

INTEGRAL LEAK TESTING OF INSULATED SWITCHGEARS FOR SF₆ EMISSIONS

The Opportunity

Photoacoustic SF₆ 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 SF₆ gas-insulated switchgears (GIS) are being used.

Since SF₆ 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 SF₆ 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 SF₆ 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.

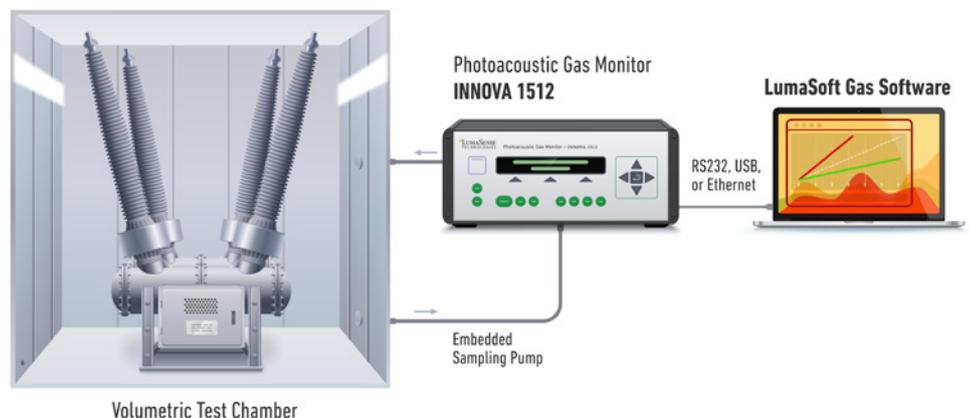
Some GIS manufacturers have chosen to use integral leak tests, not only for type testing, but also for their routine testing in order to reduce their overall manufacturing cycle time.

To meet this short cycle objective, while also meeting the low SF₆ leakage rates defined by industry standards, a highly sensitive, stable, and accurate gas analyzer is needed in the ppb to sub-ppm range.



SF₆ gas-insulated switchgear at an outdoor substation.

Fully assembled GIS units (such as dead tank breakers) filled with SF₆ 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 SF₆ 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 SF₆ 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.

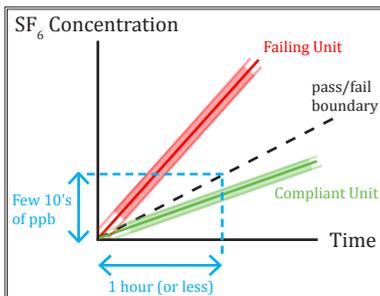
The LumaSoft 7820 (single channel) or 7880 (multiple channel) application software completes the system with user-friendly graphical interfaces to setup and supervise the leak monitor. Finally, the design of the PAS sensing platform offers great analytical flexibility: the simple addition of optical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

Measurement Results

Within a test cycle of 30 to 45 minutes, the SF₆ 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 SF₆-insulated and air insulated high-voltage switchgear and controlgear
- CIGRE Technical Brochure No. 430 (Working group B3.18): SF₆ Tightness Guide



The integral leak rate is determined from the SF₆ 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, SF₆ nameplate capacity) while also accounting for minimal measurement uncertainties.

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 SF₆ Tightness Guide issued by CIGRE
- ✓ Highly selective measurement of SF₆ with minimal cross-interferences

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

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