

# High Voltage Switchgear and Sulfur Hexafluoride

## Background

Moisture in Sulfur Hexafluoride ( $\text{SF}_6$ ) an insulating gas can cause rapid and severe deterioration of high-voltage switchgear.

During electrical power distribution at transmission voltages (ranging typically from 100 to 400 kV), power switching or load current interruption is a major problem as a result of arcing between the two contact points. The insulation properties of  $\text{SF}_6$ , used to pressurize such switchgear enclosures, effectively control arc formation. However, the entry of moisture over time results in electrical discharge, causing the  $\text{SF}_6$  to decompose into byproducts, such as hydrolysable fluorides.

These fluorides are good dielectrics and their presence does not impair the operational efficiency of the respective equipment. However, this only applies when the moisture content of the gas or its enclosure is low. In the presence of water vapor, the by-products include the highly corrosive HF, which accelerates switch contact corrosion to the point of physical breakdown. The aggressive nature of HF means that the damage may spread to the surrounding areas of the switchgear enclosure causing further damage. The moisture content of the gas must be maintained to a minimum to avoid the formation of this acid.

It is also important to maintain low moisture levels, to avoid condensation with the potential for leakage current across the surface of insulating parts.

## Measurement Technique

Moisture measurements are important at the following stages:

- Checking the moisture content of new  $\text{SF}_6$  in cylinders by industrial gas producers prior to supply and immediately prior to use by the switchgear manufacturer or transmission company.  $\text{SF}_6$  cylinders appear to be particularly susceptible to moisture ingress in storage.  $\text{SF}_6$  in good condition should have a moisture content of  $<10 \text{ ppm}_v$  equivalent to dew point  $<-75^\circ\text{F}$  dew point (at atmospheric pressure).
- Dry gas purging of new switchgear enclosures during the final stage of manufacturer or following internal maintenance work prior to pressuring and sealing with  $\text{SF}_6$ . Most commonly, high purity nitrogen or another inert gas from cylinders is used, by repeated pressurization and venting to atmosphere, until the moisture content within the enclosure has been reduced to  $<10 \text{ ppm}_v$  equivalent to dew point  $<-75^\circ\text{F}$  dew point (at atmospheric pressure).
- In service checks and continuous monitoring to ensure that moisture content in the  $\text{SF}_6$  is maintained below the critical level of  $100 \text{ ppm}_v$ ,  $-40^\circ\text{C}$  dew point (at atmospheric pressure).

For all of these applications, use the Hygroport Portable Hygrometer. This portable, easy to use instrument responds rapidly and displays moisture content in a variety of engineering units, including  $\text{ppm}_w$  for  $\text{SF}_6$ . Up to 320,000 measurement points can be stored with its built-in data logging facility and then quickly downloaded to a PC with a bluetooth wireless connection.



Hygroport Portable Hygrometer

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