Spring 2018, Volume 7, Issue 1

ICC Newsletter

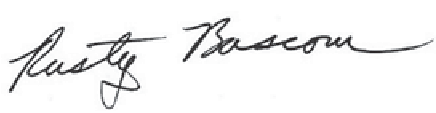
Act now! Special offer to first-time utility attendees to the ICC Spring meeting – ten complimentary registrations! Please contact thomasarnold@pesicc.org.

From the ICC Chair

Welcome to the Spring 2018 edition of the ICC Newsletter. The Insulated Conductors Committee is part of the IEEE's Power & Energy Society, where we take on the challenges of developing and maintaining guides and standards.

The work done at the ICC is integral to the design, implementation and permitting of these systems, and the operational issues associated with insulated cable must continually be discussed and investigated to foster knowledge in these specialized areas. Twice each year, we hold meetings where we write and maintain industry-guiding documents, make topical presentations discussing nuances in the electric wire and cable industry and related systems, and, most significantly, network with industry experts. We have a lot of work to do, as there are more than a dozen ICC guides and standards that need attention by the end of 2018 and others that will require revision in the coming years.

As I begin my two-year tenure as chair of the ICC, I am encouraged by the growing interest in our committee. Attendance at our meetings has grown from 214 people at the first meeting I attended, in Spring 1991, to more than 500 at the Spring 2017 meeting. I hope to continue the efforts of our outgoing chair, Frank Frentzas, to stimulate interest in our group while making our meetings productive and enjoyable. This is an exciting time to become active in the ICC. Please join us!



Earle C. (Rusty) Bascom, III
Electrical Consulting Engineers, P.C.

Industry Report: Smart Utilities

By Ram Ramachandran, SRValueconsulting LLC

2018 Strategic Directions: Smart Cities & Utilities, a new report from Black & Veatch, explores the current landscape of smart city efforts. The report finds that Big Data's potential to improve community quality of life while making critical human infrastructure more efficient and sustainable is overcoming lingering fears about costs. Bold advances in data analytics, electric transportation and next-generation communications systems are propelling smart city development, while creative financing strategies challenge old notions about massive upfront investments. The report can be downloaded at bv.com/reports.

Spring 2018 Education Session – End of Life (or Is It?)

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

We recently surveyed ICC attendees to determine which topics people are most interested in learning about. By popular request, the next ICC education session will be all about End of Life (in other words, how to know if your cable system has "bought the farm"). Extruded dielectric and paper-insulated cables will be among the cable systems discussed. Topics will include monitoring and testing technologies, steps to extend life, and the answer to that elusive question: Is my cable system at the end of its life?

Plan to attend this education session at the J.W. Marriott Starr Pass Resort in Tucson, Arizona, on Wednesday, May 9 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

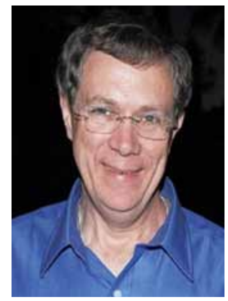
By Lauri Hiivala, ICC Awards Chair

Certificates of Appreciation (COAs) were awarded for the best presentation at a subcommittee, working group, discussion group or educational program for the Spring 2017 meeting:

- Jon Erickson, Subcommittee A Meeting, *Intelligent Undergrounding at San Diego Gas & Electric*
- Aaron Norris, Subcommittee B Meeting, *Knifeless Cable Preparation Technology, a Utility Perspective*
- John Eidinger, Discussion Group C39 Meeting, *Seismic Performance of Buried High Voltage Cables: Successes and Failures*
- Kishan Kasondra, Subcommittee C Meeting, *Los Angeles Department of Water & Power – 138 kV Cable Replacement Project*
- Drew Mantey, Subcommittee D Meeting, *Cable Aging Management Programs at Nuclear Power Plants*
- Arie Makovoz, Subcommittee F Meeting, *Pipe-Type Joint Assessment Utilizing Digital X-Ray Technology*
- Stephen Halliwell, Subcommittee F Meeting, *Pipe-Type Joint Assessment Utilizing Digital X-Ray Technology.*

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:

- Michael Joseph, Chair, Working Group A7, *Guide for Selecting and Testing Jackets for Underground Cables*
- Mike Smalley, Chair, Discussion Group A14, *Power Cable Standards*
- Todd Richardson, Chair, Working Group B3, Revision of IEEE 592, *Semiconducting Shields on Medium-Voltage (15 kV - 35 kV) Cable Joints and Separable Connectors*
- Fran Angerer, Chair, Working Group B17, IEEE 1610-2016 *Guide for the Application of Faulted Circuit Indicators on Distribution Circuits*
- Brieana Reed-Harmel, Vice-Chair, Working Group B17, IEEE 1610-2016 *Guide for the Application of Faulted Circuit Indicators on Distribution Circuits*
- Gil Shoshani, Chair, Working Group D18, IEEE 1810-2017 *Guide for the Installation of Fire-Rated Cables Suitable for Hydrocarbon Pool Fires for Critical and Emergency Shutdown Systems in Petroleum and Chemical Industries*
- Mick Bayer, Vice-Chair, Working Group D18, IEEE 1810-2017 *Guide for the Installation of Fire-Rated Cables Suitable for Hydrocarbon Pool Fires for Critical and Emergency Shutdown Systems in Petroleum and Chemical Industries.*



Technical Committee Distinguished Service Award recipient Bill Taylor

Bill Taylor received the 2017 Technical Committee Distinguished Service Award "for his leadership of cable accessory working and discussion groups and for mentoring of new engineers via educational presentations at subcommittee and educational programs."

Design of Buried and Submarine Power Cables for Earthquakes

By John Eidinger, G&E Engineering Systems Inc.

While buried (and submarine) power cables have been in use for more than 120 years, there are no IEEE or other international guidelines or standards that outline the design of these cables for the effects of earthquakes.

The performance of buried cables in past earthquakes has been spotty. In the great San Francisco earthquake of 1906, for example, Thomas Alva Edison's design for buried cables (generally < 5 kilovolts [kV]) performed well, even in areas that were exposed to several centimeters (cm) of liquefaction-induced ground movements. From the 1910s to today, submarine communication cables have repeatedly failed during offshore earthquakes; with the current widespread adoption of submarine power cables, similar failures could occur in the future. The 1995 Kobe, Japan earthquake damaged 66 kV buried cables in reclaimed land areas that were exposed to liquefaction. In the 2011 earthquakes in Christchurch, New Zealand, there were hundreds of 11 kV to 66 kV cable failures in zones that were exposed to several to tens of cm of liquefaction-induced ground movements, as seen in the photo.

Reflecting this spotty performance, several power utilities on the west

Buckling of three 66 kV XLPE cables in 2011 earthquake in Christchurch, New Zealand (courtesy Orion Electric).

coast of the United States and Canada are examining the seismic capability of their existing high voltage (115 - 500 kV) and distribution voltage (4 - 33 kV) buried and submarine cables. Where weaknesses that could lead to prolonged outages have been found, mitigation measures have been identified and some are already implemented. These measures include installation of new seismically-designed buried cables and

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Measuring Arc Flash Energy in Underground Systems

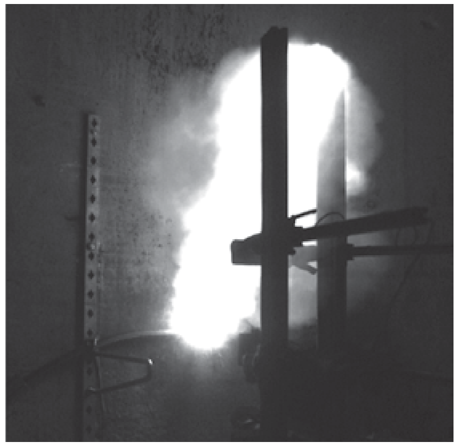
By Andrew Morris, ComEd

A series of tests to measure the actual incident energy produced by arcing faults on typical paper-insulated and extruded-insulation cables was undertaken to compare these values to those computed by generally accepted methods including the Lee equation as described in NFPA 70E and the method described in IEEE Standard 1584.

Thirteen samples of cable and splices from a typical distribution system were prepared, and a common wood screw was driven into each of the cables and splices to bridge the phase and neutral conductors and induce a fault. On the paper-insulated cables, the screw was installed to bridge two phases. Estimates of arc flash energy were then computed.

All 13 samples were mounted on standard cable brackets on the sidewall of a concrete test cell to simulate a typical distribution manhole. One end was left open to allow for access and for photographic documentation of the experiments. Each sample was then energized at 7,800 volts (V) and an approximate available current of 7,500 amperes (A) or 12,000 A (depending on the sample) for a specific time. Each fault was monitored by two sets of three calorimeters.

There was a great deal of variability between the heat levels measured at the high, mid-line and low sensors in most of the tests, suggesting that the heat output from the arcs in faulting cable tend to be highly directional. High-speed photography of the faults confirmed this. This effect was not accounted for in any of the presently accepted arc flash calculation methods.



Arc flash resulting from a cable fault.

The estimates of arc energy obtained by the Lee Method were extremely high, often between 50 and 150 percent above the energy observed during the tests. The estimates obtained by the IEEE 1584 method were more in line with observations but underestimated the energy observed, especially for the concentric cable and cable accessory samples. This result is particularly troubling since this testing approached (and exceeded) the energy forecast by the IEEE 1584 method, even without generating a three-phase arcing fault. The IEEE 1584 method fared better when the results from the faulted lead-covered cable and splices were considered. Most faults produced average heat levels approximately equal to or slightly lower than predicted.

While there were insufficient samples tested to support a truly rigorous statistical analysis, two factors were observed:

1. The energy emitted by an arcing fault on concentric-neutral cable or cable accessories is dramatically higher than that emitted by faults on lead-covered cable or accessories.
2. The emitted energy is apparently not significantly affected by the size of the cable or by the type of the splice.

It may be that the arc channel is longer in a typical concentric-neutral cable or accessory fault, or more constrained, leading to a higher arc voltage.

ICC Standards Corner

By Gary Clark, P.E., ICC Standards Coordinator

Since the Fall 2017 ICC meeting, standards activities have been ongoing, with chairs of the working groups (WG) holding webcast and teleconference meetings with their members. Three PAR submissions are currently under review by NesCom and should be approved before the Spring 2018 ICC:

- WG A11W, chaired by Kenneth Bow, PAR P1142, "Guide for the Selection, Testing, Application, and Installation of Cables Having Radial-Moisture Barriers and/or Longitudinal Water Blocking."
- WG D12W, chaired by Abbas Zaidi, PAR P2761, "Guide for Extending the Life of Cables in Nuclear Facilities."
- WG B12W, chaired by Kraig Bader, PAR P1511.2, "Guide for Investigating and Analyzing Failures of Joints on Extruded Shielded Power Cables on Systems Rated 5 kV Through 46 kV."

Fourteen standards are currently slated to be rendered inactive if not acted on by the end of 2018: 400.1, 400.3, 495, 532, 592, 1210, 1216, 1234, 1406, 1407, 1425, 1493, 1617 and C62.22.1. To be considered for the July 2018 meeting, a PAR for the revision of the standard must be submitted to NesCom by April 26, 2018.

Only four standards expire in 2019: 48, 82, 635, and 1142. Six standards expire in 2020: 634, 1120, 1185, 1428, 1511.2, and 1637. Finally, two standards are currently slated to expire in 2021: 1300 and 1682. In accordance with IEEE Standards Association (SA) policies, it is imperative that the responsible chairs and vice chairs update these documents before their expiration date.

These 26 documents represent nearly half of the 63 standards and guides that ICC sponsors. Each has a technical and financial impact on our economy, environment, and society. We appreciate all of those that continue to participate in the standards development process and encourage ICC attendees to contribute to these working groups.

Calendar

of International Events 2018/2019

Compiled by Harry Orton & Wim Boone

Offshore Wind Cabling 2018
March 13-15, 2018, Bremen, Germany
offshore-cabling.iqpc.dc

International Conference on the Properties and Applications of Dielectric Materials (ICPADM)
May 20-23, 2018, Xi-an, Shaanxi, China
icpadm2018.org

US Offshore Wind 2018
June 7-8, 2018, Boston, MA, USA
offshorewindus.org/2018ipf

IEEE EIC (Electrical Insulation Conference)
June 17-20, 2018, San Antonio, TX, USA
ieee.org>Conferences

Wire & Cable Conference 2018
June 18-20, 2018, Copenhagen, Denmark
events.crugroup.com/wireandcable/home/

Conference on Monitoring and Diagnostics (CMD)
September 23-26, 2018, Curtin University, Perth, Western Australia
cmd2018.com.au

Wind Europe Conference
September 25-28, 2018, Hamburg, Germany
windeurope.org/summit2018

CIGRE General Meeting
August 26-31, 2018, Paris, France
cigre.org/Events

Jicable
June 2019, Versailles, France
jicable.org

IEEE Electrical Insulating Conference (EIC)
June 16-19, 2019 TBD, Canada
ieee.org>Conferences

Calendar

Upcoming ICC Events

May 6 - May 9, 2018
Spring ICC – Tucson, Arizona
Visit pesicc.org/ICCWP/meetings/spring-2018-pes-icc-meeting/to view all Spring ICC presentations and activities or to register for the meeting, the Networking Luncheon and Transnational Lunch.

October 28 - 31, 2018
Fall ICC – Orlando, Florida

April 7-10, 2019
Spring ICC – Savannah, Georgia

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.

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improved emergency response. Full-scale test programs have been done to examine the seismic performance of buried unreinforced and reinforced concrete ducts as well as PVC or HDPE conduits.

CIGRE initiated committee B1.54 to document issues relating to earthquakes and other large disturbances including floods, fires, landslides, storms, and climate change. It is hoped that the B1.54 work product will lead to guidelines and standards for the design and installation of buried and submarine power cables to address these hazards. In the interim, the recommendations are to avoid using direct burial to install cables in thermal concrete in any location subject to ground failure due to liquefaction, landslide, or surface faulting; to install all buried cables over 400 meters long in duct banks and provide at least several cm of slack; to use reinforced duct banks to preclude any sharp cracks and high curvature of the duct bank due to imposed ground deformations; to install duct bank/termination vaults monolithically and with continuous reinforcement in zones prone to ground deformations; and to use special detailing provided to accommodate differential movements at the duct bank/termination interface. In all cases, the design should preclude tight curvature of the cable less than the manufacturer's recommendations.

Certified Cable for Solar or Wind Applications?

By Paul Knapp, UL LLC

When designing and building a new photovoltaic (PV) or wind project, one question is on every engineer's mind: Do I need to use certified cables? The answer is not always straightforward and may lead to confusion and headaches during and after the completion of a project.

The confusion often arises from variations in the identified body serving as the Authority Having Jurisdiction (AHJ) and the final owner of a system. Often, based on the entity in charge of the system, these projects can vary in requirements to comply with the National Electrical Code (NEC) or other local electrical codes or neither. An application may be developed by an engineering procurement and construction (EPC) firm for a utility or by a utility and eventually become privately held. The distinction of who is the AHJ and what is required may not be clear or may change with ownership. The electrical codes an application needs to comply with during the time of design and build also may change.

There have been numerous instances, particularly in Minnesota, where certified cables were not installed in some of these projects. It was only after completion and during inspection by the AHJ that it was discovered certified cable was required. This complication led manufacturers of the cable to retroactively determine if the cables used met the requirements for certification. This type of noncompliance may lead to project delays, the possible need for cable replacement or additional costly inspections. The use of certified cable should be considered in the design phase of these systems to avoid these issues.

Relevant standards to consider when choosing a certified cable for solar and wind applications include UL 4703, UL 44, UL 1072 and UL 1277.