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TECHNICAL SPECIFICATION

colour inside

Marine energy – Wave, tidal and other water current converters –
Part 2: Design requirements for marine energy systems

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

Part 2: Design requirements for marine energy systems

FOREWORD

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- 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 TS 62600-2, 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
114/168/DTS	114/176A/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 website 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- withdrawn,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.

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 outlines minimum design requirements for marine energy converters and is not intended for use as a complete design specification or instruction manual.

Several different parties may be responsible for undertaking the various elements of the design, manufacture, assembly, installation, erection, commissioning, operation and maintenance of a marine energy system and for ensuring that the requirements of this document are met. The division of responsibility between these parties is a contractual matter and is outside the scope of this document.

Any of the requirements of this document may be altered if it can be suitably demonstrated that the safety of the system is not compromised. Compliance with this document does not relieve any person, organization, or corporation from the responsibility of observing other applicable regulations.

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

Part 2: Design requirements for marine energy systems

1 Scope

1.1 General

This part of IEC 62600 provides the essential design requirements to ensure the engineering integrity of wave, tidal and other water current energy converters, referred to as marine energy converters (MECs), for a specified design life. Its purpose is to provide an appropriate level of protection against damage from all hazards that may lead to failure of the primary structure, defined as the collective system comprising the structural elements, foundation, mooring and anchors, piles, and device buoyancy designed to resist global loads.

This document includes requirements for subsystems of MECs such as control and protection mechanisms, internal electrical systems, mechanical systems and mooring systems as they pertain to the structural viability of the device under site-specific external environmental conditions. This document applies to wave, tidal and other water current converters and to structures that are either floating or fixed to the seafloor or shore. This document applies to structures that are unmanned during operational periods.

This document addresses site-specific conditions, safety factors for critical structures and structural interfaces, external load cases (including extreme load magnitude, duration, and frequency), failure probability and failure consequences for critical structures and structural interfaces (overall risk assessment), and failsafe design practices (demonstration of adequate redundancy). The effect of subsystem failure on the primary structure is also addressed.

This document does not address the effects of MECs on the physical or biological environment (unless noted by exception). This document is used in conjunction with the appropriate IEC and ISO standards, as well as regional regulations that have jurisdiction over the installation site.

1.2 Applications

This document is applicable to MEC systems designed to operate from ocean, tidal and river current energy sources, but not systems associated with hydroelectric impoundments or barrages. This document is also applicable to wave energy converters. It is not applicable to ocean thermal energy conversion (OTEC) systems or salinity gradient systems.

Although important to the overall objectives of the IEC 62600 series, this document does not address all aspects of the engineering process that are taken into account during the full system design of MEC systems. Specifically, this document does not address energy production, performance efficiency, environmental impacts, electric generation and transmission, ergonomics, or power quality.

This document, to the extent possible, adapts the principles of existing applicable standards already in use throughout the marine industry (structure, moorings, anchors, corrosion protection, etc.) and by reference, defers to the appropriate international documents. This document adheres to a Load Resistance Factor Design (LRFD) approach and the principles of limit state design as described in ISO 2394.

MECs designed to convert hydrokinetic energy from significant hydrodynamic forces into other forms of usable energy, such as electrical, hydraulic, or pneumatic may be different from

other types of marine structures. Many MECs are designed to operate in resonance or conditions close to resonance. Furthermore, MECs are hybrids between machines and marine structures. The control forces imposed by the power takeoff (PTO) and possible forces from faults in the operation of the PTO distinguish MECs from other marine structures.

The goal of this document is to adequately address relevant design considerations for MECs that have progressed to an advanced prototype design stage or beyond. This refers to technology concepts that have been proven either through analysis, open water test data, scale model testing in tanks or dry land test facilities, and that are ready for commercialization. It is anticipated that this document will be used in certification schemes for design conformity.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60812, Analysis techniques for system reliability – Procedure for failure mode and effects analysis (FMEA)

IEC 61400-1, *Wind turbines – Part 1: Design requirements*

IEC 61643-11, *Low voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power systems – Requirements and test methods*

IEC 62305-3, *Protection against lightning – Part 3: Physical damage to structures and life hazard*

IEC TS 62600-1, *Marine energy – Wave, tidal and other water current converters – Part 1:* Terminology

IEC TS 62600-10, *Marine energy – Wave, tidal and other water current converters – Part 10: Assessment of mooring system for marine energy converters (MECs)*

ISO 527-1, *Plastics – Determination of tensile properties – Part 1: General principles*

ISO 2394, *General principles on reliability for structures*

ISO 12473, *General principles of cathodic protection in sea water*

ISO 13003, *Fibre-reinforced plastics – Determination of fatigue properties under cyclic loading conditions*

ISO 14125, *Fibre-reinforced plastic composites – Determination of flexural properties*

ISO 14126, *Fibre-reinforced plastic composites – Determination of compressive properties in the in-plane direction*

ISO 14129, *Fibre-reinforced plastic composites – Determination of the in-plane shear stress/shear strain response, including the in-plane shear modulus and strength, by the ±45° tension test method*

ISO 14130, *Fibre-reinforced plastic composites – Determination of apparent interlaminar shear strength by short-beam method*

ISO 15024, *Fibre-reinforced plastic composites – Determination of mode I interlaminar fracture toughness, G_{IC}, for unidirectionally reinforced materials*

ISO 19900, *Petroleum and natural gas industries – General requirements for offshore structures*

ISO 19901-4, *Petroleum and natural gas industries – Specific requirements for offshore structures – Part 4: Geotechnical and foundation design considerations*

ISO 19902:2007, *Petroleum and natural gas industries – Fixed steel offshore structures*

ISO 19903, *Petroleum and natural gas industries – Fixed concrete offshore structures*

EN 12495, *Cathodic protection for fixed steel offshore structures*

EN 13173, *Cathodic protection for steel offshore floating structures*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC TS 62600-1 as well as the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
normal wave height
NWH
significant wave height corresponding to a concurrent 10 min mean wind speed

3.2
primary structure
<marine energy converter> collective system comprising the structural elements, foundation, mooring and anchors, piles, and device buoyancy designed to resist global loads

4 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in IEC TS 62600-1 as well as the following apply.

d	water depth
f	wave spectrum frequency
f_P	wave spectrum peak frequency
f_{ck}	characteristic concrete compressive strength
f_{ckj}	characteristic cylinder strength
f_e	elastic buckling stress
f_y	specified minimum yield stress
F_d	load design value
F_k	load characteristic value
g	gravitational acceleration