CIGRE Study Committee A3

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP[1]

WG N° A3.51	**Name of Convenor: Dr. Santosh Kumar Annadurai**
Strategic Directions #[2]: 1, 3	**Technical Issues #[3]:** 7, 10
The WG applies to distribution networks: Yes	
Potential Benefit of WG work # [4]: 1, 2, 3, 6	
Title of the Group: Example of title of the WG: Requirements for HV T&D Equipment operating under Abnormal Weather Conditions	

Scope, deliverables, and proposed time schedule of the Group:

Background:

Equipment requirements (functional/operational/general) represent a key aspect for the transmission and distribution (T&D) systems robustness, availability, and reliability in power system operation & planning. In this context, equipment standards governing requirements and specification for selection, validation & qualification standards must translate the stresses T&D equipment would be subjected to, in the network during its operational lifetime.

Main kinds of stresses affecting T&D equipment are of operational and environmental in nature. Both kinds of stresses are continuously evolving due to network enhancement, introduction of new technologies and changing environmental conditions.

In the last decades it has been observed a worsening of environmental stresses affecting T&D equipment in HV substations. Recent analysis by work of WG A3.30 – Managing T&D Equipment Overstress, showed that the stresses of environmental nature, like ambient temperature, wind speed, earthquake intensity, atmospheric discharge intensity, precipitation level, etc., have been changing with respect to defined standardized values. Therefore, CIGRE TB 816 pointed out as future work the investigation of changing environmental requirements and give guidance on the needs for updating standardized environmental requirements affecting high voltage transmission and distribution equipment.

Scope:

The new WG shall investigate evolving and changing levels and frequency of non-standard environmental requirements that might affect T&D equipment performance with emphasis, but not restricted, to:

- earthquake above 8 in Richter scale,
- atmospheric discharges above normally expected values,
- extreme ambient temperatures, snow, and ice (beyond standard values),
- heavy rains,
- wind above standard values, including tornado,
- tsunami,
- flood,
- wildfires,
- sandstorm, etc.

[1] Or Joint Working Group (JWG)
[2] See attached Table 2
[3] See attached Table 1
[4] See attached table 3

Besides that, the fast rate-of-change of temperatures observed in some regions shall also be investigated, since it can be the origin of equipment malfunction.

A wide bibliography review on non-standardized environmental requirements or values above standard shall be carried out as starting point of the investigation. Bibliographical references already collect by WG A3.30 and quoted in CIGRE TB 816 are listed as references to this TOR.

The scope of candidate equipment to be analysed shall be carefully discussed by the WG, aiming at giving focus to the work. Both transmission and distribution equipment shall be covered, as well as IEC and IEEE Standard requirements.

After analysing the bibliography, a worldwide inquire among utilities shall be carried out to identify actual problems occurred in the network operation, aiming at prioritizing the environmental stresses that shall be analysed in detail.

The result of this analysis shall be a list of environmental stress levels not yet covered by standards and the severity level of these stresses for standardization purposes to improve network resilience. These data will be the basis for a proposal to update existing equipment standards, or even proposing new requirements not yet covered by standards.

Deliverables:

Outcome of this working group will be published in a technical brochure. The brochure will provide:

- Clearly define what is meant by “abnormal weather conditions” in the context of the work.
- Detailed state-of-the-art review of current standards and technical advancements in Grid reliability against abnormal weather conditions, considering the results of equipment reliability studies carried out by CIGRE WGs e.g., A3.30, B3.57, B3.31, B1.54 and so on.
- Close working along with IEC TC17, IEEE technical committee (Substations & iGET) working under similar or common understanding on this topic.
- Define the target set of equipment.
- Survey results of various standards, methods, and practices across the globe to mitigate the effect of abnormal weather conditions.
- Identifying and prioritizing environmental stresses that are to be considered.
- Identifying gaps within existing standards and make suitable recommendations to ensure reliable Grid in view of changing environmental requirements.
- Further, identifying and recommending actions for making the grid resilient and sustainable.

The Working Group will produce some papers during Cigré sessions and colloquia. To update existing or new standards requirements for HV equipment, Tutorials will be arranged as well.

Partial deliverables shall be made available for CIGRE community by means of Webinars.

The Working Group might consider some relation to the outcomes from WG B1.54 “Behaviour of Cable Systems under large disturbances”.

☒ Technical Brochure and Executive summary in Electra

☐ Electra report

☒ Webinar

☒ Tutorial

Time Schedule: Start: **Q3.2023** **Final Report**: **1.2026**

- Q4. 2023 - call for experts
- Q1. 2024 - kick-off meeting & detailed working plan
- Q3. 2025 – Webinar 1
- Q1. 2026 – Brochure circulated for approval
- Q3. 2026 – Brochure published
- Tutorial in CIGRE SESSION 2026 – Tutorial session

Approval by Technical Committee Chairman:

Date: September 22nd, 2023

	References assosciated to extreme stresses due to environment or natural causes events
Tsunami	I. Ohno, T. Ito, H. Nakakoji, T. Kobayashi, H. Sato, "Study of seismic design and guideline of substation equipment based on the Great East Japan Earthquake", CIGRE 2014 Session, paper A3-304.
	JEAG 5003-2010 "Guideline for Seismic Design for Electric Equipment at Substations, etc.", Japan, 2010.
Earthquake (> 8 Richter scale)	I. Ohno, T. Ito, H. Nakakoji, T. Kobayashi, H. Sato, "Study of seismic design and guideline of substation equipment based on the Great East Japan Earthquake", CIGRE 2014 Session, paper A3-304.
	JEAG 5003-2010 "Guideline for Seismic Design for Electric Equipment at Substations, etc.", Japan, 2010.
	IEC 61166, "High voltage alternating current circuit-breakers – Guide for seismic qualification of high voltage alternating current circuit breakers", 1993.
	I. Manea, C. Radu, O. Tanase, F. Wassem, "Structural Analysis of High Voltage Electric Equipment with a View to Seismic Capability Assessment", CIGRE 2008 Session, paper A3-212.
	I. Ohno, S. Iwasaki, M. Kosakada, D. Yoshida, ¨Verification of Seismic Performance on EHV Gas Insulated Switchgear¨, CIGRE 2012 Session, paper A3-306
	IEC TR 62271-300:2006, High-voltage switchgear and controlgear - Part 300: Seismic qualification of alternating current circuit-breakers.
	IEC TS 61463, Bushing – Seismic qualification, 2016.
	IEC 62271-207, High-voltage switchgear and controlgear - Part 207: Seismic qualification for gas-insulated switchgear assemblies for rated voltages above 52 kV, 2012.
Volcano activity	J. Wardman, C. Stewart, V. Sword-Daniels, T. Wilson, "Impact Assessment of the May 2010 Eruption of Pacaya Volcano, Guatemala", GNS Science Report 2012/09, 2012
	Auckland Engineering Lifelines Group, Project AELG-19, "Review of Impacts of Volcanic Ash on Electricity Distribution Systems, Broadcasting and Communication Networks", Auckland Regional Council, Technical Report No.051, 2009.
Big solar magnetic storm	CBC, "Scientists probe northern lights from all angles", 2005.
	P Czech, S Chano, H Huynh and A Dutil, "The Hydro-Quebec system blackout of 13 March 1989: System response to geomagnetic disturbance", Proceedings of Geomagnetically Induced Currents Conference, 1989, Millbrae, California, EPRI Report TR-100450, 1992.
	New Scientist, "Earth dodges magnetic storm", 1989.
	E. Bernabeu, M. Baldwin, M. Till, "Harmonic Load Flow During Geomagnetic Disturbances", CIGRE Science & Engineering – Innovation in the Power Systems Industry, Vol. 3, 2015.
	P Smith, "Effects of geomagnetic disturbances on the National Grid System", 25th Universities Power Engineering Conference, September 1990.
	Z. Emin, P. Smith, "Geomagnetically Induced Currents and Their Effect on Electric Power Networks", https://network.wsp-pb.com/article/geomagnetically-induced-currents-and-their-effect-on-electric-power-networks.
	WG C4.32 – "Understanding of the Geomagnetic Storm Environment for High Voltage Power Grids", http://c4.cigre.org/WG-Area/WG-C4.32-Understanding-of-the-Geomagnetic-Storm-Environment-for-High-Voltage-Power-Grids
Severe heat, severe flooding, severe rain and humidity, severe cold, snow and ice, severe wind and sand storms – above standard values	H. Miyakawa, H. Takada, Y. Ito, M. Toyoda, J. Kida, H. Koyama, "Investigation of composite insulators in extreme environments - Heavy snow and severe pollution", CIGRE 2014 Session, paper A3-305.
	CIGRE Brochure 614, "Air Insulated Substation Design for Severe Climate Conditions", WG B3.31, 2015, www.e-cigre.org.
	Federal Emergency Management Agency (FEMA) 543 (2007), "Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings".
	IEC 60721-2-2, "Classification of environmental conditions – Part 2: Environmental conditions appearing in nature – Precipitation and wind", 2012.
	H. Hemmatjou, H. Javadi, M. Farzaneh, "Electrical Behaviour of Snow Accumulated on a Post Insulator under AC High Voltage", IWAIS XI, Montréal, 2005.
	CIGRE Brochure 634, "Impact of rain on insulator performance", WG D1.45, 2015, www.e-cigre.org.
	UNCCD, UNEP, UNESCO, FAO, ESCAP "Global Alarm: Dust and Sandstorms from the World's Drylands", United Nations.
	L.S. Nasrat, A.F. Hamed, M.A. Hamid, S.H. Mansour, "Study the flashover voltage for outdoor polymer insulators under desert climatic conditions", Egyptian Petroleum Research Institute, Egyptian Journal of Petroleum, www.elsevier.com/locate/egyjp.
	Federal Emergency Management Agency (FEMA)- FEMA-1674-DR-KS and FEMA-1675-DR-NE "Electrical Transmission and Distribution Mitigation: Loss Avoidance Study".
	IEC TS 60815-3, Selection and dimensioning of high-voltage insulators intended for use in polluted conditions - Part 3: Polymer insulators for a.c. systems, 2008.
	C.H.A. Ely, P.J. Lambeth and J.S.T. Looms, "The Booster Shed: Prevention of Flashover of Polluted Substation Insulators In Heavy Wetting", IEEE Transactions on Power Apparatus and Systems, Vol. PAS-97, No. 6, pp. 2187-2197, 1978,.

- **IEEE PES TR 83: Resilience Framework Methods and Metrics for the electric Sector, Oct. 2020.**

Table 1: Technical Issues of the TC project "Network of the Future" cf. Electra 256 June 2011, IEEE TR93 "T&D Grid mod & Climate Change" and IEEE TR83 "Resilience Metrices"

1	Active Distribution Networks resulting in bidirectional flows
2	The application of advanced metering and resulting massive need for exchange of information.
3	The growth in the application of HVDC and power electronics at all voltage levels and its impact on power quality, system control, and system security, and standardisation.
4	The need for the development and massive installation of energy storage systems, and the impact this can have on the power system development and operation.
5	New concepts for system operation and control to take account of active customer interactions and different generation types.
6	New concepts for protection to respond to the developing grid and different characteristics of generation.
7	New concepts in planning to take into account increasing environmental constraints, and new technology solutions for active and reactive power flow control.
8	New tools for system technical performance assessment, because of new Customer, Generator and Network characteristics.
9	Increase of right of way capacity and use of overhead, underground and subsea infrastructure, and its consequence on the technical performance and reliability of the network.
10	An increasing need for keeping Stakeholders aware of the technical and commercial consequences and keeping them engaged during the development of the network of the future.

Table 2: Strategic directions of the TC (ref. Electra 249 April 2010)

1	The electrical power system of the future
2	Making the best use of the existing system
3	Focus on the environment and sustainability
4	Preparation of material readable for non-technical audience

Table 3: Potential benefit of work

1	Commercial, business or economic benefit for industry or the community can be identified as a direct result of this work
2	Existing or future high interest in the work from a wide range of stakeholders
3	Work is likely to contribute to new or revised industry standards or with other long term interest for the Electric Power Industry
4	State-of-the-art or innovative solutions or new technical direction
5	Guide or survey related to existing techniques. Or an update on past work or previous Technical Brochures
6	Work likely to have a safety or environmental benefit

Comments:

1) CIGRE Official Study Committee Rules: WG Membership

https://www.cigre.org/GB/about/official-documents

a. Only one member per country (by exception of SC Chair)

b. WG nominees must first be supported by their National Committee (or local SC Member) as an appropriate representative of their country.

c. Acceptance of the nomination is granted by the SC Chair and advised to the WG Convener

2) Collaboration Space

https://www.cigre.org/article/GB/collaborative-tools-2

CIGRE will provision the WG with a dedicated Knowledge Management System Space.

The WG will use the KMS for drafting collaboration, capture and retention of discussion and meeting records.

Official country WG Members will be sent registration instructions by the Convener.

Official country WG Members may request the WG Convener to allow additional access for an extra national subject matter specialist to aid in the work at the national level, including NGN members.