IECRE OPERATIONAL DOCUMENT

IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications (IECRE System)

ME Certification Scheme: Conformity assessment of Mooring systems for Marine Energy Converters (MEC)
## CONTENTS

CONTENTS ........................................................................................................................................... 2

1. Objective ........................................................................................................................................ 3

2. Normative References .................................................................................................................. 3

3. Required documentation .............................................................................................................. 3

4. Evaluation method and procedures ............................................................................................ 4

5. Reporting ..................................................................................................................................... 6

6. Issuance of deliverables ............................................................................................................... 7
1. Objective
The objective of this Operational Document (OD) is to define the assessment method and procedure to be applied for a conformity assessment and certification of mooring systems for marine energy converters (MEC). This OD is to be considered alongside IEC TS 62600-2 and IEC TS 62600-10.

2. Normative References
The following referenced documents are indispensable for the application of this document.
IECRE OD-310: 2023 - ME Certification Scheme: Feasibility Statements, Conformity Statements and Certification requirements.
IECRE OD 310-T01: ed.3.0 - Template for a Feasibility Statements, Conformity Statements and Certificates issued by the IECRE for Marine Energy Converters (MEC)

3. Required documentation
The following documentation shall be provided by the applicant to the RECB for the design assessment as applicable:
• Mooring system description as a boundary system with critical interface per IEC TS 62600-10:2021,
• Analysis procedure overview, based on IEC TS 62600-10:2021 Clause 7.2 and Figure 1.

Supported by:
• Scope, based on IEC TS 62600-2:2019 Clause 1 Figure 1, including System Boundary, Boundary Systems, and Interfaces,
• Design process, based on IEC TS 62600-2 Clause 5.1 Figure 2,
• Technology and Risk Assessment per IEC TS 62600-2 Clause 5.3 and 5.4,
• Site description including adjacent structures and components report (impact on the MEC). The guidance of IEC TS 62600-4:2020 be considered,
• Environmental conditions, according to IEC TS62600-2 clause 5.7 and Clause 6 and IEC TS62600-2 clause 6,
• Site and Resource Characterization per IEC TS 62600-101, 202, or 301, as applicable,
• Basis of Design, based on IEC TS 62600-2:2019 Clause 5.6,
• MEC specifications, including dimensions, materials, load cases, static systems, and boundary conditions, etc.,
• Technology Qualification Conformity Statement, according to IEC TS62600-4,
4. Evaluation method and procedures

4.1 Introduction

The purpose of this conformity assessment is to verify that the MEC mooring system of a specific type is designed and documented in accordance with design specifications, specific standards, and other technical requirements.

The assessment covers the MEC mooring system as defined by IEC TS 62600-10:2021 Clause 7 and Figure 1 consistent with the MEC system scope based on IEC TS 62600-2:2019 Clause 1 Figure 1.

Mooring system includes MEC interface, mooring, line components, anchors, and umbilical(s), MEC structural arrangement, including the interface of the mooring system to the MEC.

The following are defined as MEC boundary systems in accordance with IEC TS 62600-2:2019 Clause 1 Figure 1 for critical interfaces with load exchange or electrical connection that must be defined for evaluation by this OD and shall be assessed within the Type Certification for the MEC system:

- Mooring system, covered by IEC TS 62600-10,
- Environmental,
- Resource, covered by IEC TS 62600-101, 202, or 301, as applicable,
- Sea-based Infrastructure, including the electrical cable system,
- Shore-based Infrastructure, including the electrical cable system,
- Telemetry,
- Lightning protection system.

4.2 Basis of design

The RECB shall assess the design basis which shall identify all requirements, assumptions, and methodologies essential for the mooring design, and the design documentation, including:

- Codes and standards,
- Design parameters, assumptions, methodologies, and principles,
- Load monitoring instrumentation considerations per IEC TS 62600-10:2021, Annex A, paragraph A.2.8,
- Failure point considerations as addressed in IEC TS 62600-10:2021, Annex A, paragraph A.3.18,
- Mooring system considerations of:
  - Environmental loads on mooring systems, including the effects of MEC floating unit motion, water level, and ice load,
  - Fatigue,
  - Mechanical, including the effects on the system of the power take-off,
  - Electrical, including the interface to the electrical cable system and connections, including the effects on the system of the power take-off,
  - Control, including the interface to telemetry,
- Other life cycle requirements, e.g., for manufacture, transportation, installation, and commissioning as well as for operation and maintenance.
4.3 Design assessment

The purpose of the design assessment is to examine whether the MEC mooring system basis of design is documented to be in conformity with the design assumptions, specific standards, and other technical requirements of IEC TS 62600-10:2021, as consistent with IEC TS 62600-2:2019. The assessment shall be carried out by means of document review and independent analysis.

The RECB shall verify the following aspects:

4.3.1. Material properties

The properties of the materials used in the MEC mooring system design shall be proven by material testing to be consistent with the properties applied in the design calculations. All material tests shall be carried out by a third-party test laboratory with a scope for testing those materials prior to submission to an RETL. The RETL and third-party test laboratory shall comply with the requirements of the relevant test standards. Deviating procedures shall be agreed with the RECB in advance. When necessary, third-party inspection by the RECB shall be performed to ensure traceability, validity, and quality control of the material testing process.

4.3.2. MEC and mooring system

The MEC system structure and mooring system interfaces shall be verified. Furthermore, it shall be assessed that the characteristic data of the MEC mooring system given in the specification and related documents are consistent with the design documentation to ensure that the subsequent usage of these data is sufficiently verified.

4.3.3. Design sets and analysis

- Mechanical data: it shall be assessed that the MEC characteristic mechanical data (e.g., mass, etc.) given in the MEC specification are consistent with the properties resulting from the drawings under consideration of the material properties and tolerances.
- Metocean data,
- Hydrodynamic data,
- Failure modes per IEC TS 62600-10:2021, Clause 7.5.4 and IEC 60812:2018:
  o Stability analysis
  o Watertight integrity
- MEC mooring system modelling, including an understanding of the capabilities and limitations of the modelling method used.
  The structural calculation model used by the designer for the verification of the MEC system design shall be assessed by the RECB for suitability by reviewing the design calculation report. For example, the application of finite element method, the mesh, and the used technologies (e.g., element type, boundary conditions, etc.) shall be checked. The modelling shall consider corrosion and wear. The effect of marine growth shall also be considered,
- Design load cases.

4.3.4. Evaluation of design strength calculations

The MEC system and mooring system design calculations provided by the designer shall be evaluated by the RECB through documentation review supported by the results from RECB’s independent strength calculations in regards to:

- Ultimate strength analysis - In addition to operational loads, transport and installation loads shall be considered in the strength calculations.
- Fatigue failure analysis based on projected damage throughout the lifecycle (i.e., including damage during transport, installation/recovery, and extreme conditions in addition to normal operating sea states/conditions).
• The out-of-plane bending and in-plane bending fatigue should be considered at the hull connection points where the mooring system may be subject to bending loads. Additional cases shall be considered for synthetic rope, e.g., compression fatigue and snap loads.
• The independent fatigue strength calculation shall, among others, consider the mean stress effects.
• Clearance The mooring system shall avoid dynamic contact with the umbilical, MEC and any other adjacent structure.

4.3.5. Manufacturing procedures

• During the design evaluation, the manufacturing procedures shall be assessed for suitability to reach the quality and material strengths assumed during the design verification,
• MEC mooring system manufacturing procedures shall be evaluated based on the applied and agreed design standard,
• When necessary, third-party inspection by the RECB shall be performed to ensure traceability, validity, and quality control of the manufacturing process.

4.3.6. Transportation installation, maintenance, and inspection procedures

The plans, analyses, and manuals shall be reviewed for compliance with the requirements in the design basis, e.g., transport requirements and MEC mooring system inspection and repair procedures.

4.4 Independent analyses

When deemed necessary by the RECB, independent analyses shall be performed to verify the conformity of the MEC mooring system design. The extent of independent analyses will depend upon the certification sought and the outcome of discussions with the RECB.

5. Reporting

The assessment report shall cover the following:

5.1 Introduction

5.2 Scope of evaluation
• MEC system and mooring system characteristics/description,
• Purpose/scope of the evaluation,
• Reference standards.

5.3 Documentation
• Reports,
• Specifications,
• Drawings,
• Documents for information (e.g. installation manuals, photographs, operating instructions, etc.).

5.4 Assessment
• Methodology,
• Evaluation results,
• Remarks,

5.5 Conditions and interfaces
6. Issuance of deliverables

The Feasibility, Conformity and Certificate template (OD-310-T01) shall be used to issue deliverables related to assessments of mooring systems.