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TECHNICAL SPECIFICATION

colour inside

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

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

IEC TS 62600-10, 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
114/140/DTS	114/150A/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.

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- withdrawn,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.

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INTRODUCTION

This technical specification defines rules and assessment procedures for the design, installation and maintenance of mooring system with respect to technical requirements for floating marine energy converters.

The proposed work will aim to bring together expert knowledge from the marine energy power and offshore engineering industries in order to formulate a guideline specification of the design, installation and maintenance requirements for mooring system of floating MECs.

In addition to safety and ocean environmental requirements, this technical specification focuses on the strength requirements of mooring systems for MECs.

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

Part 10: Assessment of mooring system for marine energy converters (MECs)

1 Scope

The purpose of this Technical Specification is to provide uniform methodologies for the design and assessment of mooring systems for floating MECs (as defined in TC114 scope). It is intended to be applied at various stages, from mooring system assessment to design, installation and maintenance of floating MEC plants.

This technical specification is applicable to mooring systems for floating MEC units of any size or type in any open water conditions. Some aspects of the mooring system design process are more detailed in existing and well-established mooring standards. The intent of this technical specification is to highlight the different requirements of MECs and not duplicate existing standards or processes.

While requirements for anchor holding capacity are indicated, detailed geotechnical analysis and design of anchors are beyond the scope of this technical specification.

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

ISO 17776:2000, *Petroleum and natural gas industries – Offshore production installations – Guidelines on tools and techniques for hazard identification and risk assessment*

ISO 19901-1:2005, *Petroleum and natural gas industries – Specific requirements for offshore structures – Part 1: Metocean design and operating considerations*

ISO 19901-7:2013, *Petroleum and natural gas industries – Specific requirements for offshore structures – Part 7: Stationkeeping systems for floating offshore structures and mobile offshore units*

API RP 2SK, *Design and Analysis of Station keeping Systems for Floating Structures*, 3rd Edition, October 2005

API RP 2I, *In-Service Inspection of Mooring Hardware for Floating Structures*, 3rd Edition, 2008

3 Terms and definitions

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

3.1
anchor
device that provides a holding point at the seabed for a mooring line connected to a floating MEC

3.2
catenary mooring
mooring system where restoring forces are provided by the distributed weight of mooring lines

3.3
connectors and accessories
hardware used to join various components in the mooring system not including the structures fixed to the MEC or the anchor

3.4
design criteria
quantitative formulations that describe the conditions to be satisfied with each limit state

3.5
design service life
assumed period for which a structure or a structural component is to be used for its intended purpose with anticipated maintenance, but without substantial repair being necessary

3.6
design limit
set of physical conditions during a certain reference period for which the structure member will demonstrate that relevant limit states are not exceeded

3.7
dynamic response
acceleration and resulting motion of a MEC with mooring system as it is subject to assorted loads

3.8
floating device
structure supported by buoyancy

3.9
limit state
condition for which a system or a component is at its limit of performance of its intended function

3.10
mobile mooring
temporary anchoring arrangement at a specific location for a short period of time

3.11
mooring components
general class of devices and hardware used in the mooring of floating structures

3.12
mooring line
string of components connecting a MEC to an anchor

3.13
mooring system
compliant configuration that consists of mooring lines, components, and anchors

3.14
resistance
capacity to withstand loads and motions

3.15
return period
inverse of the annual probability

3.16
single point mooring
mooring system that consists of a single connection point to the MEC

3.17
spread mooring
mooring system that consists of multiple connection points to the MEC

3.18
stiffness
ratio of change in restoring forces to change in displacement

3.19
semi-taut mooring
mooring system comprised of attributes of both taut and catenary forms

3.20
taut-line mooring
mooring system where the restoring action is provided by elastic deformation of mooring lines

3.21
axisymmetric
floating structure that is symmetric about an axis of rotation

3.22
umbilical
compliant and slender structure that is used to transport fluid, electricity, data, or other material from a MEC to another location

3.23
proof loading
test procedure that applies loads at some fraction of design load to confirm adequate structural response

3.24
consequence class
classification that correlates to the potential for damage in the event of failure with an associated set of design factors

3.25
design factor
factors that amplify loading and stresses that are used to compensate for uncertainty and the potential for damage in the event of failure in accordance with the associated consequence class

4 Abbreviated terms

ALARP	As low as reasonably practicable
ALS	Accidental limit state

API	American Petroleum Institute
ASF	Adjusted safety factor
CALM	Catenary anchor leg mooring
CFD	Computational fluid dynamics
DP	Dynamic positioning
DF	Design factor
FLS	Fatigue limit state
HAZID	Hazard Identification
HHP	High holding power
IEC	International Electrotechnical Commission
ISO	International Organisation for Standardisation
LTM	Long term mooring
MBL	Minimum breaking load
MEC	Marine energy converter
MEP	Marine environmental protection
MPM	Most probable maximum
PTO	Power take-off
PT	Project team
ROV	Remotely operated vehicle
SALM	Single anchor leg mooring
SF	Safety factor
SLS	Serviceability limit state
SPM	Single point mooring
ULS	Ultimate limit state
UV	Ultraviolet
VIM	Vortex induced motion
VIV	Vortex induced vibration

5 Principal element

5.1 General

This clause provides an overview of the content of this technical specification.

5.2 Mooring and anchor systems

An overview of existing mooring designs, components, and anchors is provided for reference.

5.3 Design considerations

Understanding the design inputs and limitations shall be considered when designing a mooring system and selecting anchor types for MECs. Fundamental design considerations include limit state categories, metocean and external conditions, external load effects, and mooring line component and anchor hardware related considerations.

5.4 Safety and risk consideration

Understanding risk factors is important in quantifying the consequence class of the mooring design. The consequence class dictates the required level of safety of the mooring design.

5.5 Analysis procedure

The limit states influence the mooring design process. The potentially complex nature of MEC dynamic behaviour and external loading effects mean that careful consideration of the limitations of analysis techniques shall be made.

5.6 Inspection and maintenance requirements

The integrity of a station keeping system and its serviceability throughout the design service life are not only strongly dependent on a competent design, but also on the quality control exercised in manufacture, supervision on-site, handling during transport and installation, and the manner in which the system is used and maintained.

6 Types of moorings and anchoring systems

6.1 General

This clause provides an overview of mooring and anchor types that may be used with floating MECs. Floating structure station keeping systems vary depending on the characteristics of the structure and on the environmental conditions. Single point moorings are frequently used for floating structures where greater freedom in motion is required, while spread moorings are used mostly on structures when maintaining a particular orientation is important. Another type of station keeping system is dynamic positioning (DP). Dynamic positioning uses actively controlled thrusters as part of the station keeping capability. Thruster-assisted moorings can be used to reduce mooring line tensions or to control heading.

The mooring components, anchor types, and sizing depend on the site requirements, design, and MEC power capture considerations.

6.2 Mooring systems

6.2.1 General

Examples of existing mooring system types for floating structures are described in the following subclauses. These examples are not exhaustive.

6.2.2 Spread moorings (catenary, taut-line and semi-taut-line)

Spread moorings are often used when weathervaning, or rotation movement of a floating structure such that it aligns to a wind or current load so as to minimize drag loading, is not desirable. Spread moorings can incorporate chain, wire rope, synthetic rope, or various combinations of materials. Spread mooring systems may use taut, semi-taut, or catenary systems. A spread moored configuration can be seen in Figure 1.