Fall 2017, Volume 6, Issue 2

ICC Newsletter

Act now! Special offer to first-time utility attendees to the ICC Fall meeting – ten complimentary registrations! Please contact thomasarnold@pesicc.org.

From the ICC Chair

It's hard to believe this year marks the 70th anniversary of the first ICC meeting. I remember my first ICC meeting in the mid-nineties. I learned a great deal from the working group discussions on standards and guides and the subcommittee presentations. But just as informative and beneficial were the discussions that occurred during breaks and dinners. The networking and building of friendships that occur among colleagues at the ICC is priceless. I found that first meeting to be so valuable that I have attended ever since.

In 2016 I had the honor of becoming the ICC chair, and it has been a pleasure to serve this great organization in that role for two years. The upcoming Fall meeting will be the end of my term, and Rusty Bascom will be taking on the responsibility as the ICC chair. I know he will do a great job.

I want to thank all of you for the dedication and contributions you provide at every meeting. It's not a coincidence that the ICC is one of the top committees in PES - it's because of all your hard work and commitment. I encourage every ICC member to be involved with our many subcommittees. This will keep the ICC ahead of new technologies, provide a learning platform for our industry, and continue to attract new members for many years to come.

I look forward to seeing everyone in Hollywood, Florida this October. Safe travels!

Frank Frentzas
Commonwealth Edison
IEEE PES ICC 2016 – 2017 Chair

Industry Report: Smart Utilities

By Ram Ramachandran, SRValueconsulting LLC

The *2017 Strategic Directions: Electric Industry Report* from Black & Veatch is now available. This report captures the views of global engineering and thought leaders on how reliability, aging infrastructure and customer demand for green energy are driving investments in transmission and distribution. The report also explores how utilities — despite headlines suggesting potential rollbacks of emissions mandates — are driving the grid further toward sustainability. It can be downloaded at https://www.bv.com/reports.

Fall 2017 Education Session – The Latest ICC Guides and Standards

By Rachel Mosier, Education Session Chair, PDC and Jared Jajack, Education Session Vice Chair, AEP

Do you ever find it hard to keep up with the most recent ICC guides and standards? At ICC, it's impossible to attend every session of interest. So how can you find out what the latest ICC publications are and how they will impact you?

That's what this session is all about. We'll be covering the most recently published and soon-to-be published ICC guides and standards, providing a primer on each one. The presentations will span all subcommittees, so there will be something for everyone.

Plan to attend this education session at the Margaritaville Hollywood Beach Resort in Hollywood, Florida on Wednesday, November 1, from 1:00 – 5:00 p.m.

ICC Newsletter Team

Harry Orton, ICC Communications Chair
Wim Boone, ICC Communications Vice Chair
Ram Ramachandran, AC Task Force Chair

ICC Awards

By Lauri Hiivala, ICC Awards Chair

Certificates of Appreciation (COAs) were awarded for the best presentation at a subcommittee, working group, discussion group or educational program for the Fall 2016 meeting:

- Paul Caronia, Subcommittee A Meeting, *Recent Developments in Peroxide Crosslinked Polyethylene*
- Andrew R. Morris, Subcommittee C Meeting, *Empirical Data on Heat Energy Liberated During Arcing Cable and Accessory Faults*
- Sarajit Banerjee, Subcommittee D Meeting, *PD Testing of Nuclear Power Plant Cables – Technical Considerations*
- Boguslaw Bochenski, Subcommittee D Meeting, *PD Testing of Nuclear Power Plant Cables – Technical Considerations*
- Alfred Mendelsohn, Subcommittee F Meeting, *AC and PD Commissioning Testing of First 500 kV Underground Transmission Circuit in North America*

COAs were also presented to all outgoing subcommittee, working group and discussion group chairs and vice chairs, or upon publication of their IEEE standard or guide:

- Mark Walton, Chair, Subcommittee A, Cable Construction and Design, Spring 2014 – Fall 2016
- Mark Fenger, Chair, Subcommittee F, Field Testing and Diagnostics, Fall 2014 – Fall 2016
- Michael Smalley, Chair, Advisory Committee, Spring 2014 – Fall 2016
- Farris Jibril, Chair, Working Group B6, IEEE 1299-1996 *Guide for the Connection of Surge Arresters to Protect Insulated, Shielded Electric Power Cable Systems*
- Farris Jibril, Vice-Chair, Working Group B10, IEEE 1637-2010 *Guide to Select Terminations for Shielded Alternating-Current Power Cable Rated 5 kV - 46 kV*
- Tim Wall, Chair, Working Group B16, IEEE 386-2016 *Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV*
- David Hughes, Vice-Chair, Working Group B16, IEEE 386-2016 *Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV*
- Jim Hunt, Chair, Discussion Group C3 *Magnetic Fields of Underground Cables*
- Bruce Bernstein, Chair, Working Group C30, IEEE P1879 *Trial Use Guide for Extending the Life of Power Cables in the Field*
- Rick Piteo, Vice-Chair, Working Group C30, IEEE P1879 *Trial Use Guide for Extending the Life of Power Cables in the Field*
- Art Maldonado, Chair, Working Group D3, IEEE 1242-2016 *Guide for Specifying and Selecting Power, Control, and Special-Purpose Cable for Petroleum and Chemical Plants*
- Ken Bow, Vice-Chair, Working Group D3, IEEE 1242-2016 *Guide for Specifying and Selecting Power, Control, and Special-Purpose Cable for Petroleum and Chemical Plants*

Sudhakar Cherukupalli was awarded the IEEE-SA Standards Medallion "for significant contribution towards development of standards pertaining to Real-time Ratings for Transmission Cable Circuits, DGA Interpretation for Condition Assessment of High Voltage Oil-Filled Cables and towards the Education Committee of the IEEE Dielectrics and Electrical Insulation Society."

Rating of Underground Power Cables with Boundary Temperature Restrictions

By George J. Anders, F. IEEE

The usual way of rating electric power cables is to compute the current such that conductor temperature does not exceed the specified limit. This limit can be different for normal and emergency operations. The procedures for ampacity calculations are well established and are part of several international and national standards.

However, in several countries (particularly in Europe), another restriction is imposed on the maximum current the cable can carry. This restriction limits the temperature rise at a point other than the cable conductor. For example, in the Netherlands, Denmark and France, the temperature rise at the cable surface is imposed to prevent soil dryout in the vicinity of the cable installation. In North America, a notion of the "boundary" temperature limit is sometimes entertained. The boundary can refer to the cable surface but also to the edge of the duct bank or a backfill.

Installation of submarine cables in the North Sea or the Baltic Sea is subjected to a temperature restriction called the 2 K-criterion. This means that a so-called "ecological point" in the seabed, situated at a depth directly above the cable, is not permitted to heat up by more than 2.0 °Kelvin (K) due to cable losses. Normally, the depth of this point is defined as *m*. In practice, the 2 K-criterion can have tremendous effects on the cable design, enforcing greater laying depths under the sea bottom and/or more expensive cables with larger conductor cross-sections.

***Rating**, continued on page 4*

PD Testing of Nuclear Power Plant Cables

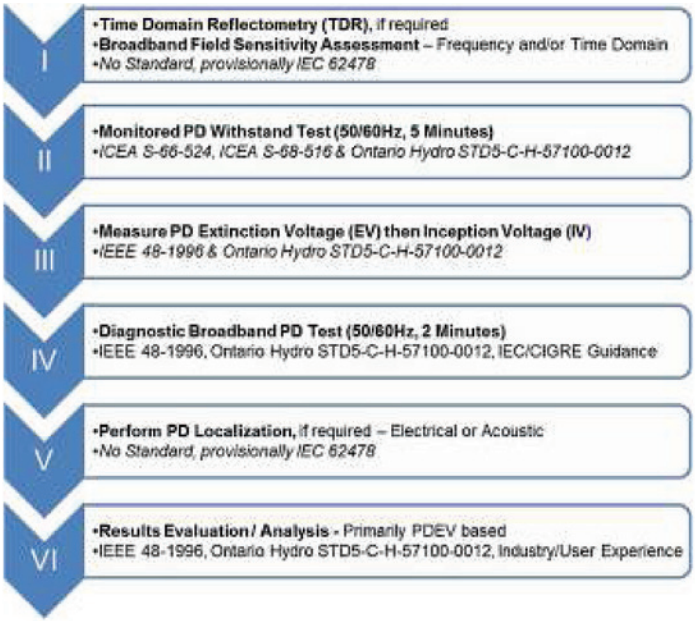
By Sarajit Banerjee, M.A.Sc., P.Eng., Kinectrics Inc.

Unplanned cable system failures in a nuclear environment can have serious consequences for plant safety and reliability. Combined with plans for North American nuclear power plant re-licensing and life extension (from 40 to 60 or even 80 years), it is inevitable that plant operators and regulators place a strong focus on implementing testing-driven cable aging management programs (CAMPs) for medium voltage (MV) plant cables.

#	Consideration	Unique Aspects influencing NPP Cable PD Testing
1	**Acceptance Criterion**	➢ Requirement for established acceptance criterion/thresholds ➢ Defined process for addressing anomalies.
2	**Risk Tolerance**	➢ Very low risk tolerance for '*false negatives*' ➢ Strong cost implications for '*false positives*'
3	**Regulatory Framework**	➢ Data used to support NRC driven CAMP requirements, license extension
4	**Component Design**	➢ EPR (versus XLPE or TR-XLPE) cable insulation ➢ Copper tape shielding (versus CN, LC, etc.) ➢ Non-linear graded accessories
5	**Practical**	➢ Outage constraints → reduced time under test
6	**Background Noise**	➢ Plant environment (various sources – low & high frequency)
7	**Quality Control / Calibration**	➢ Safety-related system cable testing require 10CFR50 Appendix B / ISO17025 QA/reporting/calibration
8	**Logistical**	➢ Mostly indoor plant testing – constraints on equipment size, portability, flammability
9	**Installation Design**	➢ Conduit or cable tray versus direct-buried ➢ Dominantly short lengths (i.e. 100 – 500'), max ~ 2500 – 4000'

The fundamental intent of adopting partial discharge (PD) testing in an MV nuclear power plant (NPP) CAMP is to diagnose latent (i.e., undeveloped) localized insulation defects in cable systems. There are, however, a number of unique PD testing considerations in NPPs, which are briefly summarized in the table to the left.

Addressing these constraints requires careful technical consideration of the test source, test methodology (levels, duration, sequence), measurement/detection methodology, and evaluation methodology/interpretation criterion. A PD test approach satisfying these considerations is shown in the chart to the right. The approach is based on extensive application experience and statistics from PD testing MV cables in Canada Deuterium Uranium (CANDU) and US pressurized water reactor/boiling water reactor (PWR/BWR) NPPs.



Utilizing this approach, PD testing has been applied in NPPs for commissioning, post-repair acceptance, maintenance, and diagnostic trending. The commissioning testing was a success and the circuit was energized in November 2016.

ICC Standards Corner

By John Merando, ICC Standards Coordinator

Since the Spring 2017 ICC meeting, standards activities have been ongoing, with working group chairmen holding webcast and telcom meetings with group members.

WG C25W, chaired by Nimesh Patel, submitted P442 "IEEE Draft Guide for Thermal Resistivity Measurements of Soils and Backfill Materials," for review by RevCom.

WG B03W, chaired by Sherif Kamel, submitted a Modification PAR for IEEE 592 "Standard for Insulation Shields on Medium-Voltage (15kV -35kV) Cable Joints and Separable Connectors" to update the title and scope. This PAR is on the September 2017 SA Standards Board meeting agenda.

No standards expire in 2017. However, much work needs to be done, since 15 standards expire at the end of 2018: IEEE documents 400.1, 400.3, 442, 495, 532, 592, 1210, 1216, 1234, 1406, 1407, 1425, 1493, 1617, and C62.22.1. Four standards expire in December 2019: IEEE Standards 48, 82, 635, and 1142. Of the IEEE standards listed above, six standards do not have a PAR: 82, 635, 1142, 1216, 1425, and C62.22.1.

Three documents (P971, P1539, and P1659) had PARs that expired before the document was completed. The effort to combine and reorganize IEEE 48 and IEEE 404 by WG B22 and B23 also requires a PAR. In accordance with IEEE SA Standards policies, no standard development or draft document writing shall be performed until a PAR is submitted and approved by the IEEE SA Standards Board.

Each standard has a technical and financial impact on world economy, the environment and our society. We encourage ICC attendees to contribute to these working groups.

Calendar

of International Events

Compiled by Harry Orton & Wim Boone

CIGRE
October 9 – 13, New Delhi, India
http://www.cigre.org/Events

Subsea Power Cables Seminar
October 18-19. London, UK https://energy.knect365.com/subsea-power-cables/

CEIDP
October 22-25. Fort Worth, TX USA
www.ieeedeis.org/ceidp/

International Conference on Condition Assessment Techniques in Electrical Systems (CATCON)
November 16-18, Rupnagar, Punjab, India
http://www.iitrpr.ac.in/CATCON2017/

JICABLE HVDC
November 20-22, Dunkerque, France
www.jicable.org

Wind Europe Conference
November 28-30,
Amsterdam, Netherlands
https://windeurope.org/confex2017/

AI Wire & Cable 2017
November 29-30 Frankfurt Germany
www.aluminium-wire-cable.com

Upcoming ICC Events

October 29 - November 1, 2017
Fall ICC – Hollywood, Florida
Visit www.pesicc.org/iccwebsite/meetings/2017Fall/Fall2017.htm to view all Fall ICC presentations and activities or to register for the meeting, the Networking Luncheon and Transnational Lunch.

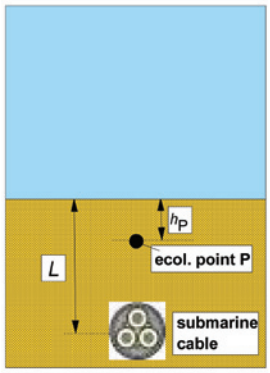
May 6 - May 9, 2018,
Spring ICC – Tucson, Arizona

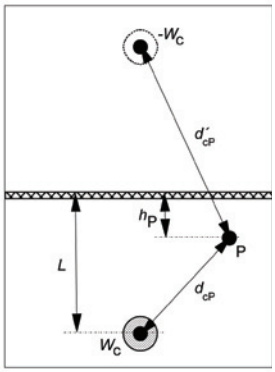
Tell Us What You Think!

ICC welcomes your feedback. If you'd like to suggest topics for upcoming issues of the ICC Newsletter or add a colleague to our email database, please contact Harry Orton at h.orton.1966@ieee.org.

***Rating**, continued from page 2*

The most common case involving a three-core submarine cable is shown in the figure.





2 K-criterion for the survey point P above the submarine cable with power losses, with representation (right) of the sea bottom as a thermal sink by means of a mirrored thermal source with power losses.

For a typical three-core submarine cable with an 800 mm^2 copper conductor and cross-linked polyethylene (XLPE) insulation, the steady state rating with the maximum conductor temperature of 90 degrees Celsius (°C) and a unity load factor is 967 amperes (A), with the total losses of 167.4 Watts per meter. However, with the 2 K-criterion, the value of the permissible current is equal to 564 A.

Testing of First 500 kV Underground Transmission Circuit in North America

By Alfred Mendelsohn, Power Delivery Solutions, Inc.

The first underground 500 kV XLPE transmission line in North America was recently completed by Southern California Edison (SCE) about 20 miles east of Los Angeles. The SCE 500 kV XLPE underground cable circuit consists of two sub circuits approximately four miles long, with two outdoor terminations and 11 joints on each cable.

Setup of four RTS reactors.

Due to the criticality of the circuit, and considering that this is the first time a 500 kV XLPE circuit was being installed in North America, SCE decided to install a permanent PD monitoring system to monitor all joints and terminations. This also facilitated the commissioning testing of the circuits.

The commissioning testing requirements for the project consisted of an AC Hipot test at 433 kV (1.5 U0) for one hour with simultaneous PD testing of all joints and terminations. This represents the highest voltage AC Hipot test in North America for an underground XLPE transmission circuit. To be able to perform the AC test, it was necessary to use four large 260 kV resonant test set (RTS) units, two in series coupled in parallel with another two in series.

The commissioning testing was performed at the end of August 2016 and all accessories and the cables were found to have negligible PD at 433 kV. The 500 kV XLPE circuits were energized in November 2016 and have been in service without any issues since then.