 2, in order that the data will be relevant to any Appropriate Assessment that may be required under Natura regulations.	21 21
Archaeology & Cultural Heritage		
Historic Scotland	The ES should address the predicted impacts on the historic environment and describe the mitigation proposed to avoid or reduce impacts to a level where they are not significant. Historic environment issues should be taken into consideration from the start of the site selection process and as part of the alternatives considered. Historic Scotland recommend that you engage a suitably qualified archaeological/historic environment consultants to advise on, and undertake the detailed assessment of impacts on the historic environment and advise on appropriate mitigation strategies. Please note that the Receiver of Wreck is unlikely to provide the necessary information on located wreck sites (this is not her role). Finally, the ES could usefully refer to specific advice on the treatment of cultural heritage in the marine environment that can be found in the Joint Nautical Archaeology Policy Committee (JNAPC) Code of Practice for Seabed Development	13 13 13
Navigation		
	The Environmental Statement should supply detail on the possible the impact on navigational issues for both Commercial and Recreational craft, viz. Collision Risk Navigational Safety Risk Management and Emergency response Marking and lighting of Tidal Site and information to mariners Effect on small craft navigational and communication equipment Weather and risk to recreational craft which lose power and are drifting in adverse conditions Evaluation of likely squeeze of small craft into routes of larger commercial vessels. Visual intrusion and noise	NSRA
Defence Estates	On assessment the proposed development falls within Naval Exercise Areas X5538 Islay and X5539 Orsay, these Naval Exercise Areas facilitate submarine, aircraft and HM Ship training. The proposed location lies directly across the coastal route for ships proceeding north to the Minch thus having navigational safety implications which will require ships to divert around the project. The location will also impinge on naval manoeuvre space required by submarines causing strategic implications. In light of the above, the MOD has concerns due to there being only one exit route from the North Channel for deploying submarines that has sufficient depth of water for it to be conducted whilst dived. It is therefore essential the Navy maintain this dived route as any encroachment into this area would prevent its use	14 14
Chamber of	Scoping report suggests that the scheme proposes to install tidal devices in area covering	NSRA

Item	Description	ES Chapter
Shipping	approximately 8 square km located due west of Rhinns of Islay Lighthouse. The proposed location has no defined Traffic Separation Scheme and commercial routes either passing through or in close proximity. So, in view of this Chamber of Shipping believe that the proposed site does not pose significant risk to the shipping activities, routes and safety and we have no objection to submit against the proposal. Having said that, in order to ensure the accuracy of the statement made in the scoping report, it is recommended that shipping related 'AIS' data analysis/information is also included in the EIA. Chamber of Shipping do, however, reserve the right to change from the current position at a later date, if any new evidence is contrary to what has been stated in the scoping report. Minimum clearance between the device and the mean sea level surface should be approximately 25m (if the device blades stay underwater). This is warranted in order to mitigate various environmental hazards prevalent for most of the year in that region. However, it is appreciated that the design has not yet been finalized, and due consideration may be given to lesser clearances from the mean sea level. This would be based on the finalization of details in the EIA and confirmation of exact location (if it is to be mounted well away from shipping traffic). One of the statements suggests a clearance from the mean sea surface of around 5m from the tip of the rotor blade and that in Chamber of Shipping's view is not acceptable As suggested in the scoping document that the technology to be installed in the proposed location is still in the development stages and in fact untested. As such, Chamber of Shipping will not be in position to provide detailed comments on the chosen design. However, there is concern over the fact that the risks posed to shipping are significant in case the device was to break loose and float on the sea surface. The suggestions made in the report that the device will be gravity mounted poses significant risk and therefore Chamber of Shipping would seek assurance to ensure that the device will be made fast to the sea bed. Use of AIS technology to mark the proposed site from the outset, thereby reducing some of the navigation risk to mariners. Cumulative Impact study – In light of recent announcements by the Crown Estates to award further zones in future for wind farm, wave and tidal developments in Scotland, Chamber of Shipping recommend that the EIA takes account of all the developments proposed in close proximity. The study report should include information on the overall impact of future proposals on shipping safety and navigation related issues (if any).	
Maritime & Coastguard Agency	In the project description, on page 4 of the scoping report, reference should also be made to the existence or absence of any other routeing/reporting measures of which Traffic Separation Schemes are but one. Page 7 - The statement "It would not be essential to permit shipping movement over the devices" is not understood Page 11 the statement "it is unlikely that there would be any potential for the safe navigation for large vessels over the site" is not understood. Page 111 The results of the traffic survey may help to inform the consultation process by identifying other marine users. The navigational risk assessment will be assessed against the requirements in MGN 371, appropriate to the project, and not just Annex 1 Section 1 as indicated in the scoping document.	14
Northern Lighthouse Board	Northern Lighthouse Board would likewise advise that you may wish to refer to MCA document MGN 371 which supersedes MGN 275 and that in addition to the Electricity Act 1989 section 36, the Scottish Government S.I. Electricity Works (Environmental Impact Assessment (Scotland) Regulations 2000. It is noted that the site will be initially planned as a demonstrator project before	NSRA/14

Item	Description	ES Chapter
	progressing to a full production site contained within the consented area. Northern Lighthouse Board would require that the Navigation Risk Assessment must be specific with regard to reduced clearance depths between the device or devices (including any installed subsea infrastructure) and Lowest Astronomical Tide levels, taking into account the effects of adverse weather conditions which will further reduce this clearance, and the resulting impact on safe navigation in this area. The NRA should also include sections relating to the promulgation of Navigation Warnings both local and national due to the international use of this area of UK sea. The warnings should be promulgated before any commencement of survey, exploration and testing, also any installation, operation, maintenance and decommissioning periods. Northern Lighthouse Board would anticipate that a Method Statement would form part of the CPA Application, and note that the number and pattern of any devices deployed either as part of your technology assessment, permanent installation and eventual de-commissioning will require careful planning to minimise the hazards posed by any permanent moorings, or temporary moorings deployed during any installation and de-commissioning activities. The requirement to install cables to shore would need separate comment contained within the Navigational Risk Assessment. We would ask that the Hydrographic Office be informed of the route and landfall location in order that the Admiralty Chart is updated to give information of the installation. We note that the concept design for connection to the near shore/shore does not indicate as to whether the entire cable route will remain sub-sea or require intermediate platforms supporting transformer stations. Any platform would create an increased danger to surface navigation and would therefore be required to have marking and lighting as per the relevant regulation and guidelines. Northern Lighthouse Board would comment that any vessels involved in the project are capable of operating in the conditions commonly experienced around the west coast of Islay with a suitable margin of additional operational and safety capacity. Consideration should also be given to the deployment of a guard or safety vessel with recovery capability for personnel, equipment and device components should any unexpected failure or incident require intervention. The barges and vessels used should be lit and marked as per the International Regulations for the Prevention of Collisions at Sea 1972. There is an area of particular concern in respect to any device proposed for the demonstrator site, in that any turbine component(s) considered as being buoyant under a failed condition would require that an indication of any catastrophic device failure should it have the ability to float free or be mobile in a sub-surface state. Any components becoming detached and which are not in negative buoyancy shall be communicated to the MCA to ensure the mariner is informed immediately. The design of the device should incorporate a monitoring capability or deployable/activated transmission and signalling system in this event. Northern Lighthouse Board would reserve the right to amend this initial statement in the light of further discussion or the provision of additional information	
9.	Ecology, Biodiversity and Nature Conservation	
Designated Sites		
Argyll and Bute Council	The proposed site SW of the Rinns of Islay does not lie within any nature conservation or historic environment or landscape designation. It is, however, overlooked by the West Islay Coast Area of Panoramic Quality (regional significance), and there are a number of listed buildings and a conservation area on the Islay coast at Portnahaven and Port Wemyss. The landscape/seascape of the area is valued more overall for its inaccessibility, remoteness and its scenic qualities than it is for its individual qualities. In addition, advice should be sought from SNH as to whether the proposal is likely to have	7

Item	Description	ES Chapter
	significant effects on the South East Islay Skerries European Special Area of Conservation and other onshore SSSI/SPA designations in the vicinity of the development, and therefore whether an 'appropriate assessment' would be required. If this is required then the EIA needs to gather the required information in order to inform this assessment.	
SNH	European Sites Two European sites require consideration from a marine perspective. Southeast Islay Skerries SAC, designated for its common (harbour) seal (Phoca vitulina) colony, located approximately 40km from the proposed development site. The location is indicated on the map provided in Appendix A of the SNH consultation response	7 and 10
	North Colonsay and Western Cliffs SPA, designated for its breeding colonies of seabirds, is located approximately 50km from the proposed development site. Currently, the site boundary of the North Colonsay and Western Cliffs SPA is proposed to be extended to include a seaward area, up to 2km offshore. This site is also indicated on the map provided in Appendix A. SNH consider that the distance this site lies from the proposed development site is at the upper end of how far most auks will travel in the breeding season.	10
	The conservation objectives for both of the aforementioned sites are provided in Appendix B of the SNH consultation response.	10
	Whilst not an issue for SNH to address as it lies within Northern Ireland's jurisdiction, it should also be noted that Rathlin Island SPA is around 40km from the proposed development site and well within guillemot/razorbill range. The qualifying species for Rathlin are guillemot, razorbill and the assemblage (puffin plus the alcides, kittiwake, herring and lesser black-backed gull and fulmar). Northern Ireland Environment Agency should be able to provide further advice on this site and we strongly recommend DP Energy contact them as soon as possible. We have copied our response to the NIEA.	10
	The European sites that require consideration from a terrestrial perspective are Rinns of Islay SPA, designated for a range of bird species including Greenland white-fronted geese, chough, corncrake and hen harrier. The Rinns of Islay is also designated in part as an SAC which is important for marsh fritillary butterfly. Consideration should also be given to possible impacts of installation and/or upgrading of overhead power lines on birds, (particularly on geese and chough which are mobile across many parts of Islay) from all other SPAs on Islay where they are included in the list of designated features. These sites are Bridgend Flats SPA, Laggan, Islay SPA, Gruinart Flats SPA, Eilean na Muice Duibhe SPA and The Oa SPA.	10
	The likely survey requirements and available sources of information for marine mammals and seabirds are set out in Appendix C and the legislative requirements for European sites are summarised in SE Circular 6/1995, as amended June 2000 – please see Appendix D. For listings of qualifying interests of each of the mentioned sites and the conservation objectives, please see: http://www.snh.org.uk/snhi/ and click on the blue "SiteLink" box.	7 & 10
	SNH identifies Rinns of Islay Site of Special Scientific Interest (SSSI) as a key site of national importance which will need to be considered by the applicant in respect of the proposed onshore infrastructure and, in particular, the cable connection where the subsea cable from the proposed tidal array comes onshore. The SSSI is designated for a range of species and habitats but of most significance to this proposal are its breeding and wintering bird communities, which are supported directly by open ground and the complexity of semi-natural habitats, particularly moorland and bog and agricultural land-use present on the site. A copy of the SSSI citation is available from "SiteLink".	Not Applicable

Item	Description	ES Chapter
	In respect of all other onshore infrastructure, SNH's advice on survey requirements for designated sites, habitats and species is provided in Section 6, Appendix C of the SNH consultation response.	
Habitats		
SEPA	Assessment of the potential impacts on the intertidal and subtidal habitats and species should be based on a suitable survey. This will inform the developer of any sensitive habitats and species vulnerable to damage and measures that can be put into place to minimise impacts upon them. Further guidance on appropriate surveys should be sought from SNH. This can form the basis of the environmental description presented in the ES document. It would be useful for the developers to get in touch with the Argyll and Bute Local Biodiveristy Action Plan so that any mitigation measures to minimise impacts on species/habitats can be developed at an early stage. Further information can be found at the following website: http://www.argyll-bute.gov.uk/biodiversity/index.htm	8 8
	Maps should be provided showing the site boundary, device locations and cable routes along with designated areas and areas containing species/habitats of conservation importance.	8
SNH	SNH advise that any survey work undertaken for the site must be relevant to the EIA and to any Appropriate Assessment that may be required under the Habitats regulations (as outlined in Appendix D) and must provide enough information to enable the three tests under European Protected Species to be carried out.	HRA
Species	The ES needs to show that the applicants have taken account of the relevant wildlife legislation and guidance namely …. It needs to be categorically established which species are present on the site, and where, before the application is considered for consent. The presence of protected species such as Schedule 1 Birds or European Protected Species must be included and considered as part of the application process, not as an issue which can be considered at a later stage.	7 7
SNH	SNH is obliged to inform Scottish Government and developers about European Protected Species which may be affected by the proposal. Please note that a license may be required from Scottish Government before undertaking some types of survey on EPS which result in disturbance. The legislative requirements relating to cetaceans and otters is detailed in Appendix E of the SNH consultation response. We advise that a minimum of 2 full years (24 months) of survey work is required for cetaceans, seals, basking sharks and birds for each phase of development. Less than 2 full years' survey data will not provide SNH with enough information to advise regulatory bodies such as Marine Scotland on natural heritage impacts of the development. SNH are currently in the process of producing guidance on survey methods and protocols for marine wildlife in relation to marine renewable devices. We hope that this will be completed by March 2010. In the interim there are a number of organisations that DP Energy can approach for advice in relation to appropriate survey methodology for marine wildlife monitoring. SNH would be happy to provide contact details of appropriate organisations if requested.	7 7 & 10
Birds		
RSPB Scotland	This sea area west of Islay will provide a habitat for a variety of marine species, those potentially most at risk are seabed habitats, diving birds, seals, cetaceans and sharks. These species are at risk of potential collision with the structures and disturbance and displacement from the development zone. RSPB Scotland advises that the assessment should consider how this proposal would be likely to impact upon these species at different times of the year. Those bird species most likely to be impacted will be diving-species such as guillemot, razorbill, cormorant, shag, eider, seaduck and diver species. The EIA should consider potential mitigation measures and should follow standard COWRIE guidelines.	10 10

Item	Description	ES Chapter
	Little data exists on the actual usage and densities of diving birds within this area and we would advise that a comprehensive survey is undertaken as part of the EIA process. It is likely that species using the area will change between seasons especially between summer and winter. Recording bird locations, numbers and behaviour, including diving duration and approximate dive distances, through surface boat based survey work should provide an indication of species/numbers using the site and any preferred feeding areas. Since boat based surveys maybe limited in the temporal coverage of the site, HD aerial video surveys may also be required to provide adequate coverage throughout the year. Standard COWRIE/JNCC methodology should be utilised for surface based boat surveys, ideally a 2year survey period as inter-annual variation may be considerable.	10
	We note that the scoping report mentions the possibility of collisions with mammals, fish and birds and recognise that turbines within a water medium have very different physical parameters in comparison to wind turbines, as do the birds that may collide with them. The concept of comparing the rotor speed of a sea-based turbine with the usage of the underwater environment by a marine organism is currently a novel one. It is a concept which is intimately tied up with a species behavioural responses to a number of variables, principle amongst these must be marine currents and distribution of food resource within an area, which will determine their diving depth, location and period. Tidal energy devices will be novel structures to organisms using the marine environment and how they react to them is not known. Although they will emit some noise and electromagnetic fields, it needs to be established how marine organisms will react to this. Furthermore, their visibility will alter depending upon both the clarity of the water column and behavioural factors such as reduced awareness of surroundings when pursuing prey.	7
	Although a difficult and new field, sub-surface monitoring would be required to form some assessment of collision potential. Survey work within the sea, especially at depth, has technical and practicality issues, the deployment of remote sensors should ideally include both video and sonar. We are aware that currently research work is being carried out on establishing the sonar signatures of birds. These could be installed on/near the structures used in the phase one demonstration project to monitor potential interactions between mammals/birds/sharks and the tidal energy devices. If a different choice of device is chosen for phase two and three then similar information should be presented to inform/consider potential impacts before each stage is initiated.	21
	Although we can see the benefits that the developer hopes to gain from a 'technology neutral approach', particularly given the infancy of the technology involved, this will make it more difficult to assess the final EIA due to a lack of certainty over the form of the final development. We would advise that a series of conditioned consents or a system of additional information is submitted to inform the EIA at different project stages/phases, or that the licensing process is applied to each phase of the project. We would also advise that the developer sets out the potential impacts of each different device clearly within the Environmental Statement (ES) to aid assessment. Initial survey work should be carried out (2 year period) to inform the assessment for the first phase.	5
	Further survey/monitoring work and assessment should be undertaken during and following the phase one demonstration stage (minimum 1 year survey data), to enable an assessment/consideration of potential impacts before proceeding to the phase two 50MW installation. At least another year of survey/monitoring of the phase two stage should be required to facilitate an impact evaluation before implementation of the 400MW final phase. This will enable a full consideration of the proposal as it develops. Further input in terms of survey requirements may be necessary at each stage.	21
	Monitoring of the final 400MW (phase three) array should be undertaken to further inform our understanding of the potential interactions between marine sub-surface tidal	Not Applicable

Item	Description	ES Chapter
	energy arrays and marine organisms. Monitoring/survey at the various project stages will probably be too short term to pick up any changes in usage of the area (dependent upon how long the project remains at phase 1 and 2) therefore longer term monitoring of any completed tidal site should be able to inform of any negative/positive impacts. Monitoring should be secured through conditions of any consent. Consideration should also be given to any potential cumulative impacts with any other wave/tidal devices and/or offshore wind farms in the vicinity.	
Mammals		
SEPA	Depending upon the form of the devices there maybe a risk of collision with sea mammals. This needs to be addressed in the ES in discussion with SNH and the Sea Mammal Research Unit (SMRU).	7
RSPB Scotland	In relation to collision, perhaps even more important than the seabirds in this context are marine mammals, particularly cetaceans. The Hebridean Whale & Dolphin Trust may have some information pertaining to this area but this is likely to be limited and boat based transects should provide some further information. Cetaceans are thought to be highly susceptible to noise and consideration of potential displacement from tidal imagery sites should be considered. The chances of a tidal array resulting in collision incidents or displacement of marine mammals needs to be assessed. It is well known that the sea area the Inner Hebrides hold a notable concentration of basking sharks. Due to its size, this species may be at particular risk of collision. Although often seen at the surface on calm summer days, much of the rest of its life history, including feeding depth and distribution, remains unknown. RSPB advise more specific consideration is given to this species – ongoing research (including satellite tagging) may provide some useful information on this species to assist in informing the EIA. Installation of devices may act like false reefs combined with a no-take fishing area, between the structures, acting as a nursery ground for fish species. Inadvertently this may attract marine organisms into the site area and therefore increase the possibility of collision impacts?	7
	RSPB Scotland are aware that the developer has been meeting with a wide variety of consultees and is meeting with the locally based Scottish Association for Marine Science (SAMS in Oban). Utilising their expertise to inform the EIA should assist in identifying and minimising potential impacts.	7
SNH	A wide range of cetacean species (dolphins, porpoises and whales) use the area for passage and for feeding. The full list of these cetaceans (regular and occasional visitors) is given in Appendix C of the SNH consultation response. All of them are protected under the Conservation (Natural Habitats &c.) Regulations 1994 (as amended) as European Protected Species (EPS), and the Nature Conservation (Scotland) Act 2004. Further information is required on the distribution and usage by cetaceans of this area before it is possible to assess whether there is likely to be any significant effects on these species. SNH can provide advice on proposed survey methodology.	7
	Otters (Lutra lutra) are also an EPS and they may be found along the Islay coastline. Further information is required on the distribution and usage of otters in this area before it is possible to assess whether there is likely to be any effect on otters as a result of the proposed shore works. The likely survey work needed for otters is addressed in Appendix C - Section 6(ii) on terrestrial ecology.	9
	As well as the cetaceans listed above which are protected as EPS, there are colonies of grey seals (Halichoerus grypus) and common (harbour) seals (Phoca vitulina) which may use the proposed development area for passage and for feeding. The beaches on the Isle of Oronsay (approx. 40 km from the development) are used by grey seals for pupping. Basking sharks (Cetorhinus maximus) have also been recorded using the area for passage and/or feeding.	7
	The legislative protection which is afforded to these species is noted in Appendix C. Available data on their distribution / frequency of use / passage routes in the proposed	7

Item	Description	ES Chapter
	development area is currently sparse. Therefore SNH advises that survey work on marine mammals and basking sharks will be required, in addition to a desk-based review of any available information. Further detail is provided in Section 3(iii) of Appendix C.	
Fish		
Association of Salmon Fishery Boards	Disruption, obstruction or interference with salmon migration both during construction and during operation – such impacts could be physical or acoustic; This raises the following questions: • The project site could be highly relevant given the importance of the area to migratory salmonids such as sea trout and salmon. • What is the optimal depth for this technology in relation to the depth between turbine and surface of the water? This may be very important given the pelagic nature of salmon and sea trout migration. • What effect would the construction processes have on fish? • Has there been any research to determine what salmon do in the proximity of tidal power generators given the turbulence generated? • Is there likely to be any need to apply anti-foulants to the structures? • Will the effects of noise and mechanical disruption be assessed prior to construction and would on-going monitoring be put in place if the project is approved and completed? • Are there likely to be electrical fields associated with the installation and will these have a discernable effect on salmon? • It is worth emphasising that the habits of sea trout are rather different and this species will use inshore areas more extensively as a feeding area before migration into freshwater systems. Accordingly there may be a risk of more prolonged interaction with sea trout in relation to the project.	11
Fisheries Research Services	The potential for offshore renewables projects to impact on migratory fish stocks will vary depending on the design and location of the development in relation to migratory routes for adults and juveniles. Potential impacts could include physical impact or avoidance due to noise or electromagnetic sensitivity. The ES will need to consider the potential impacts of the proposal on migrating adult and juvenile salmonids. The ES should review available information on migration routes and migratory behaviour of salmonids. The ES should also review available information on the impact of noise and electromagnetic sensitivity on salmonids. This should be combined with information on the development to assess potential impacts and mitigation. In cases where there is uncertainty over potential impacts it will be necessary for the developer to implement a monitoring strategy to assess the influence on salmonid fish populations. This methodology should also be detailed in the ES	11
SNH	SNH advises that the applicant also needs to consider Atlantic salmon or trout, a UK BAP species, with regard to whether the proposed tidal array may act as a potential barrier to migrating salmon travelling to or from their spawning rivers. On Islay there are a number or rivers and streams used by spawning salmon and trout, notably the Sorn and the Laggan. The barrier may be physical – the collision risk potentially presented by the turbines themselves – or it may be indirect such as potential noise disturbance or turbulence arising from the turbines. A literature review may be helpful in order to consider these issues, and consultation with the relevant District Salmon Fisheries Boards and the overarching Association of District Salmon Fishery Boards is recommended. We confirm that we do not identify a requirement for any survey work specifically in respect of fish species (other than basking shark and see Section 2.10 above for our advice on Atlantic salmon). We do, however, advise that the finalised turbine layout should be sensitive to any spawning areas that may possibly be identified (see Section 4 of Appendix C of the SNH consultation response for further advice on survey work in relation to benthic ecology).	11

Item	**Description**	**ES Chapter**
Subtidal Benthic Ecology		
SEPA	The ES should provide a description of the test site and address the sensitivities of the habitats and species present to the construction activities. It is important that during the design stage the potential damage to marine habitats is minimised as much as possible.	8
SNH	SNH welcomes the underwater survey work in the proposed development location which has been undertaken by the applicant and that these have been augmented with underwater stills and video footage to ground truth the benthic ecology of the area. Similar work will be required on the route of any underwater cabling once the location of this has been considered. We recommend that benthic survey data should be analysed by an experienced marine biologist in order to identify any habitats or species of conservation concern (Annex 1 or UKBAP Priority Marine Habitats) such as maerl. Attention should also be paid to establishing whether there are habitats that support the prey fish for birds from nearby Natura sites (such as sandbanks which may support sandeels) as well as identifying any spawning areas for fish species such as cod. This data will enable to the developer to micro locate cables to prevent damage to these habitats. If the cable makes landfall in Loch Indaal it is likely to encounter sea grass (Zostera marina) – a UK Bap Priority habitat. SNH would be pleased to advise on the suitability of any survey methods chosen.	8 8 8
10.0	Water Environment	
SEPA	The ES should provide information on the current hydrodynamics and sediment transport patterns at the project site and address the likely changes to these once the array is installed.	6
	The main activity would be carried out off-shore and would therefore not be regulated by SEPA under The Water Environment (Controlled Activities) (Scotland) Regulations 2005 (as amended) (CAR). However, steps should be taken where applicable to minimise pollution of the shoreline and on-shore water environment to barest minimum levels. The following information may therefore be of use…. Note: engineering works in coastal and transitional waters are not regulated by SEPA under CAR. Such works will continue to be regulated by the Fisheries Research Services (FRS) under the Food and Environment Protection Act 1985 (FEPA). To request a FEPA licence the FRS Marine laboratory can be contacted on 01224 876544.	5 Noted
SNH	SNH is supportive of the geophysical assessment and the desk study proposed by the applicant and considers that, for this location, this should be sufficient to assess the potential impacts of the proposed turbine array on coastal and marine processes. If the applicant needs to undertake any water flow modelling in respect of turbine placement then we recommend that this modelling also considers natural heritage aspects – please see Section 5 of Appendix C of the SNH consultation response.	6
11.0	Other Material Issues	
Waste		
SEPA	SEPA has published a range of Pollution Prevention Guidance Notes, including PPG6: 'Working at Construction and Demolition Sites' – available from SEPA's website at www.sepa.org.uk/water/groundwater/policy,_legislation__guidance/planning.aspx or from your local SEPA office. Although these guidelines are geared more towards the construction and demolition industry, the guidance on proper disposal of waste and pollution prevention measures is relevant to all developments. SEPA encourages waste minimisation and reuse/recycling whenever possible. Further details can be found on SEPA's website (found at www.sepa.org.uk/waste/resource_efficiency.aspx or in your local SEPA office). There is also a link to key partners in the SEPA Waste Minimisation Programme. Any proposals for reuse or recycling of materials, such as soils from other sites, may	5 5 Not

Item	Description	ES Chapter
	require to be registered with SEPA under a Waste Management Exemption. For further details the applicant should make contact with a member of the Environment Protection & Improvement team in the local SEPA office.	Applicable
RSPB Scotland	In considering potential impacts from contamination via leakage from devices, the likely quantities of oil/anti-fouling and other potential contaminates contained within a structure (nacelle and base) should be provided along with an assessment of different anti-fouling techniques/requirements. Consideration should be given to multiple leakage scenarios and impacts based on the escape of the full quantities contained within the different devices. Even a small release of oil can impact on seabirds and anti-fouling material could have a localised-medium effect dependant on rate of dilution. Consideration needs to be given to combined effects of the different agents used within the devices.	5 5
Traffic Management	The Environmental Statement should provide information relating to the preferred route options for delivering the turbines etc. via the trunk road network. The Environmental Impact Assessment should also address access issues, particularly those impacting upon the trunk road network, in particular, potential stress points at junctions, approach roads, borrow pits, bridges, site compound and batching areas etc. Where potential environmental impacts have been fully investigated but found to be of little or no significance, it is sufficient to validate that part of the assessment by stating in the report: • the work has been undertaken, e.g. transport assessment; • what this has shown i.e. what impact if any has been identified, and • why it is not significant. Highlands and Islands Airports	Not Applicable
	The only issue that HIA would like to see addressed (depending on the type of installation proposed) is details of the actual height and position of any structures above sea level. This would then allow the assessment to be made against the instrument approach procedures for Islay Airport	
12.	General ES Issues	
RSPB Scotland	In regards to existing data, reference should be made to the Scottish Marine Renewables SEA at http://www.seaenergyscotland.co.uk which is a key document in the formation of the scoping report. Reference should be made to DECC's Offshore Energy SEA website for information on marine species distribution, at http://www.offshoresea.org.uk/consultations/SEA_4/index.php. The JNCC website http://www.jncc.gov.uk/page-3 provides a wide range of range of marine based information from seabed habitat mapping to seabird survey methods – http://www.jncc.gov.uk/page-4514 ; http://www.jncc.gov.uk/page-1551 - seaduck survey; http://www.jncc.gov.uk/page-1554 - cetaceans. Background information of previous bird & cetacean surveys can be found at http://www.jncc.gov.uk/page-2407, http://www.jncc.gov.uk/page-2726 and http://www.jncc.gov.uk/page-2713. The COWRIE site http://www.offshorewindfarms.co.uk/Pages/COWRIE/ contains a variety of information and downloadable reports on offshore environmental assessment techniques etc. and the www.aquaret.com site. It is unlikely that any useful information would be available from the local bird recorder for this area (Paul Daw - E-mail: monedula@globalnet.co.uk). Bird Reports and the book Birds of Argyll, edited by ap Rheinallt, T. et al. (2007) will provide some information on movements of birds seen	3 3 7 7 7

Item	Description	ES Chapter
	from shore within the Inner Hebrides but not birds using the site. The EIA should also consider what mitigation is required and how it would be achieved. Post installation opportunities may arise to enhance the area / a nearby area as a wildlife resource (however see note under collision above on potential increased attraction leading to increased collision), for example there maybe potential to create a sustainable coastal and marine management zone. It is understood that this development, and its associated timescales, is dependent upon a variety of factors, including a suitable grid connection. The details of how the tidal energy site is to be connected to any shore-based facilities will need to be considered within this application or as part of a separate EIA. We hope you find these comments helpful, should you require clarification of any of the above points please do not hesitate to contact me	 21
SNH	SNH advises that the key information source for considering wave and tidal energy proposals in Scottish waters is the Strategic Environmental Assessment (SEA) for Wave and Tidal Energy that was commissioned by Scottish Government in 2006. The final report was published in 2007 and so it remains reasonably up-to-date. It includes extensive reference lists on a range of relevant issues and it can be found on the following web-site: http://www.seaenergyscotland.co.uk In particular, SNH recommends that the applicant refers to the collision risk report: http://www.seaenergyscotland.net/public_docs/Appendix%20C7.B%20Collisions_report_final_12_03_07.pdf There is also further data on marine species distribution available through BERR's Offshore Energy SEA website, specifically the report relating to the SEA 7 Area: http://www.offshore-sea.org.uk/consultations/SEA_7/index.php It will also be useful for the applicant to check available research which has been carried out for offshore wind farms by the COWRIE working group (Collaborative Offshore Wind Research into the Environment). Some of the issues which have been researched may also have relevance to tidal devices: http://www.offshorewindfarms.co.uk/Pages/COWRIE/ SNH is supportive in principle of renewable energy. We can provide further advice on natural heritage interests, at appropriate stages, as work is undertaken by the applicant in support of their formal submission. In the meantime, if further information or advice is required at this stage then please contact Rae McKenzie, based in our Bowmore office.	3 7 7 7 Noted
Consultation		
Consents Unit	Developers should be aware that the ES should also be submitted in a user-friendly PDF format which can be placed on the Scottish Government website. Developers are asked to issue ESs directly to consultees. Consultee address lists can be obtained from the Energy Consents Unit. The Energy Consents Unit also requires 8 hardcopies to be issued internally to Scottish Government consultees. Where the developer has provided Scottish Ministers with an environmental statement, the developer must publish their proposals in accordance with part 4 of the Environmental Impact Assessment (Scotland) Regulations 2000. Energy consents information and guidance, including the specific details of the adverts to be placed in the press can be obtained from the Energy Consents website; http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Energy-Consents Gaelic Language Where s36 applications are located in areas where Gaelic is spoken, developers are encouraged to adopt best practice by publicising the project details in both English and Gaelic (see also Energy consents website above).	Noted Noted NTS only Noted

Item	Description	ES Chapter
	OS Mapping Records Developers are requested at application stage to submit a detailed Ordinance Survey plan showing the site boundary, access tracks and onshore supporting infrastructure in a format compatible with the Scottish Government's Spatial Data Management Environment (SDME), along with appropriate metadata. The SDME is based around Oracle RDBMS and ESRI ArcSDE and all incoming data should be supplied in ESRI shapefile format. The SDME also contains a metadata recording system based on the ISO template within ESRI ArcCatalog (agreed standard used by the Scottish Government), all metadata should be provided in this format.	1
	Difficulties in Compiling Additional Information Developers are encouraged to outline their experiences or practical difficulties encountered when collating/recording additional information supporting the application. An explanation of any necessary information not included in the Environmental Statement should be provided, complete with an indication of when an addendum will be submitted.	Noted Noted
	Application and Environmental Statement A developer checklist is enclosed with this report to help developers fully consider and collate the relevant ES information to support their application. In advance of publicising the application, developers should be aware this checklist will be used by government officials when considering acceptance of formal applications.	Noted
	Consent Timescale and Application Quality In December 2007, Scottish Ministers announced an aspirational target to process new section 36 applications within a 9 month period, provided a PLI is not held. This scoping opinion is specifically designed to improve the quality of advice provided to developers and thus reduce the risk of additional information being requested and subject to further publicity and consultation cycles.	Noted
	Developers are advised to consider all aspects of this scoping opinion when preparing a formal application, to reduce the need to submit information in support of your application. The consultee comments presented in this opinion are designed to offer an opportunity to considered all material issues relating to the development proposals.	
	In assessing the quality and suitability of applications, Government officials will use the enclosed checklist and scoping opinion to scrutinise the application. Developers are encouraged to seek advice on the contents of ESs prior to applications being submitted, although this process does not involve a full analysis of the proposals. In the event of an application being void of essential information, officials reserve the right not to accept the application. Developers are advised not to publicise applications in the local or national press, until their application has been checked and accepted by SG officials.	Noted
	Judicial review All cases may be subject to judicial review. A judicial review statement should be made available to the public.	

Table 4.2: Abridged Scoping Opinion

When the request for a scoping opinion document was issued in 2009, Section 3.2: *Topics to be Addressed in the EIA* highlighted the results of a marine activities risk assessment which had been undertaken to predict areas where potential impacts may occur. This enabled additional focus on defining a robust scope and methods assessment process for the elements highlighted as being either "potentially significant" or having a "potential impact"

Recognising potential specific sensitivities on mammals and birds as well as the fact that, at the time, no survey guidance or methodologies existed for tidal energy developments, more detailed scope and method proposals(6&7) were defined and agreed with SNH and RSPB. These documents formed the basis for generating the two year mammal and bird surveys as found in Technical Appendices 7.1 and 7.2 (Mammals) and summarised in 10.1 (Birds). Subsequent discussions were also held with Marine Scotland and SNH on the scope and methodologies for benthic and fishing studies.

EIA Scoping – Subsea Cable Route

As discussed in Chapter 5: Project Description, a connection agreement is in place to link the 30MW development to the main sub-station at Carradale on the Kintyre peninsula. In order to define a suitable corridor for the sub-sea cables from the site to Islay and Islay to Kintyre, a cable route assessment(8) was undertaken by Briggs Marine which included:

- Site visits to carry out survey work and data gathering;
- A Desk Top Route Selection Study, to assess marine and terrestrial engineering and environmental issues associated with the cable route and landfall points. Issues considered included ecology, biodiversity, cultural heritage, marine conservation, scenery, population, topography, geology and coastal planning;
- Selection of provisional marine corridors between landing points on Kintyre Peninsular, including a chart of provisional marine corridors;
- Informal consultation throughout the Desk Top Route Selection Study with the relevant bodies and statutory consultees;
- A marine survey specification document for inclusion with tender documents; and
- A final report including route position lists and straight line diagrams of the proposed route.

Consultation on the cable route assessment was undertaken with the following bodies:

- Argyll and Bute Council;
- Caledonian Maritime Assets Ltd (Port Ellen);
- Clyde Fisherman's Association;
- Marine Scotland;
- Maritime and Coastguards Agency;
- Scottish Fishermen's Federation;
- Scottish Natural Heritage;
- Western Isles Aquaculture Association;
- Western Isles Council;
- Western Isles Fisherman Association; and
- Western Isles Fishery Trust.

Table 4.3 lists the responses and references where those responses have been addressed in this ES with respect to the cable corridor between the site and Kintra. Comments relating to the corridor between Port Ellen and Kintyre are not relevant to this application.

Consultee	Comment	ES Chapter
Argyll & Bute Council	No comment	Not applicable
Caledonian Maritime Assets Ltd	No comment	Not applicable
Clyde Fishermen`s Association	3.3 Reference is made to self burial of the cable. As the entire length of the proposed route is valuable fishing ground, much of it scallop dredging, it is wholly unrealistic to imagine the cable should not be completely buried for its entire length. Scalloping activity will quickly damage the structure of the cable. Where the cable cannot be buried, those sections must be covered by concrete matting. Rock dumping over cables is no longer a possible solution as previous rock dumping attempts have proven unsuccessful. Much of the area considered impossible to bury is prime crab and lobster ground, an unprotected cable must not be laid in those areas. 5.1 The route chosen does not avoid the most heavily fished areas but lays directly through those heavily fished areas. The same is true for the part of the route from Port Ellen to Kintyre. It is apparent that there has been no information sought on fishing activities when planning this route. 8.6 It has been proven in the past that cable laying and cable burial has a long lasting effect on scallop populations. Fishing activity and scalloping in particular are very important to the local vessels and also visiting vessels. Where cable laying or burial is to take place, negotiations and consultation with fishing interests is most important. Access for the laying and burial of the cable would necessarily need to be negotiated with fishing associations	5, 12
Marine Scotland	Comments on benthic, Intertidal, Seabirds, Marine Mammals, Fisheries & Aquaculture and Surveys	Various
Maritime & Coastguards Agency	No comment	Not applicable
Scottish Fishermen's Federation	No comment	Not applicable
Scottish Natural Heritage	Comments on route and landfall options, natural heritage considerations and survey specification	Various
Western Isles Aquaculture Association	No comment	Not applicable
Western Isles Council	No comment	Not applicable
Western Isles Fishermen's Association	No comment	Not applicable
Western Isles Fishery Trust	No comment	Not applicable

Table 4.3: Responses to Cable Route Assessment Report

Navigational PHA
As a prelude to the Navigational Safety Risk Assessment (NSRA) a Preliminary Hazard Analysis (PHA) as found in Technical Appendix 14.1 was defined and agreed with the Maritime & Coastguard Agency (MCA). The content of the PHA was also informed by scoping opinion from statutory and non-statutory bodies including The Northern Lighthouse Board, the Royal Lifeboat Association and the Chamber of Shipping.

4.3.1.3 Full EIA, HRA, ES and NSRA

Although defined as one step of the EIA process in Figure 4.1, it is clear that this is a substantial proportion of the overall process and requires further elaboration, as provided in the ensuing sections.

4.4 The EIA Process

4.4.1 Key Stages

Fundamental to the EIA process, is the systematic identification of issues that could impact the environment or users of that environment. Once identified, these issues have to be assessed to define the level of potential impact they present, so that measures can be taken to remove, reduce or offset such effects through design or operational measures. Such measures help to identify elements of the project that may require monitoring during installation, operation and decommissioning. Impacts are considered in a cumulative manner as well as in isolation. The key stages of the EIA are identified in Table 4.4 below.

Stage	Task	Aim/Objective	Work/output (examples)	Public Participation and Consultation
	Scoping study	To identify the potentially significant direct and indirect impacts of the proposed development	Targets for specialist studies (e.g. hydrodynamic studies, sediment quality)	Public participation is an important part of the planning process, in particular at the EIA and pre-application stages. Preliminary consultation with key consultees is considered important for setting the framework for consent. Consultation with statutory and non-statutory organisations and individuals with an interest in the area and the proposed development throughout the EIA process is likely to be regulated by the new consenting regime.
	Secondary data collection	To characterise the existing environment	Background data including existing literature and specialist studies	
	Primary data collection specialist studies	To further investigate those environmental parameters which may be subject to potentially significant effects	Specialist reports	
	Impact Assessment	To evaluate the existing environment, in terms of sensitivity	Series of significant adverse and benefical impacts	
		To evaluate and predict the magnitude of impact on the existing environment		
		To assess the significance of the predicted impacts		
	Mitigation Measure	To identify appropriate and practicable mitigation measures and enhancement measures	The provision of solutions to minimise adverse impacts as far as possible. Feedback into the design process, as applicable	
	Environmental Statement	Production of the Environmental Statement in accordance with EIA guidance including a Non Technical Summary (NTS)	Environment Statement 4 main volumes: NTS, Written Statement, Appendices and Figures	
	Pre-Application Consultation	Advertising of application for licensing must occur at least 12 weeks prior to submission of joint s36 Application	Joint s36 / Marine Licence Application (if applicable)	
	Post submission	Liaison and consultation to resolve matters or representations/objections	Addendum to ES	
Consenting / Licensing Decision				

Table 4.4: Key Stages of the EIA Process

The assessment process covers all stages of the Project lifecycle from installation through to the operation, maintenance and decommissioning phases. All effects are taken into account throughout lifecycle, regardless of their duration (e.g. short-term vessel activities to longer term device operation). The environment is considered to include physical, ecological and socio-economic components and linkages between the different elements of the environment are also considered.

Impacts to one receptor that may affect another are considered where a clear pathway is identified between the two. This connectivity between receptors has been considered within the assessment in Chapters 7 to 20 in order to provide a holistic assessment that considers all impacts, both direct and indirect. The initial impact is assessed in the relevant section which deals with the receptor directly affected.

4.4.2 Significance of Effects

EIA regulations require that the EIA should consider the likely significant effects of the development on the environment. The decision process related to defining whether or not a project is likely to significantly impact on the environment is at the core of the EIA methodology. The approach developed here is applicable to both terrestrial and marine based EIA and has been developed with reference to the principals and guidance provided by Marine Scotland (MS) in their Consent Manual (2), Scottish Natural Heritage draft guidance on survey and monitoring in relation to Marine Renewables Deployment in Scotland (9), the SNH handbook on EIAs (10) and the Institute of Ecology and Environment Management (IEEM) guidelines for Ecological Impact Assessments in Britain and Ireland: Marine and Coastal (11).

Common principles have been applied to evaluate the significance of each element of the environmental impact as a result of this project. These include the following:

- Environmental significance is a qualitative judgement;
- The degree of environmental significance is related to the specific impact;
- The magnitude of the impact is related to the sensitivity of the receptor affected and the capacity of that receptor to accommodate change;
- The impact magnitude encompasses the severity of the impact and the duration of the impact, and is potentially amplified by the timing of when the impact occurs;
- The impact of the proposed project may be wide ranging in nature: direct, indirect, short, medium or long term, permanent or temporary impacts;
- Impacts may be both positive and negative;
- The likelihood of a specific impact occurring should be considered; and
- Any significant residual impacts following mitigation need to be identified.

As the determination of the significance of an impact is subjective, primarily based on professional judgement, this highlights the requirement for an extensive scoping and consultation process throughout the development of the project. This is something that has been given particular attention throughout the Project to date and details of the consultation process are presented in 4.8 and 4.9

Once the scope of the EIA studies had been established, it was important to standardise the description and assessment of the impacts. Despite being a subjective process, a defined methodology was used to make the assessment as objective and quantitative as possible. As the environmental factors under consideration can vary depending on what is being assessed, there is likely to be some variation in this process.

Definitions for the sensitivity of receptors and magnitude of change were developed on a topic by topic basis and are described and presented in each topic chapter.

The sensitivity of a receptor to the proposed project considers the specific nature of the receptor (or group of receptors) and their capability to accommodate change

4.4.3 Sensitivity

Sensitivity is generally a subjective judgement, determined by a receptor's tolerance to an impact, its ability to recover from an impact or ability to adapt to the changes in the environment resulting from a development. Sensitivity may also consider a receptor's environmental designation, rarity, and whether the receptor provides an important ecosystem service. The value categories are receptor-specific and have been considered within the baseline sections of each topic specific section.

Where these aspects are considered within the sensitivity category they are outlined within the relevant criteria tables in each section.

It is important to note that the above approach to assessing sensitivity is not appropriate in all circumstances and in some instances professional judgement has been used in developing the sensitivity category used.

The sensitivity of receptor categories are as follows:

- Very high;
- High;
- Medium;
- Low; and
- Negligible

4.4.4 Magnitude

For the purposes of this assessment the magnitude of an impact is determined by the duration, timing, scale, size, and frequency / probability of an impact. The timing of an impact will depend on whether it occurs during construction and installation or during operation.

The scale of the impact will be determined by the temporal (i.e. impact duration) and spatial scale (e.g. is the impact local, regional or site specific) over which the impact applies. The size of an impact is determined by the actual area the impact covers within the spatial scale that has been defined. The duration of the impact will depend on how long the impact occurs, whether it is throughout the operational life of the Project or whether following construction the impact ceases to occur.

In some instances the frequency or probability of an impact is considered as part of magnitude and is used when we consider how often or likely an impact is to occur to a receptor or association of receptors. In such instances, the magnitude of the impact is a product of its severity and the likeliness or regularity of its occurrence. For biological receptors this may be applied to the proportion of the population that is exposed to the impact, particularly when an impact only affects a small proportion.

The overall magnitude of the effect is then determined by considering a combination of each aspect and applying professional judgment and previous relevant experience. The following magnitude categories are applied in this assessment:

- Major
- Moderate
- Minor, and
- Negligible

4.4.4 Consequence

The sensitivity of a receptor and the magnitude of impact are combined to define the severity of the impact (Table 4. 5)

Magnitude	Sensitivity				
	Very High	High	Medium	Low	Negligible
Major	Major	Major	Major	Moderate	Minor
Moderate	Major	Major	Moderate	Minor	Negligible
Minor	Moderate	Moderate	Minor	Minor	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible
Positive	Positive	Positive	Positive	Positive	Positive

Table 4.5: Consequence of Impact

4.4.5 Impact Significance

The consequence of impacts is then considered by reference to the relevant criteria in the EIA Regulations. The significance of impacts in relation to the EIA Regulations is defined in Table 4.6

Positive	Positive – to be encouraged	↕	Positive
Major	Highly significant & requires immediate action	↕	Significant impact under EIA Regulations
Moderate	Significant – requires additional control measures and/or management		
Minor	Not significant – however may require some management to ensure remains within acceptable levels	↕	Insignificant impact under EIA Regulations
Negligible	Not significant		

Table 4.6: Definitions of Significance Rankings

Each identified impact is described in terms of the sensitivity of the receptor under consideration, magnitude of potential impact and the overall consequence of the impact, which in turn determines whether the impact is significant or not under the EIA Regulations. Following this description the assigned ranking is summarised in a colour coded table. Where impacts are deemed as potentially significant and/or mitigation is required in order to ensure the impact remains insignificant, this is summarised in the box under the colour ranking table.

Residual impacts following mitigation (for potentially significant impacts only) are also summarised in a colour coded table.

The evaluation of impact significance follows the four stage process outlined in the Marine Scotland Consents Manual: [2]

1. Identify both the environmental changes from the project and the features of interest (that is, receptors) that could be affected.
2. Understand the nature of the environmental changes in terms of their exposure characteristics, the natural conditions of the system and the sensitivity of the specific receptors (that is predict the impact)
3. Evaluate the vulnerability of the features as a basis for assessing the nature of the impact and its significance: and
4. Manage any impacts which are found to be significant and require the implementation of impact reduction/mitigation measures; identify the significance of the residual impact.

4.4.6 Assessment of Cumulative and In-Combination Impacts

Cumulative impacts are considered to be those arising from interaction with similar developments, which are the impacts on receptors of one offshore renewable development combined with the impacts of other developments. In-combination impacts are considered to be those arising from interaction with unlike activities, that is the impacts arising from one offshore renewable development combined with those from, for example, offshore dredging.

Cumulative and in-combination impacts are considered throughout the EIA process and have been considered for all phases of the project. Consultation with Marine Scotland and SNH has confirmed a list of other projects which, together with the West Islay Tidal Energy Project, may result in potential cumulative impacts

The general principle for the cumulative impact assessment was to consider only those projects for which an EIA Scoping Report had been issued or requests for an EIA Scoping Opinion have been submitted to Marine Scotland.

Details of the projects to be considered for the cumulative impact assessment were provided to all EIA assessors. The assessors then considered which of these projects could result in potential cumulative impacts with the project. This decision was based on the results of the specific impact assessment together with the expert judgement of the specialist assessor undertaking the impact assessment.

Inevitably the assessment of 'future projects' is dependent upon the level of information available on those projects at the time of undertaking the cumulative assessment. Due to the fact there were different levels of detail available for different projects, the cumulative impact assessment has been undertaken qualitatively in the individual chapter.

Each EIA Chapter contains a sub section which identifies the projects which are relevant on a cumulative basis and an assessment of the relevant cumulative impacts. Figure 4.2 illustrates the projects considered in the cumulative impact assessment. Table 4.7 provides a high level description of the proposed project and also project status.

Project Name	**Project Developer**	**High Level Description of Project**	**Project Status**	
Islay offshore wind	SSE Renewables	Located 13km of west coast of Islay. 690MW capacity – up to 138 5MW wind turbines	Scoping	Expect to submit consent application towards end of 2013.
Argyll Array Scheme. Offshore wind	Scottish Power Renewables	Located 5km off the coast of the island of Tiree. 1800 MW capacity	Scoping	On hold until Dec 2013 to study reports on potential environmental impact on basking sharks and seabirds
Limpet	Voith Hydro	Installed in 2002 to generate 75 kw of electricity	Operational	
Sound of Islay	Scottish Power Renewables	10 1 MW turbines	Consented	Installation 2013 to 2015
Argyll Tidal	Nautricity Ltd/Argyll Tidal Ltd	Mull of Kintyre. 10MW capacity	TCE lease	TCE for 6 tidal turbines in the Mull of Kintyre
Sanda Sound, South Kintyre, Wave	OceanFlow	1/4th Scale demonstrator at Sanda Sound	Consented	plan to deploy a 1/4 scale Evopod device in the Sound in the 4th quarter of 2012

Table 4.7: Details of Projects Considered in Cumulative Impact Assessment

4.4.7 Mitigation Measures

Mitigation can be defined as the elimination of adverse environmental impacts, or their reduction to an acceptable level. Clearly the preferred form of impact mitigation is to prevent the impact before it happens. The least preferred is to attempt to compensate for the impact by some other measure. PAN 58 defines a hierarchy of mitigation measures as: Prevent, Reduce and Offset.

Where potentially significant impacts (i.e. those ranked moderate or higher) are identified, mitigation measures have been considered. The intention is that such measures should remove, reduce or manage the impacts to a point where the residual significance is at an acceptable level.

The full series of mitigation measures proposed is summarised as the Schedule of Environmental Commitment in Chapter 21: Summary of Impacts and Conclusions

4.4.8 Assessment of Residual Impact

All developments will, by their nature, have a degree of impact on the environment, however minimal that impact may be. Even following an extensive mitigation process of prevent, reduce and offset there will be a net environmental change, the residual impact. The component residual impacts on the environment are dealt with in their respective chapters.

The overall residual impact and the significance of this impact is what is used to judge whether the development should proceed or not, i.e. is a measure of the environmental cost against the benefit of the development. This is discussed in Chapter 20: Summary of Impacts and Conclusions.

4.4.9 Monitoring

Actions proposed to mitigate against potential impacts can take many forms and is discussed in each relevant chapter and summarised in chapter 21. In addition, where data gaps exist, it may be appropriate to implement an environmental monitoring programme to evaluate a potential impact. The proposals made in Chapter 21 will be discussed and refined with relevant stakeholders as appropriate to define a project "Environmental Monitoring Programme" (EMP).

4.5 Habitat Regulations Appraisal (HRA) and Status

4.5.1 Recommended Appraisal

Following a review of baseline data gathered during mammal and bird site survey works, SNH made the following recommendation in a letter(12) dated 2nd July 2012:

"We therefore recommend that the following SACs with seal features are considered in relation to HRA:

- South-east Islay Skerries SAC designated for Harbour seals; and
- Treshnish Isles SAC designated for grey seals."

In addition, with respect to birds it was recommended that:

"Together, this should then be used to assess whether the proposed Islay Tidal Energy Farm is likely to have a significant effect on the qualifying feature(s) and as such which site/features should be taken forward in the HRA. The location of the tidal energy farm is such that it is likely to require the inclusion of SPAs from both Scotland and Northern Ireland."

4.5.2 HRA Undertaken

In line with the requirements of the Conservation of Habitats and Species Regulations 2010, and the Conservation (Natural Habitats, &c.) Regulations 1994 (the Habitats Regulations) ('the Habitat Regulations'), HRA was undertaken to evaluate the likely significant effects arising from the West Islay Tidal Energy Park. This is provided in the HRA report addressing Special Areas of Conservation for marine mammals, along with Special Protection Areas for birds (Technical Appendix 7.9).

In February and April 2013, HRA Screening and respectively updated HRA screening reports were submitted to Marine Scotland and Department of Environment (DOE) (Northern Ireland) Marine Division (MD) as requested. These were basis for the HRA Report (Technical appendix 7.9)

Based on the results presented in the report, for marine mammals and basking sharks SNH concluded that there are no likely significant effects arising from the development, either alone, or in-combination with other plans or projects, and therefore appropriate assessment is not required.

The HRA screening report for birds (Appendix 10.2) concluded that there is no potential for the development to have a likely significant effect (LSE) on any qualifying ornithological feature at a Natura site. SNH advised that, through applying their screening criteria, there is potential for LSEs on breeding auk qualifying features (guillemot, razorbill and puffin) at six Natura sites. These potential LSEs will require to be examined in more detail through the process of Appropriate Assessment by the regulator.

4.6 The Environmental Statement

4.6.1 ES Content Requirements

In addition to the required content of an ES as defined under Annex IV of the codified EIA Directive 2011/92/EU. These stipulate that the Environmental Statement includes at least:

(i.) A description of the development comprising information on the site, design and size of development;
(ii.) The main alternatives studied by the applicant and the main reasons for his choice, taking into account the environmental effects;
(iii.) Description of the aspects of the environment likely to be significantly affected by the development;
(iv.) Description of the likely significant effects of the development on the environment;
(v.) Description of the methods used to assess the effects on the environment;
(vi.) Description of the measures envisaged to prevent, reduce and where possible remedy significant adverse effects (mitigation measures);
(vii) A non-technical summary of the information provided under (i) to (vi) above; and
(viii) Indication of any difficulties encountered by the developer in compiling the required information.

4.6.2 Structure of the ES documents

This Environmental Statement (ES) is structured in four volumes:

Volume 1 Non-Technical Summary
Volume 2 Environmental Statement
Volume 3 Figures
Volume 4 Technical Appendices

4.6.3 Structure of the ES
The ES is structured as follows:

SECTION 1: INTRODUCTION, POLICY, CONTEXT, EIA & DESCRIPTION

1. Introduction
2. Legislative & Policy Context
3. Site Selection Process and Alternatives Considered
4. The Environmental Impact Assessment, Environmental Statement & Consultation
5. Project Description
6. Physical Environment

SECTION 2: BIOLOGICAL ENVIRONMENT

7. Mammals
8. Benthic
9. Otters
10. Birds
11. Natural Fish

SECTION 3: HUMAN ENVIRONMENT

12. Commercial Fisheries
13. Archaeology
14. Shipping & Navigation
15. Landscape & Seascape Visual
16. Traffic & Transport
17. Recreation & Amenity
18. Socio-economic
19. Noise
20. EMF

SECTION 4: SUMMARY CONCLUSIONS, MITIGATION & MONITORING

21. Summary of Impacts, Mitigation and Monitoring

4.7 Navigational Safety Risk Assessment (NSRA) Process and Status

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. 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.

Prior to this NSRA, and in accordance with guidance referenced above, 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 14.1.

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.

4.8 Consultants

The ES has been prepared by DP Marine Energy Limited in conjunction with the independent consultants listed in Chapter 1: Introduction.

4.9 Consultees

Throughout the development process consultations were conducted with a number of statutory and non-statutory bodies including:

- ACEU Climate Change Team;
- Argyll and Bute Council – Planning and Operational Services;
- Argyll and Bute Renewables Alliance (ABRA);
- Association of Salmon Fisheries Board;
- British Telecom;
- British Ports Authority;
- Caledonian Maritime Assets Ltd (Cable only);
- Chamber of Shipping;
- Civil Aviation Authority – Directorate and Safety Regulation Group;

- Clyde Fisherman's Association;
- Defence Estates;
- Ecology, Research & GIS Unit;
- Fisheries Committee;
- Health and Safety Executive;
- Highlands and Islands Airports (HIAL);
- Historic Scotland;
- Islay Community Council;
- Joint Nature Conservation Committee (JNCC);
- Kintyre Community Councils;
- Local Councillors;
- Marine Safety Forum;
- Marine Scotland;
- Marine Scotland (Science);
- Maritime and Coastguard Agency (MCA);
- National Air Traffic Services (NATS);
- MPs;
- MSPs;
- Northern Ireland Environment Agency (NIEA);
- Northern Lighthouse Board;
- Planning and Building Standards;
- Road Network Management and Maintenance;
- Royal Yachting Association (Scotland);
- Royal Society for the Protection of Birds (RSPB);
- Scottish Canoe Association;
- Scottish Environmental Protection Agency (SEPA);
- Scottish Executive;
- Scottish Fishermen's Federation (SFF);
- Scottish Fisheries Protection Agency;
- Scottish Natural Heritage (SNH);
- Transport Scotland;
- Water Environment Unit;
- Western Isles Aquaculture Association (Cable only);
- Western Isles Council (Cable only);
- Western Isles Fisherman Association (Cable only); and
- Western Isles Fishery Trust (Cable only).

4.10 Public Consultation

Public consultation is an important part of the EIA process within both the scoping of the project and during environmental impact assessment.

Local residents were first made aware of the potential development in late 2008 when public notices advising of the proposal to locate Acoustic Doppler Current Profilers (ADCP) off Portnahaven to measure the tidal resource were issued. Since then, DPME and its contracted assessors have frequently visited the island to undertake surveys.

In addition, DPME have provided project information on their website www.dpenergy.com and, more recently, on a dedicated website www.westislaytidal.com.

4.10.1 Public Information Events and Communication

Since the inception of the project DPME have consulted locally with Argyll and Bute Council, the Islay Community Council, the Islay Energy Trust, local residents, local fishermen and councillors from Islay and Kintyre. Activities associated with the consultation process (generally listed chronologically) have included:

- Letters to local councillor's and community council: March 2008;
- Presentation to the Islay Community Council: AGM April 2008;
- Notification of intent to deploy ADCP devices: Ileach May 2008;
- Request for Scoping Opinion: May 2009;
- Monthly visits to undertake surveys: 2009 to 2011;
- Notification of open days displays (newspapers): Aug 2012 and March 2013;Presentation to Islay Community Council: Sept 2012 and April 2013;
- Presentation to East Kintyre Community Council: Sept 2012;
- Communication with West Kintyre Community Council: Sept 2012;
- Open day displays Bowmore, Portnahaven & Port Ellen: Sept 2012 and April 2013;
- Presentation to Argyll & Bute Renewables Alliance: Sept 2012; and
- Dedicated West Islay Tidal website: April 2013.

In addition, DPME has consulted on several occasions with the Islay Energy Trust who have acted to facilitate several consultation exercises.

4.10.2 Public Response and Sensitivities

The onshore infrastructure is not part of this application but has been recognised as a potential issue with respect to potential visual impact of the line route and sub-station. Works are ongoing on the onshore element of the project.

Questions were asked of the potential visibility of turbines from Portnahaven. In response, a series of photomontages have been supplied to the Community Council for local review, details which can be found in Chapter 15: Landscape and Seascape.

Potential issues on the fishing industry are separately dealt with in Chapter 12: Commercial Fisheries.

4.11 Difficulties Encountered

No specific difficulties were encountered in the production of this ES.

4.12 References

1. R. V Rochdale MBC ex parte Milne (No 1) and R. v Rochdale MBC ex parte Tew (1999) and R. v Rochdale MBC ex parte Milne (No. 2) [2000]

2. Marine Scotland (2012) Marine Scotland Licensing and Consents Manual – Covering Marine Renewables and Offshore Wind Energy Development. Report R 1957.

3. Scoping Opinion – The Consents Unit http://www.scotland.gov.uk/Topics/marine/Licensing/marine/scoping/DPMarineEnergy

4. ABPmer Constraints Assessment 2008

5. Request for Scoping Opinion by DP Marine Energy Ltd in respect of Islay Tidal Energy Project Environmental Impact Assessment Scoping Report May 2009 http://www.scotland.gov.uk/Topics/marine/Licensing/marine/scoping/DPMarineEnergy

6. Islay Tidal Energy Project: Marine Mammals and Basking Sharks Scope and Methods Proposal (December 2009)

7. Islay Tidal Energy Project: Bird Scope and Methods Proposal (December 2009)

8. Islay to Kintyre Proposed Sub-sea Cable Route Assessment: Environmental Appraisal (Jan 2013)

9. Scottish Natural Heritage (2011) Draft Guidance on Survey and Monitoring in Relation to Marine Renewables Deployments in Scotland. Volume 1: Context and General Principals.

10. Scottish Natural Heritage (2009) A handbook on environmental impact assessment

11. Institute of Ecology and Environmental Management (IEEM) (2010), Guidelines for Ecological Impact Assessments in Britain and Ireland. Marine and Coastal.

12. SNH HRA letter dated 2nd July 2012:

WESTISLAY TIDAL

ENERGY PARK

volume 2 // chapter 5 // project description

5. Project Description

5.1 Introduction

The West Islay Tidal Energy Park (WITEP, "The Project") development comprises of between 15 and 30 tidal energy convertors (TECs) delivering a maximum installed capacity of 30MW together with the associated infrastructure required to export the generated energy to the shore on Islay.

The project can be subdivided into two distinct elements: the TEC array and the Inter-Array and Export Cabling. For both elements a description of all phases of the project, from installation and commissioning, through operation and maintenance, to decommissioning is provided.

5.1.1 The TEC Array

There will be between 15 and 30 TECs depending on final technology and manufacturer choices. This chapter provides full details of the options under consideration and our "Rochdale Principle" technology neutral approach.

5.1.2 Inter-Array and Export Cabling

The inter-array cabling will marshalled and exported to shore via up to three subsea export cables, landing at Islay. A number of routes were considered as shown in Figure 5.1 below with potential landing points identified near Portnahaven, at Bowmore and at Kintra.

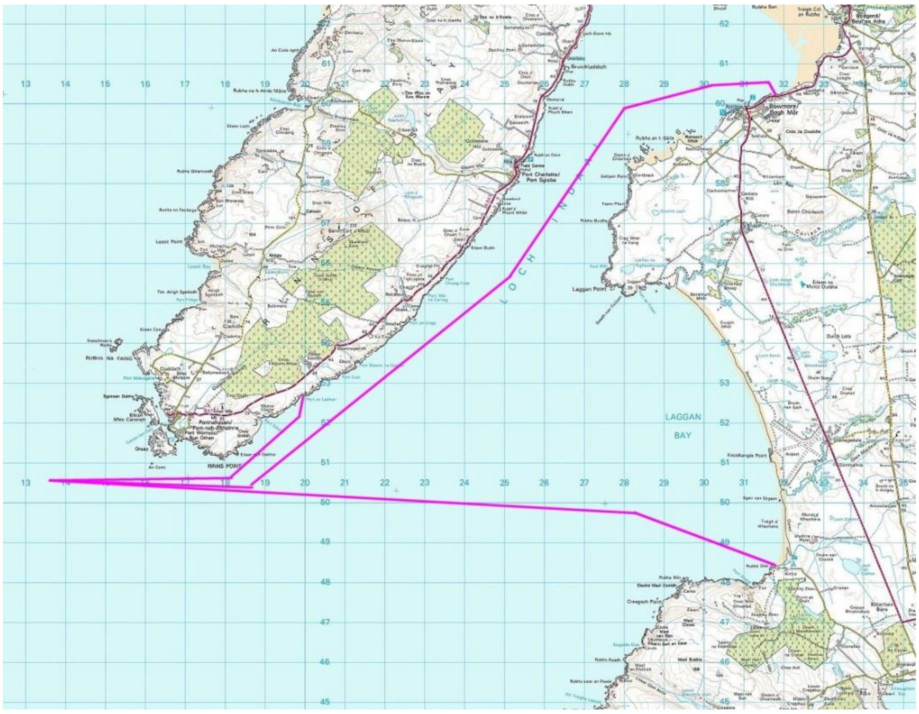


Figure 5.1: Landfall Options Considered

As illustrated in Figure 5.2, the preferred option and the one which is described within this Environmental Statement (ES) is to route the export cable east from the tidal park to a landfall location at Kintra on Islay. Although not part of this ES, the preferred onward route to the connection point at Carradale on the Kintyre peninsular is also shown for information only. Substantial Environmental Impact Assessment (EIA) works have already been undertaken over the much of the onward route in preparation for a future application(s) for consent.

This route has been selected in preference to the other two as it is the most direct route and so the most cost effective, passes through areas of limited ecological sensitivity and provides the minimum onshore route length and therefore reduces potential visibility issues.

Further EIA survey works are also being undertaken for the alternative landfall and route options and if adopted these elements will be subject to further applications for consents.

<u>Figure 5.2: Proposed Grid Connection Cable Route (For Information Only)</u>

5.1.3 Grid Connection Route Beyond Kintra (For Information Only)

In parallel with the detailed description provided for the first element of the offshore cabling to Kintra, general information is also provided on other onshore aspects of the project along the preferred grid connection route for completeness. As stated previously, it should be noted these do not form part of the current application for consent and will require further survey works. The information included within this ES will likely form the basis of a separate application(s) in the future.

NB. An italic font has been used for these sections for clarity.

5.2 Technology Approach

5.2.1 Technology Neutral Approach

The development approach taken within the Project EIA and described within this ES is to be technology and manufacturer neutral. This is consistent with the projects original scoping document [(1)], and is similarly typical of wind turbine EIA's where final device selection is only undertaken post consent and subject to a formal commercial tender process. This enables commercial agreements to be negotiated with potential suppliers at a point where financial close is imminent and tenders can be run in accordance with European procurement rules.

It is not feasible for either the supplier to offer or developer to commit to commercially competitive agreements prior to final consents being awarded. Clearly this situation is different for manufacturers involved in the development of their own demonstration arrays.

A design envelope, or "Rochdale Principle", approach has been adopted for this consent application. A wind farm would typically consent on a design envelope defined by maximum rotor diameter, hub height and sound power levels etc., leaving aside items that do not impact on the EIA such as generator, gearbox and control configuration specifications.

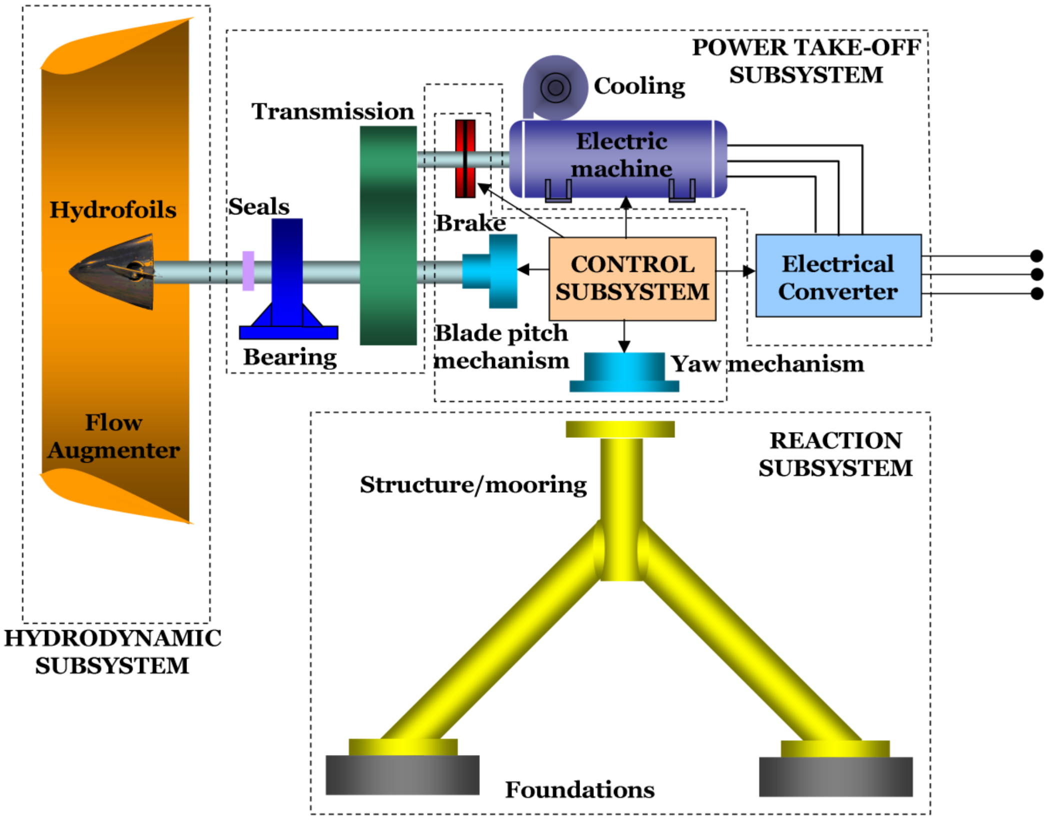
Similarly the developer will seek to define, in the course of this ES, the critical design envelope for the proposed Tidal project, thus allowing deferment of technology and manufacturer selection to the appropriate time.

5.2.2 Rochdale Principle Applied to Tidal Energy Converters (TECs)

For TECs a similar "Rochdale principle" needs to be adopted since there is wide design divergence and rapid technology advancement amongst manufacturers. In addition there is considerable fluidity in the industry with major OEM`s taking over smaller technology suppliers. This means it is difficult to directly replicate the "Danish Wind Turbine" concept for marine technologies. However with careful consideration it is possible to define an envelope that enables both selection choices from the most promising technologies and an accurate EIA to be undertaken. This design envelope is described in the forthcoming chapters.

5.2.3 TEC Configuration

TECs are fundamentally defined by two elements as illustrated below, the energy capture element (hydrodynamic and power take off subsystems) and the support, mooring and foundation structure:

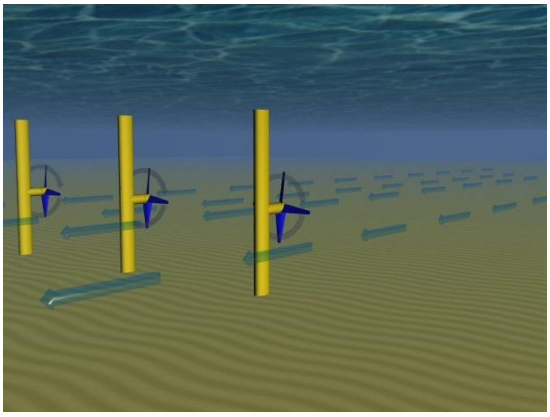


Subsystems of a TEC

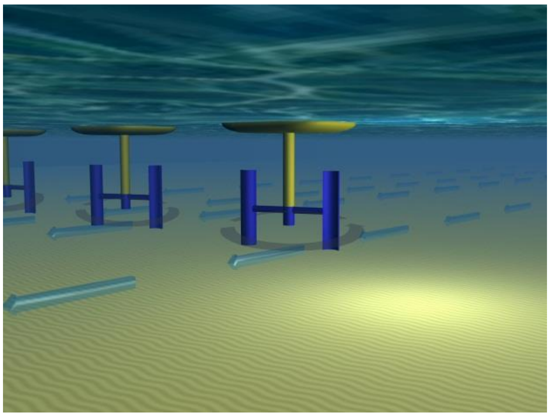
For the purposes of this ES, and based on the types of technology described below the combined hydrodynamic and power take off subsystems are generically described as the TEC's turbine.

5.2.3.1 Energy Capture

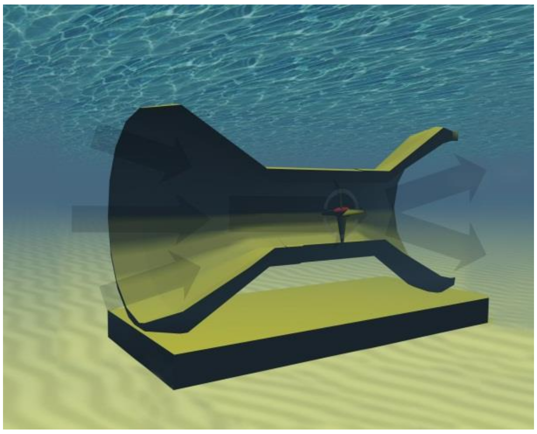
The energy capture element of the TEC converts tidal energy to mechanical and then electrical power by means of a horizontal or vertical axis turbine, or an oscillating aerofoil. A horizontal axis turbine could feature either an open or closed (venturi effect) rotor, pitched or non-pitched blades or yawed rotor. Schematic examples of such devices are shown as follows:

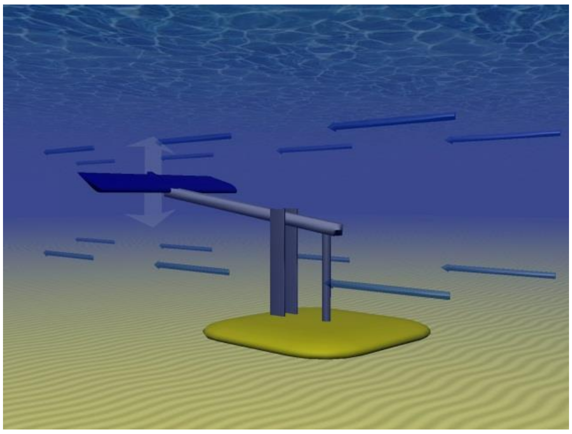


Horizontal Axis Turbine (HATT)



Vertical Axis Turbine (VATT)





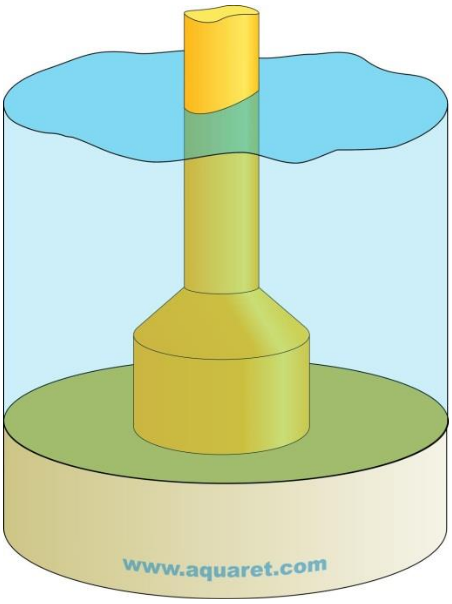
Closed Rotor with Venturi Effect

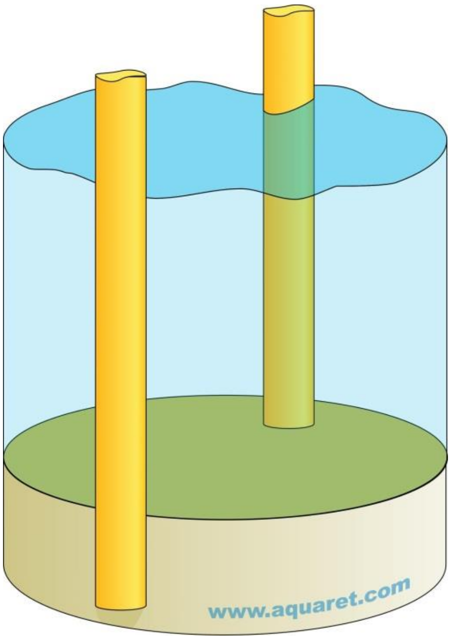
Oscillating Hydrofoil

Electrical power generated from these devices can either be conditioned to enable grid quality electricity to be produced at the device or unconditioned, where the power is delivered directly from the generator and would require further conditioning prior to connection to the grid. Whilst this doesn't have a direct implication for the EIA, unconditioned power devices would require additional equipment to be installed.

5.2.3.2 Mooring and Foundation Structure

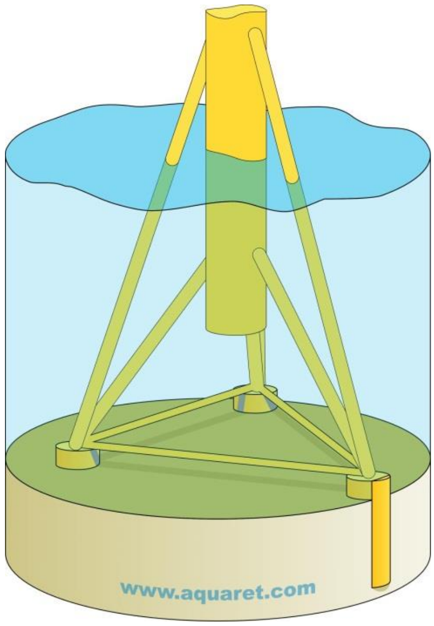
There are many different methodologies for securing the turbine in position, these include a gravity base, piled, pin-piled fixed structure or a moored floating device. The structure may be surface or non-surface piercing, both for operation and maintenance. Schematic examples of such methodologies are shown below:



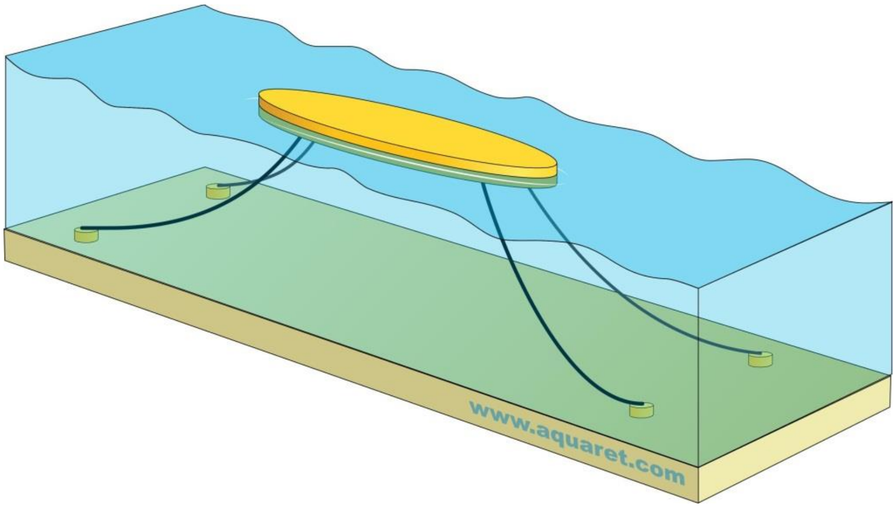


Gravity Based Foundation

Dual Piled Foundation



Pin-piled Tripod Foundation



Four Point Catenary Mooring

5.2.4 The Proposed EIA Design Envelope

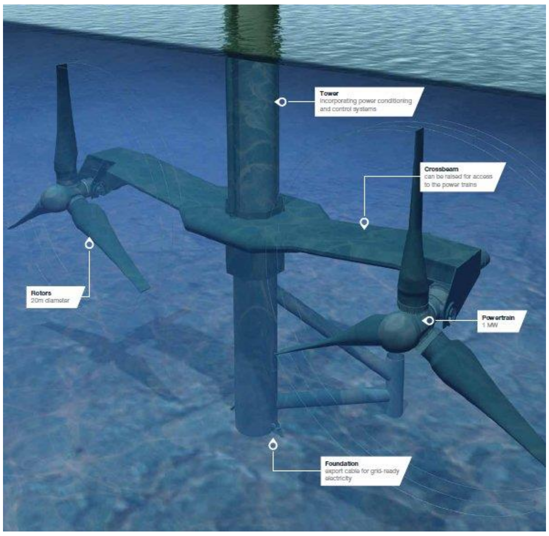
It would be impracticable to define an extremely wide design envelope which could accommodate all of the potential tidal energy options and their range of impacts within an EIA. However, enough flexibility needs to be built into the EIA process to enable a sufficient range of devices and technologies to be considered for selection at the time of deployment.

In order to maintain flexibility the key elements are selected and considered on a realistic "worst case" basis, each being appraised in relation to the various potential impacts. An obvious example of worst case scenario would be visual impact with the presumption that at least some part of the structure could be surface piercing or floating.

The key objective of the project design envelope is to assess the potentially greatest environmental impact in each specific area whether visual, navigational, or ecological. To this end a detailed list of turbine characteristics was compiled and a comparative assessment of "likely greatest effect" was undertaken. This exercise is illustrated in Table 5.3 and provides the basis for informing the EIA.

5.2.4.1 Open Rotor Horizontal Axis Turbine

Although currently 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 has been undertaken on the basis that the one of these will be selected. A number of manufacturers have adopted this approach including MCT/Siemens, TGL/Alstom, Hammerfest Strom and Voith Hydro.



Siemens/MCT SeaGen S Mark 2 – 2MW

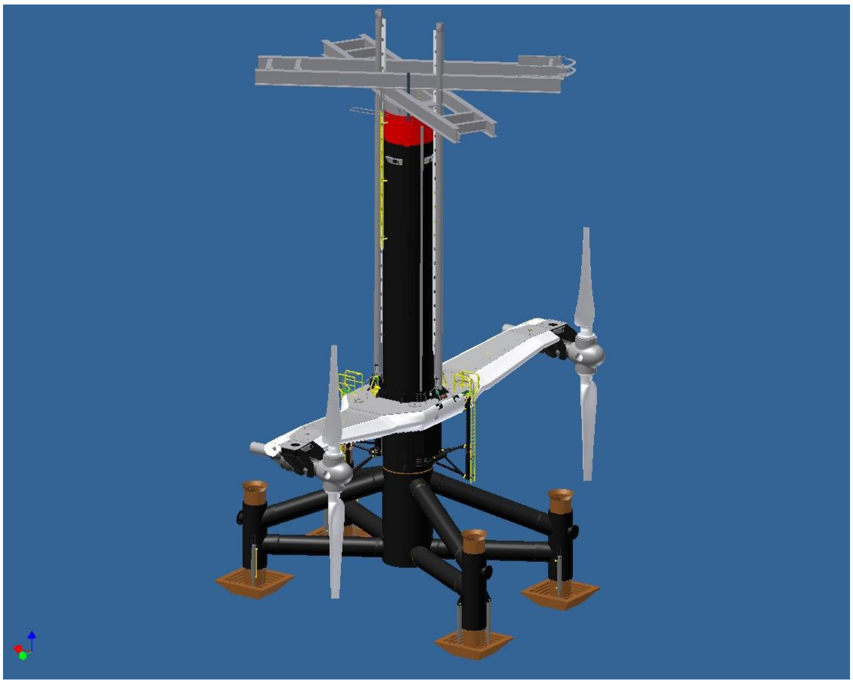
Alstom/TGL – 1MW

Hammerfest Strom AK1000 – 1MW

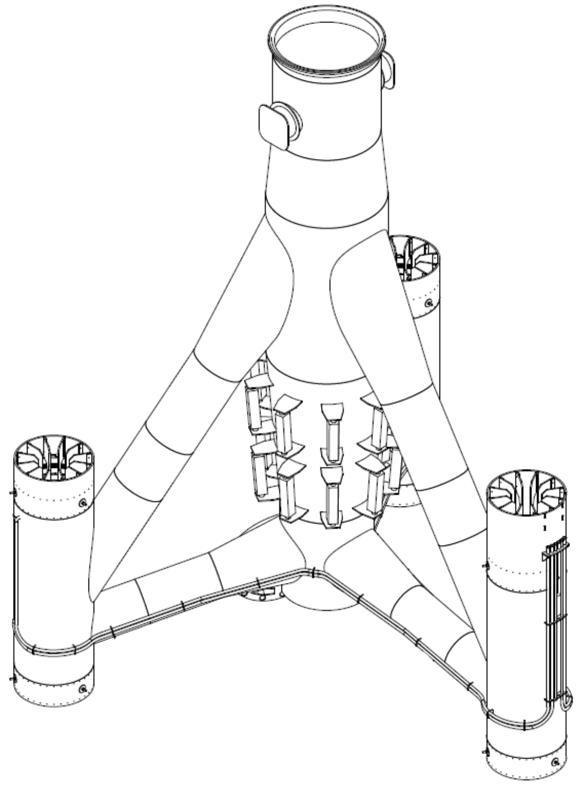
Voith Hydro – 1MW

5.2.4.2 Foundation - Support Structures

A number of installation and mounting technologies have been considered for the un-ducted open rotor horizontal axis turbine. The MCT/Siemens device incorporates two turbine units attached to a lifting cross arm mounted on a steel tower anchored in the seabed (the Seagen S). TGL/Alstom's turbine is mounted on a tripod support structure pinned to the seabed. Hammerfest Strom propose a similar tripod foundation but with gravity ballast used to keep the structure in place.

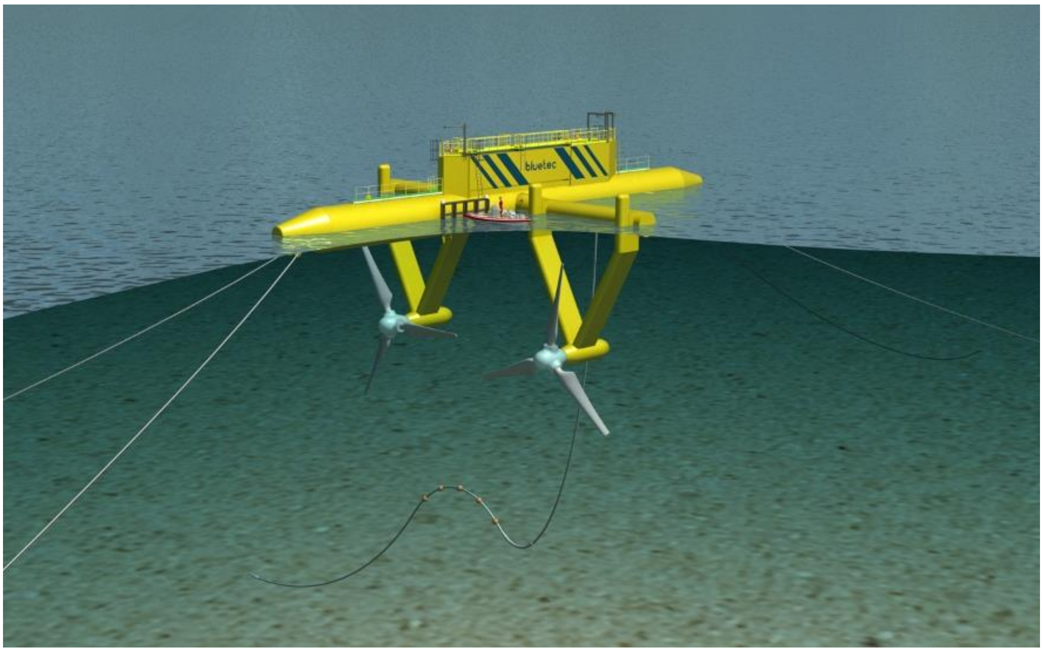


Siemens/MCT Foundation Arrangement



Alstom/TGL Foundation Arrangement

One of the key challenges for the tidal energy industry is the high installation, deployment and maintenance costs and different approaches to seabed mounting have been considered. Alternative floating solutions for turbine deployment of both vertical and horizontal axis machines have also been proposed by third party technology suppliers such as the BlueTEC device by Bluewater Energy Services.



BlueTEC Floating Platform

5.2.5 Likely Example TEC and Layout Configurations

Included within the ES are detailed specifications for both the MCT SeaGen S Mark 2 and TGL turbine devices, a description of the likely array configurations, the likely installation techniques as well as operation, maintenance and decommissioning procedures. It should be noted that reference to the BlueTEC Floating Platform represents a mooring structure and not an alternative TEC solution to either the SeaGen or TGL device. Therefore it can be assumed that the potential implementation of this methodology will have no effect on the operational characteristics of the TEC`s including location in the water column, rotor diameters or tip speed.

5.3 Project Location

The initial 30MW phase of the project described in this chapter is located within an area of wider potential that could support a project generating several hundred megawatts. The site selection process which identified the Islay site is discussed in more detail in Chapter 3: Rationale and Site Selection Process.

5.3.1 Site Location

The tidal energy site is centred on latitude 55.65°N and longitude 6.60°W and is illustrated in Figure 5.3 on Admiralty Chart 2723.

The eastern edge of the project lies at its closest point approximately 4.5km from Orsay off the island of Islay in Argyll and Bute in Scotland. It occupies an area of around 2.28km^2. The outline of the development area as indicated on Figure 5.4 and is marked by the labels A1 to A14 (coordinates given in Table 5.1 below).

ID	Latitude (Deg)	Longitude (Deg)
A1	55.66015	-6.59656
A2	55.65348	-6.59727
A3	55.65253	-6.59004
A4	55.65787	-6.58909
A5	55.65754	-6.58472
A6	55.65753	-6.58424
A7	55.64893	-6.58668
A8	55.64821	-6.59026
A9	55.64757	-6.59351
A10	55.64702	-6.59794
A11	55.65778	-6.62045
A12	55.66206	-6.62527
A13	55.66693	-6.61607
A14	55.66056	-6.61121

(WGS 1984)

Table 5.1: Co-ordinates of Proposed Development Area.

5.3.2 Marine Cable Route

The proposed cable route, illustrated in Figure 5.3, runs from the centre of the tidal energy site approximately 21km east to landfall at Kintra (131700E and 648200N) on the island of Islay. The route proposed is defined by the labels A1 to A4 (coordinates shown in Table 5.2 below).

ID	Latitude (Deg)	Longitude (Deg)
1	55.65583	-6.58774
2	55.65929	-6.58465
3	55.65915	-6.55336
4	55.65492	-6.51843
5	55.65976	-6.37797
6	55.65897	-6.32329
7	55.65801	-6.2796
8	55.65622	-6.26187

(WGS 1984)

Table 5.2: Co-ordinates of Sub-sea Cable Route to Islay.

5.4 General Site Description

5.4.1 Geology

The islands of Islay and Jura host some of the oldest rocks in Britain, dating from around 1800 million years ago. These rocks – the Rinns Complex – are primarily located on the west coast of Islay and are separated from the younger Dalradian (600 Ma) rocks by the Loch Gruinart fault. It is the Dalradian group of rocks that form the major rock component of Islay and Jura. Originally these varied sediments were deposited, buried and lithified in a submarine environment. Earth movements caused the underlying Dalradian rocks to become deformed and in places recrystallization of minerals occurred forming the metamorphic rocks quartzite, slate and phyllite. The seabed has been characterised as a rock outcrop extending southwest from the Rinns of Islay. Further detailed information on site geology can be found in Chapter 6: Physical Environment.

5.4.2 Water Depths

The water depth across the site area has been determined by detailed survey and varies from 25m to 50m LAT (Lowest Astronomical Tide).

5.4.3 Tidal Currents and Resource

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.

5.4.4 Wave and Wind Regime

Like many exposed west coast sites, the project site is subject to strong wave conditions and Atlantic swells. The currents around the Rinns point are strong both on the ebb and flood tides and this can also result in significant localised wind wave effects during 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: Physical Environment.

5.4.5 Navigation

The project site is located in navigationally unconstrained water in the approaches to the North Channel and other than the strong currents and potential for localised wind wave effects there are no restrictions on navigation other than those dictated by good seamanship. The closest Traffic Separation Schemes (TSS) lies approximately 35km away (19Nm to the south-east).

5.4.6 Designated Areas

There are no designated areas on or immediately adjacent to the site. However, a Marine Consultation Area exists in Loch Indaal and several onshore SSSI, SAC, Ramsar and SPA sites particularly on the Rinns of Islay. Further detail on designated areas is provided in Chapter 7: Biological Environment.

5.4.7 Subsea Cable Route to Landfall at Kintra

5.4.7.1 Geology

The seabed is essentially a relict surface which dates from the late Pleistocene (125,000 years ago), and its morphology has remained largely unaltered since the early Holocene (10,000 years ago) rise in sea level. It is covered by a patchy veneer of unconsolidated sediments which consists of a mixture of terrigenous (land-derived) and biogenic carbonate (mainly shell) material. Further detailed information on site and cable route geology can be found in Chapter 6: Physical Environment.

5.4.7.2 Water Depths

Depths vary from the intertidal landfall depths up to a maximum of around 90m immediately to the east of the tidal site.

5.5 TEC Design and Operation

5.5.1 Introduction and Specification

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 S Mk 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 particularly in the early phases of developments, they could be substituted for other devices within the parameters of the design envelope defined.

Both the MCT and TGL TECs feature configurations based on horizontal axis, unducted, pitch controlled, three bladed rotor turbines and a number of other devices would also fit within this design envelope and would be suitable for deployment including Voith Hydro and Hammerfest Strom.

The key difference between the MCT and TGL TEC solutions is the support and foundation design and operation and maintenance strategies. By considering both, it looks at the impact of both fully submerged and surface piercing devices. Consideration of the impact floating supports, such as the BlueTEC device referenced above is also considered.

Table 5.3 summarises the key dimensions and performance criteria for the MCT and TGL TEC used in informing the EIA. It should be noted that:

- Dimensions should be taken to be indicative, not absolute and may change during definition of the Construction Methods Statement (CMS);
- Sea bed preparation and drilling, pinning and grout type will depend on the findings of the post consent detailed geotechnical assessment and the selected drilling system utilised by different contractors; and
- Specification of paints and oils also change during the life of the project based on improvements in design and technological advances in materials.

Element	Characteristic	Turbine Specification	
		MCT	TGL
Turbine	Materials	Mild Steel, Composite Blades	Mild Steel, Composite Blades
	Installed Capacity	2MW	Up to 1.5MW
	Number of Rotors	2	1
	Width (across stream)	50m	22m
	Rotor Diameter	20m	22m
	Rotational Speed (Rated Power)	11.5rpm	14rpm@18m rotor diameter
	Swept Area	628m2 (both rotors)	380m2
	Cut in speed	1m/s	1m/s
	Rated Speed	2.4m/s	2.7m/s
	Seabed Clearance	3m	6m
	Surface Clearance (LAT)	3.5m	7m
	Protrusion Height (LAT)	21m	Not applicable
	Area of Pod Platform	7x9m	Not applicable
	Maximum Protrusion	Nominally 20.5m but up to 40m during maintenance	Not applicable
	Weight	460 tonnes (both drive trains)	150 tonnes

Element	Characteristic	Turbine Specification	
	Anti-corrosion	Impressed Current System (ICS)	Norsok Standard M-501 System (eg: Interzone 505) plus Anodic Protection
	Anti-foul	Intersleek 737	Non leaching anti foul coating (eg: Intersleek 737)
	Gearbox	Planetary	Planetary
	Hub & drive train	Pitch contol & bearings	Pitch control & bearings
Electrical Conversion	Generator	Asynchronous	Asynchronous
	Output Voltage	33kV	6.6kV
Foundation	Materials	S355 Steel	S355 Steel
	Maximum area covered	260m^2	154m^2
	Footprint of piles (3off)	4m	4m
	Height	12m	16m
	Pin pile Diameter	1.5m	1.3m
	Pin pile Depth	11m	5m
	Weight (dry)	460 tonnes (all components)	120 tonnes
Floating Platform	Materials	Platform: Standard offshore Marine Steel	
	Platform Dimensions	60m x 35m x 7m	
	Weight (including turbines)	400 tonnes	300 tonnes
	Maximum area covered	TBA	
	Footprint of piles (4off)	4m	
	Height	1m	
	Pin pile Diameter	1m	
	Pin pile Depth	10m	
	Anti-corrosion	Class 3 Offshore Coating- TBA	Class 3 Offshore Coating- TBA
Subsea Hub	Materials	Not applicable	Mild Steel
	Maximum area covered	Not applicable	150m^2
	Anti-corrosion	Not applicable	Class 3 Offshore Coating- TBA

Element	Characteristic	Turbine Specification	
Installation & Commissioning			
Turbine	Power Requirement (external)	100kW	100kW
Foundation	Seabed Preparation	Not applicable	Not applicable
	Depth of Excavation	10m	5m
	Drill Fluids	None	Biologically degradable
	Discharge (drill cuttings)	80m^3 of (typically) 30mm stone chips	20m^3 of (typically) 30mm stone chips
	Grout	Approx. 60m^3 of OPC Grout	Approx. 40m^3 of OPC Grout
	Noise	Approx. 160dB at 1m, 140dB at 100m and falls below background (EMEC) within 500m	Approx. 160dB at 1m, 140dB at 100m and falls below background (EMEC) within 500m
Vessel	Type	See vessel details section 5.26 Self-Elevating Vessel with DP2 (Innovation)	Vessel capable of lifting & handling a 120tonne foundation of 14m x 14m x 16m
	GRT	22.392	
	Length	147,5m	
	Draft	7,3m	
	Noise	(unknown, assumingly similar to DP2 vessel type North Sea Giant: SPL = background noise at 500m)	
	Fuel Usage	- Operational: - Depending on activity type (sailing, DP2, jacking) between 20 and 90 mt/day - STANDBY: - Between 5 and 10 mt/day	
	Waste/litter	None	None

Element	Characteristic	Turbine Specification	
		The'Innovation' can handle 1500 tons on 31,5m	
Moorings	Type	Floating Platform Option: Anchors: Gravity - Combination of Steel/Concrete/stone. Pin piled - Steel & concrete grout	
	Mooring spread dimensions	TBA	
	Dimensions	Not applicable	
	Footprint of piles (4off)	4m	
	Height	1m	
	Pin pile Diameter	1m	
	Pin pile Depth	10m	
Permanent Marker Buoys	Type	Not applicable	Not applicable
	Dimensions	Not applicable	Not applicable
	Attachment	Not applicable	Not applicable
Operation & Maintenance			
Turbine	Noise	See section 9	Part of ReDAPT
	Water Abstraction/Discharge	Not applicable	Not applicable
	Chemical Requirements	Not applicable	Not applicable
	Potential Discharge to Sea	Not applicable	Not applicable
	Potential Discharge to Air	Not applicable	Not applicable
Vessel	Type	See vessel details section 5.26	A suitable workboat greater than 30m length capable of towing the floating turbine & of the deck transportation & lifting of the 4 tonne floating winch unit of dimensions 2.5m x 2.5m x 2.5m
	GRT Length Draft Noise Fuel Usage Waste/litter		

Element	Characteristic	Turbine Specification	
Decommissioning			
Turbine		Removal will generally be the reverse of installation methodology	Remove as per standard O&M procedure
Foundation		Use pile cutter to cut through piles close to seabed	Use pile cutter to cut through piles close to seabed
Vessels		Similar vessels as those used for installation	Use O&M vessel and installation vessel with subsea cutter for pile removal close to seabed

Table 5.3: Project Envelope Criteria

5.5.2 General TEC Description

5.5.2.1 Introduction

This section provides further detailed descriptions of the two TEC`s referenced in Table 5.3 above. Further detail on the BlueTEC floating platform which sits under the banner of "alternative support structure" is provided in section 5.7.4 BlueTEC Floating Platform Design.

5.5.2.2 Marine Current Turbines SeaGen Mark 2

The SeaGen S Mk2 is similar to the original SeaGen S installed by MCT in Strangford Lough in 2008 which was the first marine renewable energy project to be accredited by OFGEM as a commercial tidal power station. The unit regularly runs at full rated power (1.2MW) and has currently generated over 6GWh of electricity.

MCT is developing the 2.0MW SeaGen S Mk 2 product for use in commercial scale tidal projects and where generically referenced as the Seagen S in this documentation, it can be assumed as a reference to the Mk 2 or a later iteration of the device.

The Strangford Lough installation has been subject to a rigorous 3-year Environmental Monitoring Programme the results of which have concluded that installation and operation of the SeaGen system, together with the mitigation measures put in place, has not had a significant impact on marine life at the site (2).

The most obvious difference between the Strangford Lough machine and the SeaGen S Mark 2 is the change from two to three bladed rotor turbines but this is a relatively minor design change in relation to operation and environmental impacts.

The SeaGen S Mk2 TEC has a maximum capacity of 2.0MW (1.0MW per turbine), although the power rating can be adjusted according to environmental and technical constraints to between 1.1 and 2.0MW. As illustrated in Figure 5.5 the device comprises a twin rotor pitch controlled machine consisting of a central tower with one three bladed rotor on either side mounted on a cross beam. Each rotor/turbine drives a separate generator via a gearbox, much like a hydro-electric or wind turbine. The cross beam is connected to the tower via a sleeve or collar. The complete assembly of collar, cross beam and turbines can be raised and lowered for maintenance (Figure 5.6). The total width of the device from blade tip to blade tip is approximately 50m based on a rotor diameter of 20m as shown in Figure 5.7 (Volume 3).

During operation the central tower is always visible above the surface of the sea as shown in Figure 5.8.

The turbines start to rotate and generate at a tidal speed of around 1m/s and reach rated capacity at 2.4m/s. When the tide turns, the turbine blades are rotated 180^0 to face the oncoming tide and the process is repeated. At full rated capacity (notional 1MW per turbine) the rotational speed of the turbines is 11.5rpm. With a diameter of 20m and rotational speed of 11.5 rpm, this gives a tip speed of 11.94m/s. This compares with a tip speed of around 70m/s expected from a wind turbine of similar capacity.

Figure 5.5: Representation of the SeaGen Device

Figure 5.6: Strangford Lough TEC Cross Arm Raised for Maintenance

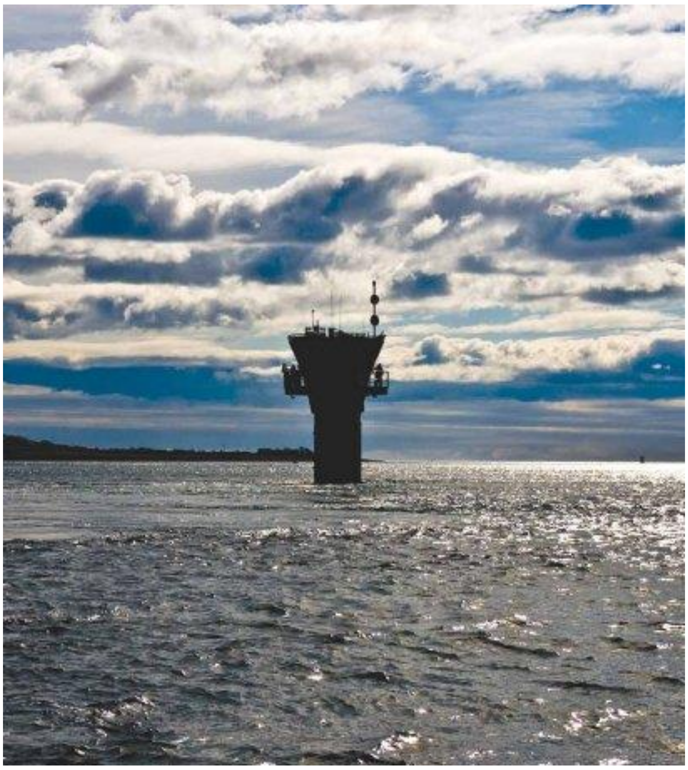


Figure 5.8: Central Tower Visible During Operation

The minimum clearance between the highest arc of the rotor and water surface will be no less than 3.5m at LAT. The clearance between the lowest arc of the rotor and seabed will be no less than 3m. In all instances these minimum clearance distances will be maintained during micro-siting. Where water depth restricts this then the rotor diameter may be reduced proportionately on a turbine by turbine basis.

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 approximately 7 x 9m in area. The pod enclosure is approximately 3.5m in height and around 7m in height at its maximum extent. The maximum height of the structure above the sea surface is nominally 21m LAT.

Figure 5.7 in Volume 3 illustrates indicative device dimensions during operation and during maintenance. The form of the structure and maximum height would change during these periods of maintenance, with the lift legs rising to approximately 40m with the cross beam and turbines coming above the water. However, such periods would only occur occasionally, be relatively short in duration and as is clear from the figure below result in minimal increased visibility due to the slender nature of the lift legs.

5.5.2.3 TGL TEC

The TGL TEC is a scaled version of the 500kW device deployed at EMEC in 2010 and 2011 and will be similar to the 1MW device which recently began testing at EMEC. The device comprises a single open rotor marine current energy converter with a maximum capacity of 1.5MW with the specific rating being adjusted according to environmental and technical constraints.

The TGL turbine (representation as shown in Figure 5.9) is similar to the SeaGen S Mk 2 powertrain in that it comprises an unshrouded, horizontal axis, 3-bladed, pitch controlled rotor, with integrated drivetrain and power electronics. However, unlike the SeaGen S Mk 2 turbine which simply adjusts rotor pitch, the complete TGL drive train yaws 180^0 on change of tide to face upstream, similar to a conventional wind turbine. This is accomplished using a tunnel thruster mounted on the aft end of the nacelle.

During 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.

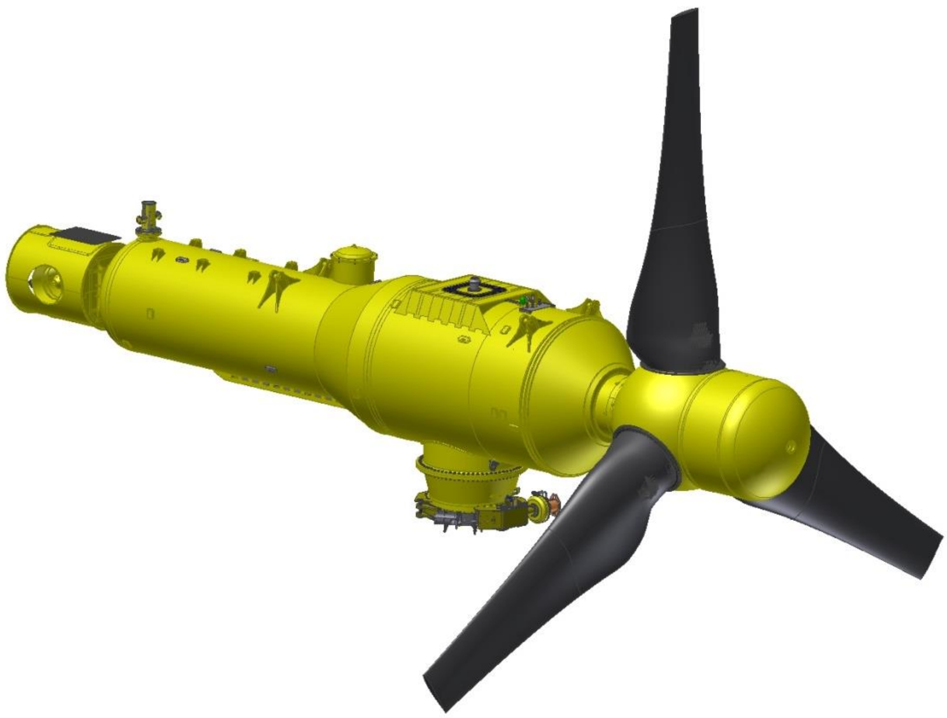


Figure 5.9: Representation of the TGL Turbine

During operation the TGL TEC is always submerged as shown in Figure 5.10 below.

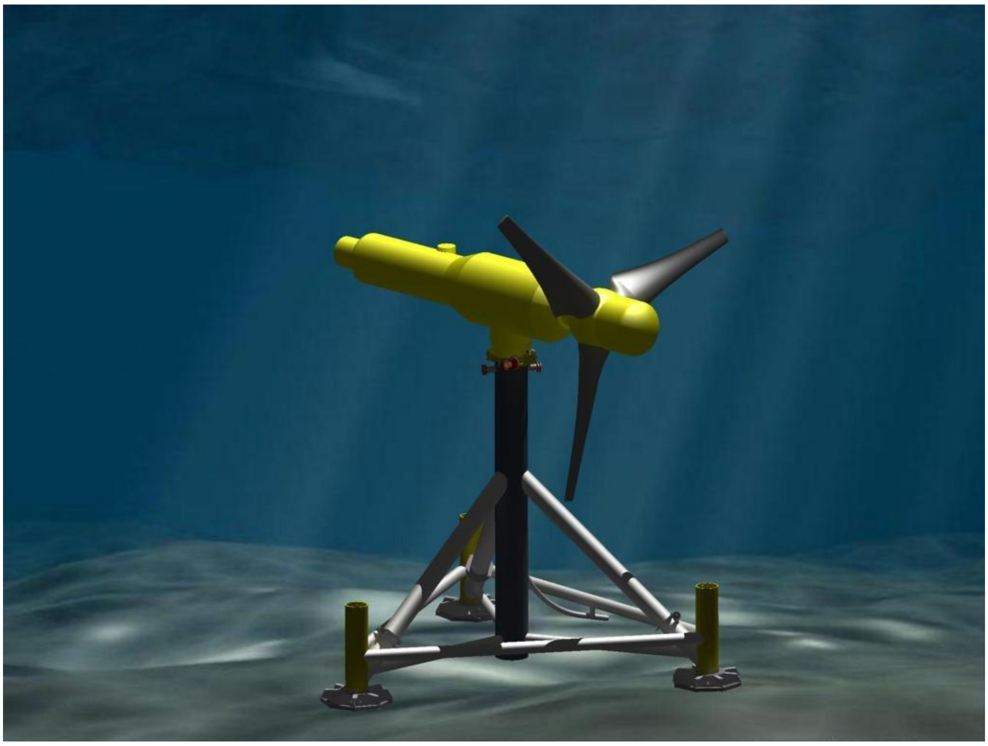


Figure 5.10: Representation of TGL TEC

Expected clearance between the highest arc of the rotor and water surface, will depend on the final rotor diameter selected for the Islay site, but based on the currently defined 22m rotor, it 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.

5.6 Array Configurations

5.6.1 General Approach

There are currently no installed tidal turbine arrays on which to derive solid engineering or environmental experience for multi turbine deployments. Therefore there is a degree of uncertainty in array design which will remain until more experience is obtained from commercial developments. A number of European and Scottish funding programmes are focused on developing this experience base.

In the absence of field experience the industry has focussed on modelling to support turbine array design and substantial work has already been undertaken across the industry in this area. This work has been based on mathematical modelling of flows and predicted wake effects from the turbines utilising empirical data input in order to calibrate the predictions where available. The measured data used for this exercise has been derived from tank tests, and from instrumentation of individual turbines deployed at locations such as at EMEC and Strangford Lough.

5.6.2 Alternative Layouts

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

- All surface piercing - based on either 15 surface piercing MCT SeaGen S Mk 2 units or BlueTEC floating platforms with either MCT or TGL turbines installed on them;
- All non-surface piercing – based on 30 individual 1MW TGL units (combined with a subsea substation); or
- A mixed site with both surface piercing and non-surface piercing.

As before, manufactures devices are given as reference only to define the array envelope and may be substituted in the future with other devices, subject to the limits of the parameters defined.

A good example of the likely greatest effect is that of the seascape visual impact assessment on the basis that the greatest impact would be derived from an array of all surface piercing devices such as the Seagen S Mk 2 or floating platforms.

Conversely an alternative layout proposal would be for all the devices to be non-surface piercing, such as TGL's TECs. Whilst this might provide an obvious seascape advantage it might be considered that this has the likely greatest effect with regard to navigational safety since it raises the question of safe marking and over-sail risks.

The EIA has attempted to identify the worst case scenarios based on all surface piercing devices (e.g. MCT SeaGen S Mk2 or floating platforms) or all fully submerged devices (e.g. TGL TECs). On no occasion did a "mixed site" layout represent the worst case scenario.

5.6.3 Other Array Infrastructure – Alternatives

Beyond the device array layout, consideration also needs to be given to the support infrastructure including approximately 20km of inter-array cabling between the turbines, the grid connection and the export cable. For near shore arrays or for small projects it is technically feasible to individually cable each machine back to shore. Whether this is the optimal solution depends on a number of factors but for projects further offshore or with substantial numbers of units it is likely that electrical grouping of machines will be required. As well as machine to machine jointing, this may also result in the requirement for an increase in voltage utilising a step up transformer, in order to reduce electrical export losses.

There are considerable engineering challenges associated with this approach for non-surface piercing technologies since the technology for some of these solutions can be as challenging as that of the devices themselves. However, a number of technology providers in particular TGL are working on design solutions in this field and these are described later within the ES but these remain as yet unproven.

One of the obvious advantages of surface piercing devices whether seabed mounted or floating is its ability to facilitate dry mate connections between multiple devices and to provide a platform for step up transformers for export if required. In the third alternative array configuration proposed within this ES the SeaGen S Mk 2 has been included to provide this function, affording both a dry connection and marshalling capability for the array.

5.6.4 General Turbine and Row Orientation

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 approximately 160/340 degrees from North as illustrated in Figure 5.13 in Volume 3.

The idealised siting principles based on the manufacturers design parameters defined below, and the primary flow directions will inevitably be affected by specific seabed conditions and 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 specific turbulence levels.

5.6.5 SeaGen S Mk2 Array Spacing

Initial studies on the wake effect of the SeaGen S Mk 2 using modelling techniques and 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 impacted by interactions between turbines. It is understood that this is likely to be a maximum downstream requirement but this will only be confirmed following evaluation of the results from preliminary array deployments. A minimum staggered downstream spacing of 200m or 10D has also been defined. The project 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, significantly greater than the manufacturer's recommended minimum separation. Whilst wake effects are unlikely to be an issue with this configuration there are likely to be practical reasons for having increased separation. Such reasons include mooring spreads during construction or environmental issues where potentially sensitive locations may need to be avoided

The minimum and maximum spacing and depth parameters for multiple row configurations are set out in Table 5.4 below.

Parameter – SeaGen S Mark 2	20m Rotor Diameter (m)
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 5.4: Depth and Spacing Parameters SeaGen S Mark 2

5.6.6 TGL Array Spacing

Initial academic studies of the wake effect of TEC devices suggest that a downstream distance of 440m or 20D based on 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 be relaxed following evaluation of the results from preliminary array deployments. For the purposes of the project 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.

Initial academic studies have resulted in a recommended cross flow (perpendicular to the flow) spacing of the TGL device of 66m or 3 rotor diameters 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 spacing and depth parameters for multiple row configurations are set out below in Table 5.5 below.

Parameter – TGL Turbine	22m Rotor Diameter (m)
Minimum crossflow spacing	66
Maximum crossflow spacing	240
Minimum separation tip to tip	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 5.5: Depth and Spacing Parameters TGL

It is worth highlighting that if the BlueTEC platform installation methodology were to be adopted the configuration and array spacing would be as per the MCT design whichever turbines were attached.

5.7 Foundation System

5.7.1 General Approach

A number of different foundation solutions have been proposed by manufacturers for TEC deployment ranging from gravity bases which require no sea bed penetration, through drilling and pinning of seabed mounting structures, to mooring systems involving heavy or elastic mooring systems secured to the seabed by pinned anchor systems. Combined gravity and pinned systems also exist.

Although most technology developers have chosen a specific foundation type for their turbine, it is feasible that in the future turbine technology may become decoupled from the device support structure, where one could match a turbine from one provider with a support structure from another. To this end a number of non-turbine manufacturers have developed foundations or platforms capable of being utilised by a number of different turbine devices.

This is an important step for the industry as installation is one of the major costs for the implementation of tidal energy projects. In parallel with the open design envelope approach on turbine selection, flexibility must also be considered for the support structure. Therefore, although the manufacturer solutions for both TGL and MCT devices rely on drilled and pinned support structures, their rotor, power train and nacelle assemblies could readily be mounted on gravity bases or on floating structures subject to detailed engineering design. This has been considered within this ES.

5.7.2 SeaGen S Mk 2 Foundation

The SeaGen S Mk 2 foundation is secured to the seabed by grouted pin piles. The foundations also support access ladders, J-tubes (to prevent export cable damage), corrosion protection equipment and a boat landing platform.

The detailed design of the Seagen S Mk 2 foundation including number of pins, pin diameter and depth will be subject to ground conditions, metocean conditions, equipment availability, installation and operations philosophy and life-cycle cost. For the purposes of the assessment a quadrapod as opposed to tripod design has been used since it represents the worst case scenario in terms of seabed impacts. Figure 5.14 illustrates a typical quadrapod foundation.

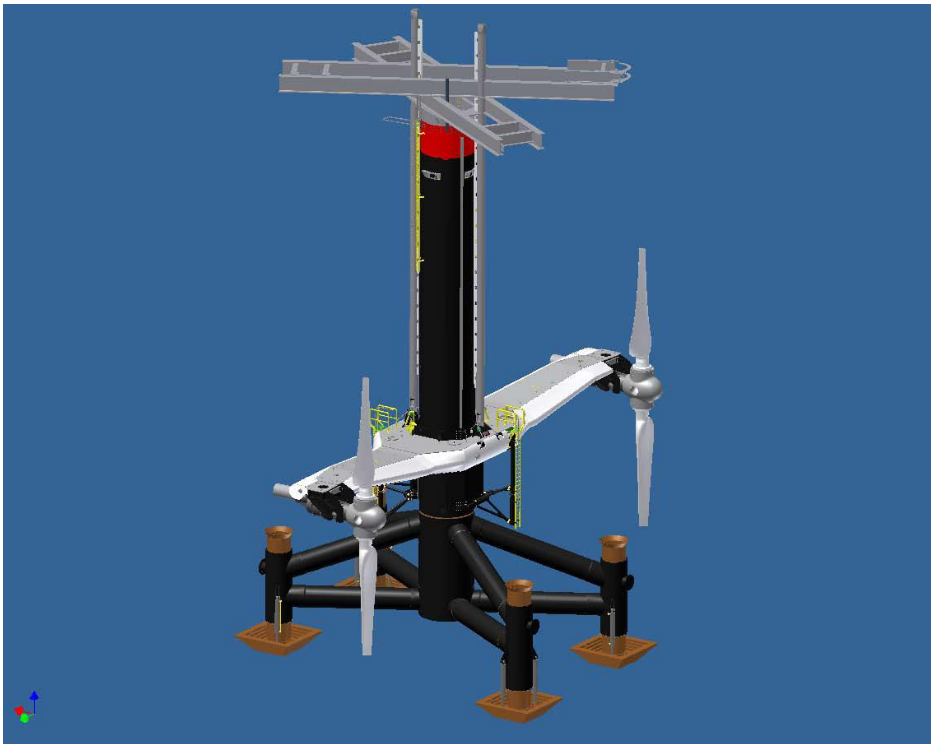


Figure 5.14: Quadrapod Foundation Illustrating Temporary Top Beams

5.7.3 TGL Foundation

The 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 including number of pins, pin diameter and depth will be subject to ground conditions, metocean conditions, barge availability, installation and operations philosophy and life-cycle cost. An illustration of the TGL foundation is shown in Figure 5.15.

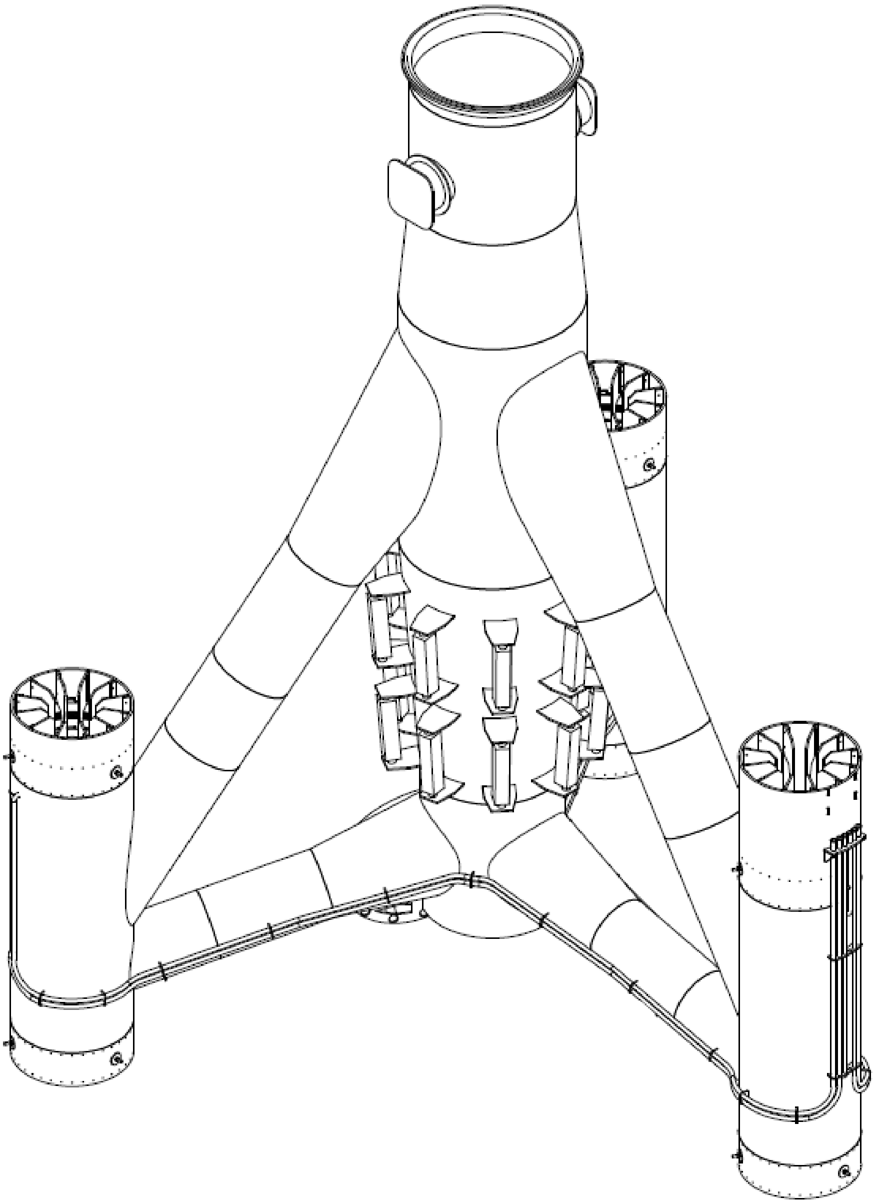


Figure 5.15: TGL Tripod Foundation

5.7.4 BlueTEC Floating Platform Design

5.7.4.1 General Description

BlueTEC is a floating open-architecture - i.e. open to any turbine and power equipment - platform for tidal turbines. It has been developed by Bluewater, a Dutch offshore oil and gas company. During this development Bluewater used its specialised skills in marine engineering, installation, operation and maintenance to provide an integrated solution to the tidal energy industry that ultimately lowers the cost of energy.

Figure 5.16 illustrates the platform which has been designed to support two MCT turbines. Similar to the MCT TEC tower, the floating platform accommodates the most critical equipment above the waterline, where it is dry and protected, allowing for easier access, inspection and repair.

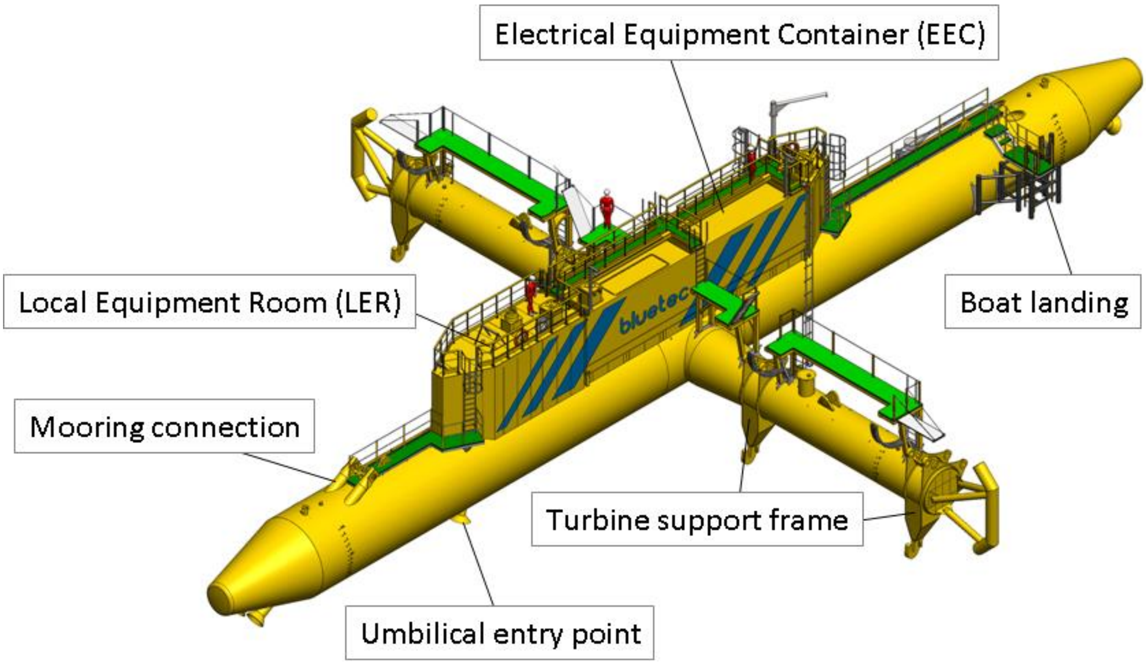


Figure 5.16: BlueTEC Floating Platform

The BlueTEC concept will be optimised for each Turbine supplier. This optimisation process may or may not result in minor dimensional changes to the hull shape. These potential changes are considered to be minor and are not expected to influence the EIA.

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 Figures 5.17a and b. Electricity generated by the individual turbines is routed onboard the platform in a watertight deckhouse and eventually grid-connected via the umbilical power cable.

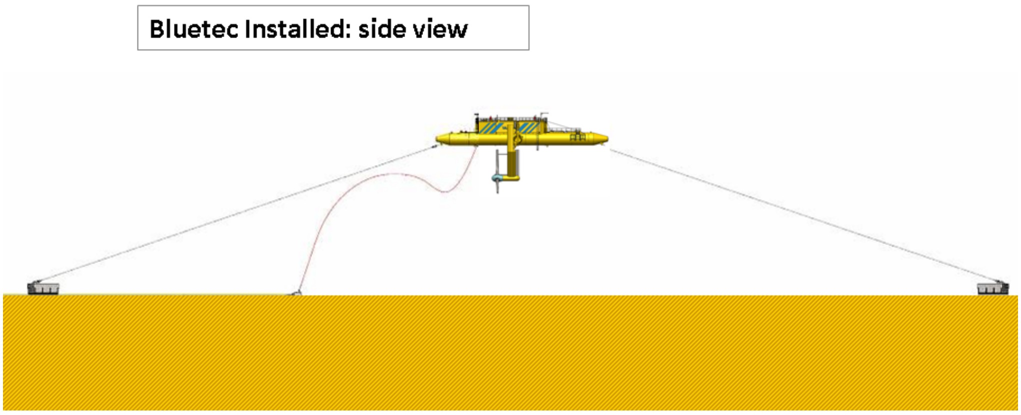


Figure 5.17a: BlueTEC Mooring System

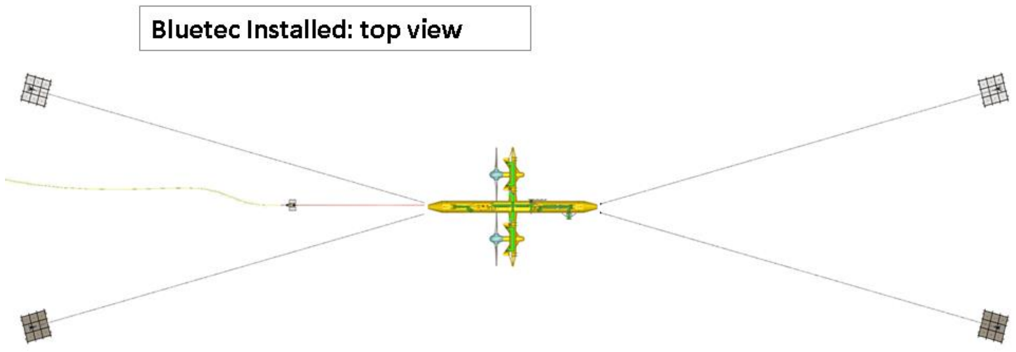


Figure 5.17b: BlueTEC Mooring System

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.

5.7.4.2 General Dimensions

Including the 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

5.7.4.3 Anchoring Points

Two options for the anchoring points are being investigated to determine which option will be used.

Gravity Based Anchors (GBA). If gravity based anchors are utilised these will be made up of steel and concrete elements with overall dimensions of approximately 8x8x3m per anchor. The GBA is generally designed in such a way that it could be installed and decommissioned using locally available vessels.

Drilled pile anchors. For drilled piled anchors the general concept 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.

5.7.4.4 Mooring System

The BlueTEC mooring system is designed so that there is no contact between seabed and mooring line. There is therefore no potential for seabed scrub. On each mooring line there will be a minimum tension of 10 tons. Based on Bluewater's considerable experience in the field of FPSO operation in UK waters, this tension is considered to be sufficient to prevent entanglement of fish and mammals.

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 purposes either a replacement platform or a temporary mooring arrangement will be installed.

The umbilical will have a diameter of approximately 80 – 100 mm and the mooring lines' diameter will be dependent on the turbine selection and site conditions. Both items will be visible for large mammals and fish and will have a pre-tension high enough to prevent entanglement.

5.7.5 Detailed Piling Design and Project Design Envelope

Both the MCT and TGL TEC's have been designed with a foundation structure utilising a steel frame multi-leg structure fixed to the sea-bed by grouted pin piles. Foundation loads are significantly affected by wave loading as well as thrust from the turbine rotor consequently the detailed engineering design for these pin piles and the structures themselves will depend on site specific conditions (both seabed and metocean). This detailed design will determine the number of legs to be used (either tripod or quadrapod) and the size and depth of the piles. For the purposes of the assessment of seabed impacts it is assumed that the quadrapod system will be used since it has the largest seabed footprint and number of drillings and therefore the highest potential for environmental effects.

Using the TGL TEC with subsea transformer station as the worst case (i.e. 4 piles per foundation) would result in a maximum of 124 drilled sockets and foundation piles.

One of the principle contractors in subsea drilling, Bauer Renewables Ltd, has a seabed drill as illustrated in Figure 5.18 (BSD 3000) capable of drilling a 2.3m diameter hole of 11m depth in one day.

For the purposes of the EIA, the design envelope has been based on the alternate options of 124 drilled sockets, of 2.3m diameter and 5m depth for the TGL and 45 drilled sockets, of 2.3m diameter and 11m depth for the SeaGen S.

Figure 5.18: Bauer Renewables BSD 3000 Seabed Drill

5.8 Materials

5.8.1 General

The majority of the material for tidal devices is found in the foundations and steelwork designed to support the drive trains. The predominant material is an S355 or standard offshore marine steel.

A list of materials included in the MCT and TGL machines is included in the manufacturer's data sheets, which also references details of compliance with recognised international standards and is provided in Technical Appendices 5.1 to 5.4

5.9 Hydraulic Systems

5.9.1 General

Almost all tidal generation systems utilise hydraulic closed loop systems to drive motors required for key operations, this includes winches and lifting mechanisms, clamping systems, and braking systems etc.

5.9.2 SeaGen S Mk 2 Hydraulic Systems

The SeaGen S device uses a hydraulic system consisting of a power pack with reservoir located above water level supplying hydraulic fluid to the following systems: lift, crane and brakes within each power train. The process of lifting the cross beam can be achieved in a matter of hours, and since the tower supports a self-contained lifting system this negates the need for a large lifting vessels to be on site when maintenance and repairs are required.

Although leakage could occur if the hydraulic pipes or fittings are ruptured, this is unlikely in a robustly designed system with stainless steel fittings as standard. A leakage would be recognised by the control system triggering a shutdown to limit discharge. The hydraulic fluid used is Hydr 32 ISO 32 TEXACO.

Details of all fluids used can be found in the data sheets in Technical Appendices 5.1 to 5.2

5.9.3 TGL Hydraulic Systems

During maintenance, the hydraulic system in the TGL TEC is used to actuate the external clamp, which connects the turbine to the tripod and allows for yawing about its axis. Low eco-toxicity, biodegradable oil is used for this clamp to mitigate risk in case of an external leak under failure conditions, although discharge to seawater is highly unlikely due to double-sealing arrangements.

During turbine deployment and retrieval, a removable sub-sea winch is used which is recovered to the vessel once the turbine is fixed to the tripod. The winch hydraulic system also uses similar biodegradable oil. Consideration has been given to using bio-compatible oils for all systems, and where possible they have been specified.

Details of all fluids used can be found in the data sheets in Technical Appendices 5.3 to 5.4.

5.9.4 BlueTEC Floating Platform

Two types of oil are used in the BlueTEC platform: lubricants at mechanical interfaces and hydraulic fluids within pressurised systems.

The primary use of hydraulic oil is within the system for the actuation of the two deployment and recovery arms on which the turbines are mounted. The maximum quantity of oil inside the platform is expected to be less than 1000L (similar to that used in an offshore wind turbine). The types of oils used and the manner of storage will comply with relevant marine environmental safety standards and the intention is to utilise biodegradable oils wherever possible.

5.10 Corrosion Protection

5.10.1 General

Corrosion protection techniques are broadly similar to those currently used in the marine industry. Techniques range from the use of offshore grade paints to anodic sacrificial protection.

5.10.2 SeaGen S Mk 2 Corrosion Protection

Corrosion protection on the steel structure of the turbines will be achieved using an Impressed Current System (ICS) which is commonly used on ships and sub-sea structures as an alternative to sacrificial anodes.

Sacrificial anodes will be used on the structure as a back-up to the ICS and where ICS cannot be used. The anodes are standard products for offshore structures and are welded onto the steel structures. The anodes typically consist of zinc and aluminium; they are connected to the structure via doubler plates to ensure the integrity of the primary structure is maintained in the unlikely failure of an anode connection. The number and size of anodes would be confirmed during detailed design.

5.10.3 TGL Corrosion Protection

The TGL tripod has been designed with a combination system of active and passive corrosion protection. It is passively protected by a coating of category 3 offshore grade paint and is actively protected by a system of Aluminium-Indium anodes positioned around the central stem. The sacrificial anodes fitted during fabrication have sufficient volume to last the life of the installation.

5.10.4 BlueTEC Floating Platform

Details of the corrosion protection to be used are currently indicative. However it is likely that all external surfaces in the submerged and splash zone including the platform, equipment and piping will be coated with two layers of solvent free epoxy coating followed by fluoro-polymer based non-toxic anti-fouling (foul release) paint. All external surfaces above the submerged and splash zone including the platform, equipment and piping will be coated with two layers of solvent free epoxy coating followed by isocyanate free finish coating. Sacrificial anodes will also be used on the structure as is normal practice in the marine industry.

5.11 Antifouling System

5.11.1 General

The prevention of marine growth is an important consideration, even in a fast flow environment and it is likely that all devices will have common anti fouling strategies although a number of different approaches, including antifouling paints are being explored on full scale prototype devices. A degree of marine growth on the foundation structure is likely particularly on devices where the foundation is likely to remain in place for the life time of the project and is not recovered on servicing. However, clearly even minor blade contamination could seriously affect flow over the surface and reduce yield performance and this would be one of the primary areas of concern particularly in the event that the turbine were out of operation for any significant period.

5.11.2 SeaGen S Anti-fouling System

Anti-foulants will be applied to the rotors and to the pile near to the heat exchangers which are susceptible to bio-fouling from mussels as observed at Strangford Lough. The paint used is inert and works by providing a surface that is difficult for organisms to stick to. The specific anti-foulant currently proposed for the SeaGen device is International Paints Intersleek 900 which, although in direct contact with the marine environment, is non-toxic. The data sheet is attached in Technical Appendix 5.2.

From experience gained on the SeaFlow and SeaGen systems, it is clear that there will not be a requirement to apply additional anti-fouling materials to the system while operating. The system will be anti-fouled during the manufacturing cycle and further treatments on site will not be necessary.

5.11.3 TGL Anti-fouling System

The TGL device uses anti-fouling coatings and materials, where required. For example, the blades will use one of three anti-foulant coatings currently being assessed as part of the Reliable Data Acquisition Platform Tidal (ReDAPT) programme by Plymouth Marine Laboratories who have been tasked under the programme to investigate biofouling and to test a number of antifouling systems. Other interface areas of the turbine use stainless steel or titanium to discourage marine growth. The rest of the structure will be painted using a two pack epoxy and will be treated during manufacture.

5.11.4 BlueTEC Anti-fouling System

Build-up of marine growth on the BlueTEC platform is unlikely to significantly affect the performance of the turbines attached to it and it is unclear what level of antifouling may be required. However, for the purposes of the EIA it has been assumed that the structure will utilise antifouling similar to that utilised on other shipping vessels. BlueTEC is part of an EU consortium investigating innovative environmentally friendly foul-release coatings and will apply the best available sustainable coatings. A decision on what presents the Best Practicable Environmental Option (BPEO) available will be made at the construction stage.

5.12 Scour Protection

The decision on whether to install scour protection will be made once the detailed design of the support structures has been performed, i.e. during the post-consenting phase but the indications of the surveys completed to date suggest that scour protection will not be necessary.

The installation of scour protection, if required, will be subject to review by regulators and consultees and it is acknowledged that the placement of scour protection post consent may require an additional Marine Licence.

Potential for scour will depend upon the presence or absence of seabed sediments at the turbine array, as well as their nature. This is discussed in more detail in Chapter 6: Physical Environment.

Scour protection (if required) would probably take the form of rock placement or deposition of rock /grout filled bags to stabilise any soft seabed sediments should a scour hole develop around the device foundation (where soft surface sediments are susceptible to tide or wave scour around the foundation). Any material used for this purpose will be of a suitable inert material, the grade of rock used should be of sufficient particle size to resist potential reworking by the marine forces acting around the pile base and as the result of extreme weather events.

5.13 Power Requirements

5.13.1 General

The majority of tidal turbines use asynchronous generators which require low levels of imported power from the grid system at each start up. Beyond this requirement the devices are self-sufficient with respect to power requirements in that any power required for systems operation is drawn from power generated during normal operation.

5.13.2 SeaGen S Power Requirements

During installation, any navigation warning lights will likely be battery powered with solar panels, partial commissioning may be carried out using a generator aboard the turbine or umbilical from the installation vessel. There are no diesel/hydrocarbons used or stored on the device.

5.13.3 TGL Power Requirements

During deployment, retrieval and maintenance activities, power will be supplied to the turbine from the maintenance vessel's LV system, or once towed in for service from the quayside LV supply.

5.14 Power Conversion System

5.14.1 General

In respect of the two example turbines (MCT and TGL) considered for the EIA baseline, the drive trains and power conversions systems are similar. They both convert the tidal flow into rotational power using a three bladed horizontal axis rotor, rotating at relatively low speed. At tidal currents of around 1m/s there is sufficient energy to start turning the turbine drive train which gradually increases in speed and power up to full load at tidal currents of around 2.5m/s. The turbine is then at full speed and rated power so then is "flat rated" as the tidal current increases providing no extra power or speed.

The drive shaft from the low speed rotor and hub is connected to the generator via a gearbox which steps up the hub rotational speed to a suitable generator speed. The variable speed element from cut in to full speed is accommodated electronically by frequency modulation in a power conditioning module within the turbine housing. A step up transformer is provided within the nacelle to step the voltage up to avoid losses during transmission to an onshore sub-station.

The gearbox also provides auxiliary power to mechanical motors as required to perform systems functions

5.14.2 SeaGen S Power Conversion System

The power conversion system comprises the blades & hub (rotor), main shaft, main bearings, gear box, high speed shaft, generator, and power electrical equipment. The hub contains the pitch system which actively controls the blade angle during operation. The main shaft incorporates a seal to the nacelle which is a standard marine type. The generator is a standard induction machine run at variable speed. The power electrical equipment comprises a frequency converter and a 690V/33kV transformer to provide grid-compliant power to the export cable.

5.14.3 TGL Power Conversion System

The power conversion system comprises the blades & hub (rotor), main shaft, main bearings, gear box, high speed shaft, generator, and power electrical equipment. The hub contains the pitch system which actively controls the blade angle during operation. The main shaft incorporates a seal to the nacelle which is a standard marine type. The gearbox is an epicyclic type, which outputs to the high-speed shaft which incorporates a disc brake. The generator is a standard induction machine run at variable speed. The power electrical equipment comprises a frequency converter and a 690V/6.6kV transformer to provide grid-compliant power to the export cable

5.15 Noise and Vibration Levels

A dedicated chapter, Chapter 19: Noise, has been written to enable environmental impact assessment to be carried out in the relevant specific habitats chapters, since noise is a significant concern with regard to the impact on marine mammals. The noise chapter makes reference to a background noise survey carried out on the site on the 10th October 2012 as listed in Technical Appendix 19.1, a noise model which has been designed to simulate the likely predicted noise of the 2MW SeaGen S Mk 2 based on measured data from Strangford Lough on the 1.2MW SeaGen S Mk 1 and the 1MW TGL turbine based on gearbox testing of the scale device in Technical Appendix 19.2. The model also includes predicted propagation based on actual seabed bathymetry. In addition, a literature review was undertaken to determine what applicable measured data was available to enable installation noise predictions to be made.

5.16 Device Offshore Infrastructure Marking

The positions of the device structures, moorings, and export cable and ancillary structures will be conveyed to the UK Hydrographic Office so that they can be incorporated into Admiralty Charts and the Notice to Mariners procedures.

The lighting and marking of the devices and the array will be to a specification required by Trinity House Lighthouse Service (THLS) and the Maritime and Coastguard Agency (MCA), and will be in accordance with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) standards. Additional guidance will be taken from:

- IALA Recommendation O-139 – On the Marking of Man-Made Offshore Structure Edition 1 Dec 2008;
- DECC Revised Standard Marking Schedule for Offshore Installations 04/11; and
- MCA Marine Guidance Note MGN 371 (M+F) - Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response Issues.

Physical marking of projects poses some challenges for non-surface piercing devices in high tidal stream areas particularly on exposed west coast sites where the combined effects of waves and tide action can make surface buoys expensive to moor and maintain. One of the benefits of surface penetrating devices whether the solid seabed mounted SeaGen S or floating and moored BlueTEC, is the facility to provide a platform for addition of aids to navigation. For these devices it is assumed that they will be both lit and painted as a special purpose marks (predominantly yellow RAL 1003). It is also likely that the devices will be equipped with either automatic identification system (AIS), and radar reflectors/transponders or both.

The layout options being considered for the project cover the use of entirely surface penetrating devices, entirely subsurface devices and a mixture of the two. Consideration therefore needs to be given to both the potential for device mounting of aids to navigation, and also the potential for marking in the event that all devices deployed were sub surface.

Proposals for marking would be designed in conjunction with, and authorised by THLS and the MCA and be dependent on the specific positions of the devices. This is discussed further in Chapter 8.3 – Shipping and Navigation.

5.17 Electrical Systems

5.17.1 General

There are a number of different approaches to the electrical system design with power conditioning either being conducted at the individual machines (similar to the approach taken by the wind industry) or conducted at the collector station. There are no significant effects of this decision on the EIA process.

5.17.2 SeaGen S Device Electrical Systems

The MCT turbine produces grid-compliant power at 33kV and 50Hz. Lightning protection is achieved via a conductor within the superstructure with associated surge suppression systems located in the electrical system.

5.17.3 TGL Device Electrical Systems

The TGL Turbine produces grid-compliant power at 6.6kV, 50Hz.

5.18 Heating and Cooling Systems

5.18.1 General

There are no water abstraction or discharge requirements for tidal turbines in general.

Some equipment in the turbines, including generators, gearboxes, brakes and bearings, produces heat in operation which will be directly cooled by the surrounding seawater. The power conditioning systems in the turbine nacelle may also require a cooling system, which will involve a liquid cooled closed loop system expelling heat to the external seawater environment via a heat exchanger.

On both the SeaGen S and the TGL turbines the internal systems are cooled by a closed 'water' circuit filled with water and non-toxic antifreeze of approximately 200 litres in volume (The coolant is 40% ethylene glycol and 60% water). This circuit dissipates its heat to the surrounding sea water through a marine keel cooler mounted on the outside of the nacelle. In the unlikely event of damage to the keel cooler this non-toxic coolant would be lost to the surrounding seawater.

5.19 Communication Systems

Like most modern industrial generation equipment tidal turbines utilise either a fibre-optic or hard-wired SCADA connection routed within the export cables for monitoring and control. Surface penetrating devices also provide the option for use of radio telemetry or satellite communications.

Communication with the device is achieved via a fibre optic cable located within the export cable duct to the onshore sub-station. The sub-station will house a modem connection enabling connection to the telephone network for offsite control and monitoring.

5.20 Chemical Use and Management

During installation, commissioning and operation a range of chemicals are used. A list of materials used by the SeaGen S and TGL TEC`s including relevant data sheets and details of compliance with a recognised international standard is provided in Technical Appendix 5.1 to 5.4. These are fairly typical of the chemicals that would be used regardless of technology or manufacturer.

5.21 Potential Discharges to Sea

5.21.1 General

With specific reference to the tidal turbines it is a general design principle that as far as possible no pollutants are permitted to escape into the environment. Design techniques include use of double seals, pressure balancing and internal drains to bilges.

During operation and maintenance HAZOP studies are undertaken to apply operational procedures which ensure that there is no fluid discharge. However, in the unlikely event that spillages are detected, specific procedures are put in place to minimise pollution, these activities are specific to each turbine model

Information regarding potential discharges to sea during installation and commissioning are provided in Section 5.26: Construction

5.21.2 SeaGen S Potential Discharges to Sea

There are no anticipated direct aqueous discharges to the marine environment during normal operation of the device. The only moving parts in the structure are the turbines themselves and the cross arm raised and lowered during maintenance activities, and the only potential contaminants are internal lubrication/hydraulic oils and transformer oil which are appropriately sealed and bunded.

Experience from the deployment of the MCT SeaGen TEC in Strangford Lough and its operation over the past four years has demonstrated that the effectiveness of the MCT design principles in respect of discharge control. It is not anticipated that there will be a requirement to introduce any additional potential contaminants such as oils, hydraulic fluids and anti-foulants during this phase of the project. There are no anticipated direct discharges to the atmosphere during normal operation of the Project.

There are no anticipated solid discharges into the marine environment during normal operation of the devices. Any waste generated during operation, for example associated with maintenance, will be collected and disposed of by licensed waste management contractors to appropriate facilities onshore.

5.21.3 TGL Potential Discharges to Sea

Fluids contained in systems with components external to the nacelle & within the detachable winch are of the biodegradable, low-toxicity type, and under normal conditions are fully contained.

For internal fluid systems, low-toxicity types have been selected as far as possible although the risk of release to the marine environment of these systems is low due to the bund affect offered by the nacelle and hub.

The TGL nacelle has a bilge system designed to expel sea water in the event of minor turbine leaks. The bilge system is has a sensor configured to prevent any oil leakage from internal systems from being pumped overboard.

5.21.4 BlueTEC Floating Platform

In normal operation, there are no discharges to sea. In the event of an unforeseen failure in an extreme event, a spill of onboard fluids may occur, such as oils from the hydraulic system or greasing oils. The maximum amount of fluids is estimated to be less than 1000 litres. Provisions will be made onboard to avoid spill, such as drainage plates, non-return valves and automatic shutdown systems compliant with marine environmental safety standards. This procedure will also be covered in the Emergency Response Procedures.

5.22 Potential Discharges to Air

Potential discharges to air during installation and commissioning are provided in Section 5.26: Construction

There are no potential discharges to air from either the SeaGen S or TGL turbine during normal operation or maintenance.

5.23 Turbine Electrical Connections

5.23.1 General

For near shore tidal farms the option exists for cabling individual turbines to shore and then grouping within an onshore substation. For tidal farm proposals further offshore or for larger projects the individual cabling solution would result in the need for the supply of large cable quantities, and result in increased transmission losses and is generally not considered to be economically viable. This leaves a number of options:

- Daisy chaining a number of turbines together to form small clusters and exporting ashore along a single cable per cluster;
- Connecting individual turbines to a central platform (subsea or surface penetrating) and then shipping ashore potentially at a higher voltage; or
- A combination of both - assembling clusters of turbines at a central platform and then exporting via a single usually higher voltage cable.

The choice of TEC and in particular whether they are surface penetrating or entirely subsea has a significant impact on the feasibility of these options.

5.23.2 Dry Mate & Wet Mate Connections

On an offshore wind farm where the turbines produce grid compliant power, it is normal practice to interconnect the turbines by "daisy chaining" individual machines and then marshalling or collecting the groups to form clusters at a voltage step up transformer station. For wind turbines this is easily achieved since, all wind farms incorporate surface penetrating structures and all connections can therefore be made dry (dry mate connections). In the same way one of the major advantages of utilising surface penetrating tidal devices whether floating or fixed is the ability to use the structure as a dry connection point. With the appropriate design of the structure it could provide a collector platform for multiple dry mate connectors, a voltage step up transformer or power conditioning equipment and act as the final export cable connection point.

For a non-surface piercing tidal farm the daisy chain approach would require three phase wet 'break and remake' connections (wet mates) capable of transferring several megawatts of power. Whilst subsea electrical connections of this type have been available for some time, these have largely involved small connectors for subsea communications or low power connections for oil field seabed equipment. The design and manufacture of reliable high voltage and current wet mate connectors is one of the main challenges facing the industry.

For a fully surface penetrating solution the use of wetmates can be eliminated entirely, and by strategic siting on a mixed site the use of wetmates can be restricted to individual machines. For the entirely non surface penetrating layout option the challenge remains. The EIA has considered the issues associated with each of the alternative options as part of the design envelope.

5.23.2.1 SeaGen S Turbine Connections

For the SeaGen S the cable is terminated at high voltage (HV) switchgear located within the turbine tower, entering the structure via J-tubes. Since the connections are all dry the machines can be easily daisy chained. It is highly likely that this methodology will be utilised on the project featuring as a minimum of three SeaGen S turbines to act as marshalling/transforming dry connections.

5.23.2.2 TGL Turbine Connections

Daisy chain connections are not currently possible with the TGL as the wet mate connector which connects the turbine module to the cable installed on the foundation is only rated for one turbine output. The current position for the TGL device as for other subsurface machines is that individual machines need to be hard wired using flying leads from the devices to the nearest dry connection. For a combined surface piercing and non-surface piercing site this function can easily be provided by the surface piercing device, or alternatively provided by a dedicated collector or marshalling platform. Subsea solutions are also being developed and the proposed TGL solution is outlined below, although it should be noted that these are still under development and therefore less likely to be utilised on this project due to project programme constraints. In any case, it is considered that the use of this technology does not form a worst case scenario as the installation methodology will be broadly similar to the foundation installation, though with lower wave and tidal loading will require significantly less depth of drilling.

5.23.2.3 BlueTEC Turbine Connections

As with the SeaGen S turbine, all connections and electrical equipment are housed within the platform and therefore connections can be made dry.

5.23.3 Marshalling/ Collector Systems

For sites further offshore, where distances to the closest grid connection point are significant, transmission losses at low voltages can be substantial. In these instances the turbine voltage would need to be stepped up to an appropriate export voltage (possibly to 132kV) and then connected to shore by subsea cable. Achieving this on a surface piercing platform is relatively straight forward; achieving this subsea is somewhat more difficult.

Alternative solutions including multi-point and multi-megawatt wet mate connectors are currently in development, as well as large capacity subsea transformer stations. The TGL solution to this problem involves an innovative buoyant hub similar in philosophy to that of the buoyant nacelle of the TGL turbine, offering rapid deployment and retrieval by relatively small vessels. TGL are designing the complete system and innovative hub to base alignment and multi-wet mate stab solutions. Its partner Seacon Europe Ltd (SCE) is designing an innovative low cost hybrid medium Voltage/optic wet-mate connector for integration within the hub.

The preliminary design for the subsea hub features a seabed mounted base unit secured either by pin piles or gravity base which would provide cable connection from the array and of the export cable and a buoyant hub containing switchgear and power conversion equipment. A preliminary concept design is as shown in Figure 5.19 below.

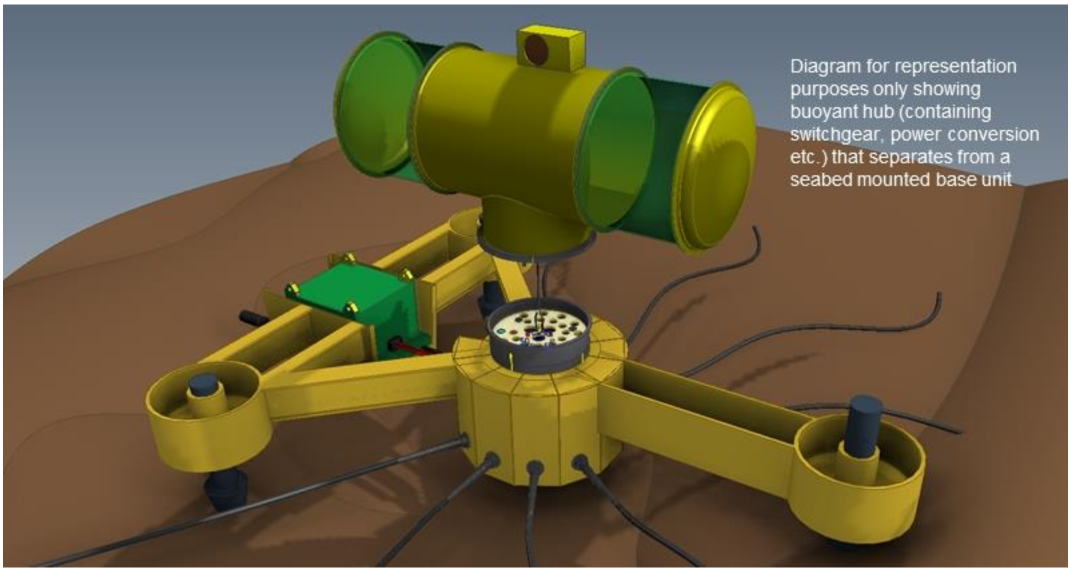


Figure 5.19: Subsea Hub

5.24 Inter-array Cables

5.24.1 Inter-Array Cabling

The inter-array cable voltage will depend on the individual device generator and transformer design which in turn will depend on device philosophy and physical space within the nacelle. However, this is likely to be of the order of 6.6 - 33 kV as it is within the wind industry. The cables are typically 3-core copper conductors with insulation/conductor screening and steel wire armouring. The insulation will be either dry type XLPE, wet type XLPE or a combination of both. All cables will contain optical fibres embedded between the cores. The cable dimensions would depend on the load current that the cable is required to carry and this may vary depending on the layout design and whether machines are daisy chained or individually connected back to the marshalling turbine(s).

5.24.2 Cable Protection/Ballasting

Regardless of the device type the need for subsea cabling between machines and between tidal farm and shore brings with it significant challenges. The majority of tidal sites are heavily scoured by virtue of the high tidal velocities and consequently the seabed has few deposits which would enable easy cable burial for protection. If left unprotected, in the high current and constantly reversing flow, cable movement will result in abrasion and wear of the protective armouring

Laying subsea cable is in itself not a new technique and there are many submarine cables for telecommunications and electricity. However, the challenges in this instance are laying cables in a high tidal energy environment and subsequently protecting the cable from potential damage due to that environment. Careful cable routing utilising natural seabed features can help keep the armoured cable out of the most aggressive tidal flows until the cable run reaches lower velocity areas.

Once in areas with lower tidal movement, and seabed sediment it is normal that the cable would self-bury over time under its own weight. In the high tidal areas where there is high energy and rock seabed, beyond the routing through natural features special techniques may also be required to protect the cable.

Approximately 20km of inter-array cables will be installed directly onto the rock seabed and configured to utilise localised fissures where possible and to be laid in parallel to the tidal flow where this is not possible. Where necessary, the cables will also be secured by the use of cable protectors, concrete mattresses or rock bags.

5.24.2.1 Cable Armouring

Cable armouring is typically employed in areas where cable burial is not possible and/or where there is a perceived high risk of damage to the cable, the Islay tidal site is such a location. Cable armouring is typically available in several types including single armoured and double armoured.

Single armoured cables are unlikely to be of sufficient weight to remain in-situ in the high tidal currents on their own and may require some sort of ballasting. It is likely that unless other options such as rock dumping or placement of concrete mattresses prove more suitable, double armoured cable will be used since it is both significantly heavier and will also provide greater protection from damage.

Double armoured cable typically consists of an inner armoured layer with steel wires of approximately 5mm in diameter surrounding the conductors, which would then be overlaid with a second layer of armouring with steel wires of 7mm in diameter (Figure 5.20).

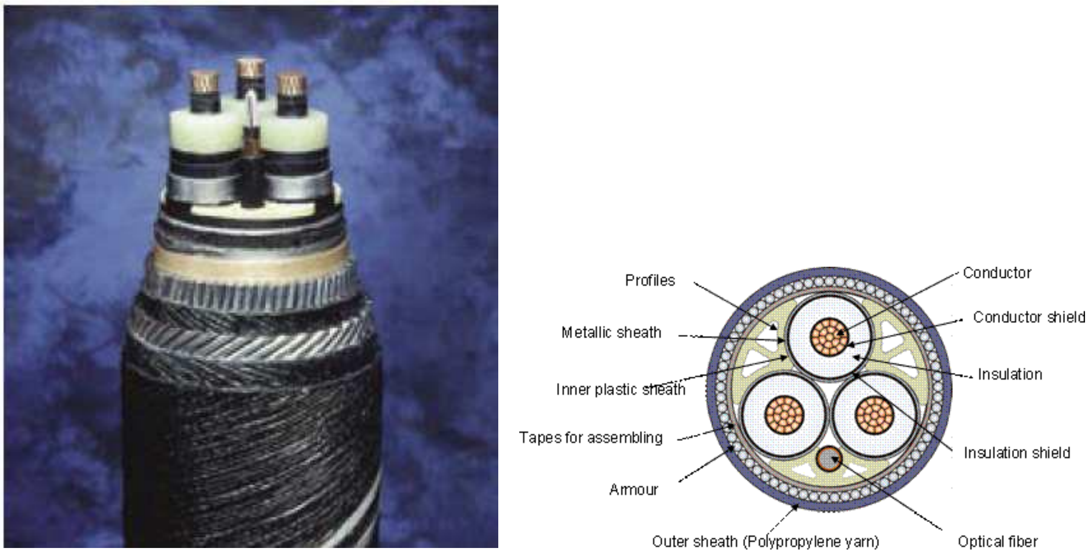


Figure 5.20: Typical Cross Section of a Double Armoured Cable

5.24.2.2 Rock Placement

Rock placement is an established practice for protecting subsea cables however it is unlikely to be a suitable solution for the inter-array cables since the size of rock required to resist the currents will be too great. However, this is considered to be the potential worst case scenario with an assumption that 100% of the cables will be covered by rock to a width of 4m either side of the cable.

5.24.2.3 Ballasting with Rock Bags Grout Bags, Sand Bags or Stone Mattresses

Stone, grout or sand bags are usually installed by divers or ROV to stabilise or fix in place a cable over short distances. Grout bags can either be deployed as pre-filled bags or for larger applications empty fabric bags are taken to the seabed and a diver coordinates the filling of the grout bag using a grout mix and pumping spread from the host vessel above. This option may be used in discrete areas.

It is most likely that 2 tonne rock bags will be employed to ballast cable strategically placed at frequent intervals. An example rock bag specification has been included in Technical Appendix 5.5.

Figure 5.21: Ballasting with Stone Bags in Situ

Figure 5.22: Rock Bags Being Lowered

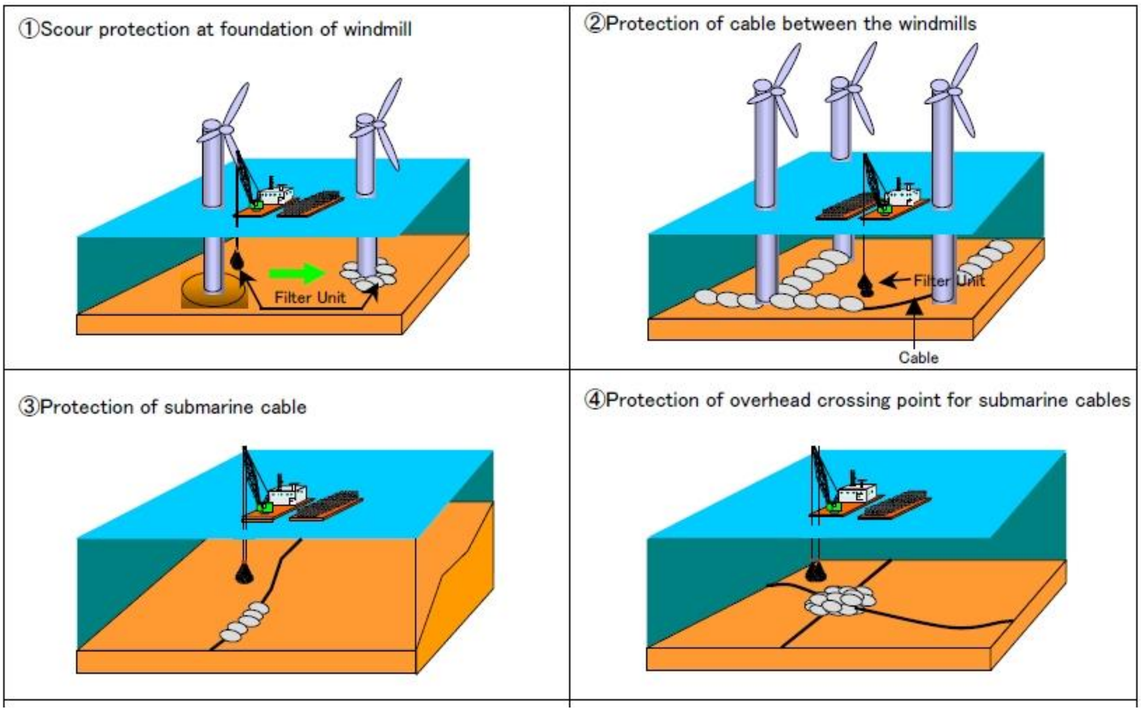


Figure 5.23: Different Applications for Rock Bag Installation

5.24.2.4 Ballasting with Articulated Metal Shell Connectors

Articulated metal shell connectors are typically used to provide cable sections with added mass and abrasion resistance in high energy environments such as cable shore landings, rock outcrops and where other forms of cable burial are not possible. The articulated sections are typically applied by divers in half sections which are then locked or bolted together to form a continuous pipe section. This option may be used in discrete areas where the weight of the cable is not sufficient and is the most likely ballasting option.

Figure 5.24: Cast Iron Cable Casings

5.25 Export Cable to Shore

5.25.1 General

The outline connection proposal is based around use of one or more double wire armoured sub-sea cable from the project to landfall on Islay with an expected export voltage of around 33kV. A review of connection options via either single or multiple cables from a single turbine marshalling point as described above or from multiple cables from multiple marshalling points is currently being undertaken. Higher voltage options up to 132kV are also being considered which may enable use of a single cable rather than multiple 33kV but this still remains to be determined.

5.25.2 Cable Type

The 3-core cable being considered comprises copper conductors with integral insulation, core screening, and steel armour (for stiffness and impact resistance). The cable would have a polypropylene outer sleeve with an external diameter of approximately 150mm (33kV) and 300mm (132kV). The AC cable will also include internal fibre optic communication links for control purposes.

5.25.3 Cable Protection/Ballasting

Similar techniques as those reported in Section 5.24.3 will be utilised depending on the seabed structure throughout the length of the export cable from the Tidal site to landfall on Islay. It is likely that rock bags will be utilised at intervals on the western end of the export cable where the tide is more aggressive and the sea-bed made up of rock. Further east there is the potential for self-burial. However, a worst case scenario presumes 100% cable coverage with rock dump to a width of 4m either side of the cable.

5.25.4 Offshore Cable Route and Landfall Locations

The most likely option for export is for a subsea power cable rated at 33kV from the Project to landfall on Islay near Kintra *(and a subsequent 132kV cable from the Islay onward to final connection point on the mainland)*. The route and landfall location are shown in Figure 5.2.

The technique for making landfall depends on the shoreline geography. If the landfall is rocky and steeply inclined, directional drilling may be required. However, where a shelving beach is available it is possible to trench the cable at low water through the intertidal zone, and plough the cable to a suitable distance off the beach to ensure the cable is not visible and safely away from human contact.

The landfall trench in the tidal zone will most likely be excavated and backfilled using shore-based tracked excavators. The short stretch of trench below low water will be created using an underwater plough as shown in Figure 5.25 towed by the cable laying vessel after the cable has been pulled ashore.

Figure 5.25: Plough for Shallow Waters and Intertidal Zone

The cable is pulled ashore from the cable lay vessel using a shore based winch. The winch normally has a footprint no bigger than 2m x 2m a slightly larger flat platform will have to be prepared at the top of the beach for the winch to sit on. The winch will either be held in place by concrete ballast blocks or by ground/rock anchors which require the drilling of no more than two 10-15cm diameter holes into the ground. The anchors are removed after work is complete and the holes are backfilled. The area of beach where the winch was located will be restored to its original profile using the same materials that were originally removed.

Figure 5.26: Onshore Cable Trenching

It is anticipated that the cable will be laid in a trench approximately 2m deep through the surf zone and across the beach.

Figure 5.27: Tidal Zone Cable Plough Trenching

After the cable has been pulled ashore the trench in the tidal zone will be backfilled to its original condition with beach sand.

5.26 Installation

5.26.1 General

Turbine support structure design, foundation design and consequently installation methodologies and costs are some of the main drivers in tidal energy park economics. Installation methods will vary from device to device, and from contractor to contractor and it is also possible that final methodologies may have to be adjusted dependent on availability of vessels at the time of construction. Therefore maintaining flexibility in installation options and designing an envelope is critical.

A detailed Construction Methods Statement (CMS) incorporating an Offshore Cable Feasibility Assessment (OCFA) will be produced prior to commencement of construction based on the final TEC selected, the identified contractor and the vessels proposed for installation. This will detail vessel movements, types and numbers and specific methodologies and mitigation measures adopted.

To date there have been no commercial tidal arrays installed or full industrial scale installation methodologies and systems proven, so the following is a combination of expected installation methodologies, based on the experience of the installation of individual tidal turbines at EMEC and Strangford Lough and experience from the offshore wind industry.

5.26.2 Methods and Key Elements

Installation methods vary depending foundation type and turbine technology but can generally be considered to consist of a number of key elements:

- Preparation Works – pre installation and foundation preparation;
- Foundation installation;
- Turbine installation; and
- Commissioning.

Each of these activities can have environmental impacts, such as noise emission, potential vessel navigational hazards, spills, soil excavation etc. The degree to which these are significant will depend on the chosen design and technology and may be reduced by an environmental impact mitigation plan.

The two examples given below utilising SeaGen S and TGL can be taken to be typical of activities involved in installation. Though not currently being considered, the use of a gravity base is likely to reduce some of these activities, as is use of a floating platform which remains a serious option.

Both the SeaGen S and TGL support structures have similar installation methodologies including pre-installation works which involve use of drilled and grouted piles.

Clearly the large size of the foundations requires sea transport and fabrication of the heavy structures is therefore conducted close to or at existing port facilities.

The major turbine equipment including the nacelle and drive train can be manufactured elsewhere and delivered by land to the seaport before mobilisation and deployment. This may involve splitting the turbine up into subassemblies based on weight or dimensional restrictions. Ancillary barges, tugs, safety vessels and personnel transfer vessels will also be required.

No decision has been made with regard to the most appropriate port facility for mobilisation but a number of options exist in the vicinity of the site, for example Glasgow Port, Mostyn or Belfast, the locations of which are shown in Figure 5.28.

5.26.3 Pre-installation Works

Detailed metocean studies, geophysical and geotechnical surveys will be required prior to construction which will inform any micro siting or pre-installation works required. Following these seabed surveys each foundation location will be chosen and oriented in order to minimise potential seabed preparation works. Initial information from the preliminary geophysical surveys and camera work undertaken to date suggests that pre-installation works such as the removal of boulders is unlikely (more so because gravity based foundations are not being seriously considered) but this will require more detailed assessment before a final decision is made. In addition, the utilisation of the self-levelling template installation methodology as detailed in 5.26.5 enables turbines and sub-sea hub to be located on rough seabed bathymetry. If more substantial features such as boulders are present which the self-levelling template cannot accommodate then the turbine would require to be relocated.

5.26.4 TGL Installation Procedure

The installation works will most likely be executed by jack-up vessels, DP2 vessels or Heavy Lift vessels (HLV) by using a seabed drilling template to execute the seabed drilling works.

Details of the installation methodology will be given in the CMS once the final design has been completed. However an outline methodology is described below.

5.26.4.1 Foundation Installation Phase 1 – Pin Pile Locations

A template is lowered at the TEC location and levelled to achieve the desired verticality of the pre-piles. Rock sockets are then drilled using a reverse circulation drill mounted on the tripod template. The piles are lowered and grouted prior to removal of the template as shown in Figure 5.29 leaving three (or four) pre-piles accurately positioned in all axes. The steel piles will protrude slightly above the seabed. The grout injected into the annular gap between steel pile and rock socket will be a cement based underwater grout.

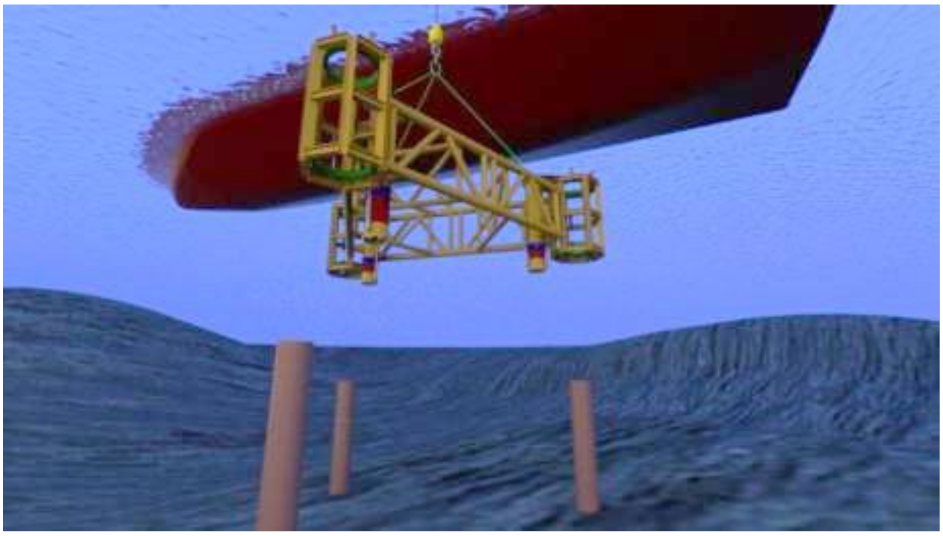


Figure 5.29: Raising Template Following Location of Pin Piles

5.26.4.2 Foundation Installation Phase 2

The foundation substructure is lowered into the pre-installed piles (pre-piles) to enable the foot sleeves to be grouted to the piles as shown in Figure 5.30. The tripod is then finally installed with cartridge plate, cable tether laid away with dry mate ready to receive the turbine module.

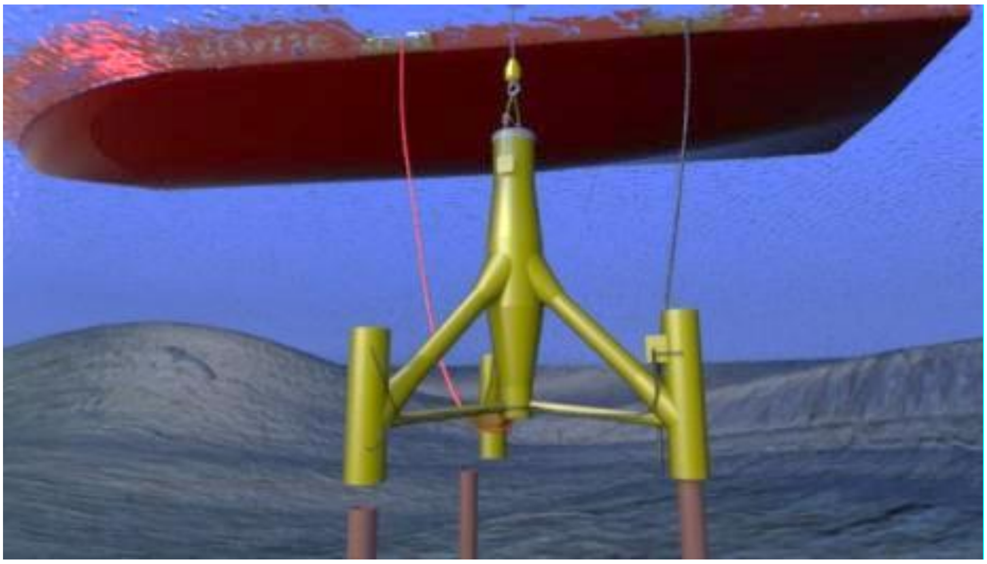
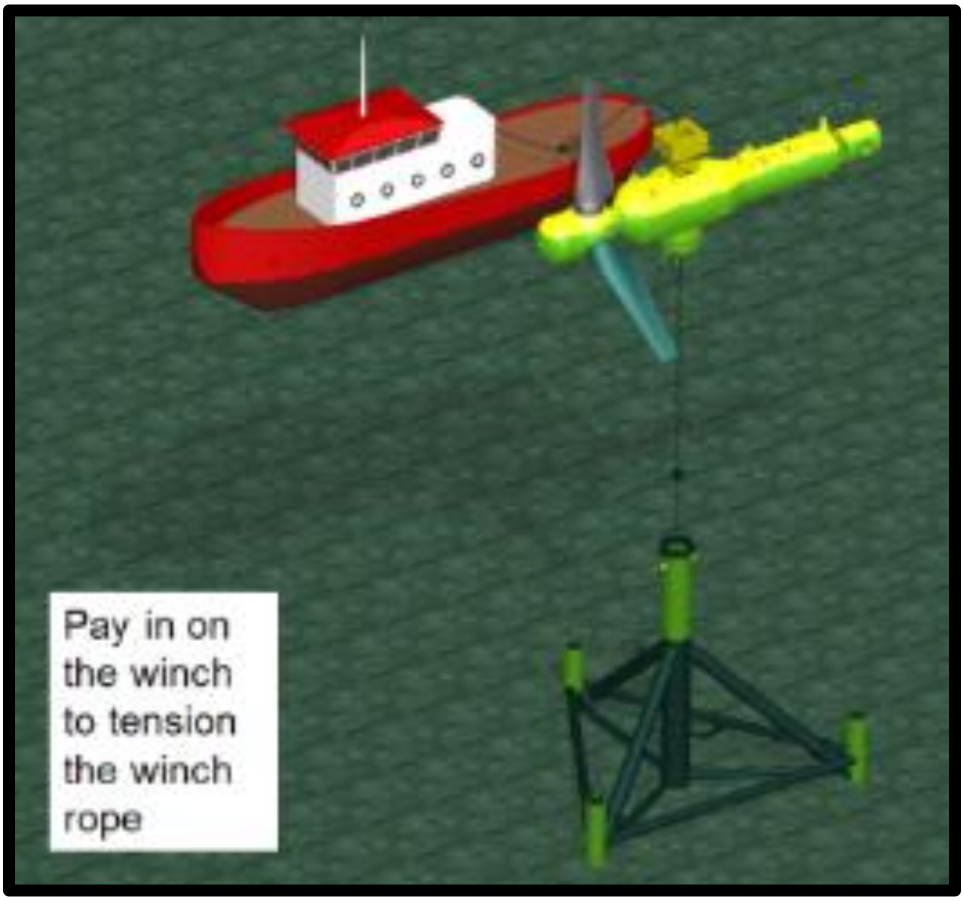


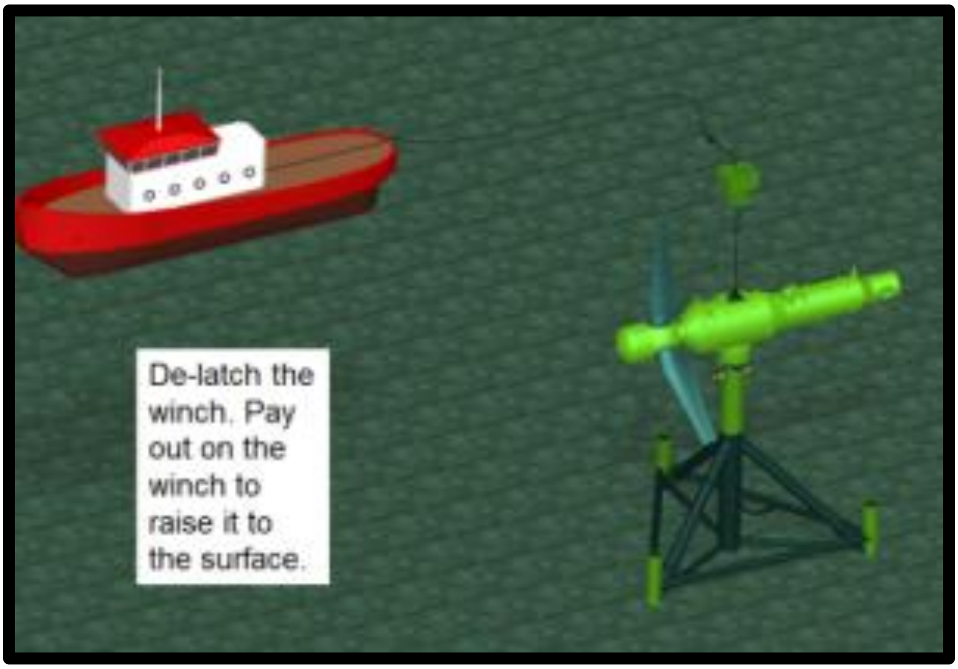
Figure 5.30: Lowering pins of Tripod into Pre-Piles

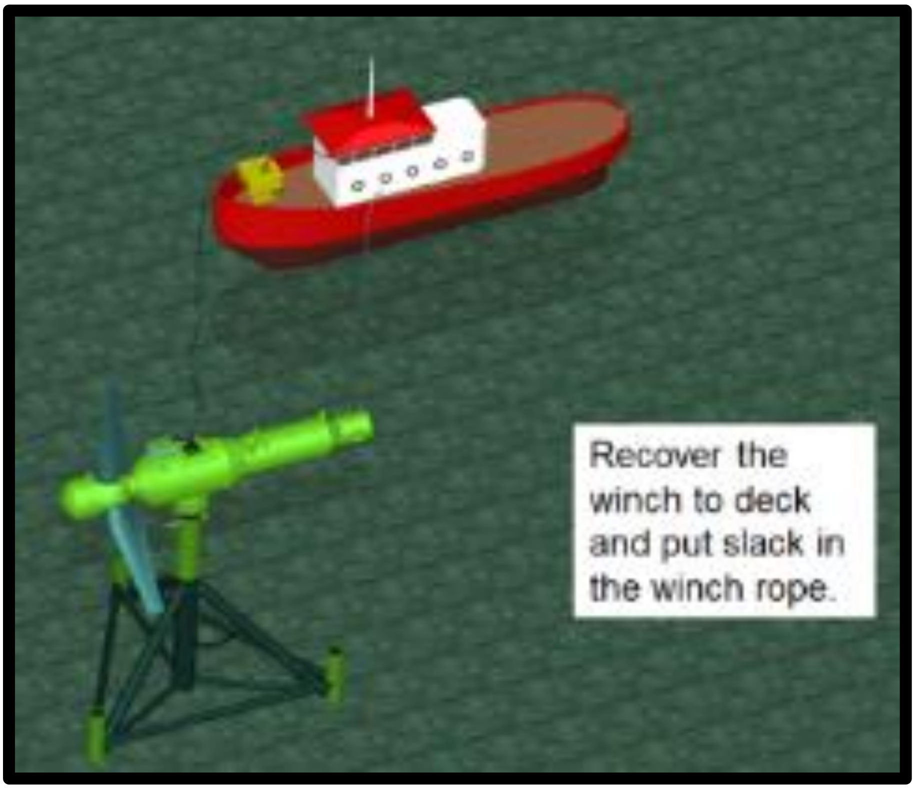
5.26.4.3 Turbine Installation

Installation of the turbine involves towing the turbine/hub to site using a small O&M vessel (Figure 5.31) as specified in Table 5.6. Deployment of the turbine/hub to the tripod is then undertaken using the detachable winch as during a normal O&M changeover. The detachable winch is then retrieved to the deck of the O&M vessel before returning to port as shown in the following figures. The installation of the subsea marshalling hub would be similar if used.

Figure 5.31: O&M Vessel Towing TGL Device


Pay in on
the winch
to tension
the winch
rope


De-latch the winch. Pay out on the winch to raise it to the surface.


Recover the winch to deck and put slack in the winch rope.

Figures 5.32: Installation Methodology TGL

5.26.5 Seagen S Installation Procedure

The installation works will most likely be executed by jack-up vessels, DP2 vessels or Heavy Lift vessels (HLV) by using a seabed drilling template to execute the seabed drilling works.

Details of the installation methodology will be provided in the CMS once the final design has been completed. However, the outline methodology is described below.

5.26.5.1 Phase 1 – Pre-pile Locations

The process of pre-pile installation is essentially similar to that of the TGL. A template is lowered at the defined location and levelled to achieve the desired verticality of the pre-piles. Rock sockets are then drilled using a reverse circulation drill mounted on the tripod template. The piles are then lowered and grouted prior to removal of the template leaving three (or four) pin piles accurately located in all directions. The steel piles will protrude slightly above the seabed. The grout injected into the annular gap between steel pile and rock socket will be a cement based underwater grout.

5.26.5.2 Phase 2 – Installation of Foundation and Turbines

The SeaGen S tower support structure and turbine assembly are lowered into the pre-piles as a unit prior to the foot pins being grouted to the pre-piles as shown in Figure 5.33.

Figure: 5.33 Heavy Lift Shearleg Vessel Rambiz

The SeaGen S units are modular and will be assembled onshore using harbour facilities before delivery to site by sea. The method of delivery will depend on the availability of vessels. They may be loaded directly aboard a specialised vessel such as the DP Jack Up "Innovation" as shown in Figure 5.34 or taken out via a floating flat-top barge into a local area of sheltered suitable storage where they will be stored awaiting installation.

Figure 5.34: DP Jackup Vessel Innovation

The SeaGen unit including all appurtenances will then be lowered onto the foundations and grouted to the foundation. One of the potential advantages of utilising specialist vessels such as the JUP Innovation is that such a vessel can take five full SeaGen S units, and drilling template and all installation equipment simultaneously on board to execute all works (drilling, foundation, turbine and inter-array cable installation) in one operation.

5.26.6 Installation of BlueTEC Floating Platform

The installation process for the fully assembled BlueTEC floating platform is divided into three phased stages:

1. Installation of the anchors and mooring lines
   The anchors are most likely to be steel tubular piles installed in a similar way and with similar vessels as the pin piles for the bottom mounted turbines, they are however likely to be of smaller dimensions.

2. Connection of the inter-array cables
   Since the devices are floating the connection of inter-array cables can be done with relatively small DP vessels.

3. Commissioning of the platform.

The devices themselves are floating and therefore connection and disconnection can be executed with widely available vessels, without the need for large offshore vessels.

5.26.7 Installation Procedure Inter-array Cabling

Three primary cable installation techniques have been considered. These are as follows:

- Direct laying of armoured cable on the seabed, with the possibility of pinning;
- Direct laying of cable on the seabed and covering with rock or concrete mattresses; and
- Trenching the cable using a trenching plough in the intertidal area.

A cable laid directly on the seabed in the vicinity of the tidal array would be particularly vulnerable to movement or impact from strong currents or the movement of coarse sediment and rocks along the seabed. The area to the immediate east of the tidal array is also fished for crab and lobster.

The options of trenching the cable into the bedrock, or covering the cable in a protective blanket of rock or concrete mattresses have been considered. Initially it is felt that the environmental and cost consideration of trenching is likely to rule out this option.

The decision on which technique to use for cable installation, and need for cable protection is linked to the navigation risk assessment, density of fishing, ground conditions and metocean conditions. All these factors will be considered in an

Offshore Cabling Feasibility Assessment which will be carried out following consent to aid the decision making process. For the purposes of the ES a worst case environmental scenario of rock dumping along the cable route has been assessed. The cables will be trenched through the intertidal areas.

For the inter-array cables a winch mounted on the SeaGen S platform or mounted on a suitable vessel will be used to connect the cable to the devices. A cable laying vessel will then be used to take the cable to the next device in the array.

5.26.8 Vessels and Device transportation

The main installation vessel will remain on site carrying out installation activities while a transport barge will be tasked with sailing between the installation site and the base port for loading of the components. The number of vessel movements will depend on the size and type of vessel and the selected turbine technology. For example the Jack Up Vessel Innovation can load five SeaGen S units and all installation equipment and transport them in one trip. There will be daily vessel movement of additional supply vessels for materials, plant, equipment and personnel. It is likely that much of the day-to-day traffic would be from Port Ellen on Islay to site.

The table below illustrates a range of typical scenarios for delivery of turbine and foundation equipment to site.

Type of Installation Vessel	**Large size Jack up barge as installation vessel**	**Medium size Jack up barge as installation vessel**	**Dynamic positioning scenario**
Size of vessel	150m x 45m	68 x 38m	155m x 30m
Foot print of mooring system	X4 triangular lattice spuds with circa 140m2 spud area	4 circular spuds ca. 10m² spud area (possibly extended with spud cans)	Dynamic positioning holding a footprint of +/- 5m
No of tugs required	Jackup vessel is typically self-propelled	Jackup vessel is typically self-propelled, but possible X1 tugs required for initial positioning (30m x 22m)	n/a
Anchoring Handling Vessel (AHV)	n/a	n/a	n/a
Flat top barge (to bring out large items	n/a	n/a	n/a
Crew change support vessel (vessel length	up to 26m		up to 26m
Install vessel	100m x 50m		100m x 50m
SeaGen unit installed by	Same vessel	JUP vessel in case SeaGen S unit split up into multiple sections or by HLV (Heavy Lifting Vessel)	DP2 vessel in case SeaGen S unit split up into multiple sections or by HLV

Table 5.6: Foundation and Turbine Installation Vessel Options

5.26.9 Different Vessels Impacts

5.26.9.1 Heavy Lift Shearleg

The heavy lift shearleg vessels hold their position by means of anchors, it is most likely that the previously installed foundation piles will be used as anchors, hence there will be few additional impacts

However, there is some potential for catenary of the anchor chain as the barge manoeuvres, with some of the resulting 'slack' chain resting on the seabed. This may result in seabed abrasion for approximately 80m of seabed along the line of each of the chains in a corridor estimated as 1m wide, resulting in up to 80m^2 of potential abrasion impacts associated with each of the potential anchor points.

5.26.9.2 Jack Up Barges

If a jackup barge is used the worst case footprint would be The Innovation which has 4 "spuds" each with a footprint of 140m^2 each. The vessel will Jack-up at least once at each turbine location and potentially at a few other locations along the export cable route during cable laying operations if it is used for this purpose.

5.26.9.3 DP Vessels

DP vessels may be used on the project but if they are they are most likely to be relatively small compared to the vessels already described. DP vessels do not have any direct contact with the seabed since they are held in position by a number of thrusters

5.26.10 Potential Discharges at Sea During Installation

5.26.10.1 Drill Cuttings

Drill cuttings will be produced during the drilling of rock sockets. For the purposes of the environmental assessment 4 sockets have been assumed for each turbine location (i.e. greatest environmental impact) plus 4 for a possible subsea collection station, resulting in a maximum of 124 rock sockets to be drilled. However, a tripod structure is more likely and depending on the selected turbine technology it is possible that only 45 rock sockets may be required.

The assessment has been based on the normal method for disposal of drill cuttings, which is to release drill cuttings directly into the water column at the seabed where cuttings emerge from drilled socket. This methodology has been successfully applied and consented in many offshore wind farms in the UK.

Chapter 6: Physical Environment provides details regarding the potential for dispersal.

The design envelope based on the 31 TGL quadrapod foundations would require the drilling and installation of 124 x 2.3metre sockets to a depth of around 5m for each turbine. The maximum volume of drill cuttings produced for this foundation type would be 2,500m^3. The likely volume based on the SeaGen S tripod structure and 45 rock sockets 11m deep would be 2,000 m^3.

5.26.10.2 Lubricant from Grout Lines

The lubricant from the grout lines is not yet confirmed but likely to be sea water.

5.26.10.3 Hydraulic Oil from Template

The hydraulic oil from the template drill is not yet confirmed but will be biodegradable as listed in Technical Appendix 5.3.

5.26.10.4 Grout Leakage or Overfill

A worst case 5% overfill has been assumed resulting in a potential leakage of around 0.5m^3 per foundation.

5.26.11 Generation of Other Onsite Waste

During construction and decommissioning some discharges to atmosphere would arise from the marine vessels required to undertake these stages of the development. In addition, there is a small risk of accidental discharges to water from the turbine array or marine vessels associated with construction and decommissioning. These are not considered to be significant and will be addressed in the Environmental Management Plan.

Apart from the drill cuttings noted above, there are no anticipated solid discharges into the marine environment during the construction phase.

The vessels and crew also produce waste (materials, food, broken parts, used oil, sewage etc.), but these will not be discharged overboard and will be sorted, assembled and disposed of onshore by a recognised Waste Disposal Contractor.

5.26.12 Safety Zones

The Project intends to apply for a temporary construction safety zone under Section 95 of the Energy Act 2004. The purpose of the safety zones is to protect project construction plant and personnel and for the safety of third parties. A safety zone of 500m is proposed. The location of this safety zone will be dependent on the location of construction activity and will therefore shift according to placement of construction plant.

Third parties will be excluded from safety zone during the construction period and this zone will be marked in accordance with Trinity House recommendations. Regular Notices to Mariners will be issued during construction phase.

5.26.13 Lighting and Marking of Construction Area

The construction area will be depicted on Admiralty Charts by the UK Hydrographic Office (UKHO), and information pertaining to construction will be disseminated through the Notice to Mariners procedure and regular communication with local and regional stakeholders. The construction area may also be marked by a series of temporary buoys around the perimeter subject to agreement with relevant authorities.

Once certain construction activities have been completed, there will be a need to mark such structures in a temporary fashion before full power from the grid connection has been obtained and a marking protocol as specified by Trinity House will be implemented. Therefore, it is proposed that the temporary lighting and marking of the site during construction is agreed between The Project Developer and relevant authorities as conditions to the relevant consent(s).

5.27 Commissioning Phase

5.27.1 General

Due to the different design features of the MCT with dry on site access and the TGL device which is submerged, commissioning procedures vary considerably between the two devices.

5.27.2 Commissioning MCT SeaGen

Once the TEC has been installed, it will be subjected to a short commissioning phase which is planned to last up to 2 weeks per device. During this phase the turbine will be subjected to various trials, which include:

- Raising and lowering the generators and turbines to and from the surface;
- ROV assessment to evaluate the sea bed condition in the area of jack up operations following installation;
- Visual inspection of pile and turbine components to ensure that they were not damaged during the installation phase;
- Electrical operation checks;
- Commissioning and installation of shore side monitoring and control systems;
- Verification of calibration of instrumentation;
- Grid connectivity tests; and
- Initial operation of the system.

During this phase of testing, the system will be manned daily, and transfers will take place via a suitably sized crew vessel from Islay. The vessel will be present during all manned commissioning operations for rapid egress of the crew. This follows from the practice adopted for SeaFlow and SeaGen in Strangford Lough.

Throughout the commissioning phase the TEC will only be operated when personnel are present on the structure. During the period when the remote or automatic mode of operation is being first tested, personnel will still be present on the structure to ensure that the systems are operating correctly and to monitor the instrumentation.

5.27.3 Commissioning TGL

The commissioning of each TGL device will take around 6 days, building up from connection checks, to full power generation, and finally power curve validation.

5.28 Operational and Maintenance Requirements

5.28.1 General

Following installation and commissioning, a period of up to 6 months of characterisation and performance testing will occur to validate performance, optimise the equipment and undertake reliability runs.

The Project would then be available to generate electricity for commercial customers. The proposed array has a minimum designed operational life of 25 years. This ES therefore considers an operational phase of 25 years.

The scheduled maintenance requirements and activities over the project lifecycle are device dependent and are described in more detail below. As the devices are designed to operate continuously, any scheduled downtime will obviously result in loss of revenue and therefore will be kept to a minimum.

5.28.2 Safety Zones

The Project intends to apply for operational safety zones around each turbine device under Section 95 of the Energy Act 2004. The purpose of the safety zones is to minimise navigational risk to other sea users and damage to the turbine devices. A safety zone of 50m around the tower of each location is proposed. The categories of users to be excluded will be determined in consultation with MCA and relevant representative bodies.

Third parties will be excluded from the safety zones during the operational period. The zone will be marked in accordance with Trinity House recommendations and will be issued in a Notice to Mariners.

5.28.3 Inspection and Maintenance Strategies

The inspection and maintenance strategy clearly varies based on machine accessibility. For the SeaGen S as shown in Figure 5.35, or other devices such as the BlueTEC platform which facilitate turbine access without removal and recovery of the turbine, scheduled maintenance will be performed using small personnel craft operated from a local harbour most likely Port Ellen on Islay.

Figure 5.35: SeaGen S Raised Cross Arm for Maintenance

Similar to the SeaGen S, the BlueTEC floating platform facilitates access to almost all the critical equipment without resorting to heavy recovery vessels. The BlueTEC platform is provided with a special tilting mechanism to safely tilt the turbines out of the water as shown in Figure 5.36. This feature enables minor maintenance can be carried out onboard without having to detach the entire device.

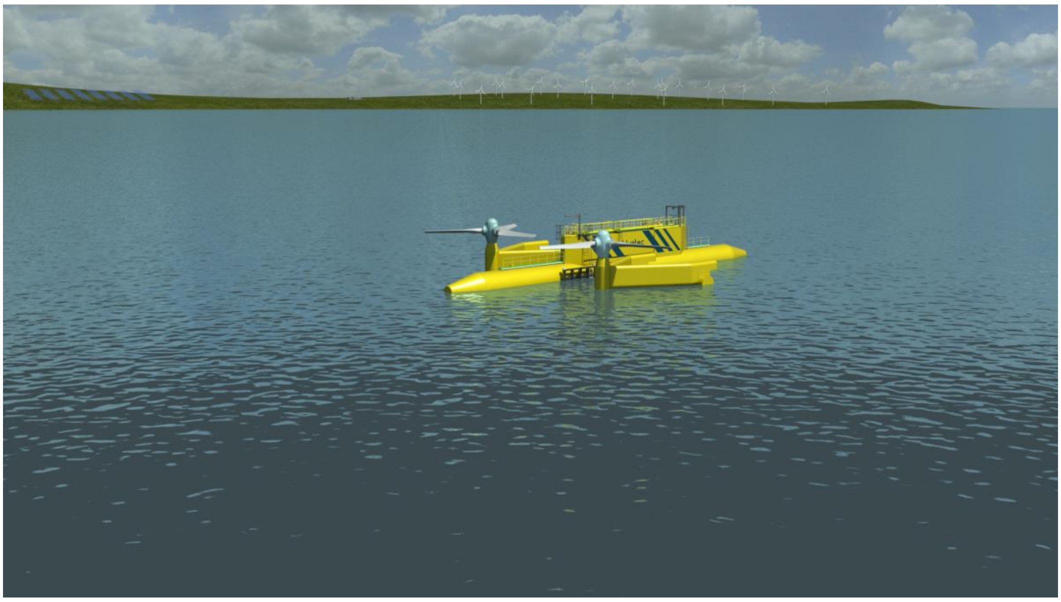


Figure 5.36: BlueTEC Floating Platform - Maintenance

For non-surface penetrating devices which do not allow recovery of the turbine without removal from foundation this requires heavier vessels and a safe harbour where the turbine can be towed or recovered to and where the device can be lifted and safely accessed. The TGL device utilises an innovative buoyant nacelle and winch/clamp arrangement to ensure that device recovery can be achieved with a relatively modest vessel. It is estimated that recovery can be achieved in approximately 30-45minutes and the device towed by vessel ashore or lifted onto deck for maintenance. Hot swopping of units is also being considered.

5.28.5 Scheduled and Unscheduled Maintenance

Scheduled maintenance applies primarily to inspections and work on minor faults such as parts susceptible to failure or deterioration. The tasks will typically be inspection on faults and minor fault rectification. Scheduled maintenance is likely to be carried out one turbine at a time, once a year per turbine. The likely maintenance period per turbine is two days.

Maintenance operations are mainly divided in two types of activities:

- Minor maintenance
- Major maintenance

Minor maintenance includes activities such as checks on the electrical systems & control units structural integrity, turbine rotation, cable connection, oil level, tank pressure, noise, vibrations, wear, dirt ingress, marine growth, corrosion, power electronics, fuse, sensors, control system, oil and filter flushing, greasing, wear in brake segments, etc. Minor maintenance will be carried out in situ. Inspections of support structures and subsea cables will also be performed on a regular basis using ROV and camera inspection.

Major maintenance includes activities such as replacement of the turbine blades, generator, gearbox, brakes, shaft failure/wear/fatigue/cracks, etc. Major maintenance may require a device to be disconnected and brought dockside or to a suitable yard facility. In a farm configuration the disconnected unit will be replaced with a spare unit.

Unscheduled maintenance would be required for a range of issues from small defects to a breakdown or damage of main components. The vessels used for this maintenance would clearly be dependent on the nature of the failure.

5.28.6 Discharge During Operation

There are no anticipated direct discharges to the atmosphere during normal operation. The only moving parts in the structure are the turbines themselves, and the only potential contaminants are internal lubrication/hydraulic oils and transformer oil which will be appropriately sealed and bunded.

There are no anticipated solid discharges into the marine environment during normal operation of the devices. Any waste generated during operation, for example associated with maintenance, will be collected and disposed of by licensed waste management contractors to appropriate facilities onshore.

There are no anticipated direct aqueous discharges to the marine environment during normal operation of the device. Based on the Seaflow experience, and the design of the SeaGen S device, it is not expected that there will be a requirement to introduce additional potential contaminants such as oils, hydraulic fluids and anti-foulants during this phase of the project.

5.29 Project Schedule

The marine part of the construction phase is scheduled to take place during the summer and autumn months as per the indicative construction programme (Figure 5.37), where suitable weather conditions are statistically more likely to occur.

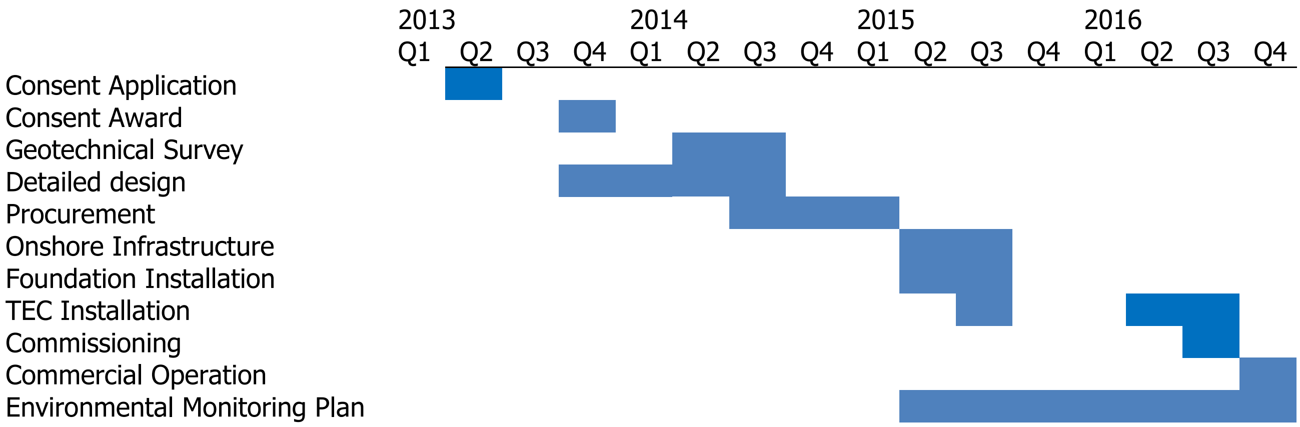


Figure 5.37: Indicative Project Programme

5.30 Decommissioning

5.30.1 General

After the planned lifetime of operation of the Project, all of the turbine devices and where appropriate, associated infrastructure, will be decommissioned.

As the exact details of the project design and the installation method are not yet finalised, a detailed decommissioning plan will be submitted for approval by the regulatory authorities prior to construction, as required by section 105 to 111 of the Energy Act 2004.

5.30.2 Turbines and Foundations

The removal of the devices will be carried out using vessels appropriate to the task but it can be assumed that the method of removing the turbine devices will be similar to the reverse of that used to install them and similar vessels will be used.

The turbines, drive trains (gearbox, generator and rotor), pod and other auxiliaries will be removed.

For any foundation structure which is not typically recovered during frequent maintenance or repair the long period of submersion is likely to have resulted in significant colonisation, by encrusting species. It may therefore be less environmentally damaging to leave all or parts of the foundation structures in place as artificial reefs. This will require consultation and agreement with the relevant statutory bodies and definition of decommissioning method.

Many of the major sub-assemblies and individual components of turbines will be recyclable and this will be done where possible. Any oil will be drained and sent for recycling at an appropriately licenced facility whilst the steel shells and any internal switchgear, transformers will also be recycled.

5.30.3 Inter-array Cables

Prior to commencing any decommissioning work detailed surveys will be conducted of the array area and inter-array cables to identify the exact location and condition of the cables and to determine whether or not it is appropriate to remove them or leave them in place. To some degree this will also depend on the method of cable protection adopted and this will only be known after detailed evaluation. Certainly in the event that possible disturbance to sediment and benthic habitats may occur it may be preferable to leave all or some sections of the cables in-situ.

Where sections of surface laid cable need to be removed then they would be recovered by a cable-laying vessel and any cable recovered and brought ashore and recycled where possible.

5.30.4 Post-decommissioning Studies

A survey will be undertaken after decommissioning to ensure that no debris is accidentally left on the seabed as a result of the project or as part of the decommissioning operation itself.

Post-decommissioning monitoring will also be undertaken of any accumulation and deterioration of material deliberately left on the seabed (for example colonised foundations) to ensure there is no subsequent adverse impact on navigation, other sea users or the marine environment. If monitoring identifies any new or increased risks posed by remaining materials e.g. where cables and foundations may have become exposed due to natural sediment dynamics appropriate action will then be taken to mitigate the risks.

5.31 Environmental Monitoring

During consultation with key stakeholders but specifically SNH it has generally been agreed that some form of environmental monitoring will be required during installation, commissioning and operation. However, the process by which definition of such an environmental management programme will be defined will be provided as part of the ES as follows:

- EIA to be undertaken across the project;
- Potential environmental impacts defined;
- Potential data gaps identified;
- Mitigation measures defined;
- Post mitigation potential environmental impacts defined; and
- Summary of Impacts, Mitigation and Implementation.

The final summary chapter of the ES will define pre and post mitigation potential effects and what mitigation measures are proposed. These measures will be discussed and agreed with SNH and other stakeholders to agree the level of environmental monitoring required for the project. However, at this point in time there is no specific definition for the scope and methodology of environmental monitoring.

5.32 Other Infrastructure – For Information only

5.32.1 General

As highlighted in section 5.1, the ES is intended to define the EIA works under taken for the tidal farm including turbines and associated infrastructure and the subsea export cable from the tidal farm to the high water mark at Kintra on the west coast of Islay. It is not intended to cover the onshore works on Islay or the Kintyre Peninsula or the offshore cable route between Islay and Kintyre. However, the following information has been provided to inform the balance of the project.

As illustrated in Figure 5.2, following landfall at Kintra the cable route continues overland to a substation located west of Port Ellen before leaving Islay via another landfall in Kilnaughton Bay. From here the cable then continues sub-sea for approximately 35km to landfall on the Kintyre peninsula prior to continuing overland to the main substation at Carradale. Given the long connection distance, it is probable that the voltage will require to be stepped up from 33kV to around 132kV to avoid excessive line losses. This will require a 33/132kV substation to be constructed on Islay.

From mean low water springs (MLWS), the responsibility for onshore infrastructure rests with The Scottish Government Consents Unit for the grid connection (wires and poles) and the Argyll and Bute Council for all other onshore infrastructure. This will include the following permanent works:

- *33kV electricity line (overhead or underground) across Islay;*
- *132kV electricity line (overhead or underground) across Kintyre;*
- *33/132kV substation on Islay;*
- *Shore connection at Kintra on Islay;*
- *Shore connection on Kintyre; and*
- *Operations, maintenance and monitoring base (probably located at Port Ellen).*

The following temporary works will also be required:

- *Temporary construction compound on Islay for cable and sub-station; and*
- *Temporary construction compound on Kintyre for cable connection.*

In addition, it is probable that an office will be set up in Port Ellen to act as an operations base. However, equipment and activities associated with the onshore works will be subject to a separate application.

Although the current preferred route for the onshore connection is as shown in Figure 5.2, alternative route options are still under investigation including the option of reinforcing the existing grid system via Jura to Port Anne.

5.32.2 Onshore Infrastructure on Islay

5.32.2.1 Landfall at Kintra to Sub-station Location

From the landfall where the 33kV subsea cable is routed, the cable will continue underground until outside the Special Protection Area where it will be connected into a termination module prior to onward routing either overhead on wooden poles or underground. This decision will depend on several factors including environmental, design and cost.

5.32.2.2 Sub-station Location and Design

It is probable that a 33/132kV sub-station will require to be located in the vicinity of Kilnaughton Bay to enable the sub-sea section of cable to transmit at higher voltages to reduce losses and the potential for fault levels

5.32.2.3 Operations Base in Port Ellen

An *operations base will be required on the island which is likely to be located at either Port Ellen or Portnahaven. The facility will include offices for construction and operations management, workshop facilities for minor servicing of the turbines, spares stockholding and operational and environmental monitoring*.

5.32.2.4 Temporary Construction Facilities

A temporary construction facility will be required to enable construction of the landfalls, electrical infrastructure and sub-station to take place. This is likely to be located along the route between both landfalls.

5.32.3 Onshore Infrastructure on Kintyre

5.32.3.1 Landfall to Carradale Sub-station Location

From the landfall where the 132kV subsea cable is routed, the cable will continue underground until connected into a termination module prior to onward routing either overhead on wooden poles or underground. This decision will depend on several factors including environmental, technical and cost considerations.

5.32.3.2 Control Building Adjacent to Carradale Substation

It will be necessary to locate a small control/metering building adjacent to the Carradale substation prior to connection into the substation. This building will *house protection and metering equipment to enable the appropriate electrical protection to be provided for the system and to meter the generated electricity prior to connection.*

5.32.3.3 Temporary Construction Facilities

A temporary construction facility will be required to enable construction of the landfall, electrical infrastructure and control building to take place. This is likely to be located initially on the west coast for landfall and cable routing before relocating to an area in the vicinity of the Carradale substation for routing, control building construction and final connection.

5.33 References

1 Request for Scoping Opinion by DP Marine Energy Ltd in respect of Islay Tidal Energy Project – Environmental Impact Assessment Scoping Report: May 2009.

2 SeaGen Environmental Monitoring Programme – Final Report (Jan 2011)

WEST ISLAY TIDAL

ENERGY PARK

volume 2 // chapter 6 // physical environment

6.0 Physical Environment

6.1 Introduction

This chapter describes the existing coastal and seabed physical processes and geomorphology of the area surrounding the West Islay Tidal Energy Park (the "Project"), and assesses the likely changes that may arise from the construction, operation and eventual decommissioning of the tidal energy devices and cables. Potential impacts on identified receptors are defined and assessed, taking account of cumulative impacts due to any other proposed developments in the area.

Changes to the hydrodynamic and sediment transport regime may also have impacts on benthic and coastal ecology, fish and commercial fisheries, archaeology, marine mammals, navigation and water sports. These impacts are considered in the relevant chapters where applicable.

This chapter is supported by the following technical documents and ES chapters:

- Drop Down Video Camera Survey (2008) – Technical Appendix 8.1
- Metocean Tables – Technical Appendix 6.1;
- Benthic Baseline Report – Technical Appendix 8.2 and
- Project Description – Chapter 5

6.2 Assessment Methodology

6.2.1 Guidance

There are no specific guidelines for the assessment of coastal processes for tidal stream projects. However, the physical environment and coastal processes EIA guidelines developed by the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) for offshore wind farms(1) are largely applicable, as are those developed by COWRIE(2) also for offshore wind farms.

6.2.2 Consultation

In response to The Request for Scoping Opinion(3) issued in May 2009, SNH provided advice on Section 5.2 Marine & Coastal Processes in their letter(4) which stated in section 2.27 Coastal and Marine Processes:

> *"SNH is supportive of the geophysical assessment and the desk study proposed by the applicant and considers that, for this location, this should be sufficient to assess the potential impacts of the proposed turbine array on coastal and marine processes. If the applicant needs to undertake any water flow modelling in respect of turbine placement then we recommend that this modelling also considers natural heritage aspects – please see Section 5 of Appendix C."*

In response to The Request for Scoping Opinion(3) issued in May 2009, SEPA responded on the issue of coastal and marine processes in their e-mail(5) of the 1st July 2009 providing useful guidance on legislative requirements and reference to good practices. However, it was recognised in the response that SEPA were not the regulative authority.

> *"The main activity would be carried out off-shore and would therefore not be regulated by SEPA under The Water Environment (Controlled Activities) (Scotland) Regulations 2005 (as amended) (CAR). However, steps should be taken where applicable to minimise pollution of the shoreline and on-shore water environment to the barest minimum levels.*

In this case the export cable landfall comes under these regulations and is assessed accordingly.

6.2.3 Scope of Assessment

The assessment is based on two potential turbine arrays considered to represent the envelope of realistic worst case scenarios in relation to coastal processes. The assessment also considers the cable route and landfall. The layouts and routes are described in Chapter 5.0 – Project Description and include:

- Cable route from the site to landfall at Kintra (Figure 5.2);
- An array of 15 SeaGen devices (Figure 5.13a); and
- An array of 30 TGL devices (Figure 5.13b).

Tidal turbines and associated inter-array and export cables may influence tidal currents, waves, seabed and suspended sediment transport and littoral transport. These physical processes are not in themselves sensitive receptors (COWRIE 2009)[2], but changes to these processes may have an impact on sensitive receptors. Therefore the extents of potential changes are defined to inform impact assessment both in this chapter and elsewhere in the ES.

Consideration is given to different spatial and temporal scales including:

- The immediate local area of each TEC over a 50m radius;
- The area of the development site over an area of approximately 2.2 km^2 plus the cables route;
- The full area over which the influence on coastal processes can be measured in relation to background variability;
- Short-term changes during specific on-site operations including construction, maintenance and decommissioning, lasting hours or days;
- Medium-term changes during post-construction or post-decommissioning recovery, lasting weeks or months; and
- Long-term changes during operation, lasting years or decades.

6.2.4 Potentially Sensitive Receptors

Potentially sensitive receptors considered in this chapter include:

- Adjacent shorelines, including islands (possible accretion or erosion);
- Low lying backshore areas (possible flooding due to increased water levels or increased wave over topping); and

- Seabed infrastructure (possible increased risk of damage due to waves, currents or sediment processes.

Within the area considered to be potentially affected by changes to physical processes there are no low-lying backshore areas at risk of flooding and no seabed infrastructure, either present or proposed. Therefore the only potentially sensitive receptor is the adjacent shoreline where erosion or accretion may occur.

Other sensitive receptors discussed elsewhere may include benthic and coastal ecosystems, fish and commercial fisheries, marine mammals, navigation and water sports.

6.2.5 Assessment of Impacts

Tables 6.1 and 6.2 below define the sensitivity of the shoreline and magnitude of change to be used for this assessment of significant impacts. These definitions are necessarily crude and predicted impacts need to be identified and considered specifically.

Sensitivity of Shoreline to Erosion or Accretion	Definition
High	Presence of backshore assets (e.g. buildings, infrastructure), economically important recreational activities or nationally important environmental features (including habitat, geology and landscape)
Medium	Presence of backshore undeveloped land (e.g. arable or high grade grazing, non-specific public amenity space), locally valued recreational activities or locally important environmental features
Low	Presence of backshore low grade grazing, low density recreational activities or locally common environmental features

Table 6.1: Definition of the Shoreline Sensitivity to Erosion or Accretion

Magnitude of Change	Definition
High	Ongoing annual rate of shoreline position change above 0.5m per year over a length of more than 50m
Medium	Ongoing annual rate of change less than 0.5m per year, but observable and measureable over an length of more than 50m or greater change over a shorter length
Low	Ongoing annual rate of change less than 0.5m per year, but observable and measureable over a length of less than 50m or ongoing change not observable over a longer length.

Table 6.2: Definition of the Magnitude of Change

Table 6.3 below sets out the criteria matrix for determining the significance of impact. Impacts identified as moderate or major are considered significant and must be addressed.

Significance of Impact	Sensitivity of Receptor	Magnitude of Change
Major	High	High
	High	Medium
	Medium	High

Moderate	High	Low
	Medium	Medium
	Low	High
Minor	Medium	Low
	Low	Medium
	Low	Low
Negligible	High/Medium or Low	No Change

Table 6.3: Criteria Matrix Used to Determine the Significance of Impacts from the Turbine Array Area on the Physical Environment

The effects of the TEC`s on the wave climate were not numerically modelled as it has been established through general research and numerous studies for offshore wind farms (Ohl et al., 2001 [(6)], Halcrow, 2003 [(7)] and ABPMer, 2005 [(8)]) that small structures set well away from the coast have negligible effect on wave conditions outside the immediate area of the structure. Effects are normally well within the uncertainty limits for the modelling. Although these assertions have not been specifically tested for an array of TEC`s, they remain reasonable, particularly given the local influence of wave – current interactions which make the wave conditions highly variable across the site. Detailed large scale physical modelling, combined with field measurements, would be required to confirm whether the rotating blades may have a local effect on waves.

The assessment of physical process changes and impacts on the shoreline in this chapter benefits from very detailed numerical modelling of currents[(9)] and waves[(10)] undertaken.

Further factors supporting the decision not to model the turbine effects on waves include:

- The proposed arrays are set approximately 6km away from the nearest point of the Islay coast so any localised effects will be smoothed below the certainty limits of the modelling methods before waves reach the coast;
- The threshold for significant impact on coastal and seabed ecology discussed in Chapter 8 would only be achieved by introducing a substantial barrier to wave action, such as an offshore breakwater;
- Tidal flow direction is perpendicular to the nearest coastline;
- The coastline generally consists of rocky cliffs with small pockets of beach; and
- Drop down video camera, benthic survey and geophys surveys have all indicated that the seabed occupied by the tidal site is substantially rock based with limited areas exhibiting evidence of sea-bed sedimentation.

6.2.6 Data Sources

6.2.6.1 Desk Based Study

Data was gathered during Scoping from the following sources.

- Admiralty Tide Tables and Tidal Stream Atlases – Firth of Clyde and Approaches NP222;
- British Geological Survey – Seabed Sediments & Quaternary;
- British Geological Survey – Solid Geology;
- British Geological Survey – Digibath 250;
- Bathymetric Data Digitised from UKHO fair sheets K9707/10 and 11;
- Scottish Executive (2007) Scottish Marine Renewables SEA;
- DECC (2008) Atlas of UK marine Renewable Energy Resources; and
- Tidal Energy in Scottish Waters – Draft Regional Locational Guidance: Marine Scotland (Aug 2012);

6.2.6.2 Site Surveys

Drop Down Video Camera Survey

In September 2008, a seabed survey[11] was undertaken using a drop down video camera. The objective of the survey work was to investigate whether the proposed site had any inherent environmental sensitivities or constraints which may limit or prohibit tidal energy development. The report is included as volume 4: Technical Appendix 8.1 and the survey data is available on hard drive on request. Surveys were undertaken on twenty three transects as shown in Figure 6.1.

Resource Assessments

A resource assessment was undertaken in 2008 using three bottom mounted ADCP`s for a complete lunar cycle and complimented with a transect survey over the wider area. Subsequently a more focussed ADCP campaign was undertaken in September of 2011. This included deployment of multiple ADCPs for a two month period and moving vessel transects both at neaps and springs. A harmonic analysis has been undertaken for both data sets.

Benthic Survey

Site specific surveys were undertaken in and around the Tidal Site and Western Export Cable Route in July and August 2012. Sampling techniques included Drop Down Video (DDV) survey, Epibenthic Beam Trawls and Benthic Grab Sampling, as well as intertidal biotope surveys. Full details are provided in Volume 4: Technical Appendix 8.2: Islay Tidal Benthic Baseline.

Geophysical Survey

In February 2013 Environmental Science Group (ESG) conducted a hydrographic and geophysical survey over the proposed Project area and cable route. The survey was carried out to provide information on sea-bed bathymetry and sub-bottom geology as part of a pre-engineering survey. The scope of work was specified to include the following aspects:

- Sea-bed Levels;
- Bedrock level and thickness of any overlying sediments;
- The presence of any large boulders, debris or other obstructions on or in the sea-bed sediments;
- Sea-bed Characterisation; and
- The presence of any magnetic targets.

6.2.6.3 Mathematical Modelling

Resource Assessment

A hydrodynamic numerical model[(9)] has been built using a program called Delft3D-FLOW to development a single regional model, within which high resolution models of the site area has been dynamically nested. The models are being utilised to provide velocity timeseries and map output, the purpose of which has been to:

- Quantify (insofar as is practicable without direct measurement) the tidal stream resource at locations of interest;
- Allow for analysis of velocity data for extended periods such as a typical year; and
- Allow the focus of further desk-based and fieldwork studies to be optimised through better understanding of the spatial variability of the velocity field.

The model was fully calibrated using project specific ADCP data from several site locations for both the 2008 and 2011 site measured data and the bathymetry was taken from detailed site geophysical surveys.

Velocity data is readily converted into power output predictions when worked up alongside device manufacturer's power curves. The work focuses on the development, calibration and validation of the Islay model suite.

The numerical modelling undertaken for the prediction of tidal current speeds does not explicitly include smaller scale turbulence (5m to 100m extent). At a smaller scale still (less than about 5m), the currents are likely to be affected by bottom boundary layer turbulence. The extent of baseline turbulence is not defined, but is considered to be significant and is known to be highly variable both temporally and spatially.

Wave Climate

Wave conditions at the site have been determined for a reference point, i.e. the "data collection point" with coordinates 55 39.200N and 6 35.700E (Lat-Long, WGS84) and a water depth of 29.5 m relative to mean sea level. Due to the lack of (long-term) wave measurements in the vicinity of the Project, detailed wave modelling has been carried out using Mike 21 SW. The model report (HMRC-UCC, 2013)[(10)] provides details on the boundary conditions, model calibration and model validation. Waves measured during the 2008 and 2011 AWAC measurement campaigns have been used for calibration.

6.3 Existing Physical Conditions

6.3.1 General Description

The area considered within this assessment includes the shoreline of the Rinns Point and the islands of Orsay, Eilean Mhic Coinnich and Frenchman`s Rocks as shown in Figure 6.2. Coastal and seabed areas beyond these limits are considered to be outside the range of measureable change to waves, currents or sediment transport resulting from the proposed development.

An unusual feature of the site is that the tidal energy is generated from flood and ebb tides being forced from deep to shallow water over the spur which extends from the Rinns south west into the sea. Depths vary from 50m to the shallower waters at 25m deep before increasing in depth to around 70m. The horizontal channelling of the sea results in high tidal energy over the shallower features of the spur without the navigational constraint more common to sites which are constrained between two land masses.

6.3.2 Designated Areas

There are no areas specifically designated for geology or geomorphology within or in the vicinity of the Site.

6.3.3 Geology

The geology of the south-eastern half of the site is dominated by sea-bed outcrops of the very hard crystalline rock of the Rinns Complex which consists of Gneisses and metagabro intrusions. The north-western half of the site has sandy gravel at the sea-bed overlying variably thick firm to thick glacial till (boulder clay) which overlies the crystalline rock. The Kintra cable route geology consists of a variably thick layer of till overlying the above mentioned crystalline rock at the turbine site then a unit of gravely sand overlying the firm to stiff glacial til (boulder clay) as the route heads east. This till outcrops at the sea-bed at the eastern end of the route.

6.3.4 Still Water Levels

The close proximity of the Project to an amphidromic point (Figure 6.3) means that the tidal elevations are relatively small. This is confirmed by the tidal gauges deployed by BODC at Port Ellen.

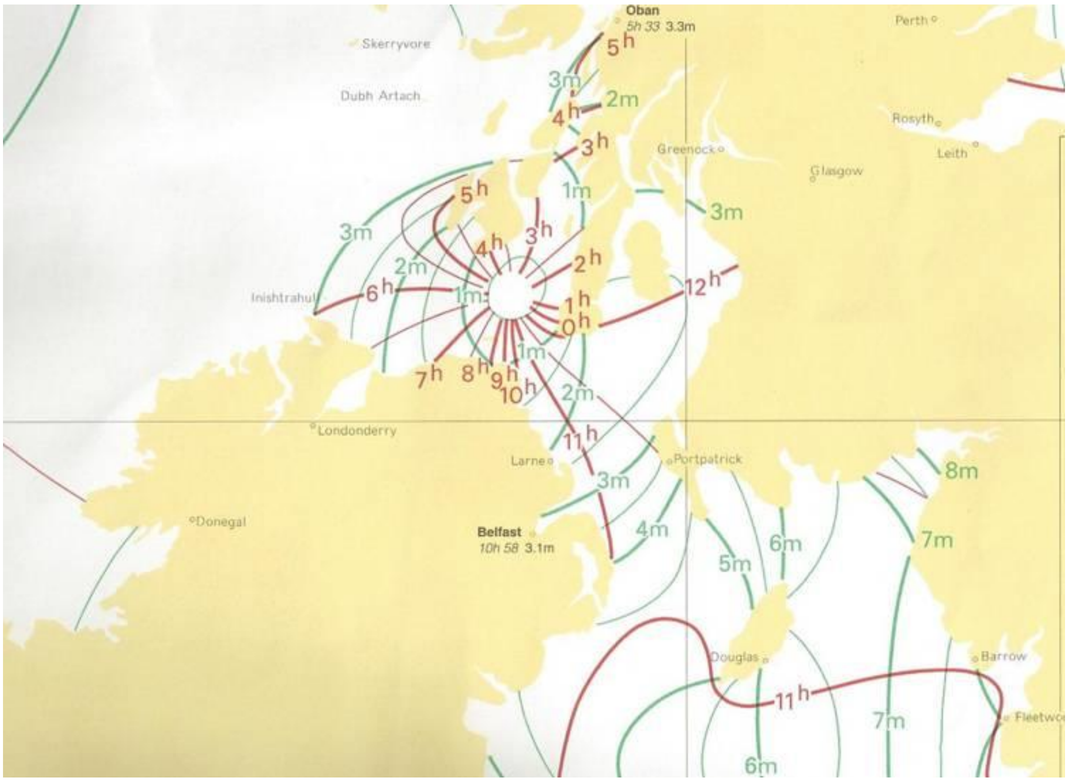


Figure 6.3: Location of Amphidromic Point Near Islay

Measured[12,13] and modelled[9] water levels were analysed as part of the metocean study carried out by Hydraulics & Maritime Research Centre – University College Cork (HMRC – UCC, 2013 [10]), resulting in the following table:

	MSL		CD (ORSAY)	
Requested Tidal Levels/Amplitudes	Admiralty	IOS	Admiralty	IOS
− Highest Astronomical Tide (HAT)	1.52	1.46	2.89	2.83
− Mean High Water Springs (MHWS)	1.20	1.24	2.57	2.61
− Mean High Water Neaps (MHWN)	0.23	0.24	1.60	1.61
− Mean Sea Level (MSL)	0.00	0.01	1.37	1.38
− Mean Low Water Neaps (MLWN)	-0.31	-0.18	1.06	1.19
− Mean Low Water Springs (MLWS)	-1.02	-1.15	0.35	0.22
− Lowest Astronomical Tide (LAT)	-1.23	-1.37	0.14	0.00
− Mean Spring Range (MSR)	2.22	2.38	2.22	2.38
− Mean Neap Range (MNR)	0.54	0.42	0.54	0.42
− Max Spring Range	2.72	2.79	2.72	2.79
− Max Neap Range	0.91	0.82	0.91	0.82
− Min Spring Range	1.67	1.85	1.67	1.85
− Min Neap Range	0.16	0.06	0.16	0.06

Table 6.4: Tidal Elevation (m)

The tidal elevations in Table 6.4 are presented in relation to Mean Sea Level (MSL) and to Chart Datum (CD) at Orsay (assuming MSL = CD (Orsay) + 1.37

m). Two methods were used during analysis: the Admiralty and more accurate IOS method.

The area is affected by tidal surges. Extreme surge levels at the Project site were obtained by transferring extreme surge levels measured at Port Ellen to the site (HMRC – UCC, 2013 [10]). Extreme values at Port Ellen were obtained from the British Atmospheric Data Centre (BADC). The resulting extreme levels at the site are provided in Table 6.5.

Return Period (years)	Site Extremes (to MSL)
1	2.24
5	2.53
10	2.62
50	2.80
100	2.87

Table 6.5: Tidal Elevation (m) Extreme Water level Estimation at Tidal Site

Future sea level rise at the site is uncertain due to the lack of detailed local measurement to confirm past trends and isostatic rebound. In the absence of more reliable data it is assumed that an annual average rate of 3.5mm per year until 2025 and 8.0mm per year to 2055 will apply (Defra, 2006)[14].

6.3.5 Tidal Currents

An initial approximation of the tidal currents was obtained from the ABPmer *Atlas of UK Marine Renewable Energy Resources* and UKHO Admiralty Charts[15]. More detailed knowledge on tidal currents for the Project was obtained from measurements during 2008 and 2011 using AWACs. The locations of these measurements are shown in Figure 6.3. In addition, modelling of tidal currents and water levels has been carried out in order to analyse data for extended periods and to quantify the tidal stream resource at possible locations of deployment (Coastal Science Ltd, 2012 [10]). The hydrodynamic model used for assessing the tidal currents and water levels was Delft3D-FLOW. The bathymetry used in this study consists of a combination of the data obtained from GEBCO, UKHO, ABPmer Faircharts, Marine Scotland and ESG. The model was fully calibrated using project specific ADCP data from several site locations.

Figures 6.4 and 6.5 show examples of the velocity vectors and speed contours for the existing spring flood and spring ebb conditions.

Under existing conditions the peak tidal currents on spring tides range from less than 0.5m/s in lee areas along the coast up to more than 3.5m/s around localised shallow areas offshore and nearshore. The currents bend around the Rinns of Islay, with slightly greater speeds on the ebb. Within the proposed array area peak currents range between about 3.5m/s on springs to about 1.75 m/s on neaps. Local bathymetry variations cause spatial variations and localised differences between flood and ebb flows.

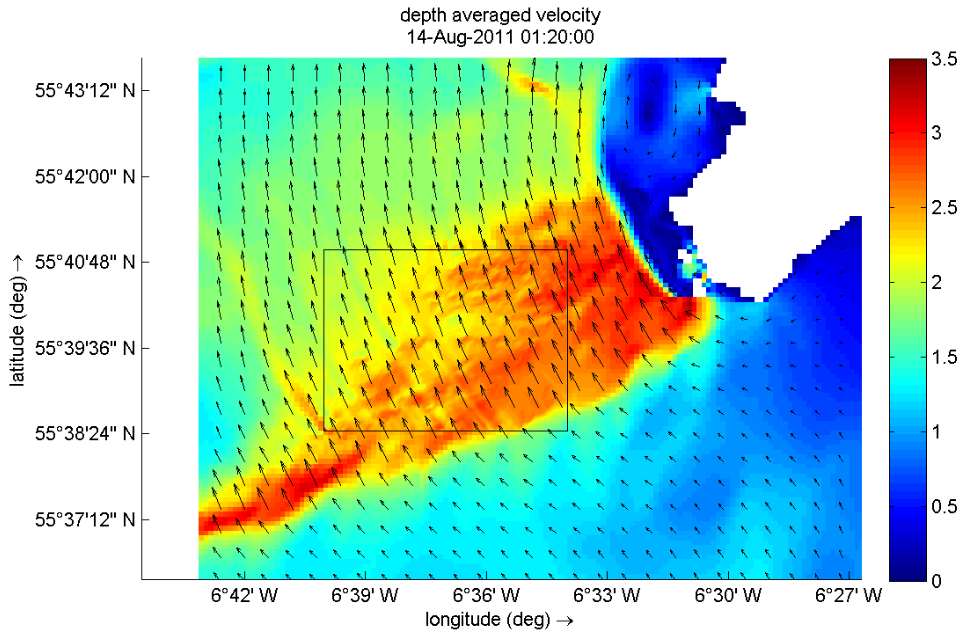


Figure 6.4: Current Magnitude and Vectors During Spring Ebb Condition

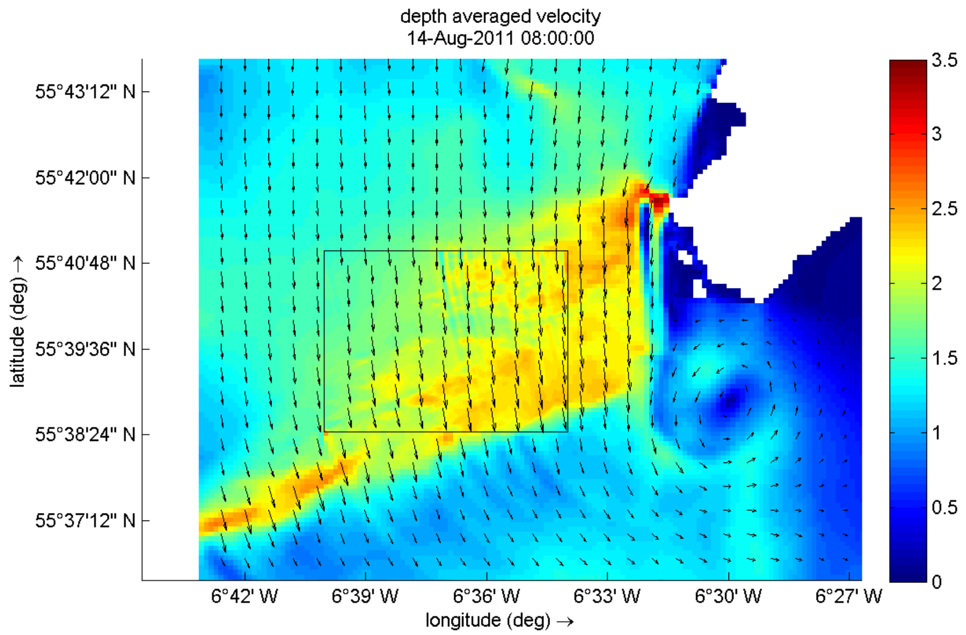


Figure 6.5: Current Magnitude and Vectors During Spring Flood Condition

6.3.6 Current Induced Turbulence

The numerical modelling undertaken for the prediction of tidal current speeds does not include smaller scale turbulence (5m to 100m extent), although these conditions are likely to prevail at site due to interaction with the existing uneven seabed and coastal features to produce turbulent vortices in both horizontal and vertical directions. At a smaller scale still (less than about 5m), the currents are likely to be affected by bottom boundary layer turbulence. The extent of baseline turbulence is not defined, but is considered to be significant and is known to be highly variable both temporally and spatially.

6.3.7 Wave Climate

Wave conditions at the site have been determined for a reference point, i.e. the "data collection point" with coordinates 55 39.200N and 6 35.700E (Lat-Long, WGS84) and a water depth of 29.5 m relative to mean sea level. Due to the lack of (long-term) wave measurements in the vicinity of the Project, detailed wave modelling has been carried out using Mike 21 SW. The model report (HMRC-UCC, 2013[8]) provides details on the boundary conditions, model calibration and model validation. Waves measured during the 2008 and 2011 AWAC measurement campaigns have been used for calibration.

In summary, the dominant wave direction is west to north-west-west (Figure 6.6). These waves are heavily dominated by swells from the Atlantic. Based on the 2008 measurements, the shape of the wave spectrum approaches the theoretical shape of a Bretschneider spectrum.

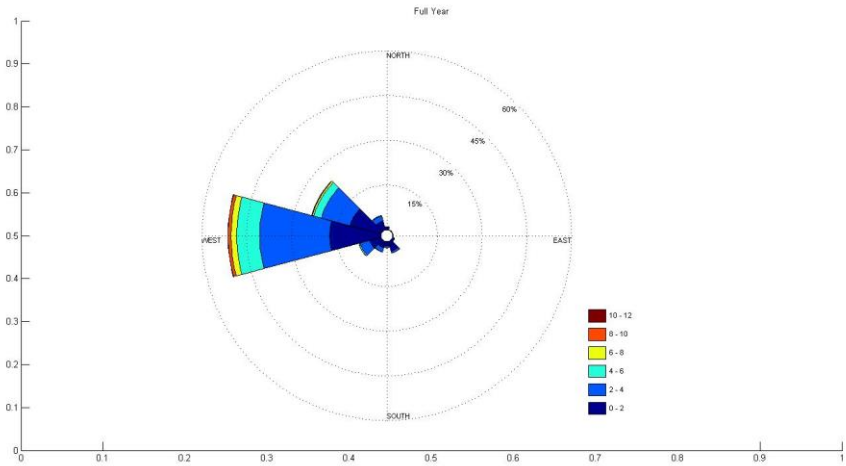


Figure 6.6: Wave rose at the site (55 39.200N and 6 35.700E)

It is clear that locally, wave conditions are heavily affected by the strong currents giving rise to severe conditions when the current and wave directions oppose and less severe conditions when the current and wave directions align. This effect has not been fully incorporated into the wave model up to now. More accurate modelling of wave-current interaction is currently ongoing.

6.3.8 Suspended Sediment and Water Quality

There are no site specific data on suspended sediment concentrations or water quality off the Rinns of Islay. Observations and anecdotal evidence indicates that water clarity and quality are normally good. There are no local sources of fine sediment. Given the strong currents it would be expected that any available fine sediment would be carried in suspension for deposition in areas outside the potential limits of influence of the Project.

6.4 Potential Impacts

6.4.1 Introduction

The tidal array and export cables may have potential to affect the hydrodynamic and the sediment transport processes in the local and broader area of the array, cable route and landfall during the life of the Project, including construction, operation and decommissioning. Where the coastal and seabed processes are likely to be affected the significance of any consequent impacts on sensitive receptors are assessed. If the impacts are considered significant, mitigation measures are required to reduce or remove the impacts to achieve an acceptable situation. The two possible array layouts and the proposed western export cable route are considered.

Potentially sensitive receptors affected by coastal and seabed processes for discussion in this chapter have been identified as the shoreline, low lying backshore areas and seabed infrastructure. The potential impact on other receptors are addressed in relevant chapters accounting for the potential changes to hydrodynamic and sediment processes. Within the area identified as potentially influenced by the proposed development there are no low lying backshore areas and no seabed infrastructure (existing or proposed). Only the shoreline is considered as a potentially sensitive receptor due to potential changes to the rates of erosion or accretion.

The potential impacts are considered to be low in general terms for the two device arrays being assessed and the western export cable route, and are then classified in relation to construction, operation and decommissioning.

6.4.2 Effects of the Project on Physical Processes

Numerical modelling has not been undertaken to define the effect of the SeaGen turbines on currents. However, numerical modelling as reported in the Skerries Tidal Stream Array: Environmental Statement (2011) [16] – Chapter 5 Physical Environment illustrates that the areas subject to short term reduction in current speed of more than 1.5 m/s under spring tide conditions extend only about 10m downstream of each device, although there is a larger area subject to short term changes of at least 0.5 m/s. It is also illustrated that the changes based on mean flows over a full 14 day tidal cycle are much smaller, with the area of mean change greater than 0.5 m/s extending for only about 15m from each device. A speed change of 1.5 m/s sustained over a period of one year is considered to be the threshold for potentially significant impact on marine ecology [17].

Previous modelling by HR Wallingford [16], indicates that the tidal devices have a small impact (short term speed changes up to about 0.5m/s) over an area extending several kilometres downstream on spring tides. There are also minor lateral and upstream changes not extending to the shoreline. These changes are not considered significant with regard to possible shoreline impacts, but are important with regard to potential power generation. Final design of the tidal device array will minimise the potential loss of recoverable power due to wake effects.

It was further reported that for the purposes of the "Rochdale" approach (See Chapter 4.0 EIA, ES and Consultation), that the modelling carried out in respect of the foundation utilises a "realistic worst case" scenario based around a 5m diameter monopile even though there is no intention to install such a foundation design. Variations to the pile diameter below 5m or to the design of the potential quadrapod foundation fall within the model's levels of uncertainty relating to impacts on benthic ecology or other receptors.

The flow modelling did not consider the effects of installation barges or jack-ups. Extrapolation of results for the turbine foundations indicates that the extent of impact will be larger with a jack-up in place, but the effect will only last for the period over which the jack-up is in place at each turbine (days).

As the Project area is not a constrained channel as is synonymous with other tidal energy sites there is no concern regarding effects on the wider tidal regime.

The current modelling provides an approximation of the drag effect of the turbines and their associated foundation structures but is not capable of representing the detailed turbulent flows resulting from the structural elements and turbine blades. Understanding of wakes is a current research subject with little certainty in numerical model results or field measurements. It was concluded that downstream wakes may extend up to about 40 blade diameters (about 800 m) downstream, but that associated amplified bed shear stress may only extend for up to five diameters (about 100 m).

The ongoing PeraWatt project funded by ETI will address some of the issues associated with turbulent wakes within restricted channels through a combination of physical and numerical modelling, plus assessment of field data. This is a four year project due to be reported later in 2013 and therefore no results are available to this assessment.

Turbulence associated with foundations, jack-ups and cables will locally amplify bed shear stress and may induce local sediment scour (Whitehouse, 1998, 2004a and 2004b; Briaud et al., 1999; Zaaijer, 2003; Den Boon, 2004; Hoffman & Verheij, 1997). Theory and experience from wind farm monitoring (DECC, 2008a and 2008b) indicates that the potential scour footprint is limited to about five times the diameter of the foundation structure and as much as ten times the cable elevation (including any installed cable protection), with rate and depth of scour dependent on the nature of the seabed.

Jack-up legs may also cause scour of similar extent as predicted for the foundations, but over a limited time period; if the seabed is highly mobile then significant scour may develop during the short turbine installation period.

The effect of the foundations and jack-up legs on the seabed is related to the potential for scour of any mobile sediment, and the subsequent redistribution of that sediment. In areas with unlimited depths of mobile sand, scour can extend over an area several times the footprint of the structure, potentially causing loss of habitat and structural instability. In these cases scour protection may be required. The proposed array is in an area of mainly exposed bedrock with areas of compacted infill deposits, but with no significant deposits of mobile sediment. Some scour and sediment redistribution may occur if detailed and site specific geotechnical investigations show that the infill deposits are likely to be affected by enhanced shear stresses in the immediate area of the foundations. However, based on available information it is considered unlikely that scour will be an issue. The potential for scour should be revisited during the engineering design process when detailed geotechnical information may be available. If scour protection is required then rock dumping or concrete scour mattresses will be the likely methods; frond mats are generally unsuitable for sites with high current speeds and minimal mobile bed material. Neither possible scour nor the effects of the scour protection will cause any change at the shoreline.

Water levels will not be affected by the development, apart from the immediate area of each turbine and jack-up where there will be an insignificant local head difference from upstream to downstream dependent on current velocity

Effects of the turbines on waves have not been modelled, but previous research and expert judgement indicates that the area of non-negligible change will be very localised (less than, say, 100m from each device) and changes at the adjacent coasts will be below the uncertainty limits of measurement and modelling.

It is anticipated that the turbine foundations will require drilled and grouted piles, and that drill cuttings (small rock fragments) will be released. At slack water released cuttings will be deposited on the bed at source. During both neap and spring tide peak currents the cuttings will be transported away from the source as part of the general sediment bed load; dispersion will be rapid and widespread due to the strong currents, depending on the density and particle size of the released material. Fine sediment will be carried away in suspension with very rapid dispersion; associated deposition rates will be too low to detect.

Modelling of sediment dispersion has not been undertaken as general experience from numerous past commercial and research studies relating to marine construction and dredging provide a clear understanding of the processes (e.g. Soulsby 1998; MCT 2005).

During decommissioning it is anticipated that the devices and foundations will be removed to bed level and any voids filled by rock dumping. Any associated dispersion will be rapid and wide spread.

The west end of the cable corridor traverses an area of strong tidal currents, severe wave conditions and high sediment transport potential. The seabed varies from bedrock with some superficial surface sediment in the west, to areas of mobile sand / gravel and sand waves towards the east. At the Kintra landfall the beach is sandy and will need to be trenched to a depth of at least 2m and backfilled with sand. The trenching will have little effect on the beach since the trench is very narrow and after the cable is laid it is simply backfilled with the beach sand.

In deeper water, the wave and current activity may be sufficient to cause movement of unprotected cable with potential resultant damage to the cable and to adjacent benthic communities. Unprotected cables may also be damaged by dragging or impacts from anchors or fishing gear. It is likely that the cable will be stabilized and protected by rock dumping or proprietary armouring systems. It is possible that some sections of the cable may be buried by trenching, but this will not be practical in areas of exposed bedrock. Rock dumping and trenching will release some sediment for dispersion. As with the drill cuttings discussed above, dispersion will be rapid as part of the ambient sediment transport.

The cables may have a very localised influence on sediment transport. Where the export cable crosses areas of mobile sand / gravel or sandwaves scour may occur with potential for the cable to self-bury, but also for spans to form with consequent cable vibration (Whitehouse et al., 2000). The extent of sediment disturbance will be limited to about 10h where h is the cable diameter, e.g. an unprotected cable of 150mm diameter may cause downstream bed disturbance over a distance of about 1.5m. If the cable is protected by rock dumping or other means, then the extent of potential disturbance will be proportionally larger. The existing bed is highly mobile and any benthic communities will be able to adapt to bed change of this magnitude.

Decommissioning of the site may require removal of the cable for reasons not related to the hydrodynamics or seabed processes. In the deep water areas removal of the surface laid cable would have no effect on the seabed beyond the immediate cable corridor.

6.4.3 Assessment of Construction Impacts

6.4.3.1 Predicted Impacts

The SeaGen devices and installation plant may have a small effect on currents over a wide area (kilometres) during construction, but the area over which changes to waves, currents and sediment transport are sufficient to have a potential influence on sensitive receptors is within about 100m of each device or installation plant regardless of array layout. There are negligible predicted impacts on the shoreline.

6.4.3.2 Potential Mitigation Measures

There are no proposed mitigation measures.

6.4.3.3 Residual Impacts

There are negligible predicted residual impacts.

6.4.4 Assessment of Operational Impacts: SeaGen devices

6.4.4.1 Predicted Impacts

The SeaGen devices may have a small effect on currents over a wide area, but the area over which changes to waves, currents, turbulence and sediment transport are sufficient to have a potential influence on sensitive receptors is within about 100m of each device regardless of array layout. There are negligible predicted impacts on the shoreline.

6.4.4.2 Potential Mitigation Measures

There are no proposed mitigation measures.

6.4.4.3 Residual Impacts

There are negligible predicted residual impacts.

6.4.5 Assessment of Decommissioning Impacts: SeaGen devices

6.4.5.1 Predicted Impacts

The decommissioning plant may have a small effect on currents over a wide area, but the area over which changes to waves, currents and sediment transport are sufficient to have a potential influence on sensitive receptors is within about 100m of the plant regardless of array layout. There are negligible predicted impacts on the shoreline.

6.4.5.2 Potential Mitigation Measures

There are no proposed mitigation measures.

6.4.5.3 Residual Impacts

There are negligible predicted residual impacts.

6.4.6 Assessment of Construction Impacts: Cables

6.4.6.1 Predicted Impacts

Trenching and placement of protection will release sediment over a short time period and the sediment will be rapidly dispersed. There are negligible predicted impacts on the shoreline.

6.4.6.2 Potential Mitigation Measures

There are no proposed mitigation measures.

6.4.6.3 Residual Impacts

There are negligible predicted residual impacts.

6.4.7 Assessment of Operational Impacts: Cables

6.4.7.1 Predicted Impacts

Trenched and/or protected cable may cause localised erosion or accretion in sea bed areas of mobile bed sediment and at the landfall. Outside the surf zone these effects will cause no changes at the shoreline. Within the surf zone the potential magnitude of erosion or accretion will be localised (Categorised as low to medium).

6.4.7.2 Potential Mitigation Measures
It is proposed to trench the cable at the landfall and in the surf zone, placement of stone protection will if possible be avoided therefore impacts on erosion and accretion will be avoided.

6.4.7.3 Residual Impacts
There are negligible predicted residual impacts.

6.4.8 Assessment of Decommissioning Impacts: Cables

6.4.8.1 Predicted Impacts
Removal of trenched and/or protected cable from the sea bed will release sediment over a short time period and the sediment will be rapidly dispersed.

6.4.8.2 Potential Mitigation Measures
The cables may be left in-situ following decommissioning. In this case there will be no further impact on the seabed or shoreline beyond the operational impacts already discussed.

6.4.8.3 Residual Impacts
There are negligible predicted residual impacts.

6.4.9 Cumulative / In-combination Impacts
Given the proximity of the Islay Offshore Wind Farm or around 6km and location in substantially different sea-bed conditions it is not expected that either development will impact on the other. Taking into consideration the projects outlined in Chapter 5.0, in-combination impacts are considered to be negligible.

6.5 Future Monitoring/Survey Requirements

No further monitoring or surveys are proposed.

6.6 Summary of Impacts

The assessment of hydrodynamic and sediment processes has indicated that the Project will have a small effect on tidal currents over a downstream distance of several kilometres, but will only have a significant effect on currents, waves and sediment distribution over an area of about 100m. The cables and cable landfall will affect surface sediment processes over a narrow corridor of no more than 50m due to trenching and placement of protection. Suspended sediment due to cable trenching and pile installation will be dispersed rapidly over a wide area.

The adjacent shoreline is the only sensitive receptor considered in this section on coastal processes. There are no predicted cumulative impacts with other existing or proposed developments. Other sensitive receptors affected by currents, waves and sediment transport processes are considered elsewhere.

Potential impact	Significance	Potential mitigation	Residual impact
Erosion or accretion of shoreline at landfall	Negligible	Cable will be trenched and buried with sand, rock armour will be avoided if possible.	Negligible

Table 6.6: Summary of Potential Impacts to the Shoreline Relating to Coastal Processes

6.7 References

1 EIA guidelines developed by the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) for offshore wind farms

2 Coastal Process Modelling for Offshore Wind Farm Environmental Impact Assessment: Best Practice Guide: COWRIE September 2009

3 Request for Scoping Opinion by DP Marine Energy Ltd in respect of Islay Tidal Energy Project Environmental Impact Assessment Scoping Report – May 2009.

4 Scoping Opinion Request For Proposed Section 36 Application For The Islay Tidal Energy Project, Islay: Scottish Natural Heritage – 4th September 2009.

5 PCS 101365 SEPA Response 01.07.09.doc

6 Ohl COG, Taylor PH, Eatock Taylor R and Borthwick AGL (2001): Water wave Diffraction by a Cylinder Array Part II: Irregular Waves. Journal of Fluid Mechanics

7 Halcrow (2003): Offshore Wind Farm Array Assessment – Wave Modelling. Prepared by Halcrow Group for CEFAS/DEFRA 2003.

8 ABPmer (2005): Assessment of Potential Impact of Round 2 Offshore Wind Farm Developments on Sediment Transfer. Prepared by ABPmer for DTI. Report R.1109. January 2005.

9 Islay Resource Assessment Modelling – Model Calibration, Validation and Initial Applications: Report R12082 (Aug 2012) by Coastal Science Ltd

10 Islay Tidal Energy Project: Metocean Study (April 2013) by Hydraulics and Maritime Research Centre UCC.

11 Subtidal Survey of Rinns of Islay, Argyll for DP Energy (September 2008) ERT1975

12 2008 ADCP Report Wallingfords

13 2011 ADCP Report Techworks

14 DEFRA FLOOD REPORT

15 ABP Energy Atlas

16 Skerries Tidal Array Environmental Statement (2011)

17 The Potential Nature Conservation Impacts of Wave and Tidal Extraction by Marine Renewable Developments CCW Policy Research No. 06/7. Prepared by ABPmer