SF6 Gas Management

Greenhouse Gas Management Services

Sutergy offer a full portfolio of Sf6 gas management systems for the power sector from Dilo GmbH, a leading SF6 management systems producer from Germany.

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Sutergy is your partner for SF_6 (Sulfur Hexafluoride) Gas Management Systems

SF_6 (Sulfur Hexafluoride) Gas Management in West Africa

SF_6 is a synthetic, very stable, chemically inert, nonflammable, and nontoxic and in normal conditions it does not react with other substances. It is colorless and odorless, and five-times heavier than air (under normal conditions). It also has good sound insulation properties since the speed of sound in SF6 is one third of that in air, making SF6 a good phonic insulator. It slowly mixes with air by convection and diffusion, and once mixed, does not separate. As it does not react with other gasses, it has a very long life.

SF_6 in the Power Sector

SF_6 was developed for use as an electrical insulating medium for the power industry. Due to its outstanding insulation characteristics (unique electrical insulation and arc interruption capability), it is used as an insulator and switching gas for gas-insulated and air-insulated switchgear and transformers and to reduce power circuit breaker interruption time. This helps to reduce interruption time thus enhancing power system stability. SF_6 gas is used in the commissioning of new high voltage (**HV**) and medium voltage (**MV**) switchgear and circuit breakers.

Applications in other sectors

SF_6 is also used to some extent in other sectors such as: in medical equipment such as x-ray machines and for electrical insulation in scientific equipment such as electron microscopes and particle accelerators. It was often also used for acoustic insulation in double glazed windows.

Greenhouse qualities of SF_6

SF_6 gas is itself not directly detrimental to the ozone layer however it is a highly potent greenhouse gas and has a Global Warming Potential (**GWP**)-Index of approximately 22,800 (i.e. it is 22,800 times more effective at trapping infrared radiation than carbon monoxide) Its GWP makes it the most potent known greenhouse gas. Its contribution is however less than one part in ten thousand of the total contribution of the other greenhouse agents and is thus negligible. Despite the very low percentage of SF_6 found in the atmosphere, the rate of growth is alarming since it can remain stable in the atmosphere for some 3,200 years making its management very critical for countries committed to climate projection.

SF_6 Gas Management Requirements in West Africa

African countries have also deployed a lot of **SF_6** power equipment besides old legacy SF_6 refrigeration systems and need to better manage such existing SF_6 bearing equipment.

Nigeria and its neighbors in West Africa should work towards compliance requirements for SF_6 recovery and disposal especially at the end of life of key systems containing SF_6 gas such as circuit breakers in the power transmission sector to reduce environmental risk.

The electric power industry and legislators in Africa need to work together to reduce SF_6 emissions to technically and economically feasible levels, thereby helping to reduce global climate change. The power sector needs to be proactive in its voluntary maintenance and reporting procedures as alternate drastic legislation to restrict the use of SF_6 would be extremely inconvenient to the power industry as against a gradual replacement process.

SF_6 Gas Management

Besides that SF_6 content of the power equipment need to be managed (filling, refilling, quality monitoring and SF_6 gas leak detection). Besides that come potential future requirements for logistics and inventory reporting to regulatory bodies such as the ministry of Environment due to the green gas character of SF_6. In the decommissioning phase of SF_6 –filled power equipment such as switch gear and circuit breakers the residual SF_6 in the systems need to be reclaimed and stored as well as properly disposed of or recycled back to technical grade standard IEC 60376 where the gas has been contaminated.

Some of the main advantages of deploying our SF_6 management systems include:

Reduced damage to switchgear and circuit breakers due to reduced protection caused by contaminated low quality SF_6 gas in the systems.

Early detection of SF_6 leakages to reduce damages identified above as well as save cost of SF_6 gas refill required and protection of the environment from unplanned emission of SF_6 into the environment. The result should be an improvement of the switch-gear and circuit breaker gas management capabilities of the system operators such as the Transmission Company of Nigeria (**TCN**).

Enable a support of Nigeria's commitment to reducing the emission of greenhouse gases such as SF_6 though environmental protection policies.

Hazardous By-Products:

Though SF6 is an inert gas its decomposed components (as a result of electrical arcing or naked flames) are toxic and hazardous, especially highly corrosive acids which result from contact of hazardous decomposition by-products of highly arched SF_6 gas with water. This also makes them dangerous for humans.

This hazardous by-products also make it necessary to have well trained maintenance teams put in charge of controls, fling and refilling processes for SF_6 gas in the Nigerian powergrid, e.g. by ensuring that contaminated cylinders and or valves and cables are not used for clean SF_6 gas. More importantly there is a need to ensure that staff members are the right protective gear when working on maintenance procedures requiring quality test refill or decommissioning of SF_6-filled systems.

Potential hazards can be classified as follows:

- Hazardous concentration (exceeding TLV) of SF_6 toxic by-products (SOF_2, SO_2, and HF) causing injury or death.

- Hazardous concentration (exceeding TLV) of SF_6. Since SF_6 gas is heavier than air, it can displace breathable air in enclosed areas such as in power plants causing injury through oxygen starvation.
- Over-pressurization of vessel, catastrophic failure by explosion, causing injury or death. This has also been very rare due to quality and pressure levels of filling equipment.
- Overheating of gas container compartments due to heat, causing catastrophic failure by explosion with resulting causing injury or death.
- Power switchgear and circuit breaker failure due to insufficient insulation and resulting loss of electricity supply.

SF_6 and power grid stability

The occurrence of the first four potential hazards identified above in real operations are very rare, but the last insulation related hazards need to be better documented in Nigeria especially in connection with the spate of blackouts and substation mishaps in the last years. It is however noteworthy that decommissioned SF_6 -may require treatment to neutralize any decomposition products remaining after the SF_6 has been removed.

Standards and specifications for use of SF_6 gas

The IEC has provides specifications for the use of SF_6 gas which include:

- IEC 60376 specification for new SF_6 gas.
- IEC 60480 specification for used SF_6 gas.
- IEC 62271-4 SF_6 reuse specification.

Replacing SF_6 in the Power Sector

SF_6-free circuit breakers based on vacuum technology and Alternative gases to replace SF_6 in Power Grids

Global warming concerns have increased the drive to replace greenhouse gases such as SF_6 as their concentration in the air continues to rise. The global power industry is looking for ways to replace SF_6 with non-greenhouse gases with comparable positive qualities such as low toxicity and flammability and significantly reduced GWP values and/or a GWP values of almost zero.

Some alternative (mainly synthetic) gases have been developed and several switchgear manufacturers now offer a first set of systems with alternative gases some of which under certain circumstances can even replace SF_6 even in HV ranges.

For example, Grid Solutions, a GE and Alstom joint venture, has identified a fluoronitrile based gas mixture dubbed **g^3-green gas** for grid-that is such an alternative. **g^3**-green gas has a global warming potential 98% lower than SF_6 an is thus not a perfect but much better solution.

SF_6-free circuit breakers based on vacuum technology have also been developed and already deployed in some grids, SF_6 circuit breakers are however still the main components deployed in African grids and need to be adequately maintained.

Arced SF_6	This is SF_6 gas which has been subject to operations with breaking fault current. Arced SF6 gas is accompanied by a strong and irritating odor indicating toxic by-products mainly SOF_2.
GWP-Index	Global Warming Potential Index It is a quantified relative measure of how much heat a greenhouse gas traps in the atmosphere. It is defined as the cumulative radiative forcing – both direct and indirect effects – integrated over a period of time from the emission of a unit mass of gas relative to some reference gas (IPCC 1996). Carbon dioxide (CO_2) was chosen by the IPCC as this reference gas and its GWP is set equal to one (1). It compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a similar mass of carbon dioxide. A GWP is calculated over a specific time interval, commonly 20, 100, or 500 years. GWP is expressed as a factor of carbon dioxide (whose GWP is standardized to 1).
HF Acid	Hydrofluoric (HF) acid. It is a toxic breakdown product of SF6. It is typically in gaseous form due to its boiling point of approximately 19°C. It is important to note that the symptoms of exposure to HF are often delayed. It however does not have a very long life due to its high reactivity.
IEC	The International Electrotechnical Commission. http://www.iec.ch/
PPE	Personal Protective Equipment
SF_6	Sulfur Hexafluoride
SO_2	Sulphur dioxide. This is a toxic breakdown product of **SF_6** gas.
SOF_2	Thionyl fluoride. It is a toxic breakdown product of SF6. It a colorless gas which decomposes over time in the presence of moisture into SO_2 and HF and condenses at approximately -43°C. It has a pungent odor (akin to rotten eggs),
TLV	Threshold Limit Value. Potentially toxic gases are assigned a value known as TLV, which is expressed as a concentration in the air, normally in parts per million by volume (**ppmv**). The TLV is a time-weighted average concentration at which no adverse health effects are expected, for exposure during 8 hours per day, for up to 40 hours per week.