

Green switching

Myths and facts about SF₆ versus SF₆ free Medium-Voltage switchgear

Myth: Switchgear that uses SF₆ gas is more efficient and environmental friendly

Facts:

Manufacturers of switchgear that uses SF₆ gas claim that SF₆ gas has a cooling effect on the conductors and that for this reason a network based on this type of equipment is more efficient. This might be the case for High-Voltage (HV) equipment where the gas is used for electrical insulation purposes and the manufacturers also make use of the cooling effect of the gas by convection. This is though only applicable for larger tanks, larger pressure and larger currents. For MV switchgear however, this principle is not used as much, as the volume and pressure of the SF₆ gas are much lower. Also, there are alternative cooling principles that are as efficient that do not use SF₆ gas.

SF₆ gas free MV switchgear has to comply with all relevant IEC standards, such as IEC 62271-1, IEC 62271-100 and IEC 62271-200, as well as being of a compact and efficient design. The environmental impact of the switchgear is determined by a Life Cycle Assessment (LCA), where the carbon footprint of the product is determined over the manufacturing, full service life and end of life phase. Based on the output of various LCA's it is proven that SF₆ gas free MV switchgear is as good as, perhaps even superior, from an efficiency and environmental point of view to MV switchgear that uses SF₆ gas.

Myth: SF₆ free switchgear requires more space

Facts:

This claim is unfairly based on two comparisons: on the one side a comparison of High-Voltage switchgear, where outdoor Air Insulated Switchgear (AIS) has indeed a bigger footprint than compact Gas Insulated Switchgear (GIS) which uses SF₆ for insulation. On the other side the comparison that is sometimes used is large and old-fashioned Air Insulated Switchgear (AIS), where the size is also larger than the more compact SF₆ insulated MV switchgear. However, both comparisons are unfair as for over 10 years modern SF₆ free MV switchgear has been available that is just as compact as SF₆ MV switchgear. This modern compact SF₆ free switchgear is available for ratings up to 24 kV, and the technical performance is perceived as equal or even better than its SF₆-containing equivalents.

Myth: SF₆ switchgear has a longer lifespan

Facts:

Manufacturers of SF₆ switchgear claim that SF₆ MV switchgear has a longer lifespan due to the fact that all primary parts are situated in a stainless steel tank. However, experiences in the field from several large utility and industrial users show that this is not the case. Due to the daily and annual temperature cycle, the gaskets that are used to keep the SF₆ gas contained wear, and this over time results in leakage. Due to the leakage of SF₆ gas into the environment the insulation level decreases, which will eventually lead to a critical failure. Independent research by a reputable test laboratory [1] has shown, that 40% of the switchgear that has been tested does not meet the guaranteed lifespan claims of the manufacturer.

Myth: SF₆-free switchgear needs more maintenance**Facts:**

Manufacturers of SF₆ MV switchgear claim it needs less maintenance than SF₆ free MV switchgear. This might be the case for withdrawable Air Insulated Switchgear, where utilities and industrial users typically use preventive maintenance schemes to check the condition of the vacuum circuit breakers and relays every 5 years. This might also be the case for older types of compact solid insulated switchgear, that doesn't have a sealed enclosure. Due to severe ambient conditions, humidity, dust and aggressive gases, the primary parts of this open switchgear might be impacted, leading to a need for a more intensive maintenance scheme of at least every 10 years. This is though not the case for modern, compact, SF₆ free MV switchgear where all primary parts and the mechanisms are housed in a hermetically sealed enclosure. Modern SF₆ free MV switchgear is maintenance free for at least 25 years.

Myth: There is not an alternative to using SF₆ switchgear**Facts:**

This is not true, as firstly, all manufacturers that produce SF₆ MV switchgear also produce SF₆ free Air Insulated Switchgear, suitable for IEC ratings up to 36 kV. Secondly, and most importantly SF₆ free MV compact switchgear is also widely available from several manufacturers and has been used since the 1990's. Compact SF₆ free switchgear is available from various European manufacturers, and the continued use of SF₆ gas is a critical issue which is publicly recognized by large manufacturers such as Eaton, Schneider [2] and Mitsubishi [3].

Myth: The effect of SF₆ switchgear on climate change is insignificant**Facts:**

Manufacturers of MV switchgear that uses SF₆ gas claim that the contribution of SF₆ to climate change is very low. This is based on a current contribution figure of 0.01%. Indeed at first glance this is a small percentage yet it only tells half the story as the concentration of SF₆ gas in the atmosphere is increasing by 8% per year and the contribution is already more than the equivalent of 200 Mt CO₂ equivalents per year. Scientific research [4 & 5] shows that, without significant measures to eliminate SF₆ emissions, the annual global emissions of SF₆ gas will continue to increase and the contribution to climate change will be the equivalent of 500 Mt CO₂- by 2050. The Global Warming Potential of SF₆ is 22,800, and this will increase over time as the gas blocks infrared light at specific wavelengths that are not blocked by any other greenhouse gas.

Other factors to consider are that the lifetime of SF₆ in the atmosphere is more than 3000 years, and once in the atmosphere, it will stay there for 3 millenniums. For this reason SF₆ gas is listed in the Kyoto Protocol as one of the substances of which the emissions should be eliminated. Sweden and Australia already have specific legislation that prohibits the use of SF₆ when alternatives are available, or legislation that tax the import and use of SF₆. There are also voluntary agreements in several other countries to minimize the emissions from SF₆ switchgear. Despite these measures the annual global SF₆ gas emission rate is currently more than 70% of the annual production rate, which stands at around 10,000 tons SF₆ gas per year.

References

1. Yvan Tits et al., Lifetime estimation of SF₆ MV switchgear according to on-site conditions in DNO's distribution networks. CIRED 21st International Conference on Electricity Distribution, Frankfurt 2011.
2. <http://www2.schneider-electric.com/documents/product-services/en/product-launch/premset/premset-brochure.pdf>
3. <http://www.mitsubishielectric.com/company/environment/ecotopics/technologies/prod/switchgear/index.html>
4. Levin et al., The global SF₆ source inferred from long-term high precision atmospheric measurements and its comparison with emission inventories. Atmospheric Chemistry and Physics, 2010
5. Rigby et al., History of atmospheric SF₆ from 1973 to 2008. Atmospheric Chemistry and Physics, 2010