

Review of Standards/Guidelines for Marine Renewables (Wave & Tide)

27 July 2014

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1 Executive Summary

In March 2014 the European Marine Energy Centre Ltd (EMEC) was funded by the Offshore Renewable Energy Catapult (ORE Catapult) to collaborate in a project to undertake a consensus review of the existing standards and guidelines available for the marine renewable (wave and tidal) industry, identifying any areas requiring updating or for which new standards/guidelines may be required. This was achieved by running an industry-wide workshop event, attended by a wide range of industry groups including technology developers, industry consultants, test centres, and representatives from Government agencies, academia, and trade bodies.

The workshop was well received, with 56 out of 65 registered delegates attending. Completed questionnaires, designed to capture feedback on awareness and use of existing standards/guidelines and the need for new standards/guidelines, were submitted by 40 delegates. Feedback from the workshop showed that there was, in general, a low awareness of the existing standards/guidelines for the sector, with less than half of those who were aware of the documents actually having considered using them. The majority of delegates who had used the existing standards/guidelines believe that both the content and range are unsatisfactory.

Four areas previously raised by the industry as possible topics for new guidelines were distributed as draft summary scopes in advance of the workshop, then presented and discussed in greater detail during the workshop and topic-specific breakout sessions. In addition, four topics for potential development of new guidelines were identified by delegates during workshop discussions. A large number of workshop delegates (76% of those who submitted a completed questionnaire) indicated that they would be prepared to get involved in Working Groups for the development of new guidelines, although some would require their time to be funded.

The key recommendations from the project, which are discussed in Section 5, are that:

1. close collaboration with the International Electrotechnical Commission (IEC) regarding the development of national and international standards should continue, and further work should be undertaken to promote awareness/use of the existing standards/guidelines across the wave and tidal industry (Section 5.1);
2. the four proposed standards/guidelines discussed in detail at this workshop should be further progressed (Section 5.4.2);
3. additional standards/guidelines in the four areas suggested by the group should be progressed (Section 5.4.3);
4. a centrally-managed, appropriately funded facility should be established to promote and oversee development and review of standards/guidelines for the marine energy sector (Section 5.2);

5. the processes involved in the development of new standards and guidelines, and the mechanism for engagement of experienced end-users in their creation and review, needs to be clearly documented (Section 5.3.1);
6. at a UK level, an improved mechanism for ensuring experienced end-user input to the development and review of standards/guidelines, should be established, actively promoted and facilitated (Sections 5.2 and 5.3.2);
7. the UK's role in development and review of Standards needs to be supported (by Government) in order for the UK to maintain its leading role in this key area.

The initial version of this report has been revised to incorporate feedback from attendees at the workshop held in March 2014.

2 Introduction

The emerging marine renewable energy industry needs to continue to establish credibility by developing proven reliable technologies for energy conversion from both wave and tidal stream resources. The commercial potential of the technologies rests in demonstrating reliability of performance and an acceptable cost of energy. Innovation is required not only in device design and initial feasibility and reliability testing, but also for developing efficiencies across the scope of all activities from design, manufacture, operations and maintenance, through to final project decommissioning. Standards and guidelines are therefore fundamental to the successful development of this industry.

In 2007 the European Marine Energy Centre Ltd (EMEC) facilitated the development of a suite of twelve standards for use by the marine renewable industry. Each document was written by an acknowledged expert, and progressed by a working group made up of individuals representing technology developers, regulators, academia, utilities, and project developers. These twelve standards were published in 2009 (see www.emec.org.uk/standards for full details). Technical Committee 114: Marine Energy – Wave and Tidal Energy Converters (TC114) was created by the International Electrotechnical Commission (IEC) in 2007 with the purpose of developing international standards for marine energy conversion systems. Six of the twelve standards described above were submitted as part of a suggested work programme for TC114.

As with all industries, it is important that standards and guidelines are reviewed regularly, and any requirement for improvements to existing, or development of new standards is identified and progressed. In recognition of its close industry contacts and past association with the development of standards and guidelines for the wave and tidal stream sectors, EMEC was funded by the Offshore Renewable Energy Catapult (ORE Catapult) to collaborate in a project to undertake a consensus review of the existing standards and guidelines, identifying any areas requiring updating, or for which new standards/guidelines are required. This was carried out through an industry-wide workshop event, free to attend, and disseminated widely amongst a range of industry groups. The key aims of the project were to:

- Review the existing suite of twelve standards facilitated by EMEC for the sector in 2007 and identify any areas that require updating;
- Investigate and report the requirements for new standards or guidelines;
- Propose an outline for key new standards or guidelines based on discussions at a targeted workshop;
- Provide other recommendations related to the production and application of standards and guidelines for the wave and tidal stream sectors in the UK (and beyond).

- The purpose of this document is to report on activities from the workshop, including recommendations for progressing the development of standards and guidelines for the marine renewable energy industry.

3 Review and Development Workshop

The workshop was held on Tuesday 25th March at the British Medical Association's conference centre in Edinburgh. The aims of the workshop were to:

- Review the twelve existing standards;
- Identify any areas that require to be updated/improved;
- Identify general requirements for potential new standards/guidelines;
- Discuss availability and accessibility of feedback mechanisms for experienced users of existing and draft standards and guidelines.

3.1 Workshop Attendees

Targeted invitations to attend the workshop were sent to technology developers, test centres, industry consultants, government bodies, and academic institutions, as well as to trade bodies for onward circulation to their members. Of the 65 confirmed registrations for the event, 56 delegates actually attended the workshop. A full list of attendees is provided as Annex 1 of this report.

3.2 Workshop Programme

The workshop was split into two sessions, with the morning session providing an introductory overview of the standards development process, and investigating awareness and use of the existing twelve standards using a simple voting mechanism (see below). Delegates offered suggestions for proposed new standards to be developed. The morning session concluded with an introduction to four areas for proposed new standards/guidelines, with presentations from industry experts covering the following points:

- Adequacy of existing industry standards and guidelines when applied to marine renewables.
- Why the wave and tidal sector is unique.
- Risks that are unique to the wave and tidal sector.
- Good practice in the wave and tidal sector.

- Considerations for standards/guidelines in the wave and tidal sector.

The afternoon session consisted of four topic-specific breakout groups, running in parallel, discussing, respectively, the requirements for developing new standards/guidelines in the areas of: Offshore Installation; Operation and Maintenance (O&M); Subsea Cable Lifecycle; and Environmental Monitoring. These had previously been raised by people in the industry as possible topics for new guidelines. Each breakout group was run twice, enabling delegates to participate in two different areas of their choice. Feedback from each breakout group was given during the closing session of the workshop.

The workshop programme is provided as Annex 2 of this report.

3.3 Awareness of Existing Standards

Part of the morning session in the workshop was used to gauge awareness of the twelve existing standards and to assess to what extent they were being used by the industry. This was facilitated by using an electronic voting system to record delegates' responses to the following three questions, asked against each of the twelve standards:

1. Are you aware of the standard?
2. Have you seriously considered using it?
3. Is it satisfactory?

Question 2 was aimed at eliciting how many delegates were familiar with the detailed recommendations and methods within the standard but did not require delegates to have actually used the standard in its entirety. This was made clear in the introduction to the session.

The responses to each of these questions are shown in Figures 1-3 below¹ (please note that the responses show actual numbers rather than percentages).

¹ Asterisk denotes standards submitted as part of a suggested work programme for IEC TC114

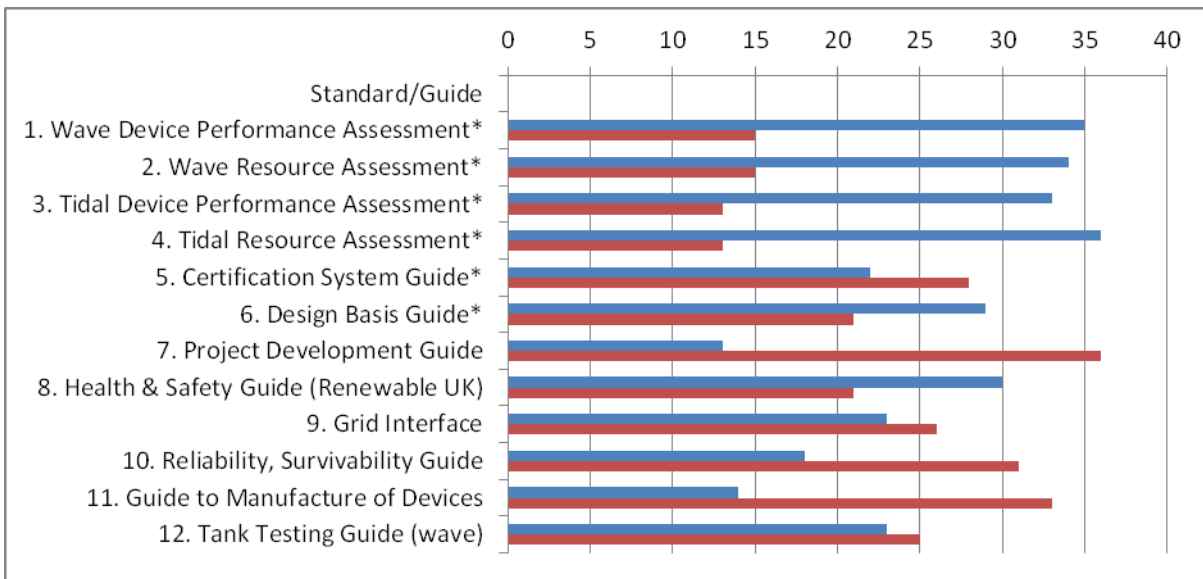


Figure 1: Responses to question "Are you aware of the standard/guide?" (■ = Yes, ■ = No)

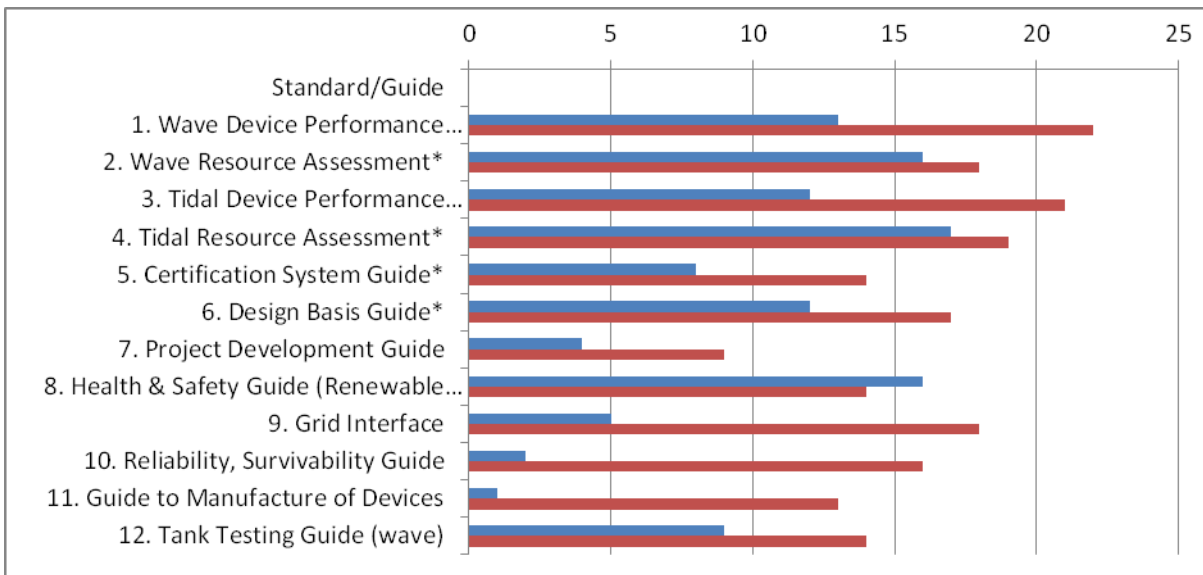


Figure 2: Responses to question "Have you seriously considered using it?" (■ = Yes, ■ = No)

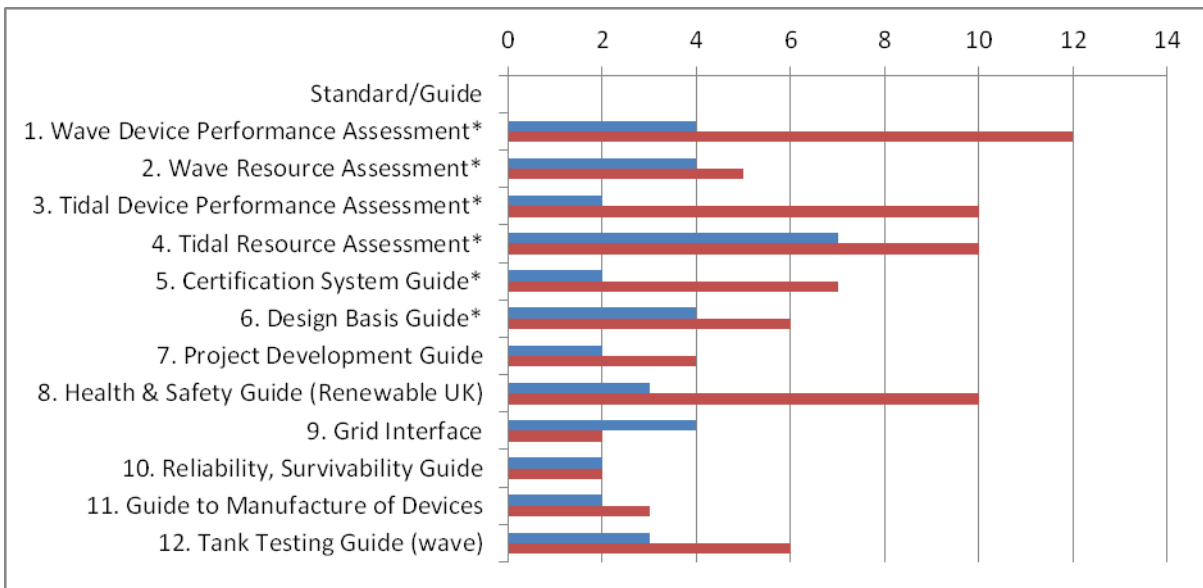


Figure 3: Responses to question "Is it satisfactory?" (■ = Yes, ■ = No)

The results of the voting session are provided in tabular format as Annex 3 of this report. These results are discussed further in Section 4 below.

3.4 Workshop Feedback

In order to capture as much feedback from delegates as possible ‘on the day’, a questionnaire was created and distributed to delegates on arrival (see Annex 4). In addition to asking specific questions, the questionnaire also provided space for delegates to record comments during the breakout sessions.

During open discussion at the workshop, delegates proposed several suggestions for additional areas for which they thought new standards/guidelines should also be developed (see Annex 5). Whilst there was not scope within the workshop to discuss the detailed coverage of these new suggestions, following the workshop delegates were sent a summary of these ideas and were asked to provide further comments.

Full details of the additional comments received are discussed in Section 4 below.

4 Discussion

4.1 Results of Voting Session

The workshop attendance consisted of 38% industry consultants, 34% wave and tidal technology developers, and 12% test centres, with the remaining 16% made up of representatives from Government, academia, and industry trade bodies. This demonstrates a very high level of industry presence, particularly from the technology developer community.

On average, 47% of the workshop delegates were not aware of the 12 existing standards/guidelines. It is clear from the results shown in Figure 1 that there is a greater awareness of the six standards which have been utilised as starting points by IEC TC114 Project Teams. In particular, there is a high awareness of the standards covering device performance assessment and marine resource assessment (at least 70% of delegates were aware of these standards).

Figure 2 shows that, of those who are aware of the standards, fewer than 50% of delegates have seriously considered using them (the exception to this is the Health and Safety guide). This may possibly be due to the stage of development of the sector, with delegates becoming aware of availability, but not yet really experiencing the need for detailed use, rather than reflecting an active decision not to use them.

Figure 3 indicates that the majority of respondents consider the existing standards to be unsatisfactory in some way. This is especially evident for the device performance standards and the health and safety guide. It should be noted that the Device Performance Assessment Guides for both wave and tidal have now been superseded by IEC Technical Specifications. The H&S guide is due to be revised under the auspices of Renewable UK who agreed to take on the care and maintenance of the guide when it was first prepared.

4.2 Suggested Areas for New Standards/Guidelines

The process for issue of a new standard by the IEC involves producing a Technical Specification, which is issued as a guide to be used and commented upon over 4 years before revision to full standard status takes place. All references to new 'standards' within this report therefore means the beginning of the process to produce a new standard, which begins with production of new guidelines, rather than standards per se.

In response to the question "Are other standards/guides needed?" delegates identified 14 potential areas for which new standards/guidelines could be developed (see Annex 5). Of these 14 areas, development of guidelines for four (ref. 1, 3, 9 & 14) are already underway in one form or another. Two of these suggestions (ref. 7 & 8) relate to offshore wind and should be referred

to RenewableUK and PEL/88 at National Standards level for consideration. Health and Safety in O&M (ref. 11) would be included in the proposed O&M guideline (see Sections 4.3.2 and 4.4.2 below). Competency of Personnel (ref. 4), Mechanical Measurements (ref. 12), and Mechanical Testing of Components covers a range of requirements applicable to many areas or for which standards already exist.

The remaining four suggestions, for which detailed discussion will be required in order to establish the need and scope, are in the following areas:

- Data sensing and communication.
- Mechanical design in shallow water environments.
- Vessels and equipment used in marine renewable energy developments.
- Subsea connectors.

The importance of certification was stressed during the workshop. Whilst certification needs to be clearly distinguished from the development of standards/guidelines, this is an issue of significant relevance for developers looking to promote their technologies on an international basis. The IEC has set up an organisation for certification of renewable energy devices/processes, etc (IECRE)². The first IECRE Management Committee meeting, together with individual sector meetings (Wind, Solar and Marine) will be held in Colorado, USA, in September 2014.

4.3 Draft Proposal for New Standards

Four areas for the development of new standards/guidelines had been identified and proposed for discussion at the workshop breakout sessions (see Section 4.4 below). The outline scopes for the development of guidelines covering these four areas, intended to be developed and issued in the format of Technical Specifications, are described below.

4.3.1 Offshore Installation

The main sections of this proposed draft should include:

- Planning/Engineering.
- Load-out and transportation.
- Offshore construction.

² Within IEC Conformity Assessment Board WG15 for Marine Renewables, the scope, extent and deliverables for certification process

- Hazard Identification and Risk Assessment (HIRA).
- Practical installation method outlines for different types of devices or building blocks e.g. piles; gravity bases; ballast; moorings and cable interfacing.
- Competencies of key people required – to assist in recruitment or procurement of labour services as well as meeting legislative requirements.
- Identification and resolution (where possible) of uncertainties or conflicts within existing Codes.
- Indication of required Design Criteria not covered by existing Codes.
- Identification of typical minimum functional specifications of equipment, e.g. cranes, vessels, winches, mooring capability.
- Appendices referring to existing codes and guidance and relevant legislation should also be included.

4.3.2 Operation and Maintenance

The main sections of this proposed draft should include:

- Requirements for on-shore support facilities.
- Typical service vessels required.
- Summary of essential skills and competencies.
- Summary of principles & good practice in inspection, repair and maintenance (IRM).
- Evaluating unscheduled maintenance requirements (including principles of reliability-centred maintenance and how such techniques as Failure Mode Effects Analysis can assist in the prediction, and hence the provision, for unscheduled maintenance).
- Records & administration of maintenance (as outlined in good practice guides such as the ISO 9000 series) with emphasis on the planned aspects of the IRM scheme.
- Maintenance and spares records and data collection.
- Offshore working, including review of the requirements for establishing a safe working environment offshore for a variety of situations, in addition to specific guidelines on maintaining safe access/egress and dealing with emergency situations.
- Hazard and risk assessment.
- Appendices referring to existing codes and guidance and relevant legislation should also be included.

4.3.3 Subsea Cable Lifecycle

The main sections of this draft document should include:

- Design of subsea cables, to include selection of materials, calculating fault levels, fibres/instrument pairs, armouring, and aspects of Health & Safety inherent in the design.
- Manufacture, loading and transportation of subsea cables, including factory testing, methods of loading, and optimum requirements for storage.
- Offshore cable-laying, including route planning, post-lay inspection, and jointing and connection of cables.
- Maintenance and repair of subsea cables.
- Decommissioning of subsea cables.
- Appendices referring to existing codes and guidance and relevant legislation should also be included.

4.3.4 Environmental Monitoring

Since the original discussions in 2010 regarding the need for an environmental monitoring guide, the sector has seen the development of highly relevant guidelines³ on the Environmental Impact Assessment process as related to the offshore renewables industry. These publications provide guidance specific to the marine energy sector and care should be taken to avoid duplication of content.

The main sections of this proposed draft distributed in advance of the workshop included:

- Methodologies available to address the potential for wildlife entanglement, entrapment and collision; disturbance or harm due to acoustic output from devices; behavioural changes in wildlife; and disturbance to seabed habitats.
- Physical Disturbance to Water Masses (the scale and implications of changes to factors such as nutrients, temperature, light levels, turbidity, surface waves and current patterns should be considered).
- Ecological Energy Balances and Flows (the potential consequence of energy extraction and physical presence of devices in the sea).

³ Marine Scotland Draft Marine Renewable Licensing Manual (<http://www.scotland.gov.uk/Topics/marine/Licensing/marine/LicensingManual>);
MARINET D4.7 Best Practice Report on Environmental Monitoring and New Study Techniques (publication pending);
EquiMar project deliverables (<http://www.equimar.org/equimar-project-deliverables.html>);
SOWFIA project deliverables (<http://www.sowfia.eu/index.php?id=22>).

- Contamination of Seawater, Seabed and Wildlife (Including Fish Stocks)
- Visual, Seascape and Landscape Impacts (Above Water)
- Submerged Landscape Impacts
- Navigation/Sea User Interference (potential impact of the presence of devices and their mooring systems on vessels and other sea users). Coverage needs to include areas over which particular care is needed, e.g. navigation; MOD interests; cables and pipelines; sea disposal sites; fisheries; recreational and tourism interests. Note that Appendices referring to existing codes and guidance and relevant legislation should also be included.

Discussions at the workshop breakout session highlighted the importance of making full use of all available guidance and other relevant resources, so it was felt that the environmental guide should concentrate on providing guidance specific to monitoring methods and practices.

4.3.5 Summary of Breakout Sessions

Annex 6 of this report provides details of who attended each breakout session. A general point raised at all four breakout sessions was that, whilst there is a need for guidelines at this stage, care must be taken to avoid duplication with material already available, and significant effort should be made to provide reference to all relevant sources. The points reported in the following sections are as expressed by delegates at the workshop and do not necessarily reflect EMEC's policy or philosophy on these topics.

4.3.6 Offshore Installation

The Offshore Installation breakout sessions were facilitated by Malcolm Bowie of First Energy Development Ltd. The general feeling from this group was that some guidelines are required rather than standards (particularly in the areas of project/interface management, installation methods, and understanding/alignment of training/competencies), as it was felt there is sufficient 'standardisation' in place at present. Key points covered in these sessions were:

- There was a strong desire for a clear guidance document into which delegates could input, and which could act as a reference guide. A roadmap which, as a minimum, identifies the best practice cross-industry was seen as a useful initiative.
- Having a central body to collate risks/hazards was discussed, with Marine Scotland, ORE Catapult and RenewableUK suggested and/or offering to be the custodian. The requirements and principals of use of such an information source needs to be defined clearly to ensure sufficient information is added but most importantly the information can be used constructively.
- Minimum competency levels in key specific areas should be recommended and in particular understanding/ alignment of training requirements properly understood. This applies

particularly to offshore survival certification and requirements for provision of additional safety systems/training relevant to the unique and challenging working environment.

- The tidal sector was perceived as having a greater need for stronger guidance and alignment with industry best practice than the wave sector, mostly due to the difficulties associated with needing to concentrate marine works around slack water periods.
- Inexperience of developers in dealing with large installation contractors was identified as a key issue. Some guidance on how to manage this interface and better understand the practical limitations/capabilities of these large contractors would help significantly.
- Project management was perceived as a potential area which could lead to cost overruns, thus some strong guidelines on interface management were seen as being a good focus area.

4.3.7 Operation and Maintenance

The O&M breakout sessions were facilitated by Stuart Baird, Director of Operations at EMEC. This group questioned the need for an O&M standard, with the general view being that standardisation would potentially increase developers' costs and could be over-prescriptive at this stage. However, the need for guidelines was recognised, perhaps using offshore wind as an example. The need for guidelines was stressed as particularly important for the less mature developers who have yet to experience installation and operation activities in a real sea environment. Key points raised in the O&M sessions were:

- There are some IEC standards for O&M but mainly for devices (e.g. pumps) rather than systems.
- The draft Design Standard considers O&M and could be enhanced in respect of wave and tide. This will require the scope to be defined in detail, to allow evaluation of requirements.
- The need for common terminology to be used to enable shared data collection and information collation regarding reliability etc was identified. IEC TC1⁴ is tasked with sanctioning the terms and definitions used in the different electrotechnical fields, and the IEC online electrical and electronic terminology database⁵ contains more than 20,000 terms and definitions. Other standards contain supplementary lists of nomenclature, and the need for some way of ensuring that these lists are regularly updated was raised, in order to avoid the unnecessary creation of additional terminology lists.
- Central data management and a repository to collate data and conduct trend analysis etc were suggested. Also, knowledge exchange between test centres across Europe/the World should be encouraged.

⁴ http://www.iec.ch/dyn/www/f?p=103:7:0:::FSP_ORG_ID,FSP_LANG_ID:1231,25

⁵ <http://www.electropedia.org/>

- Other areas for consideration within O&M guidelines include pre-construction information, marine warranty issues, met-ocean conditions, and diving operations.

4.3.8 Subsea Cable Lifecycle

The Subsea Cable Lifecycle breakout session was facilitated by Mike Nichols of Engineering Technology Applications Ltd. Feedback from this group indicated that there are too many unknowns to allow standards to be produced at this early stage. However, cable connectors and cable stability were highlighted as areas requiring guidelines to be developed. Other key points raised in these sessions were:

- Need to agree scope and the range of activities to be included (e.g. entire project lifetime; maintenance cycles; access for O&M; other requirements?).
- Need to establish through more detailed discussion what range of scope, and detail of coverage is actually achievable (e.g. modifications to cable designs; connectors; cable and component lifetimes)?
- There was strong support for separate guidelines for wave and tide sectors.
- Recommendations for competency levels required for cable installers should be specified.
- Standardisation of cable designs and repair joints.

4.3.9 Environmental Monitoring

The Environmental Monitoring breakout sessions were facilitated by Jennifer Norris, EMEC's Research Director. The general consensus from this group was that standards would be too prescriptive at this stage, but there is a definite need for guidance in certain key areas. The existing range of guidance available was discussed, and the need to avoid duplication was emphasised. The following summarises the topics covered and key points raised during the sessions:

- It was felt that at this early stage of sector development there is a need to retain flexibility in monitoring methodologies, and introducing standards would probably inhibit this flexibility and could become overly prescriptive. In Scotland, the Regulator's view is that decisions on the specific methods used for environmental monitoring should rest with individual developers (leaving scope for innovative approaches to develop), provided that such methods provide the information needed. The difficulty lies in knowing which methods will indeed provide this information.
- There was strong support for developing a national guideline(s) that can be used by both developers and regulators, which is/are recognised internationally and could potentially form the basis of a future standard.

- Guidelines should cover the principle of ‘survey, deploy and monitor’, acoustic monitoring, and methodologies for collision detection/measurement. Whilst guidance should focus primarily on relevant impacts, there was recognition that some developers may choose to do monitoring beyond that actually required by regulators, for their own project-specific purposes, and that there was a value in findings from such studies being shared.
- Guidance is required on how much baseline information is necessary, and how this should be gathered. There is also a need for clearer information about what data sources already exist (hosted and maintained by an appropriate body). Information about the scope and scale of baseline monitoring requirements is limited and variable across the UK. There is a need for more consistency in guidance, to reduce the risk to developers of wide-scale monitoring being required by regulators, where this is actually not really necessary. Lack of knowledge and consistency makes this issue a significant potential barrier. The benefits of honing down of a potentially over-precautionary approach were emphasised.
- It was felt that EMEC’s work on generic, site-wide environmental monitoring could be extended to develop guidelines, to include a ‘manual’ of techniques to use and best practice guidance (based on test centre experience). The need for dissemination of the findings of environmental monitoring of the early-stage deployments was also highlighted.
- There was a strong desire for a central database for environmental monitoring data to be established, which developers could contribute to as part of their licence conditions (e.g. TETHYS⁶ in the USA).

4.4 Feedback from Delegate Questionnaires

Workshop delegates were asked to complete and submit a questionnaire in order to gauge awareness of the existing standards/guidelines, and explore the appetite for involvement in developing new standards (see Annex 4).

A large number of respondents (76%) indicated that they would be prepared to get involved in Working Groups for the development of new standards. Of the 38 delegates who responded to the question relating to their potential involvement in Working Groups for specific standards, 29 said they would be prepared to commit to being part of a working group. The range of standards that they felt able to contribute to varied, with two delegates indicating that their company/organisation would be able to offer expertise/support across all topic areas, and the remainder identifying specific standards which they could provide input to as shown in Table 1 below.

⁶ <http://tethys.pnnl.gov/>

Topic Area	Standard/Guideline	Number of respondents prepared to offer input
O&M	O&M	6
Environmental	Environmental	6
Cables (including design, installation, protection)	Subsea Cables	4
Installation & Offshore Construction	Installation	2
Tank testing (wave / tidal)	Tank Testing	2
Energy yield and tidal development in low flow velocities	Mechanical Design in Shallow Water Environments	1
Met-ocean data gathering	Data Sensing & Communication	1
Floating Offshore	Guide to Manufacture of Devices; Reliability, Survivability Guide	1
Tidal/Wave Resource Assessment	Tidal/Wave Resource Assessment	1
Third Party Verification	Reliability, Survivability Guide; Certification System Guide	1
Risk Assessment	Installation; O&M	1
Design & requirements	Design Basis Guide	1
Reliability of devices and moorings	Reliability, Survivability Guide; Certification System Guide	1
Electrical (onshore and offshore)	Subsea Cables; Subsea Connectors; Guide to Manufacture of Devices	1
Tidal Device Performance	Tidal Device Performance Assessment	1

Table 1: Numbers of delegates prepared to commit to a Working Group for specific standards

Table 2 below summarises the number of respondents who indicated an interest in each capacity specified in the questionnaire (lead author, subject matter expert, and reviewer). It also gives a breakdown of those who felt that they were in a position to contribute on a voluntary basis.

	Lead Author	Subject Matter Expert	Reviewer
Number willing to participate	8	15	26
Voluntary: Yes	2	8	16
Voluntary: Maybe/to an extent	4	5	5
Require payment	2	2	5

Table 2: Summary of delegates' level of commitment to development of new standards

Table 3 below shows the responses to questions 3, 4 and 5 in the questionnaire.

Question	%Yes	%No
3. Have you ever used any of the standards/guidelines discussed today?	73	27
4. Do you feel that the content of the current standards/ guidelines is satisfactory?	40	60
5. Do you feel that the range of the current standards/ guidelines is satisfactory?	33	67

Table 3: Delegate satisfaction with current standards/guidelines

The main reasons given for not using the existing standards/guidelines were that they were not relevant to the respondents' role, or that the respondent was not aware of specific standards/guidelines.

It is clear from this feedback that the majority of delegates who have used the existing standards/guidelines believe that both the content and range are unsatisfactory.

5 Recommendations for Future Work

In a closing address to the workshop, the incoming USA National Committee representative to IEC TC114 commented that the USA and the rest of the world are looking closely at activity in the UK, particularly Scotland. He emphasised that the UK needs to ensure that it continues to build on its reputation in providing input to the development of standards for the wave and tidal industry. It is noted that other nations (e.g. Canada, USA) provide generous funding for development of standards, and in order to maintain the UK's impetus in this area, Government needs to be approached to provide financial support. It is very clear that without this support, the UK will not be able to maintain its leading position.

The following sections describe work that is required in order to progress the development of standards for the wave and tidal industry, and provide recommendations to take this forward.

5.1 Ensuring Improved Awareness of Existing Standards/Guidelines

Feedback from the workshop indicated that on average 47% of delegates were not aware of the 12 existing standards/guidelines. It is therefore recommended that steps be taken to raise awareness of the existing standards/guidelines and ensure greater uptake by, and engagement with, industry.

76% of respondents to the delegate questionnaire indicated that they would be willing to get involved in Working Groups for the development of new standards. Of these respondents, 21% indicated that they would be happy to contribute, but that their time and costs would need to be covered in order to do so.

This enthusiasm needs to be captured and a list compiled of expert contacts who could be invited to contribute to and/or comment on draft proposals and ongoing reviews of existing standards. This process must ensure that the appropriate level of expertise is required of active participants, for which close engagement with the British Standards Institute (BSI) is anticipated.

Funding for engagement in standards development and reviewing activities is the responsibility of national governments, and is not provided by the IEC. To date, UK involvement in this arena is almost exclusively voluntary, with some organisations being prepared to make available staff resource at their own cost. If the UK is to remain at the forefront of the sector in standards development, there must be funding made available for this engagement with expert users.

Recommendations:

This will require active promotion by the following means:

- the marine renewable energy industry in the UK should work closely with the IEC to ensure common goals and efficient working;

- strengthen the UK Mirror Committees to the IEC by expanding membership of the Mirror Committees to include end-users and technology developers;
- develop and maintain closer industry liaisons with the National Committee, BSI and relevant (expanded) Mirror Committees;
- create and maintain a dedicated online information resource that provides: links to relevant existing standards/guidelines and relevant data sources; information about the standards development and review processes; and information on standards-related activities, both nationally and internationally;
- raise awareness at regular industry meetings and conferences;
- promote other proactive outreach activities as necessary;
- develop a proposal to Government for funding a central, national, independent body to champion, promote, and, working closely with the (expanded) Mirror Committees, oversee the development and review of standards/guidelines related to the marine energy sector.

5.2 Improved Access to Relevant Information

One of the key points raised repeatedly throughout the workshop was the importance of taking full account of existing guidance, in order to avoid duplication of effort and cost. This applies to both existing guidance documentation and to relevant data resources.

5.2.1 Literature Survey and Catalogue

There is a need to undertake a comprehensive literature survey and create a database/catalogue of standards and guidelines that are relevant to marine energy. This should be developed, maintained and hosted by an appropriate independent body, and easily accessible to the sector as a national resource. Coverage is likely to include the wider range of marine renewables, i.e. offshore wind, as well as wave and tidal energy. It is anticipated that this would be the initial activity undertaken for each of the new standards/guidelines once funding is sourced for their ongoing development (see Section 5.4).

The finding from the workshop that there is very low awareness of the existing standards and guidance in the marine energy sector, even though six of the EMEC documents reviewed have been adopted by the IEC, is an indication that significant improvement is needed to dissemination of information about these documents. A central, national resource that engages closely with industry is essential if there is to be meaningful uptake of standards and guidance by the sector as it develops.

Long-term maintenance of this resource is essential, ensuring that all relevant guidance is recognised and referenced in the central data resource. The lack of this type of central data

resource increases the risk of unnecessary duplication of effort and cost. A current example of the potential for such inefficiency to arise is available in the area of acoustic data gathering and analysis for the marine energy sector: a New Work Initiation Proposal has been submitted to the IEC for Acoustic Characterisation of Marine Energy Converters (i.e. how to measure the acoustic characteristics of different types of device). At the same time, a range of guidance on measuring underwater noise from operational marine renewable energy devices has in parallel been produced by EMEC⁷, Marine Scotland⁸, and The Crown Estate⁹. Other relevant work has also been carried out under Work Package 2 of the MARINET project¹⁰ to establish standards and best practice for marine energy system testing.

In the above example, the potential duplication of effort has arisen due to the regulatory requirement for acoustic monitoring of early-stage device deployments. This is an issue of concern across a number of countries, all of which are experiencing the need for further guidance in how best to undertake the data gathering and analysis. Yet there is currently no link in place between these relevant guidelines and the standards-making process, and in the absence of such links / awareness being actively promoted, this type of inefficiency will become increasingly frequent.

Relevant developments such as these are highly predictable and the need for standards and guidelines should readily be recognised and fed into a central national database. Similarly improved activities across the National Committees will lead to better informed discussions at the international level, leading to significant efficiencies and opportunities for collaboration, rather than duplication.

5.2.2 Shared Data Resource

Feedback from the workshop breakout sessions also indicates that there is a need for a central repository to collate data, accessible by the wave and tidal industry. Many sources of useful environmental information exist (e.g. Marine Scotland, The Crown Estate, Natural Environment Research Council and other knowledge exchange websites), but a single point of access to the information available and relevant to the marine energy sector would be extremely beneficial.

Ongoing maintenance and updating of this information resource is also essential to the accurate and efficient assessment of the need for additional guidance to be developed, and is key to avoiding unnecessary duplication of effort. It is also important to ensure that the information repository and resource is regularly advertised and drawn to the attention of industry meetings and conferences (Trade Associations may be of assistance in this respect).

⁷ Lepper, P.A., Robinson, S.P., Humphries, V. and Butler, M. "Underwater Acoustic Monitoring at Wave and Tidal Energy Sites: Guidance Notes for Regulators". EMEC 2014

⁸ Robinson, S.P., Lepper, P. A. and Hazelwood, R.A. "Good Practice Guide for Underwater Noise Measurement, National Measurement Office, Marine Scotland, The Crown Estate, NPL Good Practice Guide No. 133, ISSN: 1368-6550, 2014.

⁹ Robinson, S.P and Lepper, P.A. "Scoping study: Review of current knowledge of underwater noise emissions from wave and tidal stream energy devices". The Crown Estate, 2013.

¹⁰ <http://www.fp7-marinet.eu/>

Recommendation:

A long-term central repository for standards/guidance and data relevant to the marine energy sector should be created, maintained and updated, and hosted by an appropriate independent body (as recommended in Section 5.1). This should be an easily-accessible national resource, which is actively promoted by the independent body, via appropriate industry liaison groups and other relevant channels.

5.3 Process for Development and Review of Existing Standards / Guidelines

From the discussions at the workshop and beyond, it is clear that knowledge of the general processes of standards development and review, as represented in Figure 4 below, and the mechanism for engagement of expert end-users with these processes is very limited.

There is a real need for the development of clear documentation that describes the processes by which standards and guidelines are developed and reviewed.

5.3.1 Existing Process

Figure 4 below shows the relationships between the key different national and international bodies involved in the development of new standards and guidelines and the formal review of existing ones, as overseen by the IEC. Proposals for new standards can either be made directly to the IEC as New Work Item Proposals, or can be developed in coordination with the National Committee and submitted in fully developed draft form to the IEC for consideration. Once accepted by the IEC, standards and guidelines then undergo regular formal scheduled review.

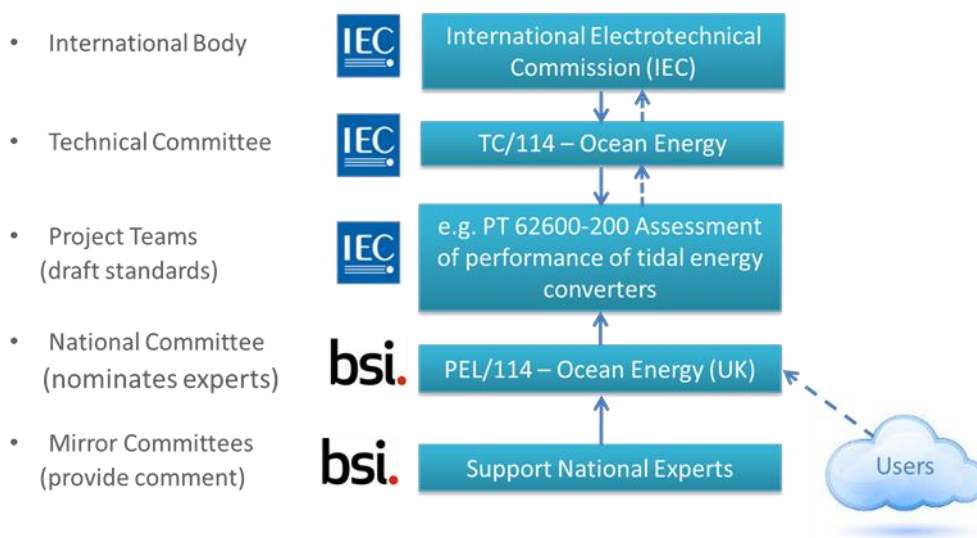


Figure 4: Relationship between bodies involved in the standards-making and reviewing process.

As part of the IEC development process, Ad-hoc Groups are established to bring together experts to discuss topics ahead of formation of formal projects. These groups are therefore central to the development and review process.

Table 4 below summarises progress with relevant projects currently being taken forward by the IEC to produce Technical Specifications (as of May 2014). Ad-hoc groups have been established by the national Mirror Committees to provide expert input to the following areas: Wave Energy Performance Assessment; and Tidal Energy Power Performance Assessment.

In the marine energy sector, New Work Item Proposals have recently been submitted (at July 2014) for Acoustic Characterisation of Marine Energy Converters (how to measure acoustic character of different types of device), River Power Performance, and Tidal Tank Testing.

Document Reference	Status
62600-2 Design Requirements	Close to being released – final revision June 2014; Committee Draft stage July 2014; draft version by March 2015; Technical Specification to be published by August 2015.
62600-10 Moorings	Seven nations represented, reviewing differences with the ISO document on moorings; major rewrite required; Committee Draft comments received by end May 2014; draft Technical Specification ready by Autumn 2014, for publishing Spring 2015.
62600-20 OTEC	Committee Draft due December 2014; requires more input from countries with development experience (France, Netherlands, and China suggested).
62600-30 Power Quality Requirements	High potential for overlap with other documents; first Committee Draft due end December 2014; draft Technical Specification ready by end December 2015.
62600-101 Wave Resource Assessment	Committee Draft ver. 3 November 2013; draft Technical Specification ready May 2014, to be published November 2014.
62600-1-2 Wave Energy Power Performance Assessment (at second location)	First Committee Draft due April 2015; draft Technical Specification one year later.
62600-103 Pre-prototype Testing (wave)	Committee Draft July 2014.
62600-201 Tidal Resource Assessment	Draft Technical Specification due July 2014; Technical Specification to be published by December 2014.
62600-301 River Energy Resource Assessment	Committee Draft by May 2015; draft Technical Specification by May 2017 (UK have decided not to participate in this).

Table 4: Summary of relevant projects being progressed by the IEC

Recommendation:

Clear documentation should be developed, that describes the processes by which standards and guidelines are developed and reviewed. This documentation should be widely accessible across the sector, and held on the central data resource discussed in Section 5.2. Close liaison with BSI and the National Committee could ensure wider dissemination and would assist in the development of a coordinated approach to progressing the uptake of standards and guidance by the sector in the UK.

5.3.2 The Need for Improvement to the Existing Process

There was a strong opinion expressed at the workshop, and in the follow-up comments, that the review process for standards and guidelines should aim to incorporate learning from experienced users. This review process currently tends to centre on specifically named expert individuals at a national level and is not generally accessible to end-users who have real experience of putting them into practice.

As well as being theoretically robust, the recommendations contained within standards, technical specifications and guidelines must be practicable and workable within normal operational, health and safety, and economic constraints if they are to be adopted by the sector. The viability and efficiency, from these perspectives, of recommendations contained within standards and guidelines are not necessarily always taken into account (or even appreciated) within the review process. This limits the effectiveness of the whole review process and consequently risks lowering the uptake by industry of the standards and guidance produced by the existing process.

The 'Users' cloud in Figure 4 has been added to the standard process diagram as a representation of the need for such input from the expert end-user: i.e. those involved in detailed use of the existing guidelines and standards, who therefore have very detailed knowledge of the practicable application of the recommendations contained within the various specifications. This type of user is typically associated with industry, whereas there is a strong tendency for members of Ad-hoc Groups to be largely from within academia. As it stands, there is limited opportunity and facility for such expert end-users to engage with the standards development process. More crucially, there is extremely limited opportunity or facility for expert end-users to engage with the review process.

In order for the review process to ensure that guidelines and standards offer the best recommendations for end users, this industrial expert end-user engagement is essential.

If the existing formal review process is to work efficiently and meaningfully, it should be further developed to ensure that input from expert and experienced users is captured, recorded and taken into account in the review process. In order to be effective, the elicitation and collation of opinion from expert end-users of standards/guidelines relating to the marine energy sector

should be administered by a suitable resourced, independent, central body at a national level. This measure should ideally be adopted by each National Committee, thus ensuring that input to the development and review process from each country is as well-informed as it can be.

A consolidated and concerted approach to improved capture of expert end-user input will ensure detailed and highly relevant input to the review of individual standards, technical specifications and guidelines by the national Mirror Groups and the IEC. Without this, uptake is likely to continue to be poor.

Recommendation:

It is recommended that centrally organised 'Users groups' are established, facilitated by an appropriate industry body (see Section 5.1), that would ensure coordination between informed and expert end-users and the appropriate National Committee/Mirror Groups, and ensure that relevant experience is taken into account in the development and review processes. Membership of Mirror Committees should be expanded to include end-users and technology developers.

5.4 Further Development of the Existing EMEC Standards/Guidelines

This section addresses the specific issues raised at the workshop in relation to: the need to improve the existing standards/guidelines (Section 5.4.1); the development of draft guidelines for the four proposals discussed in detail (Section 5.4.2); and the further development of the additional four new standards/guidelines suggested by the meeting (Section 5.4.3).

5.4.1 Improvement to the Existing EMEC Standards/Guidelines

Feedback from the workshop voting session (Section 4.1) and the delegate questionnaires (Section 4.5) indicated that the existing standards/guidelines are unsatisfactory. General comments on the existing guidelines received from the workshop are provided in the delegate feedback forms (Annex 7).

Whilst it is recognised that there is a mechanism for feedback into the standards review process by expert authors at a national level, as described in Section 5.3.1, it is recommended that a facility for national review by a wider expert user group should also be established as part of an improved national review process, as discussed in Section 5.3.2.

This type of proactive facilitation activity would be undertaken by an independent body as recommended in Section 5.1, and also fits well with the aims of the ORE Catapult. Activities should include, but not necessarily be limited to:

- Involvement of experienced end-users, especially technology developers, to define and understand what are perceived as the shortcomings of the existing documents and to capture experience of people trying to use the guidelines.
- Review by a wider audience – including insurers and investors.
- Global input – request comments from other developing test centres insofar as they are able or equipped to offer them (although this activity should be facilitated by the relevant countries' National Committees).
- Collation of the responses and opinions obtained, distilling them into coherent commentary on the documents, section by section, as relevant.
- Formation of an expert Ad-hoc group, providing a vehicle to feed opinion from the above sources into the national Mirror Group and thence into the IEC standards-making process.

Recommendation:

It is recommended that measures be taken to ensure that the National Committee take full account of expert end-users' opinion when undergoing the scheduled formal review for these documents. This process will be significantly facilitated if the recommendations for a central body to oversee standards and guidelines for the sector (as suggested in Sections 5.1 and 5.3.2) were to be instigated and maintained.

5.4.2 Further Development of the Proposals for Additional Standards/Guidelines

It is clear from this initial workshop that there is a keen appetite within the wave and tidal energy sector not only to review existing guidelines to make them more fit for purpose, but also to develop new guidelines for the industry to address gaps in currently availability.

The draft standards that were distributed in advance of, and discussed in detail at, the workshop breakout sessions, have already been progressed to the point where there is now agreement on the content.

76% of the respondents to the delegate questionnaire indicated a willingness to become involved in the further development of these new standards/guidelines, although some would require payment.

Recommendations:

In regard to the further development of the guidelines for Installation; Operations and Maintenance; Subsea Cables; and Environmental Monitoring Guidelines, the following stages are recommended:

- Funds for the development of all four proposals should be sought and obtained.
- The recommendations in Sections 5.1 and 5.3.2 for a central national resource to promote the development and review of standards/guidelines for the marine energy sector should be progressed.
- A follow-on expert event, by invitation, at which all four proposals are discussed in parallel, in greater detail. For each of the four guidelines, this will include the appointment of lead and secondary authors (whose time should ideally be paid) and an expert panel of advisors. The latter would be available to be consulted as necessary during the development of the full draft by the lead author, and would agree the final draft.
- Liaison as appropriate with the UK Mirror Groups and National Committee should be overseen by the event facilitator (or the central national resource recommended in Section 5.1, if this is in place).
- Submission of the final draft to the National Committee, for progression through to the IEC for consideration for adoption.

5.4.3 Initiate Development of the Additional Range of Four Standards

The workshop delegates agreed that the following four new areas should be taken forward as potential new guidelines¹¹ for the marine energy sector:

- Data sensing and communication
- Mechanical design in shallow water environments
- Vessels and equipment used in marine renewable energy developments
- Subsea connectors

Development of proposals for draft specifications for these four areas should be progressed in a similar manner to the draft scopes for the four proposals that were the subject of the workshop. Summary scopes should be drafted, followed by liaison with the UK Mirror Group, seeking sanction for the development of the full guideline. Once agreement is obtained, then the further development should progress as recommended in Section 5.4.2 for those four drafts that have already reached this stage.

¹¹ Suggestions for guidelines covering tank testing and energy yield for offshore wind should be referred to Renewable-UK and IEC PEL/88 at National Standards level for consideration.

Recommendations:

- Funding should be sourced.
- For each of the new suggested areas, summary scopes should be prepared, and should include a description of the key topic areas to be covered, with an initial contents list for each document, and presented in a similar manner to the four proposals that were discussed in detail at the workshop. It is recommended that any document intended to be submitted as a draft for an international standard must be edited in accordance with BS 0 (the 'standard for standards').
- Liaison by a facilitatory body (see Section 5.1) with the UK Mirror Group, seeking confirmation to progress to full draft guidelines.
- Run workshops (possibly four held in parallel), with invitations targeted at experts in the appropriate fields, to flesh out the detail of each proposal, and assign lead and secondary authors for production of the draft documents.
- Follow recommendations listed in Section 5.4.2 for the other four proposals.

5.4.4 Suggestions from other Nations

It is worth noting that there are also specific recommendations for the development of new standards for the marine energy sector that have been made in Canada and the USA.

- Canada has identified the following topics as high priority for development of standards:
- Commissioning of a Marine Energy system
- Operations, maintainability, and system monitoring
- Subsea cable networks and performance and reliability of undersea cables and connectors
- Design guidelines for marine energy system connection to distribution level grids (smaller scale projects)

The USA has identified a need for additional standards to address:

- Performance of arrays of wave, tidal and water current energy converters
- Competencies of personnel associated with deployment, maintenance, and retrieval of wave, tidal and water current energy converters
- Equipment associated with deployment, maintenance, and retrieval of wave, tidal and water current energy converters
- Environmental monitoring of marine energy converters

In the USA, both the insurance and investment communities have expressed clear interest in certification of marine energy technology to international standards. The wish is to see certification available for all project states from system components to full scale device performance, applicable not only to single prototype deployments, but also to commercial arrays. This will enhance confidence in the design, deployment, operation, maintenance and retrieval of individual devices as well as arrays of, wave, tidal and other water energy converters.

There is clearly some overlap of these suggestions for new standards/guidelines with those being developed and discussed in the UK.

There is a clear requirement for engagement both within the UK and with other nations that are identifying the same need. The detailed proactive engagement needed to maximise efficiency at the national level, whilst ensuring the appropriate level of international engagement, is beyond the scope of activity that can reasonably be expected of individuals acting on a voluntary basis. The recommendation made in Section 5.1 is therefore reiterated here: only by creating/appointing an adequately resourced, independent, national resource tasked with actively promoting and overseeing the development and review of standards/guidelines in the UK, can the UK hope to have any future in this key area.

5.5 Prioritise New Standards/Guidelines

It is recommended that the new guidelines identified in this report be prioritised and funding sought to progress their development. Funding should be sufficient to cover the costs of expert authors, workshops, facilitation, project management and publishing of the documents. Potential sources of funding include Horizon 2020, The Crown Estate (which has shown interest in funding standards in the past), the Technology Strategy Board (as the main co-ordinator of technology funding), plus other relevant funders such as Government and Regional Agencies.

Recommendation:

The new guidelines identified in this report be prioritised and funding sought to progress their development.

It is also important to ensure that the existing review process is significantly improved to make efficient use of all relevant end-user experience. This will lead to increased awareness and uptake of, and respect for, existing and new standard/guidelines as they develop.

The UK, together with the USA, Canada and Ireland will be re-drafting the Strategic Business Plan of the IEC Technical Committee TC/114 which is responsible for international standards in marine and other water current energy sectors. It is essential that the UK's ideas on future standards development and review are fed in to influence that process. It is also crucial to

include the recommendations (in Section 5.3.2) that reflect the need to ensure that expert end-user consultation is actively encouraged in the review process, and that National Committees should be responsible for ensuring that appropriate actions are taken to facilitate this crucial input to the process.

The redraft of the Strategic Business Plan is due to take place in 2014 and will be reviewed and finalised at the 2015 Plenary Meeting of TC/114.

6 Concluding Remarks

The UK is widely acknowledged as the global leader in the field of marine renewable energy. This is partly due to the government's foresight at the turn of the millennium in providing test centres for marine renewable energy device deployment in open sea. Comments made during the workshop indicated that the UK's activities in the development of standards are highly renowned and respected worldwide. Yet, as this workshop showed, we still see a surprisingly low awareness of these standards within expert groups working within the UK.

The messages from the workshop are clear: there is an urgent need for more guidance in key areas; the guidance that does exist needs to be improved; experienced end users need to have a clear route to providing input to the review process; there is a real need to avoid duplication of effort and hence to have an accurate and updated catalogue of relevant material and data.

The further development of the range of standards/guidelines discussed at the workshop should be made a priority and will build on the UK's important leading role in this field. However, in order for that role to be sustained the activity in the area must be adequately resourced.

Activities relating to standards and guidelines for the marine energy sector need to be actively promoted and overseen by an independent national body, resourced sufficiently to work in close liaison with the National Committee, Mirror Groups and relevant Ad-hoc Groups of the BSI to proactively develop the UK's involvement in this key area.

7 Contributors



The European Marine Energy Centre (EMEC) Ltd is the first and only centre of its kind in the world to provide developers of both wave and tidal energy converters with purpose-built, accredited open-sea testing facilities. The Centre is at the forefront in the development of international standards, having coordinated the development of a suite of 12 industry guidelines, six of which have been progressed for global adoption as the first international standards for marine energy. EMEC are especially keen to encourage experienced industrial ‘end-user’ input to the ongoing development of Standards as the sector progresses.

Appendix 1 List of Workshops

REDACTED

Appendix 2 Workshop Programme



In collaboration with



Standards and Guidelines for Marine Renewables (Wave & Tide) Review and Development Workshop

Tuesday 25th March 2014, 09:30 – 15:30
(BMA Conference Centre, Queen Street, Edinburgh, EH2 1LL)

Event Programme

09:30	Welcome - Tea/Coffee	
10:00	Background to the workshop	(EMEC)
10:05	Introduction to the standards landscape	(John Griffiths, EMEC)
10:20	Overview of EMEC Standards	(John Griffiths, EMEC) (ORE Catapult)
11:00	Introduction to proposed new standards:	(Jennifer Norris, EMEC)
	1. Installation and Offshore Construction	(Malcolm Bowie, First Energy Development Ltd)
	2. Operations and Maintenance	(Stuart Baird, EMEC)
	3. Subsea Cable Lifecycle	(Mike Nichols, Engineering Technology Applications Ltd)
	4. Environmental Guidelines	(Jennifer Norris, EMEC)
12:20	Suggestions for other standards/guidelines	(All)
	Introduction to post-lunch sessions	(EMEC)
	Delegates sign-up for breakout sessions	(All)
12:30	Lunch	
13:15	Breakout session 1	(All)
14:00	Breakout session 2	(All)
14:45	Tea/Coffee	
15:00	Feedback from breakout sessions, completion of questionnaire, and closing discussion	(All)
15:30	Close	

Appendix 3 Results of Voting Session

Standard/Guide	1. Are you aware of the Standard/guide?		2. Have you seriously considered using it?		3. Is it satisfactory?	
	YES	NO	YES	NO	YES	NO
1. Wave Device Performance Assessment*	35	15	13	22	4	12
2. Wave Resource Assessment*	34	15	16	18	4	5
3. Tidal Device Performance Assessment*	33	13	12	21	2	10
4. Tidal Resource Assessment*	36	13	17	19	7	10
5. Certification System Guide*	22	28	8	14	2	7
6. Design Basis Guide*	29	21	12	17	4	6
7. Project Development Guide	13	36	4	9	2	4
8. Health & Safety Guide (Renewable UK)	30	21	16	14	3	10
9. Grid Interface	23	26	5	18	4	2
10. Reliability, Survivability Guide	18	31	2	16	2	2
11. Guide to Manufacture of Devices	14	33	1	13	2	3
12. Tank Testing Guide (wave)	23	25	9	14	3	6

Appendix 4 Results of Questionnaire



Standards and Guidelines for Marine Renewables
(Wave & Tide)
Review and Development Workshop

In collaboration with



Delegate Questionnaire

Name (optional): _____

1. What is your main area of interest in attending this workshop?

2. Would you be prepared to commit to being part of a Working Group for a specific standard(s)? Yes / No

2a. If you answered "Yes" to question 2 above, please state:

(i) Which standard(s) could you participate in?

(ii) In what capacity could you participate (please tick all that apply)?

- Lead author
- Subject matter expert
- Reviewer

(iii) Would you be in a position to participate on a voluntary basis? Yes / No

3. Have you ever used any of the standards/guidelines discussed today? Yes / No

3a. If you answered "No" to question 3 above, please explain why not.

4. Do you feel that the *content* of the current standards/guidelines is satisfactory? Yes / No

5. Do you feel that the *range* of current standards/guidelines is satisfactory? Yes / No

6. If you answered "No" to questions 4 or 5 above, please explain what changes to existing standards/guidelines, or what additional standards/ guidelines you feel would benefit the industry.

5. Please use the space below to provide any additional feedback you may have regarding the need for further work to progress the development of standards/guidelines for the marine renewable (wave & tide) industry.

Appendix 5 Suggestions for other Standards/Guidelines

Ref.	Suggested Area for Other Standard/Guideline	Comments (verbatim from workshop attendees)
1	Tank testing standard should cover wave <i>and</i> tide.	<p><i>Already underway.</i> This is in hand through IEC – a new work application is under consideration. Essential for tidal turbine work. The tidal testing standard/guidelines could be readily signposted to the ITTC standard used for the wave testing one. IEC PT62600-103 covers wave. Tidal not covered yet. Agreed.</p>
2	Data sensing and communication.	<p><i>Potential new guideline.</i> This document needs a scope before the value of it can be properly assessed. Should be in the Performance Analysis and Reporting IEC standard already in use.</p>
3	Nomenclature used in marine renewable energy industry.	<p><i>Already underway.</i> There is an IEC standard of “Terminology” and other standards have supplementary lists in the appropriate sections. This would be helpful to avoid potential confusion. This already exists at the IEC – TS62600-1 TCE have already circulated numerous reports with glossary of terms and nomenclature. Numbering of both devices within arrays and of components within devices should be standardised. Reference Designation System for Power Plants (RDS-PP) is a standard naming convention for components within fossil fuelled plants which has been extended for wind energy, and could also lend itself to being extended for marine energy (http://www.vgb.org/en/db_rds_e.html#)</p>
4	Competency of personnel working in marine renewable energy industry.	<p><i>Covered within various other standards/guidelines.</i> This covers a range of requirements, some such as electrical competency are quite specialist, others in general H&S guides cover. Experience will be a prerequisite for many areas, e.g. installation. This needs to be Developer and Equipment Specific....no one else can determine the competencies and training required re maintenance operations. However general marine operations can be covered by crew on Vessels that have a minimum of Efficient Deck Hand Training (STCW) and then Client Reps on board should be able to demonstrate compliance with the IMCA Guidance on Competence and Assurance for an Observation Representative as a minimum. See IMCA TCPC 12/04 Information Note. This can be covered in the Installation/Marine Construction guide and then the O&M guide under competencies required. Agree – crucial to safe efficient marine operations.</p>

5	Mechanical design in shallow water environments.	<p><i>Potential new guideline.</i> This needs scope definition before an evaluation of the requirement is possible. See www.GL –group.com (Part IV -7-2): Structural Design - Offshore Design Rules and then suite of information from BV, DNV and API see DNV-RP-C205 as a starting point.</p>
6	Vessels and equipment used in marine renewable energy developments.	<p><i>Potential new guideline.</i> This needs scope definition before an evaluation of the requirement is possible. PWP see little value in spending time on developing a guide to Vessels and their capabilities - several publications exist already and then the Renewables UK Vessel Safety Guide which provides for how to assess a vessel’s suitability to certain operations and then selection criteria! This section links into “competency” in that many aspects of vessel safety relate directly to the specific work being planned. It may be the case that one of the guides or audit checklists recommends a vessel type for a generic scope of work; however, an experienced and competent auditor may know more about where to look in a vessel for specific requirements related to specific tasks and weather/sea conditions. Should allow for innovation in installation techniques and device design. There is a case, for discussion with vessel operators, with developers and marine renewable operations experts to agree standards or guidance for the types of vessels used, propulsion systems, deck layout, winch and crane capacity and load monitoring equipment.</p>
7	Tank testing for offshore wind.	<p><i>Refer to RUK.</i> This should be referred to RUK to consider and to PEL/88 at National Standards level. The effect of wind on the stability of structures (including the effect on wave patterns) can be a useful addition to the armoury of testing facilities. Care needs to be taken between different scaling regimes that can exist between wind and waves/ current. Not for this group - pass request to RUK.</p>
8	Energy yield for offshore wind.	<p><i>Refer to RUK.</i> This may well be covered in the 61400 series of documents issued through IE C TC/88. This would help potential developers justify the case for specific areas of interest, using accepted benchmarking as the criterion. Include energy yield for arrays of Marine Energy Converters. Not for this group - pass request to RUK.</p>
9	Mooring systems.	<p><i>Already underway.</i> There is an IEC document in preparation to cover this. There are several good mooring standards in addition. Very important, especially when seen in conjunction with electrical connections (dry/wet) and also performance implications. This is already underway at the IEC – PT62600-10.</p>

		<p>OCIMF 2008 Mooring Equipment Guidelines (MEG-3) fully documents what is available and how to design mooring systems including detailed references to API/ANSI and DNV GL rules. In particular attention is drawn to API RP 2SK recommended practice for design and analysis of station keeping systems and DNV-OS-E301 position mooring standard.</p> <p>There is a need to provide guidance for design and installation of mooring systems using gravity anchors in (a) tidal streams and (b) where wave devices exert high snatch loads.</p>
10	Subsea connectors.	<p><i>Potential new guideline.</i></p> <p>This also requires a scope before it can be evaluated. See also mooring systems.</p> <p>Off the shelf tested Wet-mates Power and Control to API, TUV and DNV GL codes available now – we have used for over 8 years. Multiple suppliers.</p>
11	Health and safety in O&M.	<p><i>Covered in O&M guideline.</i></p> <p>The proposed O&M guideline would cover Health and Safety in O&M.</p> <p>Should be sewn into the O&M Guidelines not separate, i.e. SSoW and all discussions on the O&M scope. The current RUK H&S Guidelines cover current legislation and best practices, see: http://www.renewableuk.com/en/publications/index.cfm/2013-03-13-hs-guidelines-offshore-wind-marine-energy</p> <p>This section also links into “competency.” The RUK document above states at the beginning, in a disclaimer, “Detailed professional advice should be obtained before taking or refraining from action in relation to any of the contents of this guide, or the relevance or applicability of the information herein.” This is also good advice and points the reader to ensuring competency at the earliest stages of planning any projects in the marine environment.</p> <p>Mechanical and electrical Isolation methods could be standardised to ensure competent persons are able to work safely on a range of devices.</p> <p>Particularly for personnel safety at tidal sites. Need guidance on competence for personnel transfer, flotation and immersion suits, and the use of Personnel Locator Beacons and ship-board tracking system.</p>
12	Mechanical measurements.	<p><i>Covered within various other standards/guidelines.</i></p> <p>Difficult to evaluate this without a scope of the document for review.</p> <p>Include general load case verification and loads measurements.</p> <p>Too many to list....BSI/ISO /ASME/ANSI /API a 10 min search on google will find copious standards.</p>
13	Mechanical testing in components (component fatigue in marine environment).	<p><i>Covered within various other standards/guidelines.</i></p> <p>This needs scope definition before an evaluation of the requirement is possible.</p>

		<p>I would imagine would need to be considered as part of the risk assessment process. Guidance on the areas that need attention, rather than test everything. Too many to list...DNV GL /ASME/ANSI/API a 10 min search on google will find copious standards.</p>
14	Technology qualification.	<p><i>Already underway.</i> This is part of the 'compliance' suite of documents and should be taken up in the work of WG 15 to develop a certification guide. See Horizon 2020 Work programme TRL 1 to TRL 9.</p>

Appendix 6 Groups for Breakout Sessions

REDACTED

Contact

**ORE Catapult
Inovo
121 George Street
Glasgow, G1 1RD**

**T +44 (0)333 004 1400
F +44 (0)333 004 1399**

**ORE Catapult
National renewable Energy Centre
Offshore House
Albert Street, Blyth
Northumberland, NE24 1LZ**

**T +44 (0)1670 359 555
F +44 (0)1670 359 666
Info@ore.catapult.org.uk**

Ore.catapult.org.uk