

Some lifetime factors of SF₆ alternatives : a point of view from utility

SCA3 PS2/Q7 :

The filling pressure of equipment with natural-origin gases is often above 1 MPa. Is there any experience or an estimate on the long-term leakage or other lifetime limiting mechanisms, including mechanical damage, deformation of internal parts, e.g., vacuum interrupters at 0 MPa?

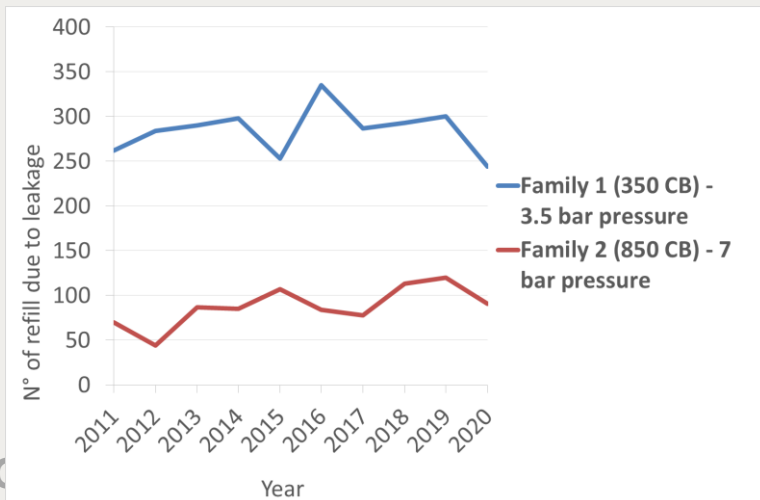
N-M.NGUYEN, France



Lifetime of SF₆ alternatives : a point of view from utility

Experience with SF₆ circuit breaker 3.5 bar vs. SF₆ circuit breaker 7 bar. Does pressure have a direct influence on leakage ?

- Two families of 245 kV SF₆ circuit breaker has been studied to verify the influence of filling pressure on leakage.
 - o Family 1 : about 350 CB, filling pressure 3.5 bar relative.
 - o Family 2 : about 850 CB, filling pressure 7 bar relative.
- Data collected during period 2011 – 2020 show that family 2 (7 bar) is far better than family 1 (3.5 bar).
- **No direct link between filling pressure and leakage rate has been observed.**



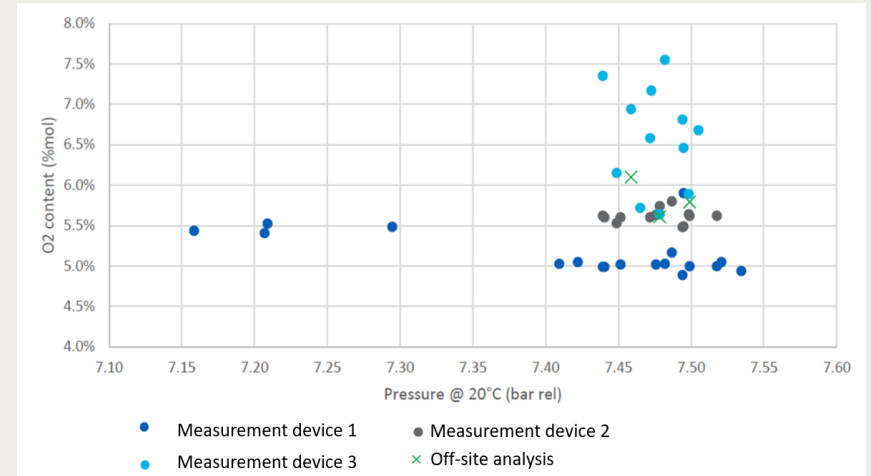
N° of leakage from 2011 to 2020

- *A higher pressure of gases should not have a direct influence on long term leakage if equipment is properly designed. Sealing material should be chosen carefully to be compatible with alternative gases.*
- *From security point of view, higher filling pressure can cause higher damages in case of explosion. For this reason, polymer insulators should be used for SF₆ alternatives equipment.*

Lifetime of SF₆ alternatives : a point of view from utility

For gas mixtures : the composition of mixtures might change over time (due to leakage and/or arcing). A tolerance of gas mixture should be defined and should be verified during the lifetime of equipment.

- From utility point of view, the tolerance of the mixture's composition should be clearly defined by manufacturers.
- It is important to verify the mixture's composition during maintenance operations with appropriate measurement equipment.



Measure of O₂ content in a gas mixture after two years in service. Measurement device 3 was not well calibrated.

Lifetime of SF₆ alternatives : a point of view from utility

For vacuum interrupter : vacuum level might be deteriorated over time.

- 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 measurement technique or monitoring device to verify quality of vacuum in the future.