CIGRE Study committe B2

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG B2.96

NAME OF THE CONVENOR
Ahmed Usama (CANADA)

TITLE
Composite Insulated Cross-arms for New-build and Retrofitted Transmission Line Supports

THE WG APPLIES TO DISTRIBUTION NETWORKS: NO

ENERGY TRANSITION
4 / Sustainability and Climate Change

POTENTIAL BENEFIT OF WG WORK
3 / likely to contribute to new or revised industry standards
4 / state-of-the-art or innovative solutions or directions
5 / Guide or survey on techniques, or updates on past work or brochures

STRATEGIC DIRECTION
1 / The electrical power system of the future reinforcing the End-to-End nature of CIGRE: respond to speed of changes in the industry by preparing and disseminating state-ofthe-art technological advances
3 / Focus of the environment and sustainability (in case the WG shows a direct contribution to at least one SDG)

SUSTAINABLE DEVELOPMENT GOAL
9 / Industry, innovation and infrastructure

BACKGROUND :

With the world transitioning towards greater use of clean renewable energy, many utilities and transmission system operators face the challenge of expanding their overhead line networks. During this on-going energy evolution, it is crucial that new lines must be constructed, and existing ones augmented in a sustainable manner, with a focus on conscious resource management and minimizing carbon footprint and community impact.

As an alternative to the traditional overhead lines with non-insulated cross-arms, the use of composite insulated cross-arms as structural elements in new-builds can enable light and compact lines which are environmentally less disruptive, require narrower right-of-way and can be more economical from a total cost-of-ownership standpoint. Additionally, in the scenario of upgradation of existing lines, retrofits with insulated cross-arms can potentially deliver voltage or ampacity uprating using existing supports and right-of-way as well as improvements in ground and corridor clearances.

Although composite insulated cross-arms have been commercially available for many years, and while their use is becoming increasingly popular and main-stream, technical guidance regarding the application of this solution remains sparse and limited.

Currently, there are no relevant international standards or application guides that deal directly with composite insulated cross-arms as a complete assembly. The existing IEC or ANSI standards address the insulator and hardware components of the cross-arm only in their individual application and thus lack the necessary guidance to tackle the nuances and complexities that come with the combination of suspension and post insulators when applied as integral structural elements of the overall transmission line support. One such issue is in regard to longitudinal stability of pivoting insulated crossarms with respect to applicable design loads (e.g. unequal wind pressures on adjacent spans) and design processes/models for analysis.

While electrical testing of the fully assembled insulated cross-arms can be somewhat coordinated with existing IEC/ANSI standards, there is a complete lack of guidance when it comes to mechanical testing involving combined three-axis loads and complex failure modes which can include post insulator buckling onsets (for EHV applications). The absence of established standards leads to a variety of test methods being employed. Manufacturers and end-users often create their own test procedures based on their technical interpretation, past experience, and available testing facilities with the goal to ensure that the requirements are stringent enough and accurately represent the intended use of the product. However, this approach can result in inconsistencies and disparities between test results and have a tangible impact on the final defined assembly ratings.

In addition, the wide range of available options and diverse designs for insulated cross-arms, such as rigid or pivoting type connections to support structures, different yokes and hardware types, solid or hollow core post insulators, single and three phase applications, and varying assembly spatial configurations (such as braced line post, horizontal Vee, tripod, double Vee, etc.) can sometimes result in uncertainty regarding the most appropriate and optimal choice for a specific application. Moreover, the fact that insulated cross-arms serve the dual function of electrical insulation and structural support being subjected to combined effects of vertical, transverse and longitudinal loads means that their application should be considered in conjunction with applicable transmission support design standards.

Thus, there is a need to analyze and address the ‘best practices’ for overall design, construction and operation of lines with composite insulated cross-arms. This includes a particular focus on sustainability, safe and efficient handling and installation of cross-arm assemblies on-site, and adequate provisions for worker access, condition assessment, live line work and cross-arm replacement during the operational phase. By addressing these considerations, the full potential of insulated cross-arms can be realized, leading to improved performance and sustainability of overhead line networks.

PURPOSE / OBJECTIVE / BENEFIT OF THIS WORK :

The increased use of composite insulated cross-arm and on critical applications further amplifies the necessity for systematic technical guidance on their design, testing and installation. Currently, insulated cross-arm projects are being implemented in different parts of the world ranging from new-builds and voltage upgrades to grid hardening and all these new applications as well as past experiences could be collected by CIGRE to produce guidelines for composite insulated cross-arms.

The proposed working group will focus on the critical aspects and highlighted gaps to develop and describe a complete set of technical requirements for transmission line supports with composite insulated cross-arms. This will enable transmission utilities to specify optimized designs and accurate ratings and improve their installation and operation practices in a more targeted and differentiated manner. Manufacturers and suppliers can use it to design and test assemblies with greater efficiency and accuracy, minimizing variations and unnecessary inputs.

The findings of this working group can also be used by international standard committees to supplement existing standards and complement development of new standard dealing with composite insulated cross-arms.

SCOPE :
The working group will investigate and report on the following:

1. Research the available literature and experiences in the state of the art on overhead lines with composite insulated cross-arms.
2. Analyze the different design approaches and propose optimized design criteria for overhead lines with insulated cross-arms.
3. Identify and enumerate sustainability aspects along with technical advantages and hinderances with the use of insulated cross-arms.
4. Analyze economic considerations of overhead line initial cost and overall life cycle cost.
5. Provide guidelines on mechanical sizing of cross-arm insulators and on selection of optimal insulated cross-arm assembly type, connection and configuration (based on line loads). Provide recommendations for design load cases and design procedures/models to evaluate longitudinal stability of pivoting crossarms.
6. Define component-level and assembly-level technical requirements of composite insulated cross-arms covering both insulators and load bearing fittings.
7. Reflect on the representativeness of the existing standards, compare the different test methods for full assembly testing of insulated cross-arms and when relevant, suggest recommended test procedures.
8. Collect data and past experiences to develop guidelines for efficient and safe handling, installation, inspection and maintenance of overhead lines utilizing composite insulated cross-arms.
9. Provide technical guidance on ampacity and voltage uprating, as well as other retrofit applications of insulated cross-arms, emphasizing critical considerations such as the design of new connection points for the insulated cross-arm and the structural reinforcement of retrofitted transmission supports.
10. Give an overview of complementary technologies that in many occasions accompany the application of insulating cross-arms.

Application and design of composite insulated cross-arms were partially discussed in the following CIGRE Technical Brochures and Working Groups:

[1] CIGRE Green Book" Compact Overhead Line Design", 2024.

[2] CIGRE WG B2.63, "Compact AC overhead lines", Technical Brochure N° 792, February 2020.

[3] CIGRE WG B2.62, "Compact DC overhead lines", Technical Brochure N° 831, March 2021.

[4] CIGRE WG 22.03 "Guide for the evaluation of composite line post insulators", Electra N° 203, August 2002.

[5] CIGRE WG B2.08, "Innovative Solutions for Overhead Line Supports", Technical Brochure N° 416 and Annex, June 2010.

[6] CIGRE WG B2.61, "Transmission line structures with Fiber Reinforced Polymer (FRP) composite", Technical Brochure N° 818, November 2020.

DELIVERABLES AND EVENTS

Deliverables Types
Annual progress and activity report to Study Committee
Electra report
Technical Brochure and Executive Summary in Electra
Tutorial
Webinar

Time schedule

Q2	2025	Recruit members (National Committees, WiE, NGN)
Q4	2025	Develop final work plan
Q4	2027	Draft TB for Study Committee Review
Q2	2028	Final TB
Q3	2028	Tutorial
Q3	2028	Webinar

APPROVAL BY TECHNICAL COUNCIL CHAIRMAN:

Rannveig S. J. Loken
March 18th, 2025