SMC/IEC TC114 Newsletter - April 2014 View this email in your browser

IEC TC114 Project Teams

- Terminology
- Design Requirements
- Mooring Systems
- Power Quality
- Wave Energy Converters Performance
- Wave Energy Resources
- Wave Energy Converters Performance - 2nd Site
- Guidelines – Wave Energy Converters
- Tidal Energy Converters Performance
- Tidal Energy Resources

Message from the Chair

Welcome to the Spring 2014 edition of the newsletter! After a long snowy and/or wet winter (depending on your location), I think we are all looking forward to some warm spring energy flowing our way.

We are a week away from hosting the 2014 IEC TC114 Plenary meetings in Vancouver (April 21-25). Final arrangements are now underway and we have confirmed that the following project teams will be conducting meetings:

- PT62600-10 Assessment of Mooring System for Marine Energy Converters
- PT62600-20 Ocean Thermal Energy Converters
- PT62600-30 Electrical Power Quality Requirements for Wave, Tidal and other Water Current Energy Converters
- PT62600-201 Tidal Energy Resource Assessment and Characterization

A total of 47 technical experts from 13 different countries will converge on Vancouver for this week of meetings. All meetings wil be located centrally in Vancouver at the Listel Hotel. The weeks events will culminate with a Delegates Dinner being hosted at the Vancouver Rowing Club.

The Canadian committee is also organizing a face to face meeting early this summer. On June 26th, the committee will meet at the University of Manitoba. The meeting will discuss the outcome of the Plenary meetings as well as current issues/challenges faced by the Project Teams. The members will also have the opportunity to learn about the renewable energy research that is being conducted at the University of Manitoba and then a tour will be arranged to the Canadian Hydrokinetic Turbine Test Centre at Seven Sisters, MB.

Each year, we see several new standards development activities being initiated. In the last quarterly, there has been a flurry of activity with new teams created or discussions initiated on the following topics:

- New PT River Resource Assessment PT 62600-301
  - A New work item proposal has been officially approved through the IEC TC114
  voting process and 6 countries (US, Canada, Netherlands, Germany, Sweden & Denmark) have agreed to provide experts to develop this standard. Canadian experts Marie-Helene Briand (Hatch) and Wayne Jenkinson (NRCan) will be directly engaging with this Project Team on Canada’s behalf.

- NWIP River Performance Assessment
  - With the previous river resource assessment approved, Canada

- Ocean Thermal Energy Conversion (OTEC) Systems
- Power Performance Assessment for River Energy Converters

Quick Links

- IEC TC114 Standards Website
- International Electrotechnical Commission (IEC)
- Marine Renewable Energy Technology Roadmap

Project Partners:

has now initiated a new work item proposal on river performance assessment. This new group will be convened by Canadian Sue Molloy. We expect this team to begin work early this fall.

- Geological & Geophysical Site Characterization
  - Preliminary discussions have been started within the committee regarding the importance of a set of geophysical site assessment guidelines specifically catered to the marine energy industry. A potential approach through CSA is currently being evaluated.

The committee has completed the first 2 years of funding through the ecoEnergy Innovation Initiative (ecoEII) program. We are fortunate, due to the hard work of our committee volunteers, that we have managed to stay very close to the target budget. We have also been successful this year in obtaining an additional $8333 from Standards Council of Canada which will be used to directly fund Canadian experts travelling internationally.

Our website (http://tc114.oreg.ca/) is continuously being updated with the latest information. Please feel free to contact me or Marine Renewables Canada directly for more information on how to get involved with this committee.

Cheers,
Russell Stothers
Chair, Canadian Mirror Committee to IEC TC114

Committee Updates & Initiatives

Project Team (PT): PT 62600-30 Electrical Power Quality Requirements for Wave, Tidal and Other Water Current Energy Systems

Electricity users expect their power supply to meet the technical specifications required for the proper functioning of their equipment. The term power quality relates to the fitness of an electricity supply to electric devices and apparatus. Fitness can be evaluated on the basis of continuity of service, variation in voltage magnitude, transient (sudden changes in) voltages and currents, and harmonic content in the waveforms of ac (alternating current) power.

Poor quality electric power is a silent predator that works slowly in the background to degrade properties and performance of virtually all equipment in the electric power supply-demand chain. While the economic impact of poor quality power is the preeminent motivator for diagnosing, identifying and mitigating poor quality issues, degradation of key performance indicators is an equally important motivator.

Many marine energy conversion projects are being tested and are close to commercial deployment worldwide. The low level of operational experience and diversity of concepts compound the challenge that poor power quality poses to this nascent technology.

Phenomena such as flicker, harmonics, voltage transients (dip/swells), dc injection, phase-unbalance and electromagnetic interference are apt to dominate the discussion on ocean power integration into existing grids and systems systems (especially for larger renewable energy farms and plants connected to weaker electrical grids). These power quality phenomena are subtle, yet important aspects that need to be understood and the relevant functional requirements should be adequately understood and developed.

In 2012, the Technical Committee (TC) 114 of the International

Canadian Sub-Committee

(SMC/IEC TC114)

- Acadia University
- AMEC Black & McDonald
- Bhuyan Consulting
- CanmetENERGY-NRCan
- Cascadia Coast Research
- Clean Current Power Systems
- CSA Group
- Dalhousie University
- Dynamic Systems Analysis
- Emera
- Glas Ocean Engineering Consulting
- Grantec Engineering
- Mavi Innovations
- National Research Council Canada
- Powertech Labs
- Rockland Scientific
- University of Victoria

Electrotechnical Commission (IEC) on Marine energy - Wave, tidal and other water current converters established a Project Team (PT) on Electrical power quality requirements for wave, tidal and other water current energy converters known as IEC PT 62600-30.

Subject to identifying unique characteristics of various marine energy devices and examining their output signatures, the team is responsible to develop an IEC Technical specification containing associated definitions, normative references, symbols & units, forms, annexes, as well as other supporting material, the core standard document would contain the following key items:

- Identifying power quality issues and conformity requirements (non-device specific and non-prescriptive) of single/three-phase, grid-connected/off-grid ocean wave and tidal power systems.
- Identify Characteristic Parameters: Define and specify the quantities required to characterize the power quality impacts of wave and/or tidal devices, including, rated power, maximum power, reactive power, voltage fluctuations (continuous operation, switching operation), and harmonics.
- Establishing adequate measures of nominal conditions and allowable deviations from these nominal conditions that may originate within the power source and/or electrical load.
- Prescribing limits of voltage and frequency variations both under steady-state and transient conditions.
- Identifying the requirements for monitoring electrical characteristics of single-phase and multi-phase ac power systems.
- Establishing measurement methods, test equipment needs, application techniques for measuring the characteristics parameters, including test & measurement conditions and result-interpretation guidelines.
- Develop procedures for assessing the compliance with power quality requirements/thresholds, including steady state voltage, frequency/voltage fluctuations, continuous operation, switching operations, and harmonics related standardized assessment methodology.

As of April 2014 the team membership is:

Canada: Jahangir Khan, Ghanashyam Ranjitkar, and Mo El-Hawary (Project Leader)
GB: Nicholas Jenkins, and Zhongfu Zhou
Ireland: Sara Armstrong, Anne Blavette, and Fergus Sharkey
Japan: Yoshiki Nakazawa
Spain: Luis Fernández Beites, and Maider Santos Múgica
US: Thomas G. Proios, and John G. Schaad.

In Canada, the PT works with its shadow committee (SC) whose members are: Wilsun Xu, (University of Alberta,) Walid Morsi (University of Ontario Institute of Technology,) Helen Bailey and Bryson Robertson (University of Victoria.)

For further information:

M E El-Hawary, Dalhousie University
elehawary@dal.ca

~~~~~~

How much power is in those tidal currents?

April 15, 2014

Richard Karsten, Associate Professor
Department of Mathematics and Statistics
Acadia Tidal Energy Institute
Acadia University

The IEC TC114 Project Team 201 was formed to establish a system for
~~~~~~

Members:

IEC-TC114

- Chair: Neil Rondorf (USA)
- Secretary: Danny Peacock (UK)
- Technical Officer: Charles Jacquemart

Sponsors:

Emera

estimating, measuring, analysing and reporting tidal current energy resources in areas including that are potentially suitable for the installation of arrays of Tidal Energy Converters (TECs). The intent is to establish the standards for obtaining suitably accurate estimates of the tidal resource through the various stages of a project's life cycle. This will enable the potential future annual energy production to be calculated in conjunction with the IEC's Power Performance Assessment of Electricity Producing Tidal Energy Converters Technical Specification (62600-200).

Project team 102 is convened by the UK representative Andy Baldock, leader of Black & Veatch's UK renewable energy team. The project team has active members from Canada, Spain, Ireland, UK, and USA. In September 2013, the team competed its third committee draft (CD), which has been circulated to the national committees IEC TC114. Several outstanding issues were addressed through a considerable reworking of the CD, led primarily by the US and Canadian members of the team.

In order to streamline the process, the committee has defined two stages of resource assessment, Feasibilty and Layout Design, differentiated by the level of acceptable level of uncertainty. While gathering data and numerical modeling are required in both stages is similar, reducing the uncertainty in the Layout Design stage requires longer data sets and higher resolution models. As well, the committee decided to distinguish between small projects, those having little impact on the tidal flow, and larger projects. For smaller projects, the flow data from ADCPs alone may be sufficient to characterize the resource. For larger projects, a hydrodynamic model is always required.

As well, the CD now outlines more detailed requirements and guidelines for gathering data from the site, in particular, how data on the tidal currents should be gathered using ADCPs. But it was recognized that it is more difficult to set standards on the collection of other meteorological data – wind, waves, atmospheric pressure, etc. – since the importance of these on the tidal flow varies from site to site.

Setting standards for the hydrodynamic modeling component for resource assessment has proven a more difficult task. Since each model has different capabilities, the committee set out a set of guidelines for choosing a model and set standards for reporting on the model inputs (bathymetry, boundary conditions, etc.) and model design (grid resolution, 2D vs 3D, etc.). More importantly, the CD outlines steps for completing and reporting on model calibration and validation. Finally, the CD gives guidance on incorporating energy extraction in the numerical model. Since this is an area of active research, the emphasis is on a full description of the method and the quantification of the energy extracted from the system, the energy harvested by the TECs and the local and far field response of the tidal system.

Finally, the new version of the CD outlines a concise format for reporting results that is consistent with the Power Performance of TECs document. However, it should be noted that several aspects of tidal resource assessment remain ongoing research. One outstanding issue is the measurement and modeling of turbulence in the tidal flows. It is widely accepted that characterizing turbulence at a site is an important part of site assessment. But measuring the characteristics of the highly turbulent flow, remains a challenge.

~~~~~~

Eyes Wide Open With Regard to Turbulence

April 15, 2014
Fabian Wolk, Rockland Scientific Inc.

The draft technical specification for tidal power resource assessment, IEC 62600-201, adopts a clear "eyes wide open" position on the subject of turbulence characterization by recognizing its importance, while clearly acknowledging its omission from the current version of the document: *"While there is potentially significant influence of TEC power performance due to turbulence inherent in the tidal flow, no corrections for the effect of turbulence should be performed in the reported assessment of power performance. Future efforts will be made to quantify this influence; however, this issue is not covered at this stage of the Technical Specification development."* As we will see in this article, these "future efforts" are already under way.

Unlike wind farms, which are typically situated in flat, open topography, tidal turbines are installed in narrow channels. These natural geographic constrictions focus and accelerate the flow, which increases the energy density available for extraction at that location. Unfortunately, natural tidal channels are rarely uniform in width or depth, and they often have abrupt topographical features and curvatures. As a result, the tidal currents are highly turbulent and this variability of flow speed affects the reliability, efficiency of energy extraction, and operational risk of tidal in-stream turbines.

The level of turbulence, or its "intensity", is modulated in time by the tidal flow and is strongly dependent on the depth and the geographic location in the tidal channel. This represents a significant difficulty in trying to predict the turbulence at the turbine installation site from standard mathematic models. Even the direct measurement of the turbulence characteristics in the tidal channel is a challenge.

The proper quantification and characterization of turbulence is not only important for proper resource assessment aspects, it is also crucial for the engineering and construction of the tidal devices themselves. Most turbine designs can regulate the loading of turbine blades in response to slow variations in the mean current speed through active or passive pitch control mechanisms. However, such mechanisms cannot react instantly to higher frequency fluctuations, causing short-term overloading stresses at the blade root, which may ultimately lead to bending failure.

Dalhousie University oceanographer Dr. Alex Hay has made recent progress in measuring turbulence in tidal channels. Jointly funded by industry and NSERC, Hay and his team of oceanographers and engineers have conducted a series of field measurements at Grand Passage, a narrow tidal channel between Brier Island and Long Island at the entrance to the Bay of Fundy in Nova Scotia. The most recent study in August 2013 involved the deployment of acoustic remote current sensors (ADCPs), on the bottom of the channel, as well as a streamlined buoyant platform, called "Nemo".

The Nemo system consists of a 3-m long streamlined flotation body made from syntactic foam that carries specialized piezo-resistive velocity turbulence sensors (shear probes). Other cutouts in the float house various ancillary instrument components, such as a 1 MHz downward-looking ADCP; an ADV; and an electro-magnetic current meter.

Figure caption: Recovery of the Nemo turbulence mooring after a five-day deployment in Grand Passage, NS. Turbulence probes are visible protruding from the nose section of the float. Photo by Greg Trowse.

The Nemo platform was tethered to the ocean floor and floated at approximately mid-depth in the water column (~15 m depth), continuously collecting high-frequency turbulence data over three full tidal cycles. Flow speeds in this channel exceed 2 m/s, so this environment represented significant challenges for the design of the mooring and the turbulence instrumentation.

Estimates of the turbulence levels, expressed in terms of the dissipation rate turbulent kinetic energy, show a pronounced flood/ebb contrast. The dissipation rate levels were a factor of ten higher during the flood than during the ebb flow and they also showed strong variations on minute-long time scales. The concurrent estimates of the dissipation rate made from the nearby bottom-mounted ADCP measurements were found to be comparable, in an average sense, to the levels detected by the Nemo platform.

In addition, measurements were made using a free-falling turbulence profiler, a vertical microstructure profiler. These types of profilers are routinely used by oceanographers to measure turbulence dissipation levels in the open ocean. The measurements with the VMP near the mooring agreed with the turbulence detected by the Nemo system. More interestingly, the VMP transects showed a significant gradient of the turbulence levels in the cross-channel direction, where measured dissipation rates changed nearly 1000-fold over a distance of 200 metres.

The work by Grand Passage represents a seminal step toward the full characterization of turbulence in tidal channels. The experiment combined various measurement technologies and demonstrated that these technologies can provide internally consistent turbulence estimates, while resolving different spatial and temporal scales.

Further work in this direction is currently under way in the UK, where a consortium of UK experts is funded by the UK Carbon Trust to conduct the Turbulence in Marine Environments (TiME) research project. The objective is to develop and implement a safe and repeatable survey methodology for the tidal energy industry to characterize turbulence in tidal flows. Using an instrument array involving ADCPs, Nemo, and Vertical Profilers, data will be collected at two sites slated for tidal energy generation, with the goal to shape these data sets into analysis and classification schemes that can be used by site developers as well as turbine designers. Progress on the TiME project will be reported in subsequent newsletters. Ultimately, this work may provide input for future amendments to pertinent sections in IEC standards documents.

~~~~~~

TC114 62066-2 Design PT

The TC114 Design PT is getting very close to releasing their first Committee Draft. The team is awaiting final internal review of sections and then the full draft will be sent for comment to the national committees. Canada is responsible for ensuring completion of t the Electrical, Mechanical and Controls section and is reviewing the other sections. The last face-to-face meeting was in Annapolis, Maryland where Eric Greene of Greene Associates hosted us. Canada, Denmark, Germany, Ireland, the UK and the USA were all represented. It was anticipated that the PT would met at the plenary but due to the last meeting being in North America it was agreed that the June meeting be held in Europe. As such there will not be a formal meeting of the Design PT but the members attending the plenary will meet informally. Philipp Gujer of GL will host us in Hamburg, Germany June 16th -17th. Canada will suggest ICOE in Halifax for the fall meeting. Opportunities for crossover conversations with other PTs are also being discussed. There is a need to discuss the work of the moorings PT and the river ad hoc group at the next meeting. If anyone has comments or concerns regarding the Design PT or messages to be passed on at the next face-to-face in Hamburg please direct them to Sue Molloy sue@glasocean.com.

~~~~~~

River Power Performance Ad Hoc Group

The River Ad Hoc group was brought together and led by Ghanashyam Ranjitkar of NRCan until October 2013. Ghanashyam has been instrumental in focusing the work of the group and while he remains as a member of the group, he passed on the Convenor role to Sue Molloy (October 2013). The group consists of members representing Canada, Germany, The Netherlands and the USA. The group interfaces with the River Resources Ad Hoc Group through its USA member Jonathon Colby of Verdant Power. It is clear to those involved that the work of the River Resources AHG needs to begin before that of power performance and the group has been actively supportive of the NWIP that was submitted by River Resources AHG in 2013. River Power Performance developed a NWIP, basing the work items on those of the MRC Power Performance PT and with modifications to accommodate the unique challenges of the river environment. This NWIP was formally submitted by SCC to IEC April 16th 2014 and upon acceptance of the NWIP the Ad Hoc Group will be converted to a Project Team. Voting for the NWIP will be happening over the next 3 months and Sue Molloy, the convener will be presenting an update to the CAG and Plenary and discussing the vote with other national committees at the upcoming meeting in Vancouver. Upon acceptance of the NWIP it is anticipated that the first face-to-face meeting will be in Halifax before or after ICOE in November 2014. Four members of the River Power Performance AHG, Bill Rawlings, George Bitter, Jonathon Colby and Sue Molloy will be attending the plenary and would all be delighted to discuss the work of the potential PT with those interested. If you have questions please contact Sue Molloy sue@glasocean.com.

Upcoming Meetings

The SMC to TC114 meets on a monthly basis via teleconference to provide updates on all current activities. The subcommittee also plans for two face-to-face meetings, one typically in the spring and one in the fall to make more progress on significant issues. The meeting in the spring is focused on ensuring all committee members are in agreement with the Canadian position on all issues to be discussed at the annual TC114 plenary meeting. The SMC to TC114 meeting in the fall is focused on assessing the current and projected needs for the upcoming year.
~~~~~~

For 2014, the meeting schedule is as follows:

January 15, 2014	Conference Call 10:00 AM PST
February 19, 2014	Conference Call 10:00 AM PST
March 26, 2014	Conference Call 10:00 AM PST
April 21-25, 2014 (Plenary)	TC114 Plenary and PT meetings In Vancouver
May 28, 2014	Conference Call 10:00 AM PST
June 26, 2014 (In person)	Meeting in Winnipeg at U of M and CHTTC
August 20, 2014	Conference Call 10:00 AM PST
September 17, 2014	Conference Call 10:00 AM PST
October 15, 2014	Conference Call 10:00 AM PST
November 7, 2014 (In person)	Meeting in Halifax (ICOE 2014 Conference Nov 4-6, 2014)
December 17, 2014	Conference Call 10:00 AM PST

Our mailing address is:
Marine Renewables Canada
121 Bird Sanctuary Drive
Nanaimo, British Columbia V9R 6H1
Canada