

This is a preview - click here to buy the full publication



IEC/TS 62600-100

Edition 1.0 2012-08

TECHNICAL SPECIFICATION



**Marine energy – Wave, tidal and other water current converters –
Part 100: Electricity producing wave energy converters – Power performance
assessment**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 27.140

ISBN 978-2-83220-330-9

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	4
INTRODUCTION	6
1 Scope	7
2 Normative references	7
3 Symbols and units	8
4 Sequence of work	10
5 Test site characterization	10
5.1 General	10
5.2 Measurements	10
5.2.1 Wave measurement for wave power	10
5.2.2 Current measurement	11
5.2.3 Tidal measurement	11
5.2.4 Bathymetric survey	11
5.2.5 Calculation of wave spatial transfer model	11
5.2.6 Modelling of the test site	11
6 Methodology	12
6.1 General	12
6.2 Sample duration and frequency	12
6.3 Simultaneity	13
6.4 Data recording	13
6.4.1 Amount of data to be recorded	13
6.4.2 Data format and retaining	13
7 Measurement and data collection for wave data	13
7.1 General	13
7.2 WMI and calibration	13
7.3 Instrumentation location	13
7.3.1 General	13
7.3.2 Direct measurement	13
7.3.3 Measures with spatial transfer model	14
7.3.4 Correction for WEC interference	14
7.4 Metocean data	14
7.5 Procedure for the calculation of derived parameters	14
8 WEC power output measurements	15
8.1 WEC output terminals	15
8.2 Power measurement point	15
8.3 Power measurements	16
8.3.1 General	16
8.3.2 Limitations on power production	16
8.4 Instruments and calibration	16
9 Determination of power performance	17
9.1 General	17
9.2 Structure of the normalized power matrix	17
9.2.1 Core structure	17
9.2.2 Sub-division of the normalized power matrix	17
9.2.3 Calculation of the capture length	17

9.2.4 Representation of the capture length matrix.....	17
9.3 Calculation of power matrix	18
10 Calculation of mean annual energy production (MAEP)	18
10.1 General	18
10.2 Standard methodology.....	18
10.3 Alternative methodology	19
10.4 Completeness of the capture length matrix for MAEP	19
Annex A (informative) Example production of a normalized power matrix.....	20
Annex B (normative) Method for power loss compensation where the measurement point is located on shore	28
Annex C (normative) Evaluation of uncertainty.....	31
Annex D (normative) Error analysis of the wave spatial transfer model	33
Bibliography.....	35
 Figure 1 – Timeline of assessment.....	10
Figure 2 – Data flow diagram	12
Figure A.1 – Power scatter.....	21
Figure B.1 – Location options for metering equipment.....	28
Figure B.2 – Positive sequence cable model.....	29
 Table 1 – Symbols and units	8
Table A.1 – Sample data.....	20
Table A.2 – Average capture length	22
Table A.3 – Standard deviation of capture length	23
Table A.4 – Maximum capture length	24
Table A.5 – Minimum capture length	25
Table A.6 – Number of data samples	26
Table A.7 – Power matrix.....	27
Table C.1 – List of uncertainty components	31

INTERNATIONAL ELECTROTECHNICAL COMMISSION

MARINE ENERGY – WAVE, TIDAL AND OTHER WATER CURRENT CONVERTERS –

Part 100: Electricity producing wave energy converters – Power performance assessment

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a Technical Specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical Specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 62600-100, which is a technical specification, has been prepared by IEC technical committee 114: Marine energy – Wave, tidal and other water current converters.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
114/87/DTS	114/95/RVC

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62600 series, published under the general title *Marine Energy – Wave, tidal and other water current converters*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

The contents of the corrigendum of April 2017 have been included in this copy.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This part of IEC 62600, which is a Technical Specification, provides performance assessment methods for Wave Energy Conversion Systems (WECS). A Wave Energy Converter (WEC) is a device which generates electricity using the action of water waves and delivers electricity to an electrical load.

Wave energy industry development is transitioning from preliminary stages to commercial production stages. Validated data gathering and processing techniques are important to improve existing technologies. This technical specification will be subject to changes as data are collected and processed from testing of WECS.

The expected users of the specification include:

- device developers who want to validate the performance of their WEC;
- investors who want to assess the performance of a device developer's WEC;
- project developers who want to assess the performance of their project against manufacturer's claims;
- surveyors contracted to carry out the assessment.

MARINE ENERGY – WAVE, TIDAL AND OTHER WATER CURRENT CONVERTERS –

Part 100: Electricity producing wave energy converters – Power performance assessment

1 Scope

This part of IEC 62600, which is a Technical Specification, provides a method for assessing the electrical power production performance of a Wave Energy Converter (WEC), based on the performance at a testing site.

The scope of this Technical Specification includes:

- a) all WECs that produce electrical power from wave energy;
- b) all sea resource zones (near and offshore, deep and shallow water);
- c) the specification applies to commercial scale WECs that are:
 - 1) compliantly moored,
 - 2) tautly moored,
 - 3) bottom mounted,
 - 4) shore mounted.

The scope of this Technical Specification does not include:

- a) WECs that produce other forms of energy unless this energy is converted into electrical energy;
- b) resource assessment;
- c) scaled devices in test facilities (tank or scaled sea conditions) where any scaling would need to be carried out to extrapolate results for a full scale device;
- d) power quality issues;
- e) environmental issues;
- f) power matrix transposition from one location to another.

This Technical Specification provides a systematic method which includes:

- measurement of WEC power output in a range of sea states;
- WEC power matrix development;
- an agreed framework for reporting the results of power and wave measurements.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60688, *Electrical measuring transducers for converting a.c. electrical quantities to analogue or digital signals*

IEC 61000-3 (all parts), *Electromagnetic compatibility (EMC) – Part 3: Limits*

IEC 61869-3, *Instrument transformers – Part 3: Additional requirements for inductive voltage transformers*

ISO/IEC Guide 98-1:2009, *Uncertainty of measurement – Part 1: Introduction to the expression of uncertainty in measurement*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO 8601, *Data elements and interchange formats – Information interchange – Representation of dates and times*

EquiMar: Protocols for the equitable assessment of marine energy converters, Part II, Chapters I.A.1 through I.A.5., Editors: David Ingram, George Smith, Claudio Bittencourt Ferreira, Helen Smith. European Commission 7th framework programme grant agreement number 213380, First Edition 2011

NDBC:2009, Technical Document 09-02, *Handbook of automated data quality control checks and procedures*. National Data Buoy Center, August 2009