

## The conditions of gas tightness of gas insulated switchgear according to standards versus warranty aspects

Assuming that high-voltage<sup>1</sup> gas insulated switchgear is designed and tested in accordance to the IEC 62271 series International Standards, IEC 62271-1 defines specific requirements (shown in the extract here below) in terms of gas tightness, depending on the selected tightness design: sealed pressure system or closed pressure system. In principle, the statements made in this document are also applicable to other high-voltage equipment not subject to the IEC 62271 series of standards (for example, gas-insulated high-voltage transformers – IEC 61869-1). Depending on the selected tightness concept, a distinction is made between closed pressure systems or sealed pressure systems.

### 5.15.2 Closed pressure systems for gas

*The tightness characteristic of a closed pressure system and the time between replenishment under normal service condition shall be stated by the manufacturer and shall be consistent with a minimum maintenance and inspection philosophy.*

*The tightness of closed pressure systems for gas is specified by the relative leakage rate  $F_{rel}$  of each compartment; standardized values are:*

- For SF<sub>6</sub> and SF<sub>6</sub>-mixtures the standardized values are 0,5 % and 1 % per year.
- For other gases the standardized values are 0,5 %, 1 % and 3 % per year.

*The value for the time between replenishment shall be at least 10 years for SF<sub>6</sub> systems and for other gases should be consistent with the tightness values.*

### 5.15.3 Sealed pressure systems

*The tightness of sealed pressure systems is specified by their expected operating life.*

*The expected operating life with regard to leakage performance shall be specified by the manufacturer. Preferred values are 20 years, 30 years and 40 years.*

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<sup>1</sup> high-voltage comprises any nominal voltage above 1 kV;

*NOTE: To fulfil the expected operating life requirement, the leakage rate for SF6 systems is considered to be 0,1% per year*

Product standards are developed on a voluntary basis and define design specifications. Taking advantage of this, switchgear manufacturers use these specifications to define and verify the design of the switchgear by type testing. In compliance with those standards, every manufactured switchgear passes a series of routine tests before leaving the factory, including, in the case of gas insulated switchgear, a tightness test. These tests demonstrate that the switchgear is correct and, in particular, the tightness test ensures that there is no leakage in excess of that determined in the type test.

Decisive for the compliance with the specified characteristics are the design of the components and the materials used. They are selected according to the defined operating conditions in the series of standards applicable to the product. The different aspects of the operating conditions and defined maintenance program are part of the validation of the product design in accordance to the specific standards or customer agreement.

Therefore, the tightness of the switchgear is a technical characteristic similar to other technical characteristics such as the rated current or voltage withstand of the switchgear. Based on the above-mentioned relationship the mentioned technical characteristic (i.e. tightness) is valid only under the specific service and operating conditions, and maintenance the switchgear is designed for. Such as, for example, ambient temperature and humidity, environment pollution (e.g. salt deposits and corrosive gases), maximum number of mechanical and electrical operations, etc.

In addition to the operating conditions, given in the standard, all measures which are defined in the product's instructions manual must be respected, to assure the tightness over the expected life time. In the past an expected life, in operation, of 20 or 30 years was considered. However, since a few years, 40 years are commonly used to define the design parameters.

The following list gives an overview of factors and events which can have an impact on the gas tightness of the switchgear:

- Damages during transportation which might be not visible in the first moment
- Mistakes during installation and commissioning of the switchgear, like damage of bushings or drilling of holes into the gas tank to fix signal plates
- Improper handling of valves, tubes and plugs during gas top-up or gas analysis

- Operation of the switchgear outside the specification e.g. under corrosive environmental conditions
- Improper operation by the operator such as undue application of forces
- Force majeure like flooding or thunderstorm damages
- Incomplete implementation of required inspection or maintenance measures
- Use of non-original spare parts
- Installation by unauthorized and/or untrained persons

As indicated by the list given above, several factors and events can have an influence on the gas tightness of the switchgear before, during the installation and throughout its service life. Most of them are outside of the manufacturer's control, and correspondingly out of its responsibility. Therefore, a commercial warranty over the whole service life, in particular, in terms of the tightness can't be given in a trustworthy manner.

In addition, it must be pointed out that the compliance to the specified characteristics doesn't imply a commercial warranty definition. Much more, the technical specification and description is only a component of a commercial contract. In the business to business relationship the commercial contract is the leading document and the technical specification is like an attachment. The contract defines all commercial aspects including the warranty conditions, which must be negotiated between supplier and customer.

In general, warranty periods for the electrical industrial goods and, in particular, for the high-voltage switchgear depend either in the particular National Laws and Regulations or in the bilateral commercial conditions agreed between the manufacturer and the customer.

## Conclusion

T&D Europe's position is that the compliance with international standards on gas tightness of gas insulated switchgear is a commitment on the design performance. The warranty period for this design performance is not defined by a standard but depends of applicable laws or agreed contractual conditions of specific contracts.

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