ANSI ASC C119
Connectors For
Electric Utility Application
Update From April, 2009 Meetings

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IEEE TP&C Subcommittee Meetings
Conductors and Accessories WG
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Subcommittees of ASC C119

- Testing Methods and Directives Subcommittee
  - Work has begun on creating a common test requirements guide document for all C119 standards similar to IEC methodology.
- C119.1-2006 Subcommittee On Sealed, Insulated Underground Connector Systems
  - The target for a revised standard to be published is 2011.
- C119.4-2004 Subcommittee On Connector Systems For Use Between Aluminum-to Aluminum or Aluminum-to-Copper Conductors
  - The target is for a Revised Standard to be published in 2010.
  - A 1yr Extension is being balloted to allow time to resolve issues on the proposed addition of a fault duty test annex.

Subcommittees of ASC C119

- C119.5-2009 Subcommittee On Insulation Piercing Connectors
  - New Standard Published!
- C119.6-2006 Subcommittee On Non-sealed Multi-port Connectors
  - The target for a revised standard to be published is 2011.
- C119.7-XXXX Subcommittee on High Operating Temperature Connector Systems
  - New Standard
  - Joint EPRI - ANSI C119 Project for Round Robin Testing of Hi-Temperature Connector Systems

Evaluation of High Temperature Conductor and Connector Systems

- Provide a tool to the designers in evaluating the reliability of various types of conductor-connector systems
- Enable designers to select the right conductor-connector system for their applications
- Provide information to the industry to improve on connector designs

Project Objectives

- The objectives of this project are to provide the power industry with:
- A tool to evaluate performance of high-temperature connectors
- A guide to operate an overhead line reliably within given limits
- A methodology to improve on connector designs

Project Summary

- The project consists of three major tasks.
- Develop a model for prediction of expected life of connectors
- Conduct thermal-cycling tests to validate the model
- Perform high-temperature tests for qualification of high-temperature connectors

Deliverables

- Results from the research will generate new knowledge on the performance of ACSS, ACCR and ACCC high temperature conductor-connector systems. The deliverables will be:
- A model to enable a utility to predict the service life of these systems
- A test protocol for high-temperature connectors

Who Should Join

- Transmission utilities that are or contemplating operating overhead lines at high temperatures using high-temperature low-sag conductors
- Price of Project

  The cost of participation is $100,000.

  EPRI Members can use co-funding

  $50,000 member & $50,000 EPRI match

Contact Information

- **Technical Contact**

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- For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

- Douglas Harms, Chairman ANSI C119

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Evaluation of High Temperature Conductor and Connector Systems

Reliable connections assure the integrity of an overhead line

- Provide a tool to the designers in evaluating the reliability of various types of conductor-connector systems
- Enable designers to select the right conductor-connector system for their applications
- Provide information to the industry to improve on connector designs

To maximize the transmission capacity of an overhead line, existing and future transmission conductors will need to operate at higher temperatures. Recently, high-temperature connectors have been developed to meet these needs. These connectors have been designed for aluminum conductor steel reinforced (ACSR), aluminum conductor steel supported (ACSS) and high-temperature low-sag conductors that operate well above 100°C and often beyond 150°C. These connectors were designed to have a larger connector size and longer connection, to counter the effects of high-temperature on the connector components. They were not tested vigorously to the extreme conditions that are encountered in the field and they were not developed based on proven models. Long term tests on traditional compression fittings at high-temperatures have revealed that fittings will lose their compressive strength over time from thermal cycling. Compression fittings have a defined life expectancy due to the aging of the material of the components. In additional to the material, the design of a fitting also plays a major role in determining its longevity.

Detailed information on the performance of these connections can have a significant impact on applying ACSS and other conductors in the power system to take advantage of the larger potential power flow capacity of these conductors.

EPRI is pursuing research to develop a tool that will evaluate the performance of high temperature connectors.

Value

The research can help raise the confidence of a utility in the application of the new conductor technology and operating overhead lines at high temperatures using high-temperature connectors.

Substantial savings can be achieved by avoiding compression fitting failures that may cause an overhead line drop. Compression fitting failures can occur if the compression fitting is overstressed or if a compression fitting is not selected properly. A line drop could easily cost $100,000 or more in repairs and restoration. In addition, there could be a potential revenue loss of $30,000 per hour, calculated using a 230 kV line that carries 1,000 ampere of current and assuming a conservative energy cost of $75 per MW-

h.

Project Objectives

The objectives of this project are to provide the power industry with:

- A tool to evaluate performance of high-temperature connectors
- A guide to operate an overhead line reliably within given limits
- A methodology to improve on connector designs

Project Summary

The project consists of three major tasks.

1. Develop a model for prediction of expected life of connectors
2. Conduct thermal-cycling tests to validate the model
3. Perform high-temperature tests for qualification of high-temperature connectors

The first two tasks will initially focus on the ACSS ultra-high strength conductor-connector system.

Prediction of expected life of connectors will involve:

1 Thermo-mechanical evaluation and physical characterization of aluminum alloys used for the fabrication of ACSS conductor-connector system.

- Thermal-mechanical testing for full annealed 1350 aluminum conductor
- Steel-core wire thermal-mechanical testing, and the associated aging parameter study
- Thermal mechanical testing for steel core sleeve material

2 Development of a thermal-cycle aging model and, incorporating models into computational tools for parametric studies, predictions of remaining life and analysis of structural tests.

- Develop finite element models to simulate steel core sleeve crimped forming mechanism
- Develop finite element models to simulate 1350-O conductor and aluminum sleeve crimped forming mechanism.
- Develop finite element models to simulate the compressive residual stress degradation due to thermal cycle and quench effects within the ACSS conductor-connector system.

Thermal-cycling tests will involve:

Conducting experimental tests for supporting information and verification of the aging model for the ACSS conductor-connector and other systems. The tests will involve high temperature, thermal cycling and quenching.

High-temperature qualification tests will involve:

Conducting "round robin" tests for high-temperature connectors to finalize and validate a standardized test protocol which can be used for ANSI C119.7 standard.

Deliverables

Results from the research will generate new knowledge on the performance of ACSS conductor-connector and other high-temperature connector systems. The deliverables will be:

- A model to enable a utility to predict the service life of these systems
- A test protocol for high-temperature connectors

Price of Project

The cost of participation is $100,000. It is anticipated that there will be a minimum of 10 participants. The scope of work will be adjusted according to the total number of participants. Tailored collaboration funding can be applied to this project.

Project Status and Schedule

It is anticipated that the project will commence in late 2008 or early 2009. The project is anticipated to be completed in 24 months.

Who Should Join

Transmission utilities that are or contemplating of operating overhead lines at high temperatures, or considering of using high-temperature low-sag conductors

Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

Technical Contact

John Chan, EPRI Program Manager at 650.855.2452 (jchan@epri.com).

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Next ANSI C119 Meetings

- Fall 2009:

  Date: Tues through Thurs, October 20 - 22, 2009

  Location: Tempe Mission Palms Hotel and Conf Center
  60 E 5th St
  Tempe, AZ 85281

- Spring 2010:

  Date: Week of March 8, 2010

  Location: Charleston, SC

- Fall 2010:

  Date: Week of September 20, 2010.

  Location: Las Vegas, NV

Contact Information

- Craig Pon is the IEEE TP&C Committee Liaison Representative to ANSI C119.4, C119.7 Subcommittees and ANSI C119 Committee

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- NEMA – C119 Secretariat

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