A Coordinated Action Plan for Addressing Collision Risk for Marine Mammals and Tidal Turbines

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A report prepared by Aquatera Limited and Pacific Northwest National Laboratory, on behalf of the Annex IV nations under the International Energy Agency (IEA) Ocean Energy Systems Initiative (OES), and the Ocean Renewable Joint Industry Programme – Ocean Energy (ORJIP-OE).

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AVAILABILITY OF REPORT

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- http://tethys.pnnl.gov/events/annex-iv-workshop-collision-risk-marine-mammals-and-tidal-turbines
- https://www.ocean-energy-systems.org/
- www.orjip.org.uk

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Acronyms and Abbreviations

CENSIS	Centre of Excellence for Sensor and Imaging Systems
EPRI	Electric Power Research Institute
GW	gigawatt(s)
IEA	International Energy Agency
m	meter(s)
MRE	marine renewable energy
OE	Ocean Energy
OES	Ocean Energy Systems
ORJIP	Ocean Renewable Joint Industry Programme
RiCORE	Risk Based Consenting for Offshore Renewables
rpm	rotation(s) per minute
s	second(s)
TW	terawatt(s)
UHI	University of the Highlands and Islands
UK	United Kingdom
WREN	Working Together to Resolve Environmental Effects of Wind Energy

Contents

1.0 Introduction

This report outlines a coordinated action plan aimed at reducing the scientific uncertainty associated with collision risk of marine animals and tidal turbines. This plan includes steps to take toward resolving the challenging issue of decreasing scientific uncertainty, but is unlikely to completely solve the problem. The content of this report was derived from the involvement of experts during a workshop held in Edinburgh, Scotland in February 2016.

1.1 Background

The International Energy Agency's Ocean Energy Systems (OES) Technology Initiative estimates that there is the potential to develop 337 GW of ocean energy by 2050. Worldwide, tidal resources are estimated to 3 TW of ocean energy. The technically harvestable part of this resource, in areas close to the coast, is estimated to be approximately 1 TW (Carbon Trust 2011). Deployment of ocean energy projects can provide significant benefits in terms of jobs and investments, often in remote and peripheral communities. For example, the development of 337 GW of ocean energy is estimated to have the potential to create around 300,000 direct jobs, contributing significantly to global employment by harnessing renewable energy sources. The global carbon savings achieved through the deployment of ocean energy projects could save up to 0.8 billion tonnes of carbon dioxide (Carbon Trust 2006).

Consenting/permitting is often cited as one of the key barriers to the development of ocean energy projects. Due to the nascent nature of the marine renewable energy (MRE) sector and a lack of sufficiently informative monitoring data, a degree of uncertainty remains about how machines and associated infrastructure will interact with marine animals, birds, fish, and the habitats that support them.

The potential for marine animals to collide with the moving parts of tidal devices, particularly the rotors of horizontal-axis tidal-stream turbines, is a primary concern for consenting/permitting and licensing of tidal developments. Where proposed tidal energy projects overlap with the habitat of protected species there are concerns that collisions could lead to injury and mortality of individuals, and in some cases could affect the long-term status of the population concerned. Of particular concern are populations that are protected because of their increased vulnerability to external factors that threaten their viability. Therefore, the industry is subject to intense scrutiny because of the fragile status of certain populations, even if ocean energy-related risks might turn out to be very limited. For the purposes of this Action Plan, and the workshop that informed it, the definitions of collision and associated interactions between marine animals and tidal turbines reflect those of the 2016 Annex IV State of the Science report (Table 1).

Uncertainty about collision risk has contributed to a limited number of consents/permits and licences being issued for tidal energy projects. Where consents/permits have been issued, they

have carried restrictions around build-out that can affect the financial viability of projects. This limitation is further exacerbated by onerous pre-application site characterization studies and post-consent/permitting monitoring requirements.

Table 1. Definitions useful for understanding interactions of marine animals with marine renewable energy (MRE) devices (after Copping et al. 2016)

Term	Definition	Comments
Encounter	To be in the presence of an MRE device	May lead to a collision if the animal in question does not take appropriate avoidance or evasive action; however, animals may pass through a turbine blade without injury, depending on the speed of the blade, and the speed and size of the animal.
Collision	Physical contact of one object with another; any part of an MRE device (not just a blade), usually with some inference of a negative outcome	Includes the pressure field around the blade. Conventional hydropower turbines are generally smaller (1.5–9 m in diameter) with higher rotational speeds (50–100 rpm) and blade tip velocities (18–32 m/s); therefore, the pressure field may not need to be included in the definition of collision with an MRE turbine. Does not always imply injury.
Evasion	To change behaviour in close proximity to an object to avoid an impact.	Informed by predator-prey behaviour.
Avoidance	To change behaviour at some distance away from an object.	

As the MRE sector moves from the deployment of single devices to small arrays, it is essential that regulators, developers, researchers, and supply chain providers work together to better understand collision risk. Then they can ensure that decision-making about future projects is informed by the best available information and data, and that it is focused on delivering timely outcomes.

1.2 Purpose

This plan is intended to help the above-listed stakeholders work together to accelerate consenting/permitting of commercially viable tidal arrays by implementing a proportionate and risk-based approach to consenting/permitting and reducing uncertainty around the risks to marine animals from colliding with tidal turbines. It was informed by the workshop held in Edinburgh, UK in February 2016, and hosted by OES Annex IV, the Ocean Renewable Joint Industry Programme (ORJIP) Ocean Energy, the University of Highlands and Islands (UHI), Highlands and Islands Enterprise, Marine Scotland, and Offshore Renewable Energy CATAPULT (Appendix A).

The objectives of this plan are as follows:

- Build consensus around the priority collision risk issues, as they relate to consenting/permitting.
- Identify key issues that are slowing the permitting process for all scales of tidal energy projects, including those that relate to policy support, delays in regulatory processes, availability of appropriate monitoring equipment, the need for clear specification of methods for obtaining monitoring data, and the best use of predictive modelling.
- Identify potential solutions for addressing these challenges.
- Provide a coordinated action plan for addressing these challenges that assigns actions to the regulatory, research, and development sectors. The intention is for these actions to be monitored and updated to ascertain whether progress is being made, and to highlight where changes or increased effort need to be placed, if progress is insufficient.

1.3 Potential Outcomes

Concerns about the risk to marine animals (marine mammals, seabirds, fish, and sea turtles) from colliding with tidal turbines have delayed and complicated consenting/permitting of tidal turbines in Europe and North America. To date, no collisions have been observed (Copping et al. 2016). However, this interaction continues to be perceived as constituting a high risk to marine mammals. The risk of collision to an individual animal is defined as the likelihood (or probability) that a collision will occur and how serious the outcome (or the consequence) might be. By reducing uncertainty around this perceived risk, regulators and tidal developers will reach a better understanding of potential impacts, the associated need for any mitigation measures, and other associated consequences.

1.4 Plan Structure

This document is organised to present the following:

- **a list of key collision risk issues** related to:
  - overarching issues;
  - policy and regulatory support for a risk-based management approach to consenting/permitting;
  - strategic research and monitoring; and
  - sharing and collaboration.
- **the Collision Risk Action Plan** that provides a clear set of actions to address each key issue and assigns responsibilities and time frames for each; and
- **next steps** in implementing and monitoring the progress of plan implementation.

2.0 Key Collision Risk Issues Identified between Marine Animals and Tidal Turbines

This section presents a list of issues related to collision risk and tidal turbines, around which the Action Plan is developed. This list was informed by the discussions that took place at the workshop held in Edinburgh in February 2016 (Appendix A). Issues are presented in the following categories:

1. overarching issues;
2. policy and regulatory support for a risk-based management approach to consenting/ permitting;
3. strategic research and monitoring data collection; and
4. sharing and collaboration of information and outcomes.

2.1 Overarching Issues

1. Closer collaboration, better communication, and strategic data sharing are needed among regulators, developers, and researchers at local, national, and international levels.
2. Using the consenting/permitting process to manage collision risk has a significant influence on project build-out plans, as well as mitigation and monitoring requirements. These requirements can significantly affect the financial viability of early stage projects and the growth of the tidal energy industry. The interaction among these requirements and their effects on the financial viability of tidal projects need to be better understood by all members of the tidal community.
3. Regulators and advisors need policy support from government to ensure that current policies are clear and/or that appropriate policies are in place to support proportionate risk management in the consenting/permitting process.
4. Acceptable levels of risk posed by MRE developments for populations of key species need to be defined.

2.2 Policy and Regulatory Support for a Risk-Based Management Approach to Consenting/Permitting

1. Adaptive management can be used to reduce scientific uncertainty, but a common understanding of adaptive management and guidance in its use are lacking.
2. The use of existing predictive models in the consenting/permitting process needs to be continuously reviewed as new data become available to ensure robust prediction of the potential for collision.[1]

[1] Impacts of tidal turbines on marine life are projected to be less than those of conventional hydropower turbines because of the open design of the tidal turbines and slower rotational speeds (Romero-Gomez and Richmond 2014; EPRI 2011).

3. Transparent methods are needed for determining what baseline information is needed to support decision-making. All baseline data must be fit for their intended purpose and include appropriate feedback mechanisms that will inform future requirements.
4. It is essential that the large amounts of data gathered related to initial deployments of single machines be examined and used extensively to inform future developments.

2.3 Strategic Research and Monitoring

1. Limited deployments of single devices have occurred to date and the first commercial arrays are yet to be installed. This means there is a lack of empirical data to meaningfully quantify collision risk and/or encounter rates for key species. Strategic coordinated monitoring and research around first deployments and early arrays are needed to reduce uncertainty and to inform the consenting/permitting process for future larger arrays.
2. Further development of suitable instrumentation is needed to detect potential collision and/or avoidance events and to monitor wildlife interactions (e.g., trajectory, predator-prey interactions) with tidal turbines and arrays.
3. Remote monitoring technologies (e.g., sonars, cameras) often produce large quantities of data and require labour-intensive data analysis. Algorithm development is needed to facilitate on-board and shore-based processing of wildlife monitoring data to optimise handling of large data sets and to reduce data storage and analysis needs.
4. Development and testing of effective mitigation measures is needed, particularly for highly sensitive sites where mitigation may be required.
5. Monitoring data are needed to validate predictive models that describe the behaviour of key species around tidal turbines, in order to improve and refine input parameters for better estimates of collision risk and avoidance. Avoidance rates for key species at different life stages are needed to inform predictive models, rather than using subjective rates of avoidance. Improved methods are needed for determining the collision effects on marine animal populations, based on estimates of collision outcomes for individual animals.
6. Estimates of collision risk for multiple MRE devices in arrays are currently calculated as a multiplication factor for the risk from single devices. Alternative approaches should be investigated and validated.

2.4 Sharing and Collaboration

1. The findings of monitoring studies need to be made available and accessible to regulators, developers, researchers, consultants, and other interested parties to encourage revisions and improvements to future baseline data collection and post-consent/permit monitoring studies that will ensure that data gathered are fit for their intended purpose.
2. Mitigation and management plans and measures of their effectiveness need to be more actively shared among regulators, developers, supply chain providers, and researchers to encourage revisions and improvements in future MRE deployment and operations plans.

3. A clear approach is needed to ensure that knowledge and data gathered from first arrays are transferrable to other projects and locations.

3.0 Action Plan

This section outlines actions, arranged by the individual issue, as listed in Section 3.0 under the four categories of actions. Actions to help address the issues are included for all stakeholders—regulators, developers, researchers, supply chain providers, trade associations, and funding agencies.

3.1 Overarching Issues

Overarching Issue 1: Closer collaboration, better communication, and strategic data sharing are needed among regulators, developers, and researchers at local, national, and international levels.

Action	Output	Responsibility	Timeframe
Continue promotion of established strategic databases e.g., the UK Wave and Tidal Knowledge Network and information platforms, e.g., Annex IV's Tethys, in a coordinated manner.	Increased awareness, accelerated availability of science findings to policy-makers ensuring best available information is used to inform decisions	All – facilitated by strategic programmes such as ORJIP Ocean Energy and OES Annex IV	Immediate and ongoing
Produce a position paper to identify the best available data and information regarding active and passive avoidance and evasion and update it regularly. Use the State of the Science report as a starting point.	Increased awareness, accelerated availability of science findings to policy-makers ensuring best available information is used to inform decisions	OES Annex IV, ORJIP Ocean Energy	Biannually
Promote awareness of data collection and monitoring efforts, as well as advances in monitoring technology.	Better availability and uptake of information to achieve consistent monitoring approaches	ORJIP Ocean Energy, OES Annex IV, knowledge transfer programmes, i.e., COLUMBUS	Commencing immediately and ongoing
Encourage developers to use strategic databases and research updates in all stages of the consenting/ permitting process, including reference to Tethys and State of the Science report in screening and scoping requests.	Improved uptake of best available information	Developers, regulators, and advisors	Immediate and ongoing
Encourage developers and researchers to share research questions, study designs, and results.	Better alignment of research plans and comparability of results	Researchers including the international community, ORJIP Ocean Energy	Immediate

Overarching Issue 2: The management of collision risk through the consenting/permitting process has significant influence on project build-out plans, as well as mitigation and monitoring requirements. These requirements can significantly affect the financial viability of early stage projects and the growth of the tidal energy industry. The interaction of these requirements and their effects on financial viability of tidal projects needs to be better understood by all members of the tidal community.

Action	Output	Responsibility	Timeframe
Communicate the effects that this issue can have on the financial viability of projects and the wider sector to regulators, advisors, developers, researchers, and supply chain providers.	Support for strategic research to reduce uncertainty ensuring that all requirements are informed by the best available information and sound science	Trade associations, industry forums, ORJIP Ocean Energy developers, and supply chain providers	Immediate and ongoing

Overarching Issue 3: Regulators and advisors need policy support from government to ensure that current policies are clear and/or that appropriate policies are in place that enable proportionate risk management in the consenting/permitting process.

Action	Output	Responsibility	Timeframe
Review existing relevant consenting/permitting processes and policies to provide the necessary information for policy-makers and regulators to develop and support a risk-based consenting/permitting process.	A white paper on risk-based consenting/permitting	Regulators and agencies supported by key industry programmes, e.g., Annex IV	Following completion of RiCORE project and dissemination of outputs
Educate policy-makers and regulators on the importance of risk management with particular focus on collision risk and its potential effects on project viability.	Change in policy and its implementation to manage risk proportionately in the consenting/permitting process	Trade associations, ORJIP Ocean Energy, developers, supply chain providers, and economic development agencies	Immediate

Overarching Issue 4: Acceptable levels of risk posed by developments for populations of key species need to be defined.

Action	Output	Responsibility	Timeframe
Produce a guidance document to help determine how to best define significance and acceptable levels of risk at population levels.	Guidance note	Regulators and agencies	As soon as is feasible
Develop improved methods for determining population level effects, based on collision estimates for individual animals and bringing in information about density-dependent processes for compensation for losses as appropriate			

3.2 Policy and Regulatory Support for Risk-Based Management Approach to Consenting/Permitting

Policy and Regulatory Issue 1: Adaptive management can be used to reduce scientific uncertainty, but there is a lack of guidance and common understanding around its use at present.

Action	Output	Responsibility	Timeframe
Produce a guidance document/white paper aimed at creating a framework for building adaptive management into the consenting/permitting process.	Approved guidance for using adaptive management	Regulators and agencies	Following completion of RiCORE (project and OES Annex IV (WREN) White Paper on Adaptive Management

RiCORE = Risk Based Consenting for Offshore Renewables; WREN = Working Together to Resolve Environmental Effects of Wind Energy

Policy and Regulatory Issue 2: The use of existing predictive models in the consenting/permitting process needs to be kept under continuous review as new data become available to ensure robust prediction of the potential for collision.

Action	Output	Responsibility	Timeframe
Review established predictive models and existing approaches to using the outputs of predictive models in the consenting/permitting process, building upon recent work by Scottish Natural Heritage,[2] and produce guidance for near-term projects.	Agreed way forward for undertaking project/site-specific collision risk assessments	Regulators and agencies supported by key industry programmes, e.g., OES Annex IV and ORJIP Ocean Energy	Immediate

[2] http://www.snh.gov.uk/docs/A1982680.pdf

Policy and Regulatory Issue 3: Transparent methods are needed for determining what baseline information is needed to support decision-making. . All baseline data must be fit for their intended purpose and include appropriate feedback mechanisms that will inform future requirements.

Action	Output	Responsibility	Timeframe
Review past data collection efforts to determine how baseline data gathered during previous projects was used to inform the consenting/permitting process. The findings of this review need to feedback into the consenting/ permitting process to inform future project requirements. The review should also consider how baseline data need to be compared with monitoring data collected after consenting/permitting to ensure that the "whole process" is considered during survey design.	Technical report to inform future decisions regarding baseline data requirements	Regulators and agencies supported by key programmes such as Annex IV and ORJIP Ocean Energy	Immediate

Policy and Regulatory Issue 4: It is essential that large amounts of data gathered around initial deployments of single machines be examined and used extensively to inform future developments.

Action	Output	Responsibility	Timeframe
Summarize data from initial deployments and make them available to regulators and researchers.	Science summaries and other key reports	Key programmes such as Annex IV and ORJIP Ocean Energy.	Annually
Ensure that data products from initial developments are examined to support to future consenting/ permitting decisions.	Uptake and use of current information for decision-making	Regulators	Following summaries and/or as data from initial deployments become available

3.3 Strategic Research and Monitoring

Research and Monitoring Issue 1: Limited deployments of single devices have occurred to date and the first commercial arrays are yet to be installed. This results in a lack of empirical data to meaningfully quantify collision risk and/or encounter rates for key species. Strategic coordinated monitoring and research around first deployments and early arrays are needed to reduce uncertainty and to inform the consenting/permitting process for future larger arrays.

Action	Output	Responsibility	Timeframe
Gather and analyse empirical behavioural data collected around installed turbines and those soon to be installed. Key examples include Tidal Energy Ltd in Wales, Meygen, Scotrenewables, Sustainable Marine Energy in Scotland, and OpenHydro in Canada.	Empirical behavioural monitoring data from a number of sites that can be collected, collated, and analysed to help reach consensus on animal turbine interactions	Developers, researchers, international research teams, supply chain providers, regulators, agencies, and funders	Commencing immediately and ongoing

Action	Output	Responsibility	Timeframe
Support a coordinated approach between government, industry, and academia in parallel with coordination across projects, to ensure effective comparisons.	Monitoring plans and data from a number of sites can be collected, collated, and analysed, for use in consenting/permitting processes	Developers, researchers, international research teams, supply chain providers, regulators, and agencies supported by industry programmes, including ORJIP Ocean Energy	Commencing immediately and ongoing
Focus strategic research programmes on priority issues; for example, those identified in the ORJIP Ocean Energy Forward Look, to reduce uncertainty and consenting/permitting risk.	Financial support for strategic research around priority issues	Government funding agencies, research programme managers, industry	Immediate

Research and Monitoring Issue 2: Further development of suitable instrumentation is needed to detect potential collision and/or avoidance events and to monitor wildlife interactions (e.g., trajectory, predator-prey interactions) with tidal turbines and arrays.

Action	Output	Responsibility	Timeframe
Develop cost-effective collision and avoidance detection technologies that can survive harsh environments. These systems should be tested to determine whether collisions can be detected over background noise and water movement, including existing technologies like strain gauges and accelerometers built into turbine blades.	A cost-effective collision and/or avoidance detection system suitable for use in tidal environments. Guidance paper developed about the use of collision and avoidance systems, including operational principles, data collection and storage requirements, and data analysis needs.	Supply chain providers and research community Research community in cooperation with regulators and public sector funders	Immediate In conjunction with development of successful systems
Develop good practice guidelines to guide survivability and preferred deployment, and use procedures for monitoring technologies in tidal currents.	Guidance document	Industry and supply chain providers, in cooperation with research community	Medium term
Further develop and integrate equipment and software to gather data on avoidance/evasion/collision and animal behaviour.	Cost-effective monitoring systems for monitoring behaviour	Supply chain providers and research community	Immediate.
Develop cost-effective methods to address biofouling of monitoring equipment, e.g., camera lenses.	More reliable monitoring equipment	Supply chain providers and research community	Immediate

Research and Monitoring Issue 3: Remote monitoring technologies (e.g., sonars, cameras) often produce large quantities of data and require labour-intensive data analysis. Algorithm development is needed to facilitate on-board and shore-based processing of wildlife monitoring data to optimise handling of large datasets and to reduce data storage and analysis needs.

Action	Output	Responsibility	Timeframe
Develop on-board and suitable shore-based processing capabilities to reduce large data sets for monitoring technologies.	Capable instruments and associated software	Research community and supply chain original equipment manufacturers (OEMs), aided by government funding organisations	Immediate and ongoing
Increase sharing of data across monitoring projects and ensure standardised approaches to data gathering.	Process to develop community agreement on acceptable data collection methods, data compression algorithms, and data storage locations. Creation of a data portal.	Researchers, regulators, funding agencies	Immediate and ongoing
Make monitoring data more widely available to allow faster development of algorithms.	Data repository hosted with the data portal.	Developers, aided by research community	Immediate and ongoing

Research and Monitoring Issue 4: Development and testing of effective mitigation measures is needed, particularly for highly sensitivity sites where mitigation may be required.

Action	Output	Responsibility	Timeframe
Review existing mitigation measures and identify needs for further development and analysis.	Review paper about existing and needed mitigation measures	Strategic programmes such as OES Annex IV and ORJIP Ocean Energy	Immediate
Create a "toolbox" of effective mitigation measures and their impacts on project timelines and costs.	Tools accessible for regulators, advisors, and developers.	Strategic programmes such as ORJIP Ocean Energy and OES Annex IV	After production of the review paper
Undertake field trials to investigate the effectiveness of mitigation concepts and techniques	Field trials	Research community, sponsored by regulators and funding agencies	After production of the review paper and concurrent with toolbox development

Research and Monitoring Issue 5: Monitoring data are needed to validate predictive models that describe the behaviour of key species around tidal turbines, in order to improve and refine input parameters for better estimates of collision risk and avoidance. Avoidance rates for key species at different life stages are needed to inform predictive models, rather than using subjective rates of avoidance. Improved methods are needed for determining the collision effects on marine animal populations, based on estimates of collision outcomes for individual animals.

Action	Output	Responsibility	Timeframe
Monitor behaviour of key species and species groups around arrays to inform predictive model input parameters, with an emphasis on evasion and avoidance.	Improved data sets for input and validation of predictive models for evasion and avoidance	Research community, supported by regulators and developers.	Immediate
Establish a formal feedback mechanism to ensure that post-deployment monitoring data are used to test earlier pre-deployment model predictions for key species to improve model predictions.	A framework to be shared broadly that will improve device- and project-specific models	Regulators and advisors, assisted by strategic programmes such as OES Annex IV and ORJIP Ocean Energy	Immediate and ongoing
Review the utility of individual-based model development for animal interactions around tidal turbines.	Recommendations for development of next-generation predictive models	Research community with regulators and funding agencies	Following production of the framework (above)

Research and Monitoring Issue 6: Estimates of collision risk for multiple MRE devices in arrays are currently calculated as a multiplication factor for the risk from single devices. Alternative approaches should be investigated and validated.

Action	Output	Responsibility	Timeframe
Improve existing predictive models to include alternative approaches to a linear-scale approach, including a focus on other means of extrapolation, when scaling up from single devices to arrays.	Technical report about efforts of linear scaling and alternative means to extrapolate from collision risk of single devices to arrays	Research community.	Immediate
Identify key data needed to validate alternative extrapolation of single to array level collision risk, and to be collected at early stage developments.	List of data needs and potential collection sites	Research community with industry and regulators	After technical report preparation and review

3.4 Sharing and Collaboration

Sharing and Collaboration Issue 1: The findings of monitoring studies need to be made available and accessible to regulators, developers, researchers, consultants, and other interested parties to encourage revisions and improvements to future baseline data collection and post-consenting/permitting monitoring studies that will ensure that data gathered are fit for their intended purpose.

Action	Output	Responsibility	Timeframe
Establish a formal feedback mechanism to improve data collection. The findings of monitoring studies need to be fed back to regulators, developers, and researchers to improve future data collection.	Feedback mechanisms including a data portal, information platforms, position papers, and technical working groups	All – facilitated by strategic programmes such as OES Annex IV and ORJIP Ocean Energy	Immediate and ongoing

Sharing and Collaboration Issue 2: Mitigation and management plans, and measures of their effectiveness, need to be more actively shared among regulators, developers, supply chain providers, and researchers to encourage revisions and improvements of future MRE deployment and operations plans.

Action	Output	Responsibility	Timeframe
Establish an expert forum to share information and provide advice on mitigation measures (applications, and lessons learned, etc). Ensure that outputs and recommendations are disseminated to the wider regulatory community, developers, and other stakeholders.	Accelerated learning and availability of science findings to inform policy	Strategic programmes such as OES Annex IV and ORJIP Ocean Energy	Immediate and ongoing

Sharing and Collaboration Issue 3: A clear approach is needed to ensure that knowledge and data gathered from first arrays is transferrable to other projects and locations.

Action	Output	Responsibility	Timeframe
Ensure that study designs, data collection methods, and data collected in one location can be transferred to the greatest extent possible to other locations.	Collaborative strategic monitoring and research projects that optimise transferrable data	Researchers and developers supported by funding agencies, and regulators, and facilitated by strategic programmes such as ORJIP Ocean Energy and OES Annex IV	Immediate and ongoing

4.0 Next Steps

This Action Plan will be published on the Annex IV Tethys (http://tethys.pnnl.gov) and ORJIP Ocean Energy (http:// http://www.orjip.org.uk/oceanenergy/about) websites. It will be promoted by both programmes to regulators, industry, researchers and other stakeholders to ensure that the priority actions identified are taken forward. Working through sector representatives who participated in and took an interest in the workshop held in February (see Appendix A), specific action holders will be contacted to ensure they are aware of their responsibilities,

An Action Log will be established by OES Annex IV and ORJIP Ocean Energy. It will be used to track progress against each action identified in Section 3.0. Progress will be regularly reviewed and communicated to stakeholders.

This Action Plan will be updated by OES and ORJIP Ocean Energy in late 2016 during which time, progress updates will be sought from key stakeholders.

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Appendix A – Agenda for Workshop

Workshop on Collision Risk for Marine Animals and Tidal Turbines
Monday February 22nd 2016
Marine Scotland, Edinburgh
10am – 3pm

AGENDA

9:00	Registration, morning coffee
10:00 – 10:15	Intent for the day
10:15 – 10:30	Introduction of collision risk task for the day • Developing action plan for follow up, for 5 years of licensing/consenting
10:30 – 11:00	Information that regulators need for consenting: Ian Davies, Marine Scotland & George Lees SNH
11:00 – 11:40	State of science on collision risk Carol Sparling, SMRU & Ben Wilson, SAMS and UHI
11:40 – 12:00	Assessment of collision risk instruments and measurement systems Shrawan Jha, CENSIS
12:00 – 12:30	Specifics on action plan • Components, actions, assignments • Separate into break out groups
12:30 – 1:00	Buffet Lunch
1:00 – 2:45	Break out groups • Planned around specific issues, questions; • Each group needs to must come out with recommendations, assignments, timeline for accomplishing tasks
2:45 – 3:00	Wrap up

Appendix B – Workshop on Collision Risk for Marine Mammals and Tidal Turbines

Monday 22 February 2016, Marine Scotland, Edinburgh

Aim

A one-day workshop held in Edinburgh, Scotland, brought together regulators, marine energy researchers, and industry representatives. Their purpose was to identify the key challenges within the consenting/permitting process regarding the risk to marine wildlife from colliding tidal turbines and to produce a coordinated action plan, thereby providing a framework to help reduce risk and associated uncertainty for developers and regulators.

The workshop was hosted by the University of Highlands and Islands, Highlands and Islands Enterprise, Marine Scotland, OES Annex IV, ORJIP Ocean Energy, and ORE CATAPULT.

Objectives1

The objectives were to:

- Identify key challenges/gaps at each stage of the consenting/permitting process with regard to regulatory/procedural issues, predictive modelling, monitoring equipment, and data interpretation.
- Identify potential solutions and actions to address each challenge/gap.
- Assign any actions identified to regulators/researchers/developers/supply chain providers.
- Collate the results into an "action plan" that provides a framework to help track progress in key areas that can be easily monitored and updated.

Workshop Groups

To ensure that all challenges or gaps were identified and addressed as fully as possible within the time available, participants were assigned to one of the following breakout groups:

- Group A: Consenting/permitting and collision risk – This group aimed to identify the key consenting/permitting barriers relevant to collision risk at each stage of the consenting/ permitting process and identify specific actions and solutions that can be implemented by regulators, advisors, researchers, and developers to tackle these barriers.
- Group B: Predictive modelling – This group aimed to identify the key gaps and issues relevant to predictive modelling. The group focused on the use of predictive modelling through the consenting/permitting process, requirements for improvement and how results can be used to help predict the potential effects of single machines and large arrays.

- Group C: Monitoring (technical) – This group considered the suitability and availability of equipment, software, methods, etc., for undertaking environmental monitoring around machines and across arrays to gather data to help reduce uncertainty about collision risk.
- Group D: Monitoring (data) – This group considered what data should be gathered through monitoring and how the data can be used to help reduce uncertainty about collision risk. The group focused on data that can be gathered around single machines and across arrays.

Workshop Participants

The purpose of the workshop was to bring together a range of regulators, marine energy researchers, and industry representatives to ensure all perspectives were captured from those involved throughout each stage of the consenting/permitting process. The following participants attended the workshop:

Group A

- Anne-Marie Belliveau, FORCE
- Peter Bromley, Tidal Energy
- Jocelyn Brown-Saracino, USDOE
- Craig Chandler, Black Rock Tidal
- Ian Davies, Marine Scotland
- Ian Hutchison, Aquatera (Chair)
- Nichole Sather, Pacific Northwest National Laboratory (Scribe)
- Kate Smith, Natural Resources Wales
- Carol Sparling, SMRU Consulting

Group B

- Cormac Booth, SMRU Consulting
- Kenneth Couston, Xodus
- Sam Eaves, USDOE
- Ross Gardiner, Marine Scotland
- George Lees, SNH
- Elizabeth Masden, UHI
- Sarah Murray, Aquatera (Scribe)
- Shane Quill, OpenHydro
- Jan Sundberg, Uppsalla University
- Ben Wilson, UHI, MASTS (Chair)

Group C

- Carys Burgess, Emera
- Emma Cotter, University of Washington
- Vicky Coy, ORE Catapult
- Cara Donovan, Atlantis
- Chris Eastham, SNH
- Jennifer Fox, Aquatera (Scribe)
- Clemency Ives, Sustainable Marine Energy
- Shrawan Jha, CENSIS
- Joseph Kidd, MarineSpace (Chair)
- Rachael Wakefield, CENSIS
- Benjamin Williamson, University of Aberdeen

Group D

- Steven Benjamins, Scottish Association for Marine Science (SAMS)
- Finlay Bennet, Marine Scotland
- Rob Burnett, DP Energy
- Andrea Copping, Pacific Northwest National Laboratory (Chair)
- Jude Hamilton, Aquatera (Scribe)
- Brian Polagye, University of Washington
- Beth Scott, University of Aberdeen
- Ida Tavner, Natural Resources Wales
- Douglas Watson, The Crown Estate
- Xu Wei, China National University

Outputs

Scribes took notes were during the breakout sessions to inform the development of this plan. The notes can be provided upon request.