

# Final report

## 1.1 Project details

<b>Project title</b>	Standardization related to wave energy DS S-614 and IEC TC 114
<b>Project identification (program abbrev. and file)</b>	ForskVE-projekt nr. 2014-1-12180
<b>Name of the programme which has funded the project</b>	ForskVE
<b>Project managing company/institution (name and address)</b>	Aalborg University Department of Civil Engineering Sofiendalsvej 11 9200 Aalborg SV
<b>Project partners</b>	Kim Nielsen, RAMBOLL
<b>CVR</b> (central business register)	DK 29102384
<b>Date for submission</b>	01.08.2016

## 1.2 Short description of project objective and results

Dansk version:

Dette projekt har muliggjort fortsat dansk engagement (der startede tilbage i 2008) i det internationale samarbejde omkring udarbejdelse af standarder for udvikling, afprøvning og design af bølgeenergi i regi af DS S-614 og IEC TC-114 i perioden 01.2014-06.2016.

Der udarbejdes bl.a. standarder for afprøvning, design og effektmålinger så det er muligt at sammenligne og markedsføre de mest lovende koncepter på tværs af landegrænser på basis af ensartede forudsætninger.

Konkrete aktiviteter i projektet inkluderer:

- Mødeforberedelse- og deltagelse, IEC TC-114 general meetings og halvårslige møder i DS.
- Deltagelse i udarbejdelse af flg. Technical Specifications: PT 62600-2 Design requirements, PT 62600-10 Mooring system, PT 62600-102 Power Performance Assessment at a Second Location og PT 62600-103 Testing of pre-prototype scale devices.

UK version:

This project has enabled the continued Danish engagement (which started back in 2008) in the international cooperation regarding the development of standards for the development, testing and design of wave energy under the auspices of DS S-614 and IEC TC-114 in the period 01.2014-06.2016.

Developed standards for testing, design and power measurements make it possible to compare and market the most promising concepts across national borders on the basis of consistent assumptions.

Specific activities in the project include:

- Preparation and participation in meetings, IEC TC 114 general meetings and biannual meetings of DS.
- Participation in the preparation of the following Technical Specifications: PT 62600-2 Design requirements, PT 62600-10 Mooring system, PT 62600-102 Power Performance Assessment to a Second Location and PT 62600-103 Testing of pre-prototype scale devices.

### 1.3 Executive summary

The purpose of this project has been to continue to engage and communicate Danish wave power industry interests in the development of international standards, a work that began under the auspices of IEC TC-114 and DS S-614 in 2008.

This has included development of standards making it possible to compare and market wave machines across national boundaries under similar conditions. At that stage of development as wave energy technology is at today, the individual wave power developers only to a very limited extent has the opportunity to participate. AAU has therefore, on behalf of the Danish wave energy industry, acted as coordinator of this work, in cooperation with Ramboll, both of which have many years of experience related to wave energy development, and contacts to each Danish wave power developers, in the Danish Mirror Committee and via the Danish Partnership for Wave Energy.

Denmark has through many years of development efforts become a pioneer in the wave energy field, although a country with a modest wave energy resource, also a country with a strong interest in being involved in this work in order to pass on our experience, promote our results, including developed concepts, test sites on a smaller scale and Cost of Energy calculations, etc.

A strong Danish representation in international cooperation, including participation in standardization under IEC TC-114, is an important part of the Partnership for Wave Energy's Strategy for Research, Development and Demonstration 2012, and will assist future marketing of Danish products developed and promotion of Danish products.

### 1.4 Project objectives

The objective of the project has been to continue the engagement, and communicate Danish wave power industry interests, in the development of international standards, a work that began under the auspices of IEC TC-114 and DS S-614 in 2008.

In detail, this has been achieved through participation in IEC TC-114 general meetings (annual) and DS S-614 meetings (biannual), and direct involvement in development of technical specifications in the following project teams:

- PT 62600-2: *Design requirements for marine energy systems.*
- PT 62600-10: *Assessment of mooring system for marine energy converters.*
- PT 62600-102: *Power performance assessment of electricity producing wave energy converters.*
- PT 62600-103 *Guidelines for the early stage development of wave energy converters: best practices and recommended procedures for the testing for pre-prototype scale devices.*

### 1.5 Project results and dissemination of results

Below, specific activities and achieved results are listed:

- DK representation at IEC TC-114 annual general meetings: April 2014: Vancouver (Peter Frigaard, AAU), April 2015: Dublin (Kim Nielsen, Ramboll), April 2016: Guangzhou (Peter Frigaard, AAU).
- DS S-614 biannual meetings: April 2014 (at DS), Dec. 2014 (teleconf.), Aug. 2015 (at DS), Dec. 2015 (at DHI).
- (Collection of) comments on various documents from IEC TC-114.
- PT 62600-2: *Design requirements for marine energy systems.* DTS published. DK expert: Peter Frigaard, AAU.
- PT 62600-10: *Assessment of mooring system for marine energy converters. Final TS published.* DK expert: Martin Sterndorff, Sterndorff Engineering.

- PT 62600-102: *Power performance assessment of electricity producing wave energy converters*. DTS published. DK experts: Kim Nielsen, Ramboll (convener), Jens Peter Kofoed, AAU.
- PT 62600-103 *Guidelines for the early stage development of wave energy converters: best practices and recommended procedures for the testing for pre-prototype scale devices*. CD expected to be published in 2016. DK experts: Jens Peter Kofoed, AAU, Kim Nielsen, Ramboll.

Especially, it should be noted that the PT 62600-102 has benefitted a lot from the current project. Kim Nielsen, Ramboll, has been convener of this PT, and the current project has, due to the early Danish experience in real sea power production, enabled that data from the Wavestar testing at DanWEC, Hanstholm, has been provided, and used as the basis for an example analysis in the Annex of the PT 62600-102 DTS. This has been noticed and appreciated internationally, as this kind of openness and willingness to share real sea data, is rare in the wave energy sector.

## **1.6 Utilization of project results**

As the project partners are heavily engaged in specific wave energy development projects, including projects related to both small and large scale testing hereof, the technical specifications which has been developed (and are under development) will be of high value for further work in these projects. Furthermore, although the currently funded project has ended, the work in IEC TC-114 and DS S-614 has to continue.

## **1.7 Project conclusion and perspective**

The project, which have now been concluded has fulfilled the objectives set up at the beginning of the project – even a bit more than anticipated has been achieved, as the project funds has been stretched to cover 2,5 years of activities, rather than the initially intended 2 years. Besides the tangible outcome of the work, in terms of published documents, valuable international network connections have been established through the activities.

Even though the project partners have not yet – despite submitted applications – been able to raise funds to enable continued heavy engagement the standardization work, it is ambition to stay involved at some minimum level, and continue to seek for funding to enable a more whole-hearted involvement in the future.

### **Annex**

Link to website of IEC TC-114 where current status on documents and work programs can be found:

[http://www.iec.ch/dyn/www/f?p=103:23:0::::FSP\\_ORG\\_ID,FSP\\_LANG\\_ID:1316,25](http://www.iec.ch/dyn/www/f?p=103:23:0::::FSP_ORG_ID,FSP_LANG_ID:1316,25)

Link to available standards originating from IEC TC-114, adapted by DS through S-614:

<https://webshop.ds.dk/da-dk/s%C3%B8gning?q=62600>