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Guidance for Civil Engineers Working in Marine Renewable Energy Areas – Keynote Address

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Abstract

This paper provides an overview of the evolution of a guide document for civil engineers produced by the American Society of Civil Engineers (ASCE) Coasts, Oceans, Ports, and Rivers Institute (COPRI) Marine Renewable Energy (MRE) Committee over the last five years. The document will provide guidance to MRE designers and analysts, providing confidence as to reliability and insurability. All papers in the MRE session address specific civil engineering aspects of MRE projects. The papers cover multiple engineering disciplines required for relatively new MRE technologies that are arriving into the well-established and documented ocean environment. Some papers naturally touch on the electrical and mechanical issues involved with specific MRE device technology. The guide document that has evolved includes chapters developed by experienced engineers, generally working in sub-committees, including sections addressing:

- Environmental Loads,
- Geotechnics,
- Government Issues,
- Moorings,
- In-Stream Hydrokinetics (ocean, riverine, and tidal currents)
- Ocean Thermal Energy Conversion,
- Risk and Reliability,
- Submarine Cables, and
- Wave Energy Converters.

In most areas the guide points towards existing well-established codes including API, ISO and Classification Societies, as well as newer evolving international codes such as those being developed by the International Electrotechnical Commission (IEC). Several MRE committee members also sit on the IEC Technical Committee (TC) 114 US Technical Advisory Group (TAG) and improve liaison between IEC and ASCE COPRI. In some areas, particularly geotechnics, the guide provides information not found in existing codes. Engineers who read the guide will gain a basic knowledge of a wide range of MRE devices, as well as an understanding of how to deal with the civil engineering aspects of their design and analysis. This information is difficult to find in a technical and comprehensive form elsewhere. This paper presents an insight as to what will be in the ASCE COPRI MRE guide.

Introduction

You have all heard the joke about the camel being a horse designed by committee; however, it must be recognized that while perhaps not as physically attractive as a horse, a camel does an admirable job of providing transport in an inhospitable environment. Let us introduce our marine renewable energy camel equivalent. Formed in July of 2009, the MRE committee was created by members of COPRI with an interest in the new (for the U.S.A. at least) field of marine renewable energy. The committee's purpose is to study and disseminate information on the planning, design, construction, inspection, maintenance, operation, pollution control, and technical functioning of marine renewable energy facilities above and below the water. This includes consideration of: environmental loading; foundations and anchoring; mooring systems; transmission cable burial and protection; studying and reporting on federal, state, and regional efforts to plan and regulate MRE construction and maintenance activities; requirements for shore based facility infrastructure; and port and harbor infrastructure to support the

construction and maintenance of MRE facilities. The committee coordinates its activities directly with other committees of COPRI and other ASCE divisions and cooperates fully with the Coastal Engineering, Ocean and Offshore Engineering, Ports and Harbors and Waterways Committees. While subcommittee members have published conference and journal papers addressing the work of their subcommittees, the goal is to soon publish a comprehensive guide including input from all of the subcommittees, bonded by a common theme of decreased risk and increased reliability.

The Committee Process (or just what have we been doing for the past five years)

The MRE committee membership, while fluctuating somewhat over the past five years, has remained fairly stable given the relative infancy of MRE developers and technology. Figure 1 shows the present makeup of the committee membership and the subcommittee chairs. There are approximately 60 MRE committee members in total, with representative from academia (12), developers (4), government (4), and a wide depth and breadth of industries. Each member is encouraged to participate in one or more subcommittees appropriate to their areas of experience and expertise. Several MRE committee members also sit on the International Electrotechnical Commission (IEC) Technical Committee TC-114 U.S. Technical Advisory Group for Marine Energy and improve liaison between IEC and ASCE COPRI.

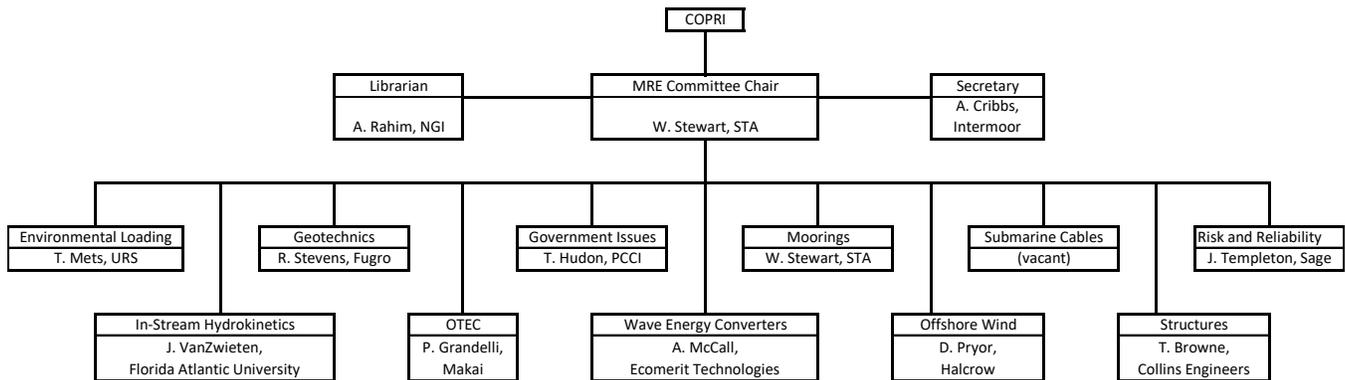


Figure 1: ASCE Marine Renewable Energy Committee Organization

The committee receives administrative and financial support from ASCE, which will publish the completed guide. Administrative support has included the provision of a document e-room which all members have access to, and which provides a place to store guidance and reference documents, meeting minutes, and subcommittee working documents. Members work at their own pace while reporting to committee chairs and to the MRE Committee Chair during monthly teleconferences (also facilitated by ASCE). The committee meets face-to-face once a year in conjunction with the Offshore Technology Conference.

The first order of business was for each of the subcommittees to layout their objectives. Each subcommittee is summarized below. It should be noted that the activities of each subcommittee are coordinated with the activities of the other subcommittees.

Environment Loads Subcommittee

The environmental loads subcommittee is responsible for defining categories of environmental forces, describing how site-specific environmental load parameters are developed, analysis methods, application of environmental loads to System components, and referencing applicable codes and standards.

Geotechnical Subcommittee

The geotechnical subcommittee provides geotechnical expertise to the Committee and collects, studies and disseminates information on geotechnical site assessment and geotechnical engineering for seafloor-based and floating marine renewable energy structures. This has been the most active subcommittee within the MRE Committee.

Government /NGO Issues Subcommittee

The Government / NGO issues subcommittee was established to liaise between the MRE Committee and the various Government and NGO stakeholders on issues of licensing, permitting and standards that affect civil engineers engaged in MRE development projects.

Mooring Subcommittee

The Moorings Subcommittee provides mooring and anchoring expertise to the Committee. The Subcommittee collects, studies and disseminates information on open ocean and sheltered waters moorings, relating to their planning, design, installation, operation, inspection, maintenance, environmental impact, economics, reliability and navigational issues.

Submarine Cables Subcommittee

This subcommittee researches, studies and disseminates civil engineering information related to submarine cables for marine renewable energy structures/facilities, including: planning and design; installation and protection; inspection, maintenance and serviceability; environmental aspects; and legal, regulatory and political aspects (in cooperation with the Government/NGO Issues Subcommittee).

Structures Subcommittee

This subcommittee studies and disseminates information on the planning, design, construction, inspection, maintenance, operation, pollution control, and technical functioning of MRE structures above and below the water, including: interaction on foundations of MRE structures with other MRE Subcommittees (Geotech, Moorings, etc.), interaction on environmental loading of MRE structures with other MRE Subcommittees, provides guidance on the applicable standards and resources for MRE structure, and provide guidance on logistical challenges to landside port infrastructure supporting the construction and maintenance of MRE structures.

Risk and Reliability Subcommittee

Risk and reliability is a theme common to all of the subcommittee efforts, and this subcommittee provides advice to each subcommittee to ensure that risk reduction and increased reliability are properly accounted for.

In-Stream Hydrokinetics

This subcommittee studies and disseminates information on the planning, design, construction, inspection, maintenance, operation, environmental impacts, economics, and navigational issues related to in-stream hydrokinetic energy extraction. This sub-committee considers devices that extract energy from both fresh and salt water currents, including those found in streams, rivers, canals, tidal flows, and the open ocean.

Ocean Thermal Energy Conversion (OTEC) Subcommittee

The OTEC subcommittee disseminates non-proprietary information about plans and facilities for shore-based and ocean-based OTEC projects. To the extent possible, it seeks to adapt relevant standards published by ASCE, as well as other organizations such as ABS, API, and DNV. Unlike the other MRE technologies, OTEC is under the licensing authority of the National Oceanic and Atmospheric Administration, per the OTEC act of 1980.

Wave Energy Converter Subcommittee

This subcommittee disseminates information on the planning, design, construction, inspection, maintenance, operation, environmental impacts, economics, and navigational issues related to wave energy extraction.

Offshore Wind Subcommittee

This subcommittee disseminates information on the planning, design, construction, inspection, maintenance, operation, environmental impacts, economics, and navigational issues related to offshore wind energy extraction.

Once the subcommittees were established, and populated, work began meeting the subcommittee objectives. This has resulted in a technical session on Risk, Reliabilities and Safety Factors for Marine Renewable Energy Structures at the 2010 COPRI Congress, a number of published papers by MRE Committee members (Stevens and Rahim, 2013; Stevens and Rahim, 2014; and VanZwieten, et.al, 2014) and the OTC MRE session papers that follow this Keynote address.

ASCE Guidelines for Civil Engineers Working in Marine Renewable Energy Areas

Once published by ASCE, the guidelines will provide guidance to Civil Engineers regarding appropriate codes and standards for use in the planning, design, construction, inspection, maintenance, operation, pollution control, and technical functioning of marine renewable energy facilities above and below the water; will provide guidance to Civil Engineers on interfacing well established civil engineering practice and its adaptation to the relatively new field of MRE; will provide examples of projects with lessons learned; and will introduce a common approach to risk assessment and reliability goals for MRE facilities.

While some new guidelines will be introduced, particularly in the field of geotechnical analysis and foundation design (Stevens et al., 2015), the document focus is on the selection of the most appropriate existing codes and standards for the civil engineering aspects of MRE projects.

The MRE Committee continues to seek volunteers to assist us with the committee's work.

References

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