**SF₆ and Alternatives**

**Global Standards and Technical Activity**

Institute of Electrical and Electronic Engineers (IEEE)

  
  Scope: This document summarizes the state of the art in 2018 including technical considerations, toxicity, cost and availability of SF₆ alternatives and the contemporary environmental / regulatory situation. IEEE switchgear and substation standards are reviewed in the context of SF₆ alternatives.

- **PC37.100.7** - Guide for the evaluation of performance characteristics of non-Sulfur Hexafluoride insulation and arc quenching media for switchgear rated above 1000 V (2022, estimated).
  
  Scope: The guide reviews existing standards and performance criteria for switchgear rated above 1000 V. Each aspect of performance is discussed within the context of Sulfur Hexafluoride alternatives, how their behavior may differ from existing technologies and how this behavior may lead to changes in the qualification process.

  
  Scope: This guide describes the on-site handling of non-SF₆ gases and their gas mixtures used in electric power equipment. This includes gas mixing, filling, analysis, recovery, reclamation, and recycling.

  
  Scope: The purpose of this guide is to provide state-of-the-art technologies and procedures to minimize SF₆ gas emission to a minimum functional level for the electric power equipment to preserve the environment.

  
  Scope: This guide describes generally accepted processes for moisture level measurement, moisture data interpretation, and moisture control in gas-insulated switchgear

International Electrotechnical Commission (IEC)

- **60376** - Specification of Technical Grade Sulphur Hexafluoride (SF₆) and Complementary Gases to Be Used in Its Mixtures For Use In Electrical Equipment (2018).
  
  Scope: This Standard defines the quality for technical grade SF₆ and complementary gases such as nitrogen and carbon tetra-fluoride for use in electrical equipment.

- **60480** - Specifications for the re-use of sulphur hexafluoride (SF₆) and its mixtures in electrical equipment (2019).
Scope: This Standard provides criteria for the re-use of SF6 and its mixtures after recovery and reclaiming from electrical equipment (e.g. for maintenance, at the end-of-life).

- **62271-4 (revision)** - Handling Procedures for Gases and Gas Mixtures for Insulation and/or Switching (2020).

Scope: This part of IEC 62271 applies to the procedures for handling of gases and gas mixtures for insulation and/or switching during installation, commissioning, repair, overhaul, normal and abnormal operations and disposal at the end-of-life of high-voltage switchgear and controlgear.

**International Council on Large Electric Systems (CIGRE)**

- **Technical Brochure 730** - Dry Air, N2, CO2 and N2/SF₆ Mixtures for Gas Insulated Systems (2018). Provides the latest information on basic and practical properties of the potential gas-insulated systems using dry air, N2, CO2 and N2/SF₆ mixtures.
- **Technical Brochure 802** - Application of Non-SF₆ Gases or Gas Mixtures in Medium and High Voltage Gas Insulated Switchgear (2020). Describes the needs for adaptations or new requirements for the safe, reliable and sustainable application of non-SF₆ gases and gas mixtures in gas-insulated switchgear.

**SF₆ & Alternatives Coalition**

- **Considerations for Planning an SF₆ Phase-Out** (2020). Recommendations for decision-makers on how to plan for a system-wide or market-wide phase-out of SF₆.
- **Alternative Insulation Technologies** (2019). An overview of the alternative insulating gases on the market and how they compare with SF₆ in certain performance criteria.
- **Advantages of Shipping Gas-Insulated Equipment with Dry Air** (2019). A best practices guide for OEMs to reduce cost and facilitate customer tracking/reporting of SF₆ emissions.
- **SF₆ Reporting Challenges** (2016). An explanation of how use of GIE nameplate for emissions tracking can lead to erroneous calculations.
- **Nameplate Adjustment** (2016). Recommended processes to support accurate reporting of SF₆ emissions.
Other Associations

- **ASTM International**
  - **D1933-03** Standard Specification for Nitrogen Gas as an Electrical Insulating Material (2017)
  - **D2472-15** Standard Specification for Sulfur Hexafluoride

- **T&D Europe Manufacturing Association - WG Gases for Switchgear**
  - T&D Europe Position Paper on SF$_6$ and SF$_6$ Alternative Technologies (2020). T&D Europe supports a clear regulatory framework at European level enabling a reliable long-term planning basis for all stakeholders.

- **German ZVEI - WG SF$_6$ & Alternative Gases**
  - SF$_6$ in der Energietechnik (2020). Explores the use of SF$_6$ in energy technologies (available only in German).

- **Fraunhofer Institute for Energy Economics and Energy System Technology**

- **University of Antwerp**