WES Development Guidance – Lessons Learnt from Real Sea Deployments

Guidance on Compliance

WES_KH03_ER_02

Revision	Date	Purpose of issue
1.0	22/03/2017	WES External Issue

Project Participants

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Glossary

AIS	Automatic Identification System. An electronic system installed on vessels above a minimum size that sends out and receives information of location, speed and vessel details.
ALARP	As Low As Reasonably Practicable
CAPEX	Capital costs. “One off” costs for the design, procurement and fabrication of an item.
CDM	Construction (Design and Management) Regulations
CMS	Construction Method Statement
CoB	Centre of Buoyancy
CoG	Centre of Gravity
EIA	Environmental Impact Assessment
EMEC	European Marine Energy Centre
EMP	Environmental Monitoring Programme. The on-going monitoring proposed and followed during the deployment of device and associated seabed assets.
EPS	European Protected Species
ERCoP	Emergency Response Cooperation Plan. An official plan from the MCA.
ERP	Emergency Response Plan
FAT	Factory Acceptance Test
FMEA	Failure Mode and Effect Analysis
HIRA	Hazard Identification and Risk Assessment
HV	High Voltage. Currents over 1000V AC.
IMS	Integrated Management Systems. Sometimes referred to as a Safety Management System or an Integrated Safety Management System.
LAT	Lowest Astronomical Tide
LCOE	Levelised Cost of Energy. A means of comparing the cost of energy between different sources that includes all capital costs, operational costs, depreciation, costs of borrowing money etc.
MCA	Maritime Coastal Agency
MS-LOT	Marine Scotland Licencing and Operations Team. As Scottish Ministers are the licensing authority for most matters in Scottish inshore and offshore waters, MS-LOT are a team within Marine Scotland that issue marine licences on behalf of Scottish Ministers. MS-LOT provide a ‘one-stop-shop’ for all marine licence applications and Section 36 consents in Scottish waters.

NRA	Navigation Risk Assessment. A judgement of how much risk the device will pose to other maritime users, both in service and in the case of failure.
O&M	Operations and Maintenance
OPEX	Operational costs
OSC	Orkney Supply Chain
PA	Local Planning Authority. Usually associated with any onshore works and permissions.
PPE	Personal Protective Equipment
PR	Public Relations
ROV	Remotely Operated Vehicles
STCW	The International Convention on Standards of Training, Certification and Watch keeping for Seafarers specifies the minimum standards for training and qualification for those working at sea.
TPV	Third Party Verification
TRL	Technology Readiness Level
USBL	Ultra-Sonic Baseline. A method of underwater position measurement using acoustics.
WEC	Wave Energy Converter
WES	Wave Energy Scotland
WES Stages	A series of defined steps along a technology's progression through the WES programme.

Executive Summary

To inform developers within the programme and to minimise the risk of having to relearn past lessons, Wave Energy Scotland has commissioned a number of projects to capture industry Know-How. This document is part of the third Know-How project, which aims to produce a set of guidance documents that draw on the lessons learnt from real sea deployments at EMEC. The guidance documents are underpinned by the deployment experience built over the last 12 years within the Orkney Supply Chain (OSC). The input to development of these guidance documents is unprejudiced in drawing together both the positive and negative lessons learnt and cover a depth of expertise captured within each of the participating supply chain companies.

This guidance document highlights the issues to be considered under the theme of compliance and most specifically the regulatory licensing, Health and Safety (H&S) and electrical safety requirements. The sections are not exhaustive; however, these sections were discussed as important topics during the OSC workshops.

The main sections covered under compliance are:

- Technology Programme Development and Planning
- Marine Licensing
- Health and Safety including electrical and maritime safety

There are other industry guidelines covering aspects of marine licensing, H&S[1], this report, based on the lessons learnt from the OSC, should complement these other guidelines.

The blue highlighted boxes are there to question the developer team to ensure awareness, planning, engagement and implementation of the critical, high level checklist items. Where appropriate they are referenced back to the checklist proformas.

Following the guidance document are checklist proformas relevant under compliance. Only compliance specific topics have been covered within these checklists. Throughout the checklists, it is clear that the OSC advises developers to prepare well in advance; ensuring sufficient plans are in place to facilitate efficient, safe operations.

[1] Marine Scotland Licensing and Consents Manual – covering marine renewables and offshore wind energy development, available here: http://www.gov.scot/Resource/0040/00405806.pdf and EMEC Guidelines for Health and Safety in the Marine Energy Industry http://www.emec.org.uk/standards/guidelines-for-health-and-safety-in-the-marine-energy-industry/

1 Introduction

The potential for job creation and internationalisation in the wave energy sector is considerable. The wave resource potential to the UK alone is estimated to be up to 27 gigawatts (GW)[2] of theoretical energy, with the opportunities for R&D immense. The European Marine Energy Centre (EMEC) in Orkney has hosted the majority of the world's wave and tidal sector prototype testing. However, challenges to the wave development trajectory in terms of device survivability, reliability and performance, including cost effective installation, recovery, operations and decommissioning works have undermined the successful development of the wave energy sector.

With the formation of Wave Energy Scotland (WES) in 2015, the aim has been to bring a measured and phased approach to technology development to address these challenges. The phased approach is now established in the stage-gated WES technology development programme. Novel Wave Energy Converters, PTO developers, material specialists, subsystem and component innovations passing through the WES programme will be thoroughly analysed and tested ensuring the wave sector is prepared and ready prior to large scale prototype deployments in the sea.

This WES commissioned guidance document has been produced to capture the knowledge and lessons learnt by the Orkney Supply Chain (OSC) during the last 12 years. The contributing companies comprised a range of expertise encompassing environmental, electrical, marine operations management, diving and vessel hire companies, and include Aquatera, Bryan J Rendall Electrical, EMEC, Green Marine, Leask Marine, Offshore Subsea Consultancy Services, Orcades Marine, Scotmarine, Sula Marine and the Xodus Group. The guidance documents demonstrate the approach taken in capturing this wealth of knowledge without jeopardising the inherent intellectual property of any individual supply chain company.

Four major themes have been considered as part of this project, and each is explored in detail in its own report delivered as part of this project;

- WES_KH03_ER_02 – Guidance on Compliance
- WES_KH03_ER_03 – Guidance on Handling
- WES_KH03_ER_04 – Guidance on Installation
- WES_KH03_ER_05 – Guidance on Operations and Maintenance.

A description is provided separately describing how the project was brought together, how feedback was discussed, and how the priority lessons learnt were captured[3]. Details of participating companies are also given in this overview.

This guidance document focuses on the theme of Compliance, and covers issues pertaining to adherence of regulatory, statutory requirements, standards and industry best practices. The Compliance theme has a number of synergies with the other themes of Handling, Installation and Operation & Maintenance (O&M), and where issues overlap with the other themes they will be reinforced to indicate adherence to:

- Licensing requirements at pre-consented and non-consented sites,
- Third party verification requirements,
- Safe onshore and offshore regulations, and,
- Best practice.

The main compliance issues covered below affect all aspects of a programme lifecycle (see Figure 1). The holistic understanding of where specific compliance issues have arisen is

[2] Delivering UK Energy Investment: Low Carbon Energy, DECC, March 2015
[3] EMC_KH03_ER_01 – Approach and Supply Chain Introduction

informed by the perspective of the OSC and covers all phases of a programme lifecycle. These range from unclear programme testing and deployment objectives through to failure to plan for decommissioning.

Often compliance is treated as an afterthought and it is not recognised as a key threat to the development programme. In addition, there is often a lack of budget covering these processes. By looking ahead to create an understanding of the compliance requirements at the next project lifecycle stage, budgetary arrangements can be planned for.

It is essential to develop a compliance plan to provide this forward look and highlight the requirements for the following project lifecycle stage. The compliance plan can also aid scheduling and highlight potential constraints as many aspects of compliance have long lead times which are statutory and cannot be shortened. The integration of a compliance plan within an integrated management system de-risks any delays through the WES Stages, and overall programme life cycle, through to decommissioning of the WEC device. Beginning a high level compliance plan within the programme lifecycle will ensure confidence that the trajectory from earlier TRL levels through to in-sea prototype deployments is realistic and shortened. The introduction of the programme lifecycle can provide the opportunity to become aware of the compliance issues encountered during site screening and gain understanding of the licensing and permitting requirements, H&S requirements, impacts that design compliance issues may have during design development, and the overlap with Handling, Installation and O&M activities.

The following sections are not exhaustive in terms of all compulsory regulatory, statutory laws, standard or best practices. This document only includes items that were flagged as particularly pertinent issues with the OSC. Where possible, these have been described in detail in terms of the project-based requirements. The document should be used as guidance only. It should be noted that information and guidance provided within this document is appropriate at time of writing but is liable to change with regulations and legislation being updated. Developers should consult with the appropriate regulatory and public advisory bodies to ensure they fully adhere to the correct process for the proposed installation location. Developers should note that such governmental bodies have produced multiple guidance documents to facilitate developers through the statutory regulatory and legislative processes. Such documents should be referred to in the first instance.

Checklist proformas relevant to the compliance theme have been provided in the attached appendix. It is important to re-emphasise the overlap of other checklist proformas that will fall under the WES themes for handling, installation, O&M and having synergies with the compliance theme.

This suite of guidance documents should be used interactively and as an aid in providing a framework for engagement between developers and the supply chain during the planning and implementing of large-scale testing.

2 Technology Programme

Successfully meeting all compliance targets will happen more effectively if backed by an overall strategic plan which is scrutinised and adapted through a technology programme (as demonstrated in Figure 1). Such a lifecycle should begin with the technology development programme objectives, defined in the Technology development strategy. Figure 1 illustrates the various stages in the lifecycle, their sequencing and the interrelation between them. The diagram demonstrates the importance of considering health and safety, planning and consultation at all stages of the technology programme lifecycle.

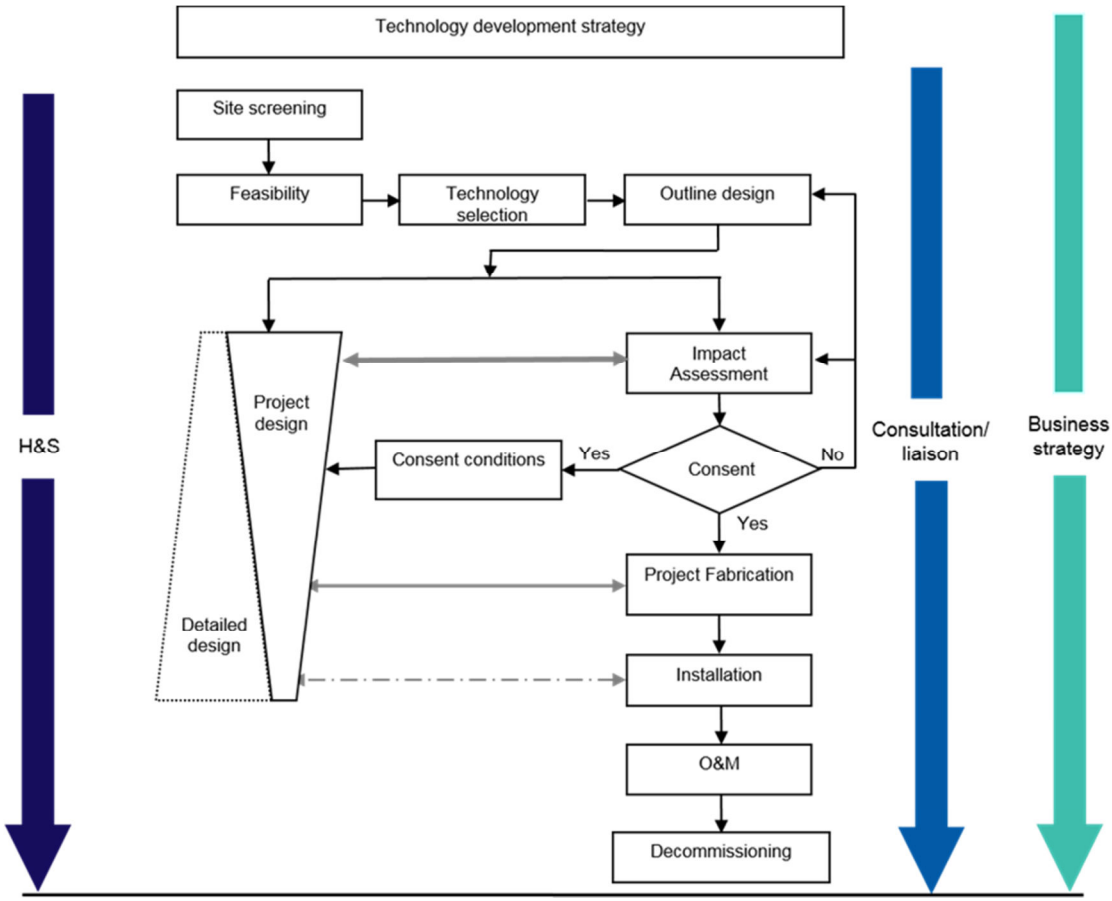

Figure 1 - Programme/project lifecycle (EMEC, 2009)[4]

It is essential that compliance is considered at each project lifecycle stage and future requirements are understood in advance. An example of failing to consider compliance is not ensuring that the regulatory requirements associated with decommissioning have been complied with prior to installation works. Developers must consider decommissioning and debris recovery operations prior to deploying. This is done by producing a Decommissioning Programme, which outlines the planned methodology, and ensures sufficient funds are in place. Depending on the project duration, it may be necessary to submit a Decommissioning

[4] Programme/project lifecycle diagram from EMEC's Guidelines for Project Development in the Marine Energy Industry, available here http://www.emec.org.uk/guidelines-for-project-development-in-the-marine-energy-industry/. The guideline is aimed at a range of marine energy developers and makes recommendations on the technical, environmental, H&S, legal and commercial issues that need to be considered through the programme/project lifecycle.

Programme to the appropriate regulator (currently the UK Department for Business, Energy and Industrial Strategy[5]) prior to installing the device.

As outlined above, at each of the project lifecycle stages it is necessary to gain an awareness of what will be required at the next stage; adequate preparation will ensure compliance. During the workshops the following topics were identified and focused on in terms of compliance: licensing; planning; health and safety; operational methods; insurances; reporting; maritime safety; and electrical safety. The following section discusses the requirements for each of these.

Have objectives been set that include compliance with all regulations and statutory requirements across all the project lifecycle stages? (Stages 1 and 2)

Is there adequate budget for the programme allowing for the regulatory process and the associated liabilities? (Stage 2)

2.1 Planning

Planning is an integral part of any technology development programme. The systems put into place will be guided, supported and evidenced within the plans developed. Table 1 demonstrates the plans detailed throughout the workshop discussions. The OSC recommended that to varying levels of extent, all the plans listed would be useful e.g. within the HR Plan there would be a Skills Capability Matrix which would help ensure all the necessary personnel are contracted. Clearly there will be various levels of requirement, ranging from statutory requirement to best practice. During the workshops, it was recommended that, to varying degrees, the plans listed in Table 1 should be discussed with contractors for collaboration or communication purposes as the project moves from Stage 1 to Stage 3. Often plans will be live documents continually updated to reflect that current situation.

The plans are related to each of the WES themes, however they have overlap and reference to other themes. For example, site plan is considered for installation, but would have certain requirements that would fall under Compliance (local planning authority planning permission). Handling and Installation plans are intrinsically linked, for example, the Lifting activities will be covered in installation and recovery plans.

[5] Note: This is due to change in April 2017 when Marine Scotland will become the regulator for decommissioning in Scotland.

Technology Development Programme Plans			
Compliance	**Handling**	**Installation**	**O&M**
Business/Strategic	**Onshore/Offshore**	**Commissioning**	**Marine Operations**
Programme/Project	**Supply Delivery**	**Installation/Recovery**	**Test Plan (wet/dry)**
Integrated Management System	**Transportation**	**Site plan**	**Data Capture**
HSE/ERP	**Lifting**	**Infrastructure**	**Communications**
Consenting/Licensing	**Shipping**	**Environmental**	**Maintenance**
Risk Management Contingency	**Tow**	**Electrical systems integration**	**Integrity Monitoring**
Data Management		**Diver Intervention**	**Diver Intervention**
Inspection/Verification		**Connections/ Disconnections**	
HR		**Inventory / Storage**	
Procurement			
Decommissioning			

Table 1 - Programme plans

Planning is introduced under compliance as a best practice at Stage 1 in most cases, although there are plans that will have strong regulatory, statutory requirements. The intention is to create awareness at a Pre-WES Stage of the plans necessary for a successful technology programme. Those plans will be more fully developed at Stage 1.

It is important that developers receive the correct support in the development or peer review of the onshore and offshore plans, as described in Table 1. Utilising the experience of third party contractors can help ensure the feasibility of the plans that fall under the other topics covered in this suite of reports, namely Handling, Installation and O&M. Dedicating time for development and recording of each plan will help to build a strong IMS, underpinned by process and procedures which ensure each plan is thorough.

The following sections are on the specific requirements under compliance that have been flagged by the OSC. Relevant questions to demonstrate compliance are highlighted in the blue boxes as questions and referenced as appropriate in the checklists in Appendix A:

3 Requirements

3.1 Licensing

Licensing is an important way of monitoring and protecting activities that are happening in the marine environment. The licensing process for offshore activities would normally begin prior to Stage 3. However, it is important to be aware, plan and begin stakeholder engagement in the early stages in order to remove the risk of delays in deployments. There is no dedicated body or organisation that advises developers which licences/permits are required, however test site operators like EMEC have guidance available to walk developers through the process and advise of the statutory licences/permits, licensing process and any best practice. In addition, environmental consultants can be contracted to help develop a compliance plan and advise what licences/permits will be required. Environmental consultants can act as agents and apply for licences and permits on the developer's behalf.

In Scotland, the foreshore and seabed out to a distance of 12 nautical miles are presumed to belong to The Crown, with management of this resource being the responsibility of The Crown Estate Commissioners. As proprietor, The Crown may grant titles or leases of parts of the foreshore and seabed out to a distance of 12 nautical miles. Within the Energy Act 2004, provisions are included for The Crown to grant leases for Renewable Energy Zones on the UK's continental shelf out to 200 nautical miles. Therefore, to place a development on the seabed, it is necessary for developers to obtain a lease from The Crown Estate (or the holder of the rights). Currently, The Crown Estate has a new leasing round open offering the opportunity for developers to access seabed for wave and tidal projects of up to 3MW across the UK[6]. The process and time required to acquire a Crown Estate lease may not be appropriate for WES developer testing programmes, therefore, an alternative route for deploying wave devices is to utilise already leased sites including test sites.

Marine Scotland are the regulatory body within Scotland with regards to marine licensing and have spent many years honing the licensing process whilst taking into account the statutory consultees' remit[7]. Marine Scotland has produced a licensing policy guidance document[8] to assist developers applying for both Marine Licences and Section 36 consents (refer to Sections 3.1.1 and 3.1.3 respectively for further information). As outlined in the guidance document, it is the developers' statutory requirement to comply with regulatory standards and processes and ensure that the necessary licences and consents are obtained prior to conducting any installation works. The key licences and consents required may include, but are not limited to:

- Crown Estate seabed lease;
- Section 36 consent under the Electricity Act 1989;
- Marine licence under the Marine (Scotland) Act 2010 and Marine and Coastal Access Act 2009;

[6] Further information regarding The Crown Estate's current leasing opportunities is available here: https://www.thecrownestate.co.uk/energy-minerals-and-infrastructure/wave-and-tidal/ocean-energy/current-leasing-opportunities/. For information regarding the process of acquiring a seabed lease, please contact The Crown Estate directly.

[7] For instance, in Scotland Scottish Natural Heritage (SNH) is a statutory consultee (otherwise known as a Statutory Nature Conservation Body) regarding the natural environment, therefore SNH provide expert advice to Marine Scotland taking into consideration the relevant legislation.

[8] Marine Scotland Licensing and Consents Manual – covering marine renewables and offshore wind energy development, available here: http://www.gov.scot/Resource/0040/00405806.pdf The manual is a key part of the offshore renewable energy planning system, providing developers with guidance and advice for the whole of the consenting licensing process from initial pre-screening and pre-application to the issuing of permissions and post consent.

- European Protected Species licence under The Conservation (Natural Habitats &c.) Regulations 1994 (as amended); The Conservation and Habitats Regulations 2010 and the Offshore Marine Regulations 2007 (as amended); transposed via the (Wildlife and Countryside Act 1981 (as amended) and Wildlife and the Natural Environment (Scotland) Act 2011);
- Basking Shark licence (Wildlife and Countryside Act 1981 (as amended) and the Wildlife and Natural Environment (Scotland) Act 2011);
- Works licence (Ports and Harbours) under the relevant local Harbour Order; and
- Planning permission under The Town and Country Planning (Scotland) Act 1997 (as amended by the Planning (Scotland) Act 2006).

The acquisition of the necessary licences and consents prior to undertaking installation works is particularly relevant in terms of decommissioning, as there have been experiences where developers have installed devices in Scottish waters, without the necessary permissions and provisions in place for decommissioning of the device. The regulator grants licences and consents with conditions attached, to ensure full compliance with all relevant legislation. Demonstration/testing facilities, such as those at EMEC, are likely to have some/all of the necessary licences in place for accessing the site, so early consultation with their licensing team is recommended.

As outlined above, it is ultimately the developers' responsibility to ensure that the required licences are obtained prior to undertaking the associated works. Developers should also consider the requirements for onshore planning permission and a Works Licence (granted by certain harbour and port authorities). It is recommended that a consent compliance plan is produced in Stage 2 or during the FEED stage, so that there is a clear grasp of the timescales and tasks involved with remaining compliant.

It is common practice to engage with environmental consultancies to ensure compliance with the licensing process and acquisition of all statutory consents, licences, permissions and permits. Such contractors will have suitably qualified practitioners that are able to undertake robust Environmental Assessments to establish the potential impacts that the project may have and to identify the most appropriate mitigation and monitoring mechanisms that are in line with best practices. Although there is a cost associated with contracting environmental consultancies, many developers have incurred additional cost, time and effort during the licensing process when doing it themselves. It is essential to balance the requirement for an environmental consultancy with in-house expertise and ensure if any support is contracted, that it is proportionate to the scale of the development.

Has a consent compliance plan been developed? (Stage 2)

3.1.1 Marine Licence

Certain activities require a marine licence before they can be carried out in Scottish waters. Typical licensable activities include:

- the deposit and removal of substances or objects in the sea or onto/from the seabed;
- construction and improvement works; and
- dredging.

Marine licences are issued by Marine Scotland from the Marine Licensing and Operation Team (MS-LOT). The application form for a marine licence is available online[9].

[9] Scottish Government webpage containing links to all marine licence application forms and associated guidance is available here: http://www.gov.scot/Topics/marine/Licensing/marine/Applications

In support of an application it is usually necessary for a developer to produce certain supporting documentation covering the following areas:

- Environmental Description;
- Environmental Assessment;
- Navigational Risk Assessment;
- Environmental Monitoring Plan;
- Decommissioning Programme; and
- Third Party Verification (TPV).

The level of detail required in these supporting documents should be proportional to the size and impact of the development. For guidance on the regulator's definition of proportionality refer to Marine Scotland's Survey, Deploy and Monitor approach[10]. It should be noted that pre-consented sites, such as EMEC, tend to have much of this documentation already available and it is only necessary to produce device-specific assessments to understand any additional impacts/risks associated with the deployment and removal in support of a marine licence application.

The turnaround time for processing marine licence applications, from receipt of completed application form and supporting documentation to issue of a licence, is typically about three months[11]. Any issues raised by consultees and stakeholders during consultation that require further information regarding the project or have the potential to jeopardise the project would be discussed with the developer in detail as soon as possible. It is important that developers are aware that late submission of their marine licence application is likely to delay their installation.

As part of the application it is good practice to produce a Commitments Register which summarises all realistic and tangible commitments made in the marine licence application. These are identified in an Environmental Monitoring Programme. The commitments are likely to be related to issues of environmental concern in which the regulator wishes to see some mitigation, for example, this may include monitoring of the device in operation. Some of the commitments made by the developer may affect the final device design. For each material change to the design that is subsequent to the impact assessment and commitments register, the impacts and list of mitigation and monitoring commitments will need to be reviewed before work can proceed. It is critical to be aware of operational implications resulting from the commitments and these should be reviewed prior to producing detailed method statements/schedules. This will reduce the potential for delays and additional costs associated with deployment.

Has supporting documentation been prepared to support a marine licence application? (Stages 2 and 3)

3.1.2 Project Envelopes

In order for the regulators and consultees to understand the nature of the project effects, it is necessary for the developer to supply a clear overview of all aspects of the project from device transport, to installation and commissioning, through operation and maintenance, as well as removal and decommissioning. The project description should not just cover tangible

[10]Guidance document on the Survey, Deploy and Monitor (SDM) Policy is available here: http://www.gov.scot/Topics/marine/Licensing/marine/Applications/SDM. The guidance document has been developed to provide regulators and developers with an efficient risk-based approach to taking forward wave and tidal energy proposal. The SDM policy has been designed to enable novel technologies whose potential effects are poorly understood to be deployed in such a way that will simultaneously reduce scientific uncertainty over time whilst enabling a level of activity that is proportionate to the risks.

[11]Section 36 licensing requires a longer turn-around time.

aspects (e.g. infrastructure on site, timescales) but also details of the monitoring programme and consideration of accidental events and emergency procedures.

It is well understood from past experience that uncertainties will remain in the project design and methodologies until late in the planning stages. Therefore, it is common practice to develop a range of possible parameters in which the likely and worst-case scenarios of the project fall within, allowing the granted licence/consent to have conditions attached which would impose that any permitted development kept within the specified range[12]. It should be noted that the other documents in this series can help developers ask the right questions regarding marine operations etc., it is believed this will aid the development of the design and project envelope.

This also allows contingency measures to be applied for in the licence. One example may be if there is an unforeseen requirement to install additional deposits on the seabed to aid seabed attachment. There have been cases where devices have been deployed without contingencies in place and have required marine licence variations or new marine licences at very short notice to permit works. Applying for a project envelope which includes contingencies saves both time and money.

How many uncertainties remain in the project design and methodologies? (Stage 2)

Have contingencies been built into the project envelope and marine licence application? (Stage 2)

3.1.3 Section 36 Consent

Section 36 of the Electricity Act 1989[13] requires projects with a device generating capacity of greater than 1MW to seek consent under the Act. This is required in addition to a marine licence. Section 36 consent is only required once the developer is considering a commercial installation.

3.1.4 Planning Permission

Current legislation requires consent to be granted from the Local Planning Authority (PA) under The Town and Country Planning (Scotland) Act 1997 (as amended by the Planning (Scotland) Act 2006) for all onshore elements of the project. It is advisable for the developer to make contact with local PA as early as possible to discuss the feasibility of the plans and the likely issues and conditions. It is worth being aware of the potentially onerous conditions that can be set by the PA (e.g. appearance, noise, emissions etc.) during the design phase. Early engagement (WES Stage 2) may also highlight any environmental information requirements that the PA may require prior to making a decision. It is recommended this is done at the point when onshore site location has been concluded, as the requirements may influence all site development activities.

Once planning permission has been granted, developers should conduct a review of the conditions and implement measures and protocols as necessary. It is highly likely that the PA will require to be informed on initiation and completion of works. If the developer introduces any design modifications, it will be important to engage the PA to ensure

[12] This approach must be used appropriately: at the time of application the proposed project parameters must not be so wide ranging as to represent effectively a different project.

[13] Further information regarding Section 36 consents is available from the Scottish Government website: http://www.gov.scot/Topics/marine/Licensing/marine/Section36. This is an information page outlining those developments that require a Section 36 consent, the associated Environmental Assessment process, and the public bodies that are consulted regarding Section 36 consent applications.

conditions of the planning permission continue to be met and no additional planning permission is required.

If significant onshore works are planned, has early engagement with the local PA been conducted? (Stage 2)

3.1.5 Environmental Impact Assessment

The majority of developer projects coming through WES are unlikely to require an Environmental Impact Assessment (EIA). The EIA Directive (85/337/EEC) came into force in 1985 and applies to a wide range of projects defined in Annexes I and II of the Directive. Annex I projects require an EIA, whereas projects listed under in Annex II will require an EIA depending on their size, nature and location. Marine renewable projects come under Annex II and require an EIA if their generating capacity is greater than 1MW. If developers need further advice on whether an EIA will be required, a decision by the regulator on whether or not the project requires an EIA can be made through a 'screening procedure'[14].

For projects not requiring a formal EIA, it may still be necessary to undertake a scaled down form of Environmental Assessment. This is required to provide sufficient information for the regulator and consultees to process, assess and determine the application. This is a detailed assessment[15], of the potential environmental impacts of your project, and is commonly conducted by a suitably qualified practitioner on behalf of a developer. The assessment also includes identifying suitable mitigation measures in order to gain a full appreciation of the residual impact. Where impacts cannot be mitigated, it may be necessary to conduct monitoring work to assess the level of impact and determine when an impact threshold has been crossed.

The following outlines the method of evaluating the potential environmental impact pathways (identified for each receptor), to assess:

- What impacts are of most concern?
- What the magnitude of the impact is from the device and cumulatively the surrounding area?
- How the impacts will be minimised and managed? and
- What the potential for residual impacts will be?

In order to measure, and therefore assess, the potentially significant impacts of a development there must be a baseline of environmental conditions against which the significance of predicted environmental impacts can be assessed. Developers must gain a sound understanding of all the different environmental aspects (physical, biological and human) which potentially could be affected by the proposed project. This is commonly termed a site characterisation/baseline characterisation and is undertaken to identify potential environmental impacts. The results of the characterisation can be documented in an Environmental Description of the site. The baseline produced may also need to be of suitable detail to support subsequent survey monitoring programmes and therefore, it is worth ensuring the data collected is of sufficient resolution (spatial and temporal). The baseline characterisation is generally a mixture of desk-based research and site surveying. To determine a baseline for the site, it may be necessary to undertake survey work, to establish the site conditions and species presence, distribution and abundance. There are various methods for undertaking survey work which are receptor-specific. Scottish Natural

[14] It is worth contacting Marine Scotland Licensing and Operation Team in the first instance to understand the process behind the screening procedure.

[15] This process will require an Environmental Impact Assessment (EIA) if the development has a generating capacity of greater than 1MW or is specified under Marine Works (EIA) Regulations (provided here: http://www.legislation.gov.uk/uksi/2007/1518/made).

Heritage has produced guidance on surveying and monitoring in relation to marine renewable developments[16]. It should be noted that established test sites are likely to have much of the required information regarding baseline characterisation already available.

Once a baseline characterisation has been undertaken, and the site baseline is established, it is then possible to begin identifying the impact pathways. This is done in four simple steps:

0.1. **Identify** both the environmental changes from the proposed project and associated works and the features of interest (i.e. receptors) that could be affected;
0.2. **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 (i.e. predict the impact);
0.3. **Evaluate** the vulnerability of the features as a basis for assessing the nature of the impact and its significance; and
0.4. **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.

Figure 2 provides an overview of the impact assessment process. On the Scottish Government website there is an impact assessment tool, known as 'IMPACT', which can help in identifying the possible impact pathways[17].

[16] Scottish Natural Heritage has produced draft guidance on surveying and monitoring in relation to marine renewable deployments in Scotland: http://www.snh.gov.uk/docs/B925810.pdf. They provide guidance, options and detailed protocols for conducting site characterisation surveys and impact monitoring programmes for marine renewables developments in Scotland.

[17] IMPACT is an online tool produced by Aquatera that allows users to identify the potential key environmental impacts associated with wave and tidal energy development and to access guidelines and recommendations for how best to assess, monitor and manage these impacts. This tool is available here: http://www.gov.scot/Topics/marine/Licensing/marine/tool.

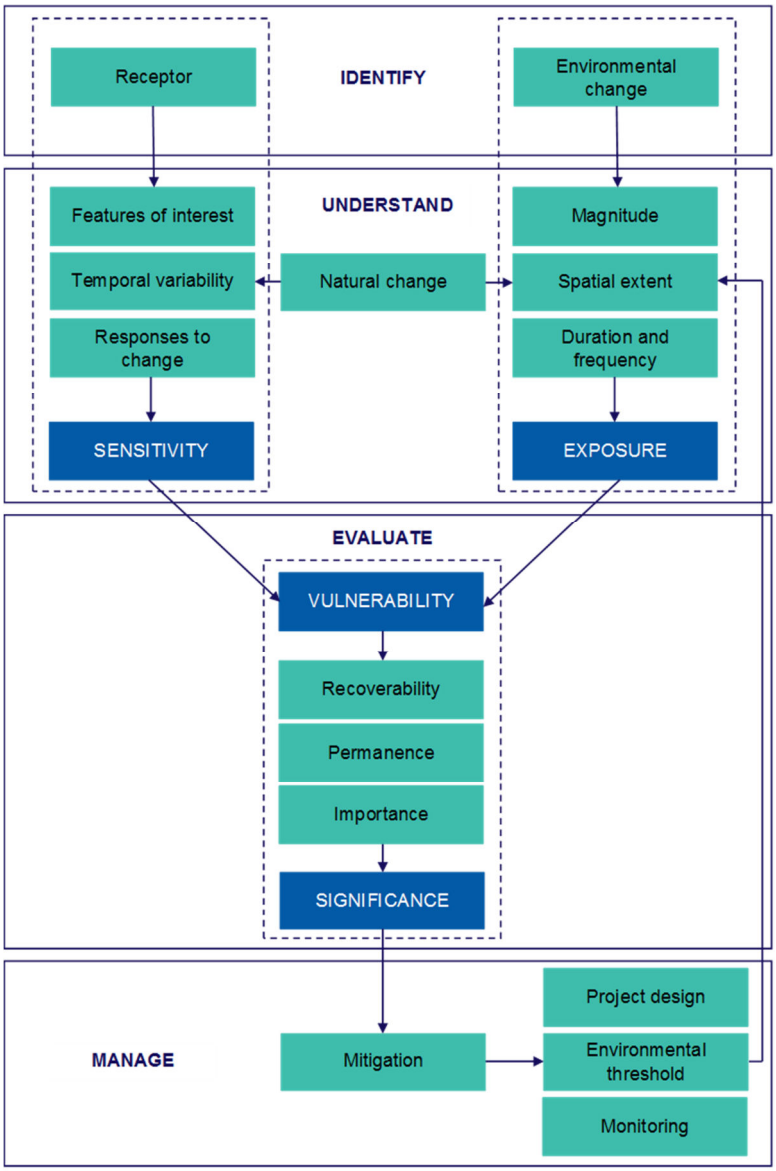

Figure 2 - Impact Assessment process

It is important that the developer budgets time for a suitably qualified practitioner to conduct the assessment if in-house experience is not available. Depending on the scale and location of the project, EIA and Environmental Assessments can take a significant amount of time to compile the information necessary, including survey work, to be able to undertake a well-informed assessment.

For applications requiring an EIA, there is a 4 months' mandatory consultation period for all onshore planning permissions. The 4-month period begins once the planning application has been accepted by the local PA and processing has begun. This period can run in parallel to a Section 36 consent application processing and consultation by Marine Scotland. The local PA are a statutory consultee for all Section 36 consent applications.

Have suitable budgetary and time provisions been made for contracting EA work? (Stage 2)

3.1.6 Environmental Report

As an EIA and Environmental Assessment is a process undertaken, the Environmental Report (termed Environmental Statement for formal EIAs) is the documenting of the process and the findings. The developer is required to produce an environmental report which

outlines the process undertaken during the Environmental Assessment (or EIA for projects with a generating capacity >1MW) including the survey methods employed, results and justification of any decisions reached on the impacts.

This will be used by the regulator and their consultees to evaluate the survey results and potential impacts. The environmental report should be submitted well in advance of the proposed deployment date, to allow sufficient time for assessment by the consultees and dialogue to resolve any outstanding issues. As stated above, there is a minimum 4 months' consultation period for planning applications, during which the environmental report will be required.

It is important that developers are aware that late submission of licence application supporting documentation is likely to delay installation.

Has sufficient time been built into the schedule to allow the Environmental Assessment to be undertaken and the associated report to be produced? (Stage 2)

If an environmental report has already been produced (e.g. for an established test site) have the implications of its findings and recommendations been considered in relation to your activities? (Stage 3)

3.1.7 Environmental Monitoring Plan (EMP)

As part of a marine licence application it is necessary to identify mitigation measures to reduce the likelihood of any potential impacts occurring and to monitor and assess the extent of any residual impacts. This is the opportunity to propose methods for monitoring the device in respect to issues of concern identified in the Environmental Assessment[18] and document in the Environmental Report. Therefore, the EMP is developed as a consequence of the Environmental Assessment findings. The framework and principles of the EMP[19] should be agreed with the regulator and relevant governmental bodies e.g. SNH, as commitments made therein are very likely to be incorporated into licence conditions.

The EMP is an iterative document, the framework, principles and details of which will be agreed as part of any consent from the regulator. The results of mitigation and monitoring carried out in accordance with the EMP must be submitted to the regulator in fulfilment of any licence conditions. It is recommended that the developer produces a dissemination strategy to ensure reporting is complied with.

The EMP should contain a Construction Method Statement (CMS) and Vessel Management Plan (VMP) specific to the project. The inclusion of the CMS and VMP allows the plan to be used a reference document for vessel operators and project workers, ensuring that any relevant commitments made in the EMP are complied with. A copy of the EMP is usually provided to any vessel skippers involved in the project.

Developers should be mindful of the budget required to comply with each of the proposed commitments prior to agreeing to include them in the EMP. The commitments made in the EMP may span the entire project lifespan, from pre-deployment to post-decommissioning.

[18] As the wave energy sector is still in its infancy and there are numerous different technologies that can be deployed, there are many uncertainties regarding the significance of specific impacts. As more knowledge is gained from the results of operational monitoring, these uncertainties will reduce. Therefore, robust EMPs are vital.

[19] Also sometimes referred to as the Environmental Monitoring and Management Plan

Has sufficient budget been allocated to allow for the development of the EMP and undertake those commitments stipulated within it? (Stages 2 and 3)

Have reporting and monitoring requirements been captured in the operational plan and method statements? (Stage 3)

3.1.8 Navigational Risk Assessment

Navigational Risk Assessments describe the potential navigational risks and mitigation measures associated with deployment of a device in relation to the specific site, taking into account the latest guidance and experience available, including the Maritime Coastguard Agency's Marine Guidance Notice 543[20]. Note that test sites are likely to have conducted a Navigational Risk Assessment for the site and may conduct regular vessel traffic surveys.

The water depth and overall height from the seabed of the proposed device should also be considered in the Navigational Risk Assessment to demonstrate that the developer can ensure adequate under keel clearance at lowest astronomical tide (LAT). Developers should also take account of MGN 372[21] and IALA Recommendations O-139[22] regarding the marking and lighting of their devices.

Have the appropriate standards been taken into consideration when conducting the Navigational Risk Assessment? (Stages 2 and 3)

3.1.9 Third Party Verification (TPV)

Developers are required by the regulator to produce an independent structural verification report for their device and its foundation, including any moorings, which is specific for the conditions likely to be experienced at the site. The report must be provided by an independent body with sufficient experience, standing and reputation. As there are no guidance documents available on TPV, to ensure the selected TPV supplier is appropriate it is highly recommended to consult with the regulator, MS-LOT.

Early input from the TPV supplier can ensure that effective and efficient mechanisms are in place for meeting required standards. The OSC recommended that a third party is used to provide advice from the initial design stages. This should ensure that during the development of the design, guidance is utilised on the standards the design will eventually be certified against.

[20] Marine Guidance Note 543 (M+F) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – UK Navigational Practice, Safety and Emergency Response – available at: https://www.gov.uk/government/publications/mgn-543-mf-safety-of-navigation-offshore-renewable-energy-installations-oreis-uk-navigational-practice-safety-and-emergency-response

[21] Marine Guidance Note 372 Guidance to mariners operating in vicinity of UK OREIs – available at: https://www.gov.uk/government/publications/mgn-372-guidance-to-mariners-operating-in-vicinity-of-uk-oreis

[22] International Association of Marine Aids to Navigation and Lighthouse Authorities Recommendation O-139 on The Marking of Man-Made Offshore Structures- available at: http://www.hydrosphere.co.uk/site/assets/files/1140/iala_recommendation_0-139_marking_of_manmade_offshore_structures.pdf

Has an appropriately experienced organisation been selected to conduct the TPV? (Stage 2)

3.1.10 Decommissioning Programme

Decommissioning of devices capable of generating power is governed by Sections 105 to 114 of the Energy Act 2004. Responsibility for decommissioning under the Energy Act has not been devolved to the Scottish Government as yet, and thus lies with the UK Department for Business, Energy and Industrial Strategy (BEIS). However, in Scotland, this responsibility will become Scottish Ministers in April 2017, and therefore will be within Marine Scotland's remit.

Currently, when a developer has been granted a marine licence (by Marine Scotland), a Notice to Decommission (Section 105 notice) is issued by BEIS to the project developer. This places a requirement on the developer to produce a Decommissioning Programme. Guidelines[23] are available regarding the production of this document. Decommissioning Programmes are subject to two rounds of consultation[24]. Once both consultation rounds have been completed, the Decommissioning Programme is approved by BEIS and financial securities are put in place. It is best practice to have the Decommissioning Programme approved prior to commencement of installation.

Marine Scotland requires a marine licence application for removal to be approved prior to decommissioning, if not covered in the original marine licence for installation. The inclusion of removal in the marine licence for installation, tends to depend on the project duration. Due to the duration of most WES projects, it is likely that the majority of marine licences applied for under WES will include installation, operation and removal. If removal is not included in the installation marine licence, it will be necessary to apply for a marine licence for removal works. As with all marine licencing, Marine Scotland is the regulatory authority for issuing a marine licence for removal.

Does the marine licence for installation include decommissioning? (Stage 2)

3.1.11 Other Licences

There may be instances where additional licences/consents are required in relation to particular species or surveys. The following is a list of possible additional licences that may be required, however this is not an exhaustive list:

- Licence to disturb European Protected Species (EPS) under the Habitats Regulations 1994 (as amended in Scotland);
- Licence to disturb basking sharks under the Wildlife and Natural Environment (Scotland) Act 2011;
- Harbour Works Licence issued by the Harbour Authority if site falls within Harbour Authority jurisdiction.

[23] Guidance notes produced by UK Government Department of Energy and Climate Change on 'Decommissioning of offshore renewable energy installations under the Energy Act 2004', is available here: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/80786/orei_guide.pdf. Sections 105 to 114 of the Energy Act 2004 introduced a decommissioning scheme for offshore wind and marine energy installations. This guidance document has been produced regarding the operation of the scheme to assist businesses in understanding their obligations under the scheme.

[24] The Decommissioning Programme is submitted for two rounds of consultation. The first is for 30 days around a range of stakeholders specified by BEIS. Following the incorporation of any feedback, the Decommissioning Programme is then submitted to BEIS for a second 30-day circulation around Whitehall before finally being submitted to the Secretary of State for approval.

In addition, depending on the acoustic impact during installation and decommissioning, it may be necessary to register on the Noise Register[25], if operations are expected to be between 10Hz-10kHz. Marine Scotland will advise if any of these licences and any associated mitigation[26] will be required.

3.1.12 Stakeholder Engagement

When processing an application, MS-LOT seeks expertise from a variety of sources, including statutory and non-statutory consultees. Although the consultation process is a formal process built into the licence/consent processing procedure, there is also the opportunity for developers to have prior discussions with groups and organisations external to the application process. This could be with the statutory consultees themselves (i.e. Scottish Natural Heritage, Scottish Environmental Protection Agency, Maritime and Coastguard Agency, Northern Lighthouse Board), local interest groups (e.g. sailing clubs), stakeholders (e.g. landowner) or with the non-statutory consultees (e.g. fishery and conservation groups). It is highly advisable to understand those parties who are likely to have concerns/interests regarding the project and begin discussions with them as soon as possible, preferably prior to submitting the marine licence application. This can facilitate an easier consultation period later in the licensing process and can reduce costs if there are any design changes that can be captured earlier. Keeping interested parties and the general public up to date on plans and the progress of the project is crucial, particularly if wanting to further develop in the locality.

Note that the general public and other sea users have access to marine licence notifications and Notices to Mariners. Therefore, activities which are undertaken without suitable approvals are commonly identified to the regulator by these parties. This highlights the importance of complying with the statutory licensing process and maintaining the faith of stakeholders in demonstrating good intent on following regulations.

If appropriate, have the consultees and stakeholders that are likely to have concerns regarding the project been identified? (Stages 2 and 3)

3.2 Health and Safety (H&S)

The wave energy sector is characterised as being innovative, dynamic and at the forefront of technology. Compliance with sound management principles should enable it to be effective in managing the health and safety challenges it faces.

Elements common in effective health and safety management systems include:

- H&S being integrated in all business decisions and, particularly for a relatively new industry sector such as wave and tidal, consideration in the design of both devices and projects;
- Worker engagement, which encourages individuals to contribute to health and safety performance and reporting, along with support through effective training;
- Prioritisation of most significant risks to enable efficient risk reduction, not allowing minor risks to hinder progress;
- Wherever possible eliminate risk, ensuring residual risks are controlled and managed.

[25] A Marine Noise Registry (MNR) was developed by Defra and JNCC to record human activities in UK seas that produce loud, low to medium frequency 10Hz – 10kHz impulsive noise. The following webpage is Scottish Government guidance on the use of MNR and those developments/activities that are applicable: http://www.gov.scot/Topics/marine/Licensing/marine/guidance/noise-registry.

[26] Such mitigation is likely to be limited to undertaking marine mammal observations during key activities, although it could extend beyond this, depending on the project details.

It is essential to comply with an established H&S approach as outlined in the Construction (Design and Management) Regulations. New CDM regulations have come into force from the UK Government in 2015. The H&S Executive has published Legal Series guidance that supports CDM 2015[27]. This is a proven approach to project risk management and achieving good H&S standards. The aim of CDM and its relation to compliance is as follows:

- Improve the planning and management of projects from the very start;
- Early hazard identification, eliminating or reducing them at the design or planning stage with the remaining risks being properly managed;
- Targeting effort to where it can improve H&S most;
- Discourage unnecessary bureaucracy; and
- Achieve compliance with the law.

Should a developer not wish to use CDM as the model for their Integrated Management System (IMS)[28], they will still have to provide the same information to comply with the requirements of the Management of Health and Safety at Work Regulations 1999.

Achieving required regulatory standards in safety for wave technology type activities will require the establishment of a suitable safety management system, within a wider management system. Although the availability and use of such systems are not actively verified onshore, there are punitive penalties if systems are not in place when things go wrong. The complexity and nature of wave energy operations mean that CDM Regulations are very likely to apply and should be followed as best practice. This requires significant commitment from senior managers, funders etc.

It is worth noting that if CDM is considered applicable, then it must be applied to the project from the very beginning. There is a common misconception that because very short projects are not *reportable*[29], they don't need to be completed to the same rigour. This is not the case, and punitive measures would still apply in the case of incident where it was shown that the safe working practices outlined in CDM were not followed.

For example, some technology developers have not operated any comprehensive safety or IMS and they have had numerous near misses and failures. Even well managed companies are still exposed to significant safety and other risks.

Compliance with Health and Safety is necessary across all the WES Stages.

What is the chosen IMS in place and are you aware of the CDM approach and UK regulations? (Stage 1)

Can you demonstrate the H&S approach across each Stage, including in the handling, installation and O&M activities? (Stage 2)

[27] The following publication provides guidance on the legal requirements for Construction (Design and Management) Regulations 2015, it is available to purchase here: http://www.hse.gov.uk/pubns/books/l153.htm. The guidance document describes: the law that applies to the whole construction process on all construction projects, from concept to completion; and, what each duty holder must or should do to comply with the law to ensure projects are carried out in a way that secures health and safety.

[28] Also, commonly referred to as Safety Management System (SMS) or Integrated Safety Management System (ISMS).

[29] Under Construction (Design and Management) Regulations 2015 (CDM) definitions for when a project becomes 'notifiable' or 'reportable' are provided. This is in relation to the requirement to report/notify the Health and Safety Executive (HSE). Whether or not a project is reportable/notifiable is based on the duration of the project and number of person days involved.

3.2.1 Risk Assessment

The assessment and management of risks lies at the heart of safety (and environmental) regulation and, as a result, such practices should also lie at the heart of the IMS, CDM and EIA activities. The requirement for all risk management activities is based on the ALARP triangle:

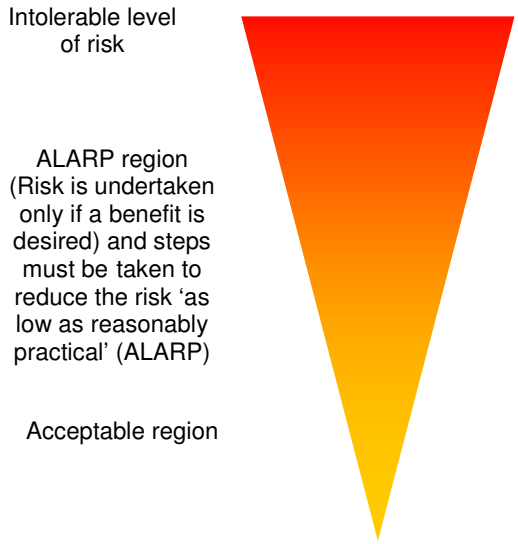

Figure 3 - ALARP risk reduction triangle (EMEC Risk Management SOP001)

Developer's compliance towards risk assessment involves incorporating a culture of risk identification at every phase and stage of development, including identification of risks from the activities of others who conduct services within the boundaries of the technology programme. The output of a risk assessment or Hazard Identification and Risk Assessment (HIRA) is the risk register. This is a live document and should be reviewed periodically to ensure continued validity, allowing for changes to the system of work/materials/equipment etc. The risk register also underpins the operational method statements[30].

The fact that all plans and devices change during design and early deployment activities needs to be taken into account within planning and technology specific regulatory, permitting and assurance related activities. This may mean keeping competent authorities informed of changes, updating compliance documentation and, if necessary, applying for new/additional licences including updating the risk register. Incorporating a change management process within the organisational IMS will help inform the necessary re-direction of resources, budget and business processes that impact company operations.

Has a technology risk register been established? (Stage 1)

Is there a process in place for maintaining the risk register and evidencing of updates? (Stage 1)

Have the risks associated with developed plans (e.g. operational method statements) are captured on the risk register? (Stage 1)

[30] See guidance Operations and Maintenance Stage 1.

3.2.2 Emergency Response Plan (ERP)

A separate site Emergency Response Plan (Project ERP) should be in place during the construction and O&M phases of the development programme, with appropriate additions or adjustments for specific and 'one off' operations. Where subcontractors are involved, the plan should detail 'bridging' arrangements between the Emergency Response Plans of individual contractors and particular individual vessels engaged. Operators and developers are required to use the MCA's '*Emergency Response Cooperation Plan (ERCo*P)' in formulating their emergency response plans and site Safety Management Systems. ERCoPs provide information to external parties relating to emergency response planning and requirements. ERCoPs are required for the construction, operation and decommissioning phases.

When developing the ERP, consideration of the remoteness of the site location and the extreme local conditions (dictated by the nature of the device, wave or tidal energy) and the response times of emergency services should be made. Appropriate arrangements (e.g. equipment and trained personnel) should be provided to ensure self-sufficiency and preservation of life until emergency services attend.

It is recommended that ERP exercises be regularly undertaken to validate the planned procedure and to ensure that operations staff are familiar with it. It is particularly important to engage local emergency services, including medical facilities in understanding the potential needs of the project and the environmental conditions under which they may be asked to assist.

The ERP is further discussed in the O&M section.

Are you aware of the requirement for ERPs? (Stages 2 and 3)

Have the appropriate ERPs been produced prior to conducting activities? (Stages 2 and 3)

Has an ERCoP been submitted covering each of the project's phases? (Stages 2 and 3)

3.3 Operational Method Statements

Operational method statements are documented and controlled records kept of the process to complete the planned operational activities, describing in detail the equipment and activities involved in installation, recovery, operation, maintenance and decommissioning of the device and its subsystems.

This is a key output of operational planning. Outcomes of the HIRA process for example, should feed into method statements and tool box talks to ensure that all those engaged in carrying out the works are aware of the residual hazards and risks and any steps that they should be taking to mitigate them. Building the routine of writing and developing operational method statements supports successful deployments and creates a feedback loop of lessons learnt for any repeated operations.

These method statements should be utilised throughout the WES development programme, and are as equally applicable to scale tank testing as open water deployments.

3.4 Insurances

Developers will be required to put in place and maintain, during the period of their at-sea testing, sufficient insurance appropriate to that stage of testing to cover the requirements. This insurance requirement will likely include:

- Third party liability insurance;
- Employer's liability insurance;
- Professional Indemnity insurance in the region of £10 million;
- Any other insurance required by applicable law.

Has an appropriate insurance broker been identified with appropriate polices in place? (Stage 3)

3.5 Reporting

Most insurance compliance systems require some form of record keeping and reporting and some, such as CDM, rely upon the records as evidence of compliance that H&S was considered during the design and build stages. There have been examples where developers have not had an IMS in place and therefore, were not able to demonstrate or comply with insurance investigations.

It is recommended from the outset that the project establish a document control and record keeping procedure for all documentation. Throughout the project various types of documentation shall be raised detailing specific information about the construction of the project. It is important to ensure all technical and safety related information contained within the documentation is controlled, so changes may be identified and effectively controlled. Examples of typical project documentation which will require to be controlled include:

- Project Health & Safety Management System procedures and documentation;
- Pre-construction Information;
- Construction Phase plans;
- Drawings;
- Design documents;
- Specifications;
- Minutes of project meetings;
- Project reports;
- Method statements;
- Risk Assessments;
- Test & Commissioning reports;
- Training records and certification;
- Equipment certification;
- Construction daily reports.

In addition, the CDM regulations require a Health & Safety File to be created and maintained for the life time of the structure. This file is required to contain all relevant information relating to the structure (further detail is contained within the ACOP - L144).

Have you a document control system in place? (All Stages)

3.6 Maritime Safety

Requirements for maritime safety are paramount in the wave energy sector. Activities during open sea deployment will involve all aspects of maritime safety but it is important to become

aware of the requirements prior to installation of a device. Below are high-level guidelines for compliance:

- To the extent that it is possible, work should be carried out onshore;
- For offshore activities, all vessel movements under the control of the responsible person for the site will require the submission of passage plans in accordance with Maritime and Coastguard Agency (MCA) guidelines;
- Information should be provided to local vessel operators, fishermen, sailing clubs and other leisure users including Notice to Mariners;
- MCA or the General Lighthouse Authorities can provide guidance on site markings, security levels, etc. in accordance with the relevant legislation;
- During periods of significant activity, a marine coordinator should be appointed;
- Arrangements should be in place to ensure the location of site workers is known.

Prior to a marine licence being awarded, a Navigational Risk Assessment (NRA) will be required by the regulator (see Section 3.1.8).

Any device or equipment deployed at sea should have assured basic structural integrity and should not create an undue hazard if it fails[31]. A TPV is required by the regulator prior to a marine licence being granted. It is also essential to have ERPs in place, in case of failure.

Has the above high-level guidance been followed in planning operations and conducting a NRA? (Stages 2 and 3)

If an NRA has been previously undertaken (e.g. for an established test site) are you aware of its implications on your activities? (Stage 2)

Does the TPV cover the device and foundation mechanism for the conditions in which it is being installed? (Stage 3)

Have ERPs been put in place and a marine contractor designated for unplanned and emergency situations? (Stage 3)

3.7 Electrical Safety and Compliance

Wave devices and their accompanying infrastructure use a range of voltages. AC supply above 1000V phase-phase is normally considered as high voltage (HV) and require enhanced precautions to allow work to be carried out in safety. It should nevertheless be emphasised that low voltage systems, and in particular the high-energy systems commonly found in generation equipment, still present the risk of serious injury or death.

Work on electrical systems should only be undertaken by competent persons, appointed in writing. The appointment should detail the extent of authorisation to work on the electrical system. A written set of electrical safety rules should be provided.

Before working on an electrical system (relevant to Stage 2 and Stage 3) it will be necessary to ensure that the circuit has been correctly identified, that it has been isolated from all sources of electrical supply or stored energy and has been proved dead. For high voltage systems, the additional precaution of earthing is required. The ability to create this safe working environment must be designed in from the preliminary electrical design stages. It

[31] See guidance Operations and Maintenance Device structure, Site conditions

must be ensured that all electrical components have sufficient IP (Ingress Protection) ratings[32].

An electrical permit to work system should be used to control work on high voltage equipment and is also likely to be beneficial for many low voltage systems.

Electrical systems for marine energy converters include subsea cables and connectors in addition to onshore electrical infrastructure (switchgear, transformers and in some cases power converters) and the device itself. The system should be designed to facilitate safe operation, ensuring that each part of the system can be isolated and, for high voltages, earthed to make safe for work. Component parts should be adequately rated for the range of frequency, voltage, current and hydrostatic pressures to which they will be exposed, including transient and harmonic voltages and fault currents. Where a power converter is located remotely from its' generator, particular attention should be paid to ensure that protection systems function correctly over the full range of frequencies and that circuit breakers are rated to break the prospective fault current at those frequencies.

Particular issues for marine renewables include:

- Circuit identification: where there are multiple feeder cables it will be necessary to establish sound procedures to ensure that the correct cable is isolated onshore to allow work at the offshore end;
- Isolation from all sources of supply: this will be particularly important when using permanent magnet or other types of generator capable of self-excitation, where work or testing on the subsea cable system or connectors is likely to require electrical isolation from the generator as well as from the shore supply. Isolation requirements should be considered at the design stage. If remotely operated equipment is selected for isolation purposes, it will require careful thought to ensure that it can be confirmed that the remote equipment has operated correctly to provide isolation and then that the equipment can be secured in the isolated position.

It is essential that developers appreciate the lessons learnt from experienced electrical/PTO WEC contractors, and it is recommended that early engagement with experts and suppliers will ensure that all electrical interfaces are standardised were possible.

Have competent persons been identified and appointed for working on the electrical systems? (Stage 2)

Has an authorisation to work or permitting system been established (e.g. electrical permit to work)? (Stage 2)

[32] IP ratings are defined in the international standard EN60529 (British BS EN 60529:1992). They are used to define levels of sealing effectiveness of electrical enclosures against intrusion from foreign bodies and moisture. This is particularly important in the marine environment, with regard to rusting of components (e.g. circuit breakers rusting 'on').

4 EMEC Billia Croo/Scale site requirements

EMEC has a detailed 'client lifecycle'[33] as a standard operating procedure (SOP). The step by step process is an integral service beginning with initial developer contact and technical requirements. A timeline is outlined below summarising the steps through EMEC.

Stage 1 - Initial contact to contract signing

- Introduction to facilities
- Discussion around technology feasibility and availability
- Signature of non-disclosure agreement
- Draft contract issued

Stage 2 - Contract signing to installation date

- Comprehensive details provided by EMEC
- Documentation produced by developer
- Regulatory consents achieved
- Readiness review

Stage 3 - Installation and testing period

- All marine operations undertaken safely
- UKAS accredited device performance assessment (full-scale only)
- Further monitoring of device

Stage 4 - Decommissioning and demobilisation

- Regulatory consents completed
- Berth vacated and facilities cleared

The respective timelines from initial contact through to decommissioning at the Billia Croo grid-connected test sites and the Scapa Flow scale site are given in Table 2.

	Billia Croo	Scapa Flow
Stage 1	**3 months**	**2 months**
Stage 2	**9 months**	**3 months**
Stage 3	**1 – 5+ years**	**3 – 12 months**

Table 2 - Timelines from initial contract through to decommissioning

The detailed amount of documentation that is required and discussed in the above sections and prepared at Stage 1 will ensure a smoother transition from contractual agreement through to grid connection on one of the 5 current testing berths.

In terms of consenting, EMEC also follows a detailed Consenting SOP[34] that provides informational support in terms of the key documents necessary in order to obtain a Marine Scotland license. The following summarises the required documentation:

[33] EMEC Client Lifecycle SOP011-13-01 20161109.doc

[34] EMEC Consenting Process SOP076-06-01 20150112.doc

- Scoping document – description of device and proposed testing
- Marine License application form
- Environmental Report
- Project specific environmental monitoring programme (PEMP)
- Project specific Navigational Risk Assessment
- TPV
- Decommissioning plan

EMEC also provides developers with a Consenting Guidance for Developers at EMEC Billia Croo Test which is accessible once a developer has initiated the contractual discussions with EMEC.

5 Conclusion

In summary, compliance with statutory and regulatory requirements should be identified and prioritised as objectives in all plans and covering all phases within the technology programme. Many aspects of licencing, required to maintain compliance, involve lengthy, time consuming activities and so early recognition of the requirements to be addressed is necessary for a successful project output. H&S, risk assessment, standards, verification and certification cover many aspects within onshore and offshore handling, installation and O&M/recovery of marine wave energy converters.

At each WES Stage identification and prioritisation of each checklist item, supported by detailed description in the following proformas, will provide guidance to WES developers moving from one stage of development to the other. Ultimately, this will ensure lessons learnt to date from at-sea operations can be addressed prior to a successful full scale commercial deployment.

Following are the compliance checklist proformas. It is important to note the checklists are categorised under the respective WES Stage (Pre-WES, Stage 1, Stage 2, Stage 3) based on the following guidelines for relevance. At the appropriate stage the developer should be:

- Pre WES – Gain an awareness of checklist item. Understanding differences in requirements between sites.
- Stage 1 – Plan for addressing checklist item, taking into consideration statutory timescales/requirements where necessary. Be aware of design modifications that may be required in following stages, mitigate where appropriate.
- Stage 2 – Engage/collaborate/analysis during scale tank testing to mitigate/address checklist item. Begin preparing required plans ready for completion/submission and implementation in Stage 3. Ensure plans are in line with available standards, guidance documents and best practice.
- Stage 3 – Implement checklist item in onshore/offshore activities. Record any lessons learnt and opportunities for future testing, disseminate findings for industry-wide learning.

5.1 Checklist Definitions

The Checklist threads below in Table 3 are the priority checklist items covered in detail with the Orkney Supply Chain (OSC) and prioritised under the compliance guidance. The OSC agreed on specific definitions for each thread for clarity. The proformas should be used interactively and provide a framework for further discussion ahead of future activities.

Thread	Definition
Integrated management systems	Ensuring that a holistic approach to total quality management is adopted at the start and maintained through the progression of the programme. In particular, it is recommended that suitable CDM and safety management practices are adopted.
Record keeping and reporting	Ensuring that all necessary data is acquired, records are kept and reports and outputs produced to meet the programme objectives. The investors, funders and other stakeholder expectations, regulatory requirements, best practices, standards and future programme activities are documented including wider technology development.
Risk management and insurance	Ensuring that the hazards, opportunities and uncertainties associated with all programme activities are identified, understood and managed appropriately and that where necessary suitable mitigation and insurance has been put in place.
Contingency arrangements	Suitable plans and related arrangements are in place to implement if and when things change or don't go as planned.

Thread	Definition
Third Party Verification (TPV)	Ensuring that there is effective scrutiny, guidance, vision and challenge within the development and decision making process from individuals with real and valuable experience to contribute. This will include knowledge about design of both onshore and offshore sites/activities.
Site conditions	Ensuring that the specific influences of environmental, social and industrial site conditions on design and operations are understood. This includes taking into account both the laboratory and factory conditions and onsite reality of onshore and at sea conditions.
Inspection and Monitoring	Ensuring that suitable means for inspection and monitoring have been considered and are put in place. Typical monitoring activities will cover integrity, performance, environmental interactions, safety etc.
Licensing	Ensuring that the full regulatory and permission framework for the technology programme is understood and the provisions are met or exceeded.

Table 3 - Checklist definitions

Appendix A: WES Development Pathway and Checklist Proformas

Throughout the development workshops the documenting of supply chain issues and recommendations was carried out using proformas. The workshops were designed to build the proformas and indicate which specific topic and associated issue were important to address at which Stage.

An indication of the topics that should be considered at each Stage of the WES NWEC Programme has been provided below. In addition, a high level overview of the pre-WES requirements is also included. It is understood that each of the WES programmes will have a variation of these typical activities, dependent on the system development programme and the most appropriate stage gated progression. The checklist proformas for each of the prioritised OSC threads relevant to Compliance follow this.

Pre WES Concept Creation Feasibility Work	**WES Stage 1** Concept Characterisation & Refinement	**WES Stage 2** Concept Optimisation & Demonstration of Engineering Specification	**WES Stage 3** Small Prototype Development
• Basic technology research • Technology concept formulated • Geometry • Hydrodynamics • Numerical modelling • Natural period • Weight distribution • Small scale tests	• Concept development • Systems engineering • Numerical model and simulation • Power performance estimates • Device efficiency • Shape optimisation • Scale model / component testing	• Concept refinement • Technology optimisation • Control system design • FEED study • Large scale tank testing • Numerical model validation • LCOE calculation • CAPEX estimation • Subsystem testing	• Refined system • Design and fabrication understood • Large open water model developed • Fully operational system • Performance proven for full system • Certification of system

Integrated Management Systems	Aim: Ensuring that a holistic approach to quality, health, safety, environmental (QHSE) management is adopted at the start and maintained throughout the developer's progression of the WES programme.

In particular, focussing on the adoption of CDM regulatory and safety management practices. In the early stages, it is only necessary to develop an awareness of an Integrated Management System (IMS) and how it will fit within the programme. However, as the project progresses through the WES Stages, it will be necessary to implement an IMS incorporating QHSE. The IMS should cover both onshore and offshore activities and the interface between them. If necessary, it may be prudent to employ a specialist experienced QHSE manager (depending on in-house experience). As offshore operational work is undertaken, it will be necessary to ensure adherence to CDM regulations and requirements. As part of the IMS, ensure that monitoring and control mechanisms are in place and that reporting is used as a feedback loop to improve all operations. All management decisions should be reported alongside the associated justifications. Ensure that decommissioning is a consideration in the IMS and that there are sufficient resources available to manage decommissioning.

Pre WES	**WES Stage 1**	**WES Stage 2**	**WES Stage 3**
☐ Awareness of the requirement for an appropriate IMS and quality system to be put in place.	☐ Develop and /or operate within an Integrated Management System (IMS), covering the regulations of Construction Design and Management (CDM)	☐ Implement the fully operational IMS.	☐ Monitor and control the IMS. ☐ Ensure CDM regulations are adopted and followed throughout detailed design. ☐ Ensure management of communications equipment, from local onshore facilities to test site, remote operational offices to test site and device are implemented. ☐ Establish clear chain of command that is communicated to all project personnel and subcontractors both on and offshore. ☐ Organograms should be available on all vessels, offices and included in the IMS and other operational plans to ensure there is a clear understanding of the relevant responsible person.

Relevant Industry Standards, Guidelines

The Construction (Design and Management) Regulations 2015, see: http://www.hse.gov.uk/pubns/books/l153.htm

Record keeping and reporting	Aim: Ensuring that all necessary data is acquired, records are kept and reports and outputs produced to meet the programme objectives. Ensure investors, funders and other stakeholder expectations, regulatory requirements, best practices, standards and future programme activities are documented including wider technology development.

Record management system process to record and archive diverse documents that become a record of the technology programme including inputs and outputs of all activities for monitoring and control.

Pre WES	**WES Stage 1**	**WES Stage 2**	**WES Stage 3**
☐ Awareness of industry data portals and databases to support reporting and analysis, e.g. Offshore Renewable Energy Catapult, Marine Scotland.	☐ Develop laboratory information (data) capture and management plan. ☐ Maintain records of design cases those used, as built/tested, and any design changes in one system for referencing.	☐ Monitor and control a (data) management system in place for data logging tank testing inputs and outputs. Develop the field information (data) management system for offshore testing in Stage 3.	☐ Implement, monitor and control field information (data) management system. Ensure feedback loop as testing progresses. ☐ Record and report successes, failures and near misses. Ensure feedback system is in place to record and report such events.

Relevant Industry Standards, Guidelines

EMEC Guidelines for Health and Safety in the Marine Energy Industry http://www.emec.org.uk/guidelines-for-health-and-safety-in-the-marine-energy-industry/

ISO/TC 114 Horology see http://www.iso.org/iso/standards_development/technical_committees/other_bodies/iso_technical_committee.htm?commid=51734

Risk management and insurance	Aim: Ensuring that the hazards and uncertainties associated with all programme activities are identified, understood and managed appropriately and that, where necessary, suitable mitigation and insurance has been put in place.

At the early stages, it is necessary to establish a framework within which risk management underpins technology programme decision making processes and design reviews. The risk management process will link to the technology programme insurance process.

Throughout all the WES Stages and beyond, it is essential to continually update the risk register and ensure it is a live document. Develop a change management process into the IMS, and ensure there is a full understanding of the process by all staff. Ensure that insurance underwriters are aware of the contents of the risk register to ensure that appropriate cover is arranged. HIRAs should be conducted prior to operations and be updated appropriately. The outputs from the on-going HIRA process should be fed back into the risk register. Build detailed method statements for all stages and operations and use them to guide day to day performance, undertake tool-box talks prior to operations to ensure all contractors and crew are aware of planned activities. Carry out post operations reviews and provide feedback loop for future best practices. Similarly, record and report successes, failures, near misses. Develop and undertake periodic HSE audits and track actions within the risk management process. When planning decommissioning operations, evaluate recovery options to arrive at an optimal decommissioning approach and that emergency procedures during decommissioning operations have been considered to ensure all infrastructures remain safe at all times.

Pre WES	**WES Stage 1**	**WES Stage 2**	**WES Stage 3**
☐ Awareness of general risks associated with the wave industry. ☐ Establish technology risk register.	☐ Maintain and update the risk register during concept characterisation.	☐ Risk register updated from FEED, tank testing results, and subsystem testing, including initial HIRA workshop held during operations planning. ☐ Consider detailing requirements and optimising design to get cost effective insurance cover in place.	☐ Include a representative from each main contractor in the relevant HIRA, and ensure there is suitable representation on behalf of the client, potentially requiring an independent person with the experience and competencies required. ☐ Ensure that previous events, successes and near misses have been analysed and incorporated into method statements. ☐ Keep risk register updated and live. ☐ Ensure client or client rep is on site during marine operation to reduce risk of miscommunication. ☐ Demonstrate all necessary insurances are in place, prior to any operations being undertaken.

Relevant Industry Standards, Guidelines

NREL Risk Management framework - http://www.nrel.gov/docs/fy15osti/63258.pdf
EMEC Guideline for Health and Safety in the Marine Energy Industry - http://www.emec.org.uk/guidelines-for-health-and-safety-in-the-marine-energy-industry/

Third Party Peer Review / Third Party Verification	Aim: Ensuring that there is effective scrutiny, guidance, vision and challenge within the development and decision making process from individuals with operational experience to contribute.

This will include local knowledge about onshore and offshore sites/activities. Early third party peer review input with experienced experts can provide support to meet regulatory and other compliance requirements. Peer review with locally experienced contractors on TPV will assist in checking reality of recommendations.

Pre WES	**WES Stage 1**	**WES Stage 2**	**WES Stage 3**
☐ Awareness of the requirement for a TPV at WES Stage 3 and the opportunities available for peer review/assistance into all levels of activities; design assessment, manufacturing, testing, including measurements of performance, reliability, survivability. ☐ Undertake a peer review of your concept.	☐ Engage with experienced operational expertise for third party peer review to inform concept characterisation and refinement of design for installation, handing and operations.	☐ Complete appropriate third party peer review of technology design evolved during FEED.	☐ TPV to cover device function, reliability, structure, handling, installation and operability and linked with insurance and/ or licensing requirements. ☐ Demonstrate third party peer review of marine plans has taken place ☐ Demonstrate third party peer review of onshore plans has taken place ensuring device supply and delivery options. ☐ TPV of Moorings/Foundations/Anchors required prior to in sea testing. ☐ Keep records of TPV input and advice.

Relevant Industry Standards, Guidelines

EMEC Guidelines for Marine Energy Converter Certification Schemes. http://www.emec.org.uk/guidelines-for-marine-energy-certification-schemes/

Site conditions	Aim: Ensuring that the specific influences of environmental, social and industrial site conditions on design and operations are understood.

This includes taking into account both laboratory and factory conditions and onsite reality of onshore and at sea conditions. In early stages of concept design consideration of separate component tests in offshore site conditions is less expensive than building a full scale system for survivability, reliability and performance testing. The feedback and knowledge gained can inform an integrated system and subsystem concept refinement and optimisation. The physical oceanographic and hydrodynamics of the site describe the range of conditions that may be experienced over time and space, this is vital for modelling overall performance. Onshore site conditions are critical to understand, for example seasonal weather which impacts device handling. Early engagement with local marine contractors who have knowledge of the environmental and practical site conditions can improve device design and deployment planning.

Pre WES	**WES Stage 1**	**WES Stage 2**	**WES Stage 3**
☐ Describe in concept feasibility what types of site conditions your device is targeted at and may be sensitive to.	☐ Show through preliminary analysis how structural integrity is achieved and maintained. ☐ Materials considered should demonstrate evaluation against corrosion or other mechanical/ structural failure of device	☐ Select Stage 3 test site(s) and schedule site assessment visits. ☐ Collate and manage environmental site data, identifying gaps against the design parameters, evaluate the use of modelling tools incorporating environmental data and hydrodynamics to describe range of conditions that may be experienced on site over time and space. ☐ Prepare weather window scenarios incorporating wave/tidal hind cast data. ☐ Establish site data requirements for any onshore sites. ☐ Develop plans for welfare needs and human logistics as part of onshore planning. ☐ Plan for remote site maintenance facilities with spares and toolkits.	☐ Verify that site conditions have remained consistent since the surveys undertaken by taking into consideration any additional data for the site that has become available.

Relevant Industry Standards, Guidelines

EMEC Guidance on Assessment of Wave Energy Resource http://www.emec.org.uk/assessment-of-wave-energy-resource/

IHO (International Hydrographic Organisation), 2008 Standards for Hydrographic Surveys

IEC TS 62600-101:2015 Marine Energy, Wave, tidal and other water current converters – Part 101: Wave energy resource assessment and characterisation.

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Inspection and monitoring	Aim: Ensuring that suitable means for inspection and monitoring have been considered and put in place covering integrity, performance, environmental interactions, safety etc.

Structural, electrical (ship to shore) and environmental (site) inspection and monitoring plans are suggested and in some places required. It is suggested that there be an initial vetting of contractors, and some degree of on-going oversight to ensure standards are maintained. Upon device delivery from non-local locations, consider inspecting and containing non-native species (inc. demersal, benthic and bio-fouling species) within and upon the device. Undertake a pre-operations survey of deployed equipment such as moorings before mobilisation if there is any risk of displacement or damage that could significantly affect operations. Inspection of seabed prior to deployment and verification of seabed conditions after deployment are required by regulators.

Pre WES	**WES Stage 1**	**WES Stage 2**	**WES Stage 3**
	☐ Be aware of the benefit and statutory requirements for inspection and monitoring of internal components, the whole system, the resources and environmental impacts to reduce failure and downtime of the device.	☐ Identify and plan for inspection and monitoring requirements.	☐ Develop a FAT in preparation for commissioning. ☐ Carry out required environmental monitoring plan to satisfy regulator. Ensure the tools and procedures are in place to satisfy the compliance plan. ☐ Apply a rigorous approach of photographing the complete installation activities to capture placement of all components, ties etc. Photograph everything coming out to capture wear patterns, corrosion, fouling etc. ☐ Maintain and monitor a detailed site plan identifying all subsea assets, including those buried. ☐ Conduct a post decommissioning survey immediately after all removal works have been completed.

Relevant Industry Standards, Guidelines

EMEC Guidelines for manufacturing, assembly, and testing of marine energy conversion systems, 2009. http://www.emec.org.uk/guidelines-for-manufacturing-assembly-and-testing-of-marine-energy-conversion-systems/

Licensing	Aim: Developers should ensure that the full regulatory and permission framework for the technology programme is understood and the provisions are met or exceeded.

During the early stages, it is necessary to gain an understanding of the regulated nature of the sector and the needs that must be met for compliance. There are several guidance documents available which outline the licensing process, however if in-house expertise is not available, engaging with an environmental consultant/practitioner will reduce the burden of obtaining the statutory licences and consents. Throughout all the design stages, it is worth considering licensing limits and best practice approaches. Undertaking early engagement with the regulator and the statutory consultees will help to inform design decisions and operational plans. Developing and adopting a project envelope which encompasses the worst-case scenario in terms of navigational and environmental impact, is a prudent approach when the design may not be fixed. Consider onshore planning requirements and conduct early engagement with local stakeholders to include input into design decisions and operational plans. Start the licensing process as early as possible and inform the authorities of any significant changes to the plans with sufficient time for due scrutiny and response. Developing an environmental monitoring programme that is consistent with answering strategic research questions will alleviate future monitoring requirements. Once the licence has been granted, ensure compliance with conditions and monitoring and mitigation commitments are adhered to. Planning a reporting and dissemination strategy for monitoring results will help to inform future deployments and educate the industry. Ensure a decommissioning programme is developed prior to installation, and the statutory consultation is undertaken.

Pre WES	**WES Stage 1**	**WES Stage 2**	**WES Stage 3**
☐ Recognise the need for all necessary licenses, permits and approvals to be achieved, through each project phase including decommissioning.	**Established site (such as EMEC)** ☐ Understand the extensive requirement for licensing and permitting for a non-permitted site.	**Established site (such as EMEC)** ☐ Conduct any survey work required by the licensing authority. ☐ Develop a wide project envelope that includes any material deployments that may be required as contingency e.g. additional mass within gravity mooring. ☐ Understand from the regulator, whether it is preferred for a scoping report to be submitted or if the regulator already has sufficient information regarding the project. Note scoping is normally only undertaken for developments with a generating capacity of >1MW. ☐ Prepare marine licence application and associated documentation (e.g. Construction Method Statement, Navigational Impact Assessment and Environmental Monitoring Programme). ☐ Develop environmental monitoring plan in association with the potential environmental impacts raised.	**Established site (such as EMEC)** ☐ Update and follow the consents compliance plan. ☐ Produce a commitments register. ☐ Submit an application for a marine licence and any other licences and consents required. ☐ Submit planning application for onshore works, if required. Once planning permission is granted, review conditions and implement as necessary. ☐ Submit decommissioning programme to the relevant regulator. ☐ Ensure compliance with the licence conditions and the appropriate conditions are met prior to any installation activities. ☐ Keep the regulator informed of works progress and any delays. ☐ Ensure data collection, analysis and reporting is aligned with the consent compliance plan.

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		Established site (such as EMEC) ☐ Prepare planning application for onshore works, if required. Engage with the local planning authorities to determine any additional requirements for the specific site, and with landowners to discuss feasibility and permissions. ☐ If the device is being transported from outside UK waters, it may be necessary to develop a biofouling management plan. Seek advice from the appropriate regulators regarding requirements (e.g. navigational marking and lighting). ☐ Plan for decommissioning programme required prior to installation. Understand if there is a requirement for financial bond. Be aware of the potential need for a separate marine licence for removal depending on project duration. ☐ Gain an understanding of any additional data required to undertake the Environmental Assessment or EIA.	**Established site (such as EMEC)** ☐ Undertake the necessary reporting in line with consent conditions. ☐ Review decommissioning programme prior to decommissioning allowing sufficient time for consultation. ☐ Establish a reporting schedule with the regulator to ensure that results from environmental monitoring are disseminated. ☐ Implement traffic management plan, if necessary. ☐ Commence data collection in line with licence conditions.
	Non-permitted site (additional requirements) ☐ Apply for a Crown Estate lease ☐ Begin discussions with Marine Scotland regarding plans. ☐ Gain a clear understanding of any surveying requirements associated with developing a baseline characterisation of the site. Be aware of what site data may need to be collected and what is already available. Note for larger projects it may be necessary to collect two years' worth of survey data.	**Non-permitted site (additional requirements)** ☐ Ensure marine licence and planning application includes the operational works associated with the installation and decommissioning of seabed cable, if required. ☐ Refine consent compliance plan and maintain schedule for all licensing milestones.	**Non-permitted site (additional requirements)** ☐ Expect site monitoring and data collection requirements to be greater than that for a pre-consented/established site. ☐ Ensure that data storage and management plan is produced and implemented. ☐ Engage planning authority in any design refinements to ensure conditions are met. ☐ Keep landowner informed of progress of developments and delays. Inform local stakeholders of progress.
Relevant Industry Standards, Guidelines			
Marine Scotland Licensing and Consents Manual: http://www.gov.scot/resource/0040/00405806.pdf Scottish Natural Heritage Guidance on Survey and Monitoring in Relation to Marine Renewables Deployments in Scotland: http://www.snh.gov.uk/docs/B925810.pdf			