Study Committee B3

Substations and Electrical Installations

Paper ID – 1082

First F-gas-free and climate-neutral insulated 420 kV GIS busducts installation at TransnetBW

Mark KUSCHEL[1], Laurentiu-Viorel BADICU[2], Jochen CHRISTIAN[2], Mario KIEPER1, Kerstin KUNDE[1], Udo PRUCKER[3], Jörg RIEDL[1]

[1]Siemens Energy, [2]TransnetBW, [3]Trench Germany

Motivation

- Favourable timing to test a new SF_6 alternative, as this pilot project is part of a large infrastructure project (reconstruction of Daxlanden Substation)
- Gaining own experience with an SF_6 alternative, that contains only atmospheric natural origin gases
- Saving of around 60 % of the entire SF_6 quantity of this project, by replacing it in the GIBs with a total length of 4000 m

Selection of the SF_6 alternative

- Gas handling: reduced complexity compared to SF_6, without special precautions in normal operation and in the event of an incident
- GWP = 0 (TransnetBW requirement: GWP < 1)
- The selected alternative enables a climate-neutral operation beyond 2050 as well

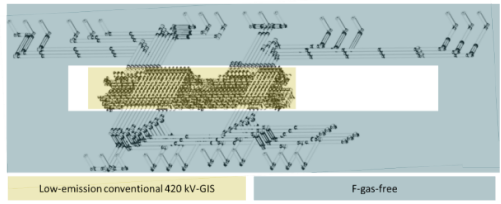
420 kV F-gas-free GIB technical data

Highest voltage of equipment	420 kV
Rated frequency	50 / 60 Hz
Rated short time current / Time	63 kA / 3s
Rated BIL	1425 kV
Rated SIL	1050 kV
Power frequency withstand voltage	650 kV
Rated continuous current	5000 A
Rated peak withstand current	170 kA
Ambient temperature	-50…+40°C

Conclusion

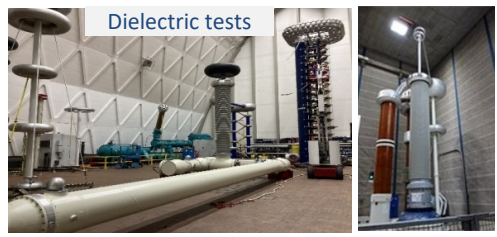
- The SF_6 saving potential of the GIB is very high. At the same time, the risk failure of such modules is rather low.
- Onsite testing of SF_6-free equipment through pilot projects is necessary in order to gain field experience with the new technologies and their handling.
- The replacement of SF_6 by gas mixtures of natural gases is safer concerning the future regulation changes.
- TransnetBW will keep on installing and testing SF_6-free equipment based on atmospheric natural gases for GIS and AIS from all prequalified suppliers.

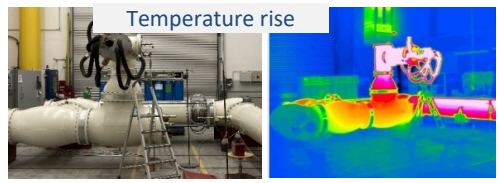
New substation Daxlanden after rebuild

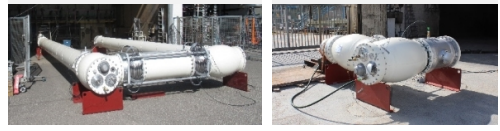


*Only the GIS-C1 is shown as an example. The GIS-C2 is executed identically

Exemplary type tests impressions







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Clean Air operational experiences

The positive operating experience and increasing installations show that Clean Air is suitable for replacing SF_6 as an insulating gas up to 420 kV.

With Clean Air the same reliability and MTBF can be expected as with SF_6 equipment. In fact, no major failures have been recorded so far.

Exemplary Clean Air installations

First life tank CB with vacuum interrupter and Clean Air were installed already in 2010. Meanwhile LT, DT, Instrument Transformers and GIS are installed worldwide in all climatic zones.

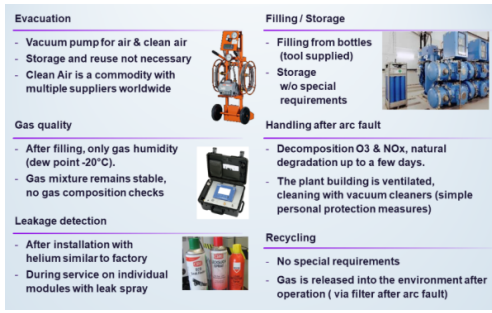
Design overview of the 420 kV GIB

To ensure the dielectric performance the dimension and pressure of Clean Air is increased in comparison to SF_6. The related bursting type tests were successfully passed.

Busducts comparison	SF_6	Clean Air
Tightness in % pro year	< 0,1	< 0,1
Filling pressure rel. at 20 °C in MPa	0.56	1.08
Gas weight in kg/m	3,5	3,3
GWP_{System} in t CO_2-eq. / 100 m	26.460	0

Clean Air gas handling

Clean Air enables much simpler, safer and faster gas handling!



Life cycle assessment (LCA)

- With Clean Air the CO_2 footprint is significantly lower, the materials have a marginally influence
- In a CO_2-neutral economy only the gas remains climate-impacting as the needed energy will be generated by renewables without any CO_2 emissions
- Hence, Clean Air enables climate-neutral power grids without CO_2 compensation

LCA CO_2 Footprint according ISO 14040 [1)]