

IEEE Power Engineering Society Entity Annual Report

2015

Entity: ELECTRIC MACHINERY COMMITTEE

Chair: Kevin MAYOR
Vice-Chair: Kiruba HARAN
Secretary: Kay CHEN

1. Significant Accomplishments

The activity and accomplishments of the Electric Machinery Committee continued in 2015 at a high level with contributions in terms of industrial standards, GM panel sessions, paper submissions, and liaisons. The significant items are listed below, and the plans for 2016 are given in clause 7.

1.1. Standards

The following standards were completed and became available in 2015:

- **IEEE Std. C50.13**, *IEEE Standard for Cylindrical-Rotor 50 Hz and 60 Hz Synchronous Generators Rated 10 MVA and Above*
- **IEEE Std. 1129**, *IEEE Guide for Online Monitoring of Large Synchronous Generators (10 MVA and Above)*
- **IEEE Std. 1434**, *IEEE Guide for the Measurement of Partial Discharges in AC Electric Machinery*
- **IEEE Std. 1812**, *Trial Use Guide for Testing Permanent Magnet Machines* **This standard was acknowledged by EMC and PES Prize Standard awards – see clause 4 below.**

1.2. PARS

The following PARS were approved in 2015:

- **P11** (Revision): *Standard for Rotating Electric Machinery for Rail and Road Vehicles*
- **P115** (Revision): *Guide for Test Procedures for Synchronous Machines Part I--Acceptance and Performance Testing Part II--Test Procedures and Parameter Determination for Dynamic Analysis*
- **P433** (Revision): *Recommended Practice for Insulation Testing of AC Electric Machinery with High Voltage Rating up to 30 kV at Very Low Frequency*
- **P110** (Revision): *Guide for Synchronous Generator Modeling Practices and Parameter Verification with Applications in Power System Stability Analyses*
- **P1553** (Revision): *Standard for Voltage Endurance Testing of Form-Wound Coils and Bars for Hydrogenerators*

1.3. Task Forces

Due to the continued high level of discussion on the topic of evolving grid codes, their impact on large machine design and performance, and the alignment of the associated IEEE standards, a task force was launched to review the topic and make recommendations for further activity.

- *IEEE Task Force on the Impact of Grid Codes on Generator Design and Standards*

This task force is making extremely good progress with regular online meetings, and effective use of the IEEE *Collabratec* platform for document sharing and collaborative work.

1.4. Panel Sessions

At the 2015 General Meeting in Denver, the EMC subcommittees held several successful and well-attended panel sessions on a variety of topics:

- Condition Monitoring of Electrical Machines
- Advanced Motors and Drives for Transportation
- Advanced Topics in Electrical Machines
- Electrical Machines for Harsh Environments
- Interconnection Requirements for Renewable Generation
- WTG Performance on Weak Grids; Part 1: Technical concepts
- Marine Hydrokinetic Generation

2. Benefits to Industry and PES Members from the Committee Work:

The IEEE PES Electric Machinery Committee constitutes a forum of experienced, well-qualified engineers active in all walks of industry where electrical machines constitute an integral element in their successful operation and development.

Specifically the EMC provides the following benefits:

- Provision and maintenance of standards that set benchmarks and define requirements for consistent design, quality and performance of electrical machines from a power of 10 MVA up to the largest electrical machines in the world at 2000 MVA.
- Set-up task forces and study groups to constantly review the scope, alignment and applicability of the standards to the evolving industry needs.
- Organize panel sessions at the IEEE PES General Meetings to present new developments in the field of electrical machines, and promote active discussion on evolving topics of interest and concern to both academia and industry.
- A forum of engineers providing a resource of broad and deep knowledge and experience in the field of electrical machines, from which both young and experienced engineers can draw inspiration in their work and career development.

3. Benefits to Volunteer Participants from the Committee Work:

The work of the IEEE provides the opportunity for engineers, both young and old, to share technical knowledge, experience, opinions and concerns on a huge variety of topics within the field of electrical engineering.

Additionally, by participating in the development and revision of standards, volunteers can actively contribute to the very documents that determine the design and performance of the equipment they design and study, and provides the opportunity to advance their knowledge and understanding of the underlying concepts, reasoning and criteria.

In contributing to the papers and presentations, volunteers can enhance and promote their own knowledge and expertise to a wide audience of like-minded professionals.

4. Recognition of Outstanding Performance:

In 2015 the following awards were presented within the Electric Machinery Committee as recognition of the contributions made to both the IEEE PES and the EMC in particular:

EMC PRIZE PAPER AWARDS:

H. N. Villegas Pico and D. C. Aliprantis

Voltage Ride-Through Capability Verification of Wind Turbines with Fully-Rated Converters Using Reachability Analysis,

Transactions on Energy Conversion, Vol. 29, No. 2, June 2014, pp. 392-405.

K. Yamazaki, A. Suzuki, M. Ohto and T. Takakura

Circuit Parameters Determination Involving Stray Load Loss and Harmonic Torques for High-Speed Induction Motors Fed by Inverters,

Transactions on Energy Conversion, Vol. 28, No. 1, March 2013, pp. 154-163.

G. M. Shane and S. D. Sudhoff

Design Paradigm for Permanent-Magnet Inductor-Based Power Converters,

Transactions on Energy Conversion, Vol. 28, No. 4, December 2013, pp. 880-893.

EMC WORKING GROUP RECOGNITION AWARD: Haran Karmaker

IEEE Std. 1812, Trial Use Guide for Testing Permanent Magnet Machines.

The paper by H. N. Villegas Pico and D. C. Aliprantis, and the standard chaired by Haran Karmaker were also selected as winners of the Power and Energy Society Prize Paper and Standard awards and were presented at the Awards Dinner held during the 2015 General Meeting in Denver.

EMC DISTINGUISHED SERVICE AWARD: Kevin Mayor

FELLOWS:

Recognition was finally given to a well-known and highly respected member of the EMC for many years; **Clyde Maughan**, who was elevated to IEEE Fellow for contributions in the field of large generator insulation systems and generator failure mechanisms. A very well deserved recognition of Clyde's significant contribution to the work of the EMC.

CYRIL VEINOTT AWARD:

This year the Cyril Veinott Award was presented to Babik Fahimi at the 2015 Awards Dinner.

Congratulations for all for their continued commitment and contribution to the work of the EMC.

5. Coordination with Other Entities (PES Committees, CIGRE, standards, etc.):

The Electric Machinery Committee liaises with the following IEEE committees and institutions which share common fields of interest:

- ***IAS: Industry Applications Society***
Related topics on the applications of electrical machines. Additionally the IAS and PES are sponsors of The International Conference on Electrical Machines and Drives (IEMDC) in which the EMC is actively involved.
- ***PSRD: The Power System Relay Committee***
The PES has responsibility for relay protection tasks, some of which are of interest to the Electric Machinery Committee in that they provide protection and control functions for electric machines.
- ***ISO: International Organization for Standardization***
The ISO issues several technical standards which are of relevance to electric machines, e.g. regarding the measurement of noise and vibration, and recommended vibration limits.
- ***IEC: International Electrotechnical Commission***
CIGRE: International Council on Large Electrical Systems
The IEC issues standards on the design and performance of electrical machines which complement those of the IEEE. There is a strong liaison with common participants who work to align the requirements of these standards where conflicts and unnecessary deviations are evident.
CIGRE does not issue standards, but has Study Committees and Advisory Groups in the field of rotating machines that survey current industry practices and experience, and issue reports, guidelines, brochures and tutorials. Several EMC members participate in both CIGRE and IEEE working groups and conferences.

6. New Technologies of Interest to the Committee:

In past years ‘new technologies’ have focused predominantly on superconducting machines, and the EMC ran a working group on this topic for some years. Whilst this remains a topic of interest, the introduction of the technology into rotating equipment has been limited due to commercial viability (material costs, performance and reliability) and technical challenges (winding design and cooling technologies when used in rotating equipment). It continues to be of interest in special applications where space is at a premium.

On large machines, there is an increasing focus on better availability through reduced down-time facilitated by developments in on-line monitoring and predictive maintenance. The EMC has responded to this with an updated guideline on monitoring (IEEE Std. 1129), and follows technology developments in related instrumentation, measurement and diagnostic techniques (e.g. fiber optic devices).

With the advent of renewable energy initiatives around the world, the EMC new technology focus has shifted towards the understanding and mitigation of the impact of these fluctuating power sources on both machine and grid performance. In particular:

- Increased performance of thermal plant demanded by evolving grid codes across the world (see task force in clause 1.3)
- Higher variations in load, and a more rapid ramping of load changes, leading to greater thermal and mechanical cycling of components
- Greater resilience in withstanding grid faults and loss of power to avoid complete plant shutdown
- The use of power electronics to enhance stability

Another emerging application of electric power technologies is in electric aircraft, and IEEE PES has the opportunity to help shape this space. Experts from EMC are partnering with NASA to chart out a technology roadmap for MW scale machines and drives. IEEE PES is co-sponsoring a workshop in April to bring together key stakeholders from government, industry and academia to identify opportunities and challenges as electrification of large aircraft is considered (see clause 7).

7. Significant Plans for the Next Period:

In 2016 the EMC will continue to work on the standards that are the mainstay of its contribution to industry, but will also strive to bring the work carried out within the EMC and the benefits to a wider audience, and broaden its appeal to younger engineers. Specifically:

- Grainger CEME/IEEE Workshop on “Technology Roadmap for Large Electrical Machines”. University of Illinois 5-6 April 2016.
- PES EMC is the lead sponsor of the 2017 IEMDC conference. The current Motor Subcommittee chair, and the past EMC chair, are co-chairs of the conference. The organizing committee has started making detailed plans and preparations for the conference.
- To attract the next generation of volunteers, we will hold additional EMC meetings at venues other than the PES General Meeting. The ideas and planning will be elaborated in 2016; the first ‘event’ will be held during the IEMDC conference in 2017.
- EMC members are active in the creation of a formal power point presentation to promote PES leadership, and will participate in the PES Public Relations initiative at committee level.
- Closer cooperation with the Excitation Subcommittee of Power Generation related to the work on grid codes, and NERC / FERC regulation changes.

Submitted by: Kevin MAYOR

Date: 31 January 2016