CIGRE Study Committee B3

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG[1] B3/A3.67	**Name of Convenor:** Maik Hyrenbach (DE)
Strategic Directions #[2]: 1,2	**Sustainable Development Goal #[3]: 7,9**

This Working Group addresses these Energy Transition topics:

	Storage		**None of them**
	Hydrogen		
	Digitalization		
Y	**Sustainability and Climate Change**		
	Grids and Flexibility		
	Solar PV and Wind		
	Consumers, Prosumers and Electrical Vehicles		
	Sector Integration		

Potential Benefit of WG work #[4] : 3,6

Title of the Group: Operational safety of Medium Voltage GIS in case of abnormal leakage

Scope, deliverables and proposed time schedule of the WG:

Background:

With the new EU F-gas regulation the standard insulation gas in MV GIS, SF_6, will be substituted from 2026 by other insulation gases. Main proposed solutions are using mixtures of natural origin gases (NOG) as N_2, O_2, CO_2 or dry air. To keep the compact dimensions of the switchgear, the significant lower dielectric performance of these gases compared to SF_6 is compensated by a higher gas pressure.

As with any technical system, defects over lifetime cannot be excluded 100%. One possible defect of a GIS is an abnormal gas leak, leading to a reduction of the gas pressure over weeks, days or even hours.

The majority of SF_6 MV GIS are operating at <150 kPa abs for all voltage levels. Dielectric type tests are performed at minimum functional pressure acc. IEC and the full test voltages can be withstand at levels often at 120 or 130 kPa, which is only slightly above ambient pressure. Due to design margins some equipment could even demonstrate to keep the test voltage levels at ambient pressure (100 kPa).

The impact of gas loss for SF_6 MV GIS was therefore very limited and it was commonly accepted by many operators to continue operation at reduced pressures or even ambient pressure. Primary MV GIS have usually manometers and even alarm contacts indicating leaks and even report alarms to remote substation controls. Short term reaction on leaks is possible. In secondary distribution networks using ring main units (RMU), today with SF_6 often there are no alarm contacts or even no manometers indicating any gas loss. The equipment is usually inspected e.g. every 3rd year and gas loss might be recognized very late after it happened.

For NOG or air MV GIS this situation will change. For dielectric reasons they require filling pressures up to 250 kPa at 24 kV and even up to almost 400 kPa at 40,5 kV (based on actual available product data). In case of total loss of overpressure down to only 40% or even 25% of the insulation gas might be available for electrical insulation. This question marks the operational safety in case of al leak. The type test levels can clearly not be passed and the operating voltage might be at or even above the dielectric withstand. Failures like internal arc failures cannot be excluded, without actions taken to de-energize the equipment right in time.

Purpose/Objective/Benefit of this work:

The objective of the working group is to discuss what operating voltages including transient voltages are expected in real networks and what safety margins are needed to state operational safety in case of abnormal leakage during operation. These new test voltages shall be defined by the group as a base for further tests and additional design features of high pressure MV GIS using air or NOG.

Derived from this, pressure levels for products can be defined by the manufacturers down to which the operation of the equipment can be continued, based on common rules. In case the pressure levels are above ambient pressure, alarm levels can be defined to be used by the operators for de-energization to secure the equipment.

Scope:

The working group would investigate and report on:

1. Definition of power frequency U_{dSOP} (SOP = safe operation) and lightening impulse U_{pSOP} test voltage levels lower than the type test levels U_d and U_p, but still allowing safe operation of the equipment, including a safety margin definition. The values shall be defined in a tabular format according to IEC 62271-1:2017 table 1.
2. Definition of the pressure p_{SOP} related to the test voltages down to which the safe operation of equipment is given.
3. Definition of the pressure p_{SSW} (SSW = safe switching) down to which the safe operation of switches is given, including a definition which tests have to be performed for the switches (no full test duty) by the manufacturer.

For equipment with p_{SOP} and/or p_{SSW} above ambient pressure, definition of alarm levels for pre-warning and de-energizing.

Deliverables:

☒ Annual Progress and Activity Report to Study Committee
☒ Technical Brochure and Executive Summary in Electra
☐ Electra Report
☐ Future Connections
☐ CIGRE Science & Engineering (CSE) Journal
☒ Tutorial
☒ Webinar

Time Schedule:

- Recruit members (National Committees, WiE, NGN) Q1 2024
- Develop final work plan Q2 2024
- Draft TB for Study Committee Review Q2 2026
- Final TB Q4 2026
- Tutorial Q1 2027
- Webinar Q1 2027

Approval by Technical Council Chair: **Date**: February 14th, 2024	

Notes:
[1] Working Group (WG) or Joint WG (JWG),
[2] See attached Table 1,
[3]See attached Table 2 and CIGRE reference Paper: Sustainability – at the heart of CIGRE's work.
[4] See attached Table 3

WG Membership: refer Comments at end of document

Table 1: Strategic directions of the Technical Council

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-of-the-art technological advances
2	Making the best use of the existing systems
3	Focus on the environment and sustainability (in case the WG shows a direct contribution to at least one SDG)
4	Preparation of material readable for non-technical audience

Table 2: Environmental requirements and sustainable development goals

	CIGRE selected the 7 SDGs that are the most relevant to CIGRE. In case the WG work refers to other SDGs or do not address any specific SDG, it will be quoted 0.
0	Other SDGs or not applied
7	**SDG 7: Affordable and clean energy** Increase share of renewable energy; e.g. expand infrastructure for supplying sustainable energy services; ensure universal access to affordable, reliable, and modern energy services; energy efficiency; facilitate access to clean energy research and technology
9	**SDG 9: Industry, innovation and infrastructure** Facilitate sustainable infrastructure development; facilitate technological and technical support
11	**SDG 11: Sustainable cities and communities** Increase attention on sustainable and resilient buildings utilizing local (raw) materials, power for electric vehicles, strengthening long-line transmission and distribution systems to import necessary power to cities, developing micro-grids to reinforce the sustainable nature of cities; protect and safeguard the world's cultural and natural heritage; reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and waste management
12	**SDG 12: Responsible consumption and production** E.g. Promote public procurement practices that are sustainable; address reducing use of SF6 and promote alternatives, encourage companies to adopt sustainable practices and to integrate sustainability information into their reporting cycle, address inefficient fossil-fuel subsidies that encourage wasteful consumption
13	**SDG 13: Climate action** E.g. Increase share of renewable or other CO_2-free energy; energy efficiency; expand infrastructure for supplying sustainable energy; strengthen resilience and adaptive capacity to climate-related hazards and natural disasters; integrate climate change measures into national policies, strategies and planning; improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
14	**SDG 14: Life below water** E.g. Effects of offshore windfarms; effects of submarine cables on sea-life
15	**SDG 15: Life on land** E.g. Attention for vegetation management; bird collisions; integration of substations and lines into the landscape

Table 3: Potential benefit of work

1	Commercial, business, social and economic benefits 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 directions
5	Guide or survey related to existing techniques; or an update on past work or previous Technical Brochures
6	Work likely to contribute to improved safety.

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, WiE and NGN nominees.

b. WG nominees by NCs 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.