

SF₆ end-of-life treatment of T&D equipment (>1kV) in Substations

Background

SF₆ has proven its excellent dielectric properties for the safe and secure operation of electrical equipment. Its only drawback is the very high global warming potential which casts a serious cloud over this substance when released into the atmosphere. In the electric power industry, large numbers of SF₆-containing transmission and distribution equipment are operating in Substations and other similar installations such as Power Plants and Gas Insulated Lines. SF₆ emissions from this equipment could occur during production, commissioning, operation and servicing and in the case of end-of-life handling. While SF₆ emissions from state-of-the-art electrical equipment during normal operation are negligible, a recent study by the well-accepted Fraunhofer Institute of Energy Economics and Energy System Technology (IEE) claims that end-of-life treatment is by far the dominant source of SF₆ emissions.

Present challenges

The installation of SF₆-containing electrical transmission and distribution equipment started in the 1970s for high-voltage equipment and extended down to medium-voltage in the 1980s. There is an increasing number of installations coming to their end-of-life in the coming years.

Although the use and handling of SF₆ is regulated for this equipment, regulations (e.g. the European F-Gas regulation) have not given clear requirements on end-of-life treatment of SF₆ and do not rigorously sanction improper SF₆ end-of-life handling or stimulate re-use or recycling of SF₆.

Policymakers in some regions in the world are engaged in reducing CO₂ equivalent emissions and also SF₆ due to its high global warming potential. However, the majority of the SF₆ efforts focus on new installations of electrical transmission and distribution equipment where SF₆ might be replaced by more environmentally friendly candidates. This approach may limit the amount of banked SF₆ in the future but still does not address the predominant emission potential from the installed base.

In addition, there is a high number of SF₆-based technical solutions from many manufacturers in very different market segments, operated by TSO, DSO and industry. Unfortunately, no clear instructions available at present on how this equipment can be treated at end-of-life in a responsible way with minimal impact on the environment. Without guidance, mishandling actions from non-experts in this area might lead to higher SF₆ emissions.

The Joint Working Group's task

The scope of the Joint Working Group B3/A3.59 entitled "Guidelines for SF₆ end-of-life treatment of T&D equipment (>1kV) in Substations" is to give practical guidelines for appropriate SF₆ end-of-life treatment contained in transmission and distribution equipment as a blueprint for environmentally responsible end-of-life handling of SF₆ in the electric power industry, which bears the risk to become the main source of SF₆ emission during equipment's life cycle.

A technical brochure shall:

1. Give an overview of existing SF₆ end-of-life techniques and practices;
2. Collect and analyse existing SF₆ end-of-life recommendations, specifications, standards and regulations;
3. Conduct a gap analysis where SF₆ end-of-life practices or recommendations, specifications, standards or regulations are missing;
4. Establish guidelines for appropriate and practical SF₆ end-of-life treatment (i.e. removal, storage, transport, final disposal and possible re-use/recycling) while minimizing the end-of-life emissions and ensure safe end-of-life handling;
5. Provide advice for future regulation(s) addressing the safeguard of appropriate SF₆ end-of-life treatment and ensuring minimal SF₆ end-of-life emissions.

The Joint Working Group consists of members with a wide variety of experience from all over the world, dealing with SF₆-containing transmission and distribution equipment in all phases of its lifetime: From the equipment design, manufacturing and testing, commissioning at the installation site, operation, servicing, and decommissioning until the final (used) SF₆ gas treatment.

The Joint Working Group will discuss and record practical guidelines for SF₆ end-of-life treatment in relevant stages:

1. Preparation of the equipment for decommissioning, by establishing a checklist for preparatory work that has to be done before the physical decommissioning;
2. Equipment decommissioning procedures, including the recovery of SF₆, based on best available practices;
3. Formulate handling procedures for decommissioned equipment following SF₆ recovery to not simply treat the equipment as waste, but as reusable material depending on its contamination level. Procedures will vary for equipment containing non-arced gases, slightly arced gases or heavily arced gases as well as for failed equipment;

4. On-site storage of retrieved (used) SF₆, supplying information on how the gas may be temporarily stored on-site before being transferred to its final treatment;
5. Transport of retrieved (used) SF₆ in accordance with relevant legislative requirements and appropriate labelling;
6. SF₆ quality evaluation procedures that shall determine if the retrieved (used) SF₆ is ready for re-use after reconditioning or must be treated as waste;
7. Reconditioning of SF₆ for re-use, detailing its preconditions and available processes;
8. Final disposal procedures for non-reusable SF₆ which cannot be put back into any lifecycle and must be incinerated;
9. Recommendations to existing or new regulation(s) to safeguard appropriate SF₆ end-of-life treatment which will be based on a gap and best practice analysis. This will enable the regulators to review the local regulations and adapt accordingly.