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QUESTION N° : 7

Some lifetime factors of SF_6 alternatives: a point of view from utility

1. Long-term leakage of SF6 alternatives and influence of filling pressure

The filling pressure of equipment with natural-origin gases is often above 1 MPa (vs. about 0.7 MPa for SF_6). It is necessary to verify the influence of higher pressure on leakage rate of equipment.

To investigate the relationship between long-term leakage and filling pressure, leakage data of two families of 245 kV SF_6 circuit breaker installed in our network have been studied. The observation period is between 2011 and 2020. The two families have approximately the same average age of about 35 years old.

- Family 1: this family of 245 kV circuit breaker has a filling pressure of 0.35 MPa relative. This family represent a park of about 350 equipment on our network.
- Family 2: this family of 245 kV circuit breaker has a filling pressure of 0.7 MPa relative. This family represent a park of about 850 equipment on our network.

To quantify the leak of each family, the number of SF6 refill in operation has been used. Due to lack of monitoring data, each time the pressure drop to refill alarm, operator must realised a refill in service. Each refill is counted as one leak. The result is presented in Figure 1.

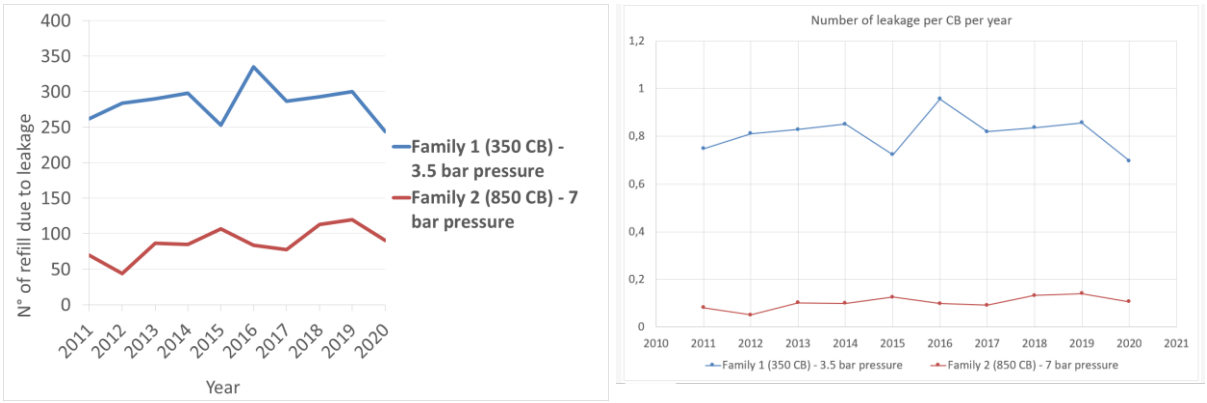

Figure 1 : Leakage for family 1 (350 CB at 0.35 MPa) and family 2 (850 CB at 0.7 MPa) during the period 2011 – 2020, by total number (left) and per CB per year (right).

The result show that family 2 has far less leakage than family 1, both in total number and in number of leakage per CB per year. The filling pressure of family 2 is much higher than that of family 1. Thus, it can be concluded that the filling pressure is not a decisive factor for leakage. It is more related to the design of equipment.

For alternatives with a higher filling pressure than SF_6, it should be possible to have an equivalent leakage rate with SF_6 if the equipment is properly designed. Sealing material should be chosen carefully to be compatible with alternative gases.

2. Tolerance of mixture's composition

During the lifetime, the composition of a mixture can changed due to leakage and/or arcing. From the utility point of view, it is necessary to have a clearly defined tolerance for each gas mixture. This tolerance should be defined by manufacturer and should be verifiable by appropriate measurement devices.

It is also important to have a well calibrated measurement device. As shown in Figure 2, bad calibrated measurement device can give a wrong composition of the mixture.

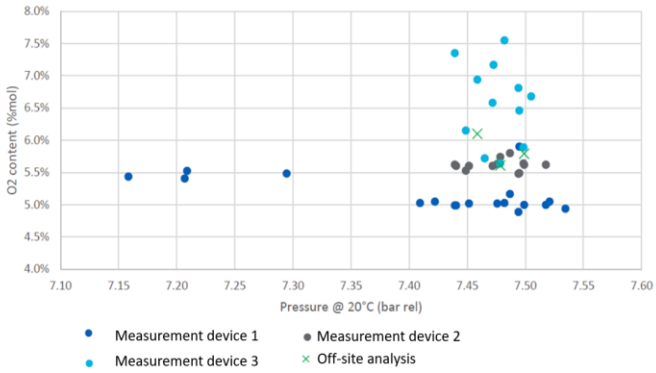

Figure 2 : Measurement of mixture's composition by different devices after two years in service. Measurement device 3 was not well calibrated.

3. Loss of vacuum and perspective of measure or monitoring vacuum quality

For vacuum technology, loss of vacuum in vacuum interrupters can be a long term risk, even though the probability of this failure is quite low (Cigré TB 589).

It is not easy today to verify the quality of vacuum in service. It is interesting to study/develop in service measurement technique or monitoring device to monitor the quality of vacuum in the future.