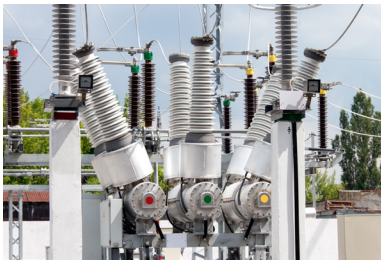
Application Note

INTEGRAL LEAK TESTING OF INSULATED SWITCHGEARS FOR SF_6 EMISSIONS



SF_6 gas-insulated switchgear at an outdoor substation.

The Opportunity

Photoacoustic SF_6 Leak Detectors are market-leading instruments to perform integral leak testing on gas-insulated switchgear and to check compliance against international standards.

With the global trend moving toward more high-voltage and ultra-high-voltage infrastructures in the Transmission and Distribution industry, more and more SF_6 gas-insulated switchgears (GIS) are being used.

Since SF_6 is the most potent greenhouse gas with an extremely high global warming potential, emission standards are being enforced by regulating authorities. At the same time, no viable alternative to SF_6 exists in the short term for the power industry, so stakeholders have been proactive and set in place voluntary action plans to define more stringent emission standards for the design, manufacturing, and operation of SF_6 GIS.

Monitoring Needs

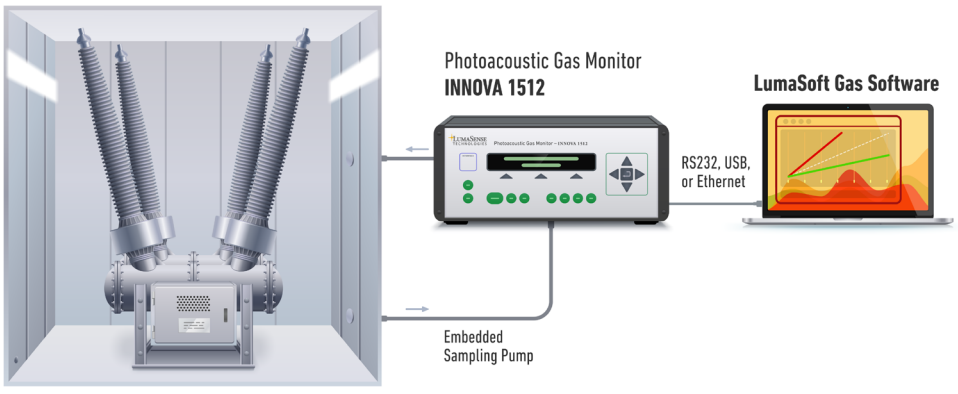
Highly sensitive gas monitors have become necessary components of integral leak tests, which are required to verify the conformity of switchgears with the low permissible leakage rates as defined in those international standards, and to enable self declarations by OEMs.

These integral leak tests, also known as cumulative sealing tests or tightness tests, are the preferred test method for type testing of medium-voltage and high-voltage GIS according to the IEC 62271-1.

Some GIS manufacturers have chosen to use integral leak tests, not only for type testing, but also for their routine testing in order to reduce their overall manufacturing cycle time.

To meet this short cycle objective, while also meeting the low SF_6 leakage rates defined by industry standards, a highly sensitive, stable, and accurate gas analyzer is needed in the ppb to sub-ppm range.

Fully assembled GIS units (such as dead tank breakers) filled with SF_6 at their nameplate capacity are routinely tested in large volumetric test chambers to check their compliance with the maximum allowable leak rate. The integral leakage rate is determined from the temporal increase of the SF_6 concentration in the accumulation volume containing the test object. Pass/Fail criteria is typically checked after 30 to 45 minutes.



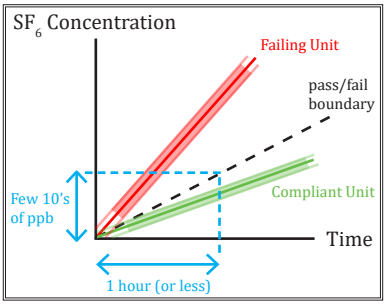
INNOVA 1512
Photoacoustic Gas Monitor

Our Solutions

Based upon state-of-the-art photoacoustic IR spectroscopy (PAS), the INNOVA 1512 has a low detection limit of 6 ppb. The gas samples are drawn directly from the test chamber and are automatically compensated for spectroscopic interference from water vapor IR absorption, as well as the pressure and temperature effects.

Where applicable, the SF_6 leak detector can be bundled with an INNOVA 1409 Multipoint Sampler enabling either the parallel monitoring of multiple test chambers from a unique PAS analyzer, or enabling the sampling from multiple locations in a unique chamber.

The LumaSoft 7820 (single channel) or 7880 (multiple channel) application software completes the system with user-friendly graphical interfaces to setup and supervise the leak monitor. Finally, the design of the PAS sensing platform offers great analytical flexibility: the simple addition of optical filters make it possible to measure alternative gas or insulating gas mixtures.



The integral leak rate is determined from the SF_6 concentration build-up rate in the test chamber's free volume. Pass/Fail criteria have to be set based upon the chamber dimensions and the switchgear characteristics (external envelope volume, SF_6 nameplate capacity) while also accounting for minimal measurement uncertainties.

Measurement Results

Within a test cycle of 30 to 45 minutes, the SF_6 concentration will not increase more than a few tens of ppb. The INNOVA 1512 is accurate enough to measure true quantitative values at this low detection limit. It leverages the photoacoustic technique to feature a strong accuracy and linearity over a high dynamic range (minimum 4 decades with a 1-point span calibration). As a result, the test procedure can be applied with the same efficiency and quality on the results as long as the "zero" offset (initial background concentration) is properly measured.

Additional Reference Documents

- IEC 62271-1: Common specifications for SF_6-insulated and air insulated high-voltage switchgear and controlgear
- CIGRE Technical Brochure No. 430 (Working group B3.18): SF_6 Tightness Guide

Your Benefits

- ✓ **Operational advantages: fast and reliable leak monitoring**
- ✓ **Minimal operation & maintenance costs: no consumable, "zero" calibration**
- ✓ **Easily expandable to other/different gas(es) by selecting a different optical filter**
- ✓ **Best-in-class quantitative leak detection method in a reference document of the industry: the SF_6 Tightness Guide issued by CIGRE**
- ✓ **Highly selective measurement of SF_6 with minimal cross-interferences**

Contact your LumaSense applications engineering representative for more details on integrated solutions.

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