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feb/mar 19





# CHOOSE TO REUSE: ENVIRONMENTAL

## BENEFITS OF RECONDITIONED

# SF<sub>6</sub>

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**W**hen it comes to medium and high voltage circuit breakers, there is no better electrical insulator than sulfur hexafluoride (SF<sub>6</sub>). The manufactured gas is most commonly used to fill circuit breakers within utility substations to prevent and quench arcing events. Transmission substations transfer high voltage power to distribution substations, which subsequently disperse the incoming electricity to lower voltages suitable for consumers on power grids. Both transmission and distribution circuit breakers are vulnerable to arcing events, which can be triggered by power surges, partial discharges and lightning strikes.

SF<sub>6</sub>'s impeccable dielectric strength, arc quenching capabilities and resilience to remain thermally stable are just a few reasons why this gas has remained a staple in the transmission and

distribution (T&D) industry. It has been the preferred gas in switchgears for over 50 years.

### Two Types of SF<sub>6</sub>

Sulfur hexafluoride is available in two types: virgin SF<sub>6</sub> and reconditioned SF<sub>6</sub>. Virgin sulfur hexafluoride is generated overseas in Europe and Asia. Its production is a known source of green-

house gas emissions. According to the *Environmental Science & Technology Report*, SF<sub>6</sub> production in China contributed to 10 percent of gas emissions from the country between 1990 and 2010. This is a huge environmental concern due to the long atmospheric lifespan of SF<sub>6</sub> – an astounding 3,200 years.

Moreover, virgin SF<sub>6</sub> impacts climate change as the gas is highly potent. SF<sub>6</sub> has a global warm-

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**Figure 1:** SF<sub>6</sub> gas separator, which uses a cryogenic process to recondition contaminated SF<sub>6</sub> gas to >99.99% purity

ing potential (GWP) of 22,800. To help put this into perspective, one pound of virgin SF<sub>6</sub> released into the atmosphere has the same effect as 11 tons of carbon dioxide. With the results of multiple research studies regarding the effects of emissions and by-products, it is surprising to learn that some original equipment manufacturers (OEMs) for circuit breakers and electrical utilities are proponents for utilizing only virgin SF<sub>6</sub>.

Reconditioned SF<sub>6</sub>, on the other hand, offers overwhelming benefits. After undergoing the correct cleansing/separation process, used SF<sub>6</sub> can be transformed to a new condition and offers the following advantages:

- Unlike air and oil – the first used insulating mediums in the industry – reconditioned SF<sub>6</sub> is 100 percent recyclable, which provides an ecological benefit in the reduction of the industry’s carbon footprint.
- An alternative to product disposal without increasing budgetary costs.

Additionally, virgin SF<sub>6</sub> poses a risk to the environment if emitted into the atmosphere. Preventing SF<sub>6</sub> emissions is possible with properly trained staff, reliable maintenance equipment and utilization of reconditioned gas.

Although SF<sub>6</sub> production is unavailable in the United States, there are a few suppliers who can provide reconditioned gas at premium grades that exceed the necessary standards for use in gas insulated equipment (GIE). Sourcing SF<sub>6</sub> locally can help greatly reduce the carbon footprint in North America without compromising the product quality or durability of GIE.

### SF<sub>6</sub> Reconditioning Programs

Generally, contaminated SF<sub>6</sub> goes unnoticed until a breaker fault is reported or during routine maintenance. SF<sub>6</sub> that does not meet International Electrotechnical Commission (IEC) and Institute of Electrical and Electronic Engineers (IEEE) standards is usually set aside for disposal. A more cost-effective and eco-friendly option is to reuse by participating in an SF<sub>6</sub> reconditioning pro-

gram. These programs guarantee locally available product to the end user while being mindful to the environment. Choosing to recondition gas in place of disposal discourages importation of virgin gas and, in turn, helps reduce SF<sub>6</sub> emissions from not only the creation process, but from exhaust or fuel emissions that take place during transport to North America.

An additional advantage for sourcing reconditioned SF<sub>6</sub> is cost savings. Virgin gas is typically sold at a premium and guarantees a greater than 99.99 percent purity rating. What many users do not realize is that technology is currently available that can separate by-products and air from tainted SF<sub>6</sub>. The filtration process makes it possible for used SF<sub>6</sub> to reach federal and international standards for tech grade gas, all at a lower cost. This cost savings does not compromise quality. Whether your SF<sub>6</sub> supply is restocked with greater than 99.9 percent or 5/9 gas (99.999 percent), the result is the same: a circuit breaker filled with a reliable product that requires minimal maintenance (provided best handling techniques are practiced).

### Alternative Gases

As of late, alternative gases are a hot topic in the electrical sector. The negative impact of SF<sub>6</sub> emissions has pushed the industry to develop an alternate medium that is much safer for the environment. While implementing a substitute gas is possible, there are still various factors that make the elimination of SF<sub>6</sub> impractical.

The most notable alternative gases are comprised of gas mixtures. These special formulas require a special housing different from SF<sub>6</sub> com-



**Figure 2:** Analysis equipment measures purity and contamination levels in SF<sub>6</sub> gas





**Figure 3:** Cylinders used to store SF<sub>6</sub> gas

partments, necessitating a complete overhaul of T&D grids across North America. Most importantly, very little research has been completed regarding procedures for handling alternative gases that have been exposed to arcs. There are no known methods on how to recycle the gas mixtures for repeated use.

### Conclusion

From a technological view, there are no significant differences in the makeup of engineered virgin SF<sub>6</sub> and reconditioned SF<sub>6</sub> that has undergone a cryogenic process to remove by-products. Circuit breaker manufacturers and electrical utilities should consider the value of choosing to reuse and eliminate the specification for virgin gas in operational and maintenance procedures. The cultivation of alternative gases does show promise for the electrical industry's future, however, further examination of the by-products, maintenance procedures and recycling capabilities is needed before discounting SF<sub>6</sub> completely.

Reusing properly treated SF<sub>6</sub> removes the need for generating new product and, more importantly, helps lower the carbon footprint in the United States. As long as there is an option to reuse, there are no sound reasons for using virgin gas in circuit breaker applications. For now, reconditioned SF<sub>6</sub> is the alternative gas solution.

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