GE
Grid Solutions

National Grid

Begins Journey to SF_6-free HV Substations

CASE STUDY


Sellindge - Overall view during site works

The entire electrical transmission industry is buzzing over the technical achievement of energizing the first high voltage gas-insulated line (GIL) using an environmentally friendly alternative to SF_6. This SF_6 alternative insulation medium is called g^3. To date, there has been no alternative to SF_6 technology since its inception in the 1970's, when it was introduced as an insulation medium in high voltage (HV) switchgear.

Indeed, on April 13 2017, National Grid achieved a huge industry milestone with the energization of the first SF_6-free 420 kV gas-insulated line in their Southeast England network. The new Sellindge substation was deployed in an operationally critical part of the UK's transmission network to help ensure the region would continue to benefit from a secured and reliable supply of electricity. It plays a vital role in the ElecLink project, which will increase the UK's energy security, reliability and capacity by connecting with the French electricity transmission network.

> *We are very pleased to collaborate with National Grid on this project, the first in the world to use a g^3 solution. Utilities wanting to take the step to reduce their global warming potential now have an alternative to SF_6.*
>
> ~Giuseppe Sottero, General Manager
> GE Gas-Insulated Substations

Industry Framework: Mitigating Climate Change

In a world of ever increasing power demand, utility companies have a vital role in connecting millions of people safely, reliably and efficiently to the energy they use. This requires continual evaluation of operations, equipment and processes in an effort to respond to the changing environment.

As a matter of course, SF_6 has been a critical technology under review for some time. Sulfur-hexafluoride (SF_6) is used in the HV electrical transmission industry because it is an excellent gaseous dielectric medium.

Unfortunately, it is also the greenhouse gas with the largest global warming potential (GWP)* – 24,300 times more than CO_2.

Thus, much effort has been made across the industry in the last decades to find a viable alternative. Today, with g^3 gas from GE, the industry is well-positioned for the next breakthrough in high voltage equipment.

National Grid at the Forefront of Decarbonization Technology Implementation

With strong commitments to their regulator and stakeholders regarding the ongoing reduction of SF_6 gases released into the atmosphere, National Grid has set voluntary targets to reduce greenhouse gas (GHG) emissions across their UK and US businesses by 45% by 2020 (baseline: 1990). This corporate philosophy led National Grid to select g^3 technology in 2015 for a new project as part of their Network Reinforcement Program.

The introduction of GE's g^3 solution provides an opportunity for National Grid to be at the forefront of new technology development, and obtain an early understanding of the performance of the equipment. In addition to its negligible environmental impact, this new gas checked all the boxes for National Grid's health and safety pre-requisites and stringent performance specifications.

In an interview with Mark Waldron, who spearheaded the project for National Grid, he expressed that: "*g^3 opens the way for reducing or eliminating SF_6, and that's something that for National Grid is really important.*"

> *If we can move to a world where we are not using SF_6 at all, this is clearly a better way of managing the problem, rather than using a damaging gas and having to manage it. The g^3 project at Sellindge is the start of a road that we can go down to remove SF_6 from equipment newly installed on the network.*
>
> ~Mark Waldron, Switchgear Technical Leader
> National Grid, UK

The Impact of SF_6 is Significant

Replacing 1 kg of SF_6 with the corresponding mass of g^3 is the carbon equivalent of removing 16 cars running one year off the road.*** The potential for global warming reduction is further underscored when you look at the sheer quantity of SF_6 installed worldwide. Specifically, studies indicate 10,000 tons of SF_6 are installed each year, with 80% concentrated in the transmission industry alone.

With the Sellindge GIL installation, the estimated gas emissions savings are significant. More than 7,000 tons of CO_2 equivalent** (CO_2e) will be saved over the service life of the 230 meter-long gas-insulated circuits, which connect the substation to the bushings and overhead lines.

SELLINDGE GIL (comparison)	GIL Gas Quantity	CO_2e Gas Qty.	Gas Emissions†	CO_2e over 40 years
SF_6 GWP 23,500	1.54 tons SF_6	36,237 tons CO_2e	0.30 tons SF_6	7,247 tons CO_2e
g^3 GWP 327	0.734 tons g^3	240 tons CO_2e	0.15 tons g^3	48 tons CO_2e

†Based on 0.5% emissions per year, over 40 years. | CO_2e = carbon equivalent

7,199 tons CO_2e gas emissions avoided over lifetime

Environmental benefit of g^3 technology applied on Sellindge project

What's more, the environmental benefit does not compromise the technical performance: g^3 applications exhibit the same technical performance, they operate in the same ambient conditions (down to -30 °C), and they feature the same dimensional footprint when compared to SF_6 equipment.

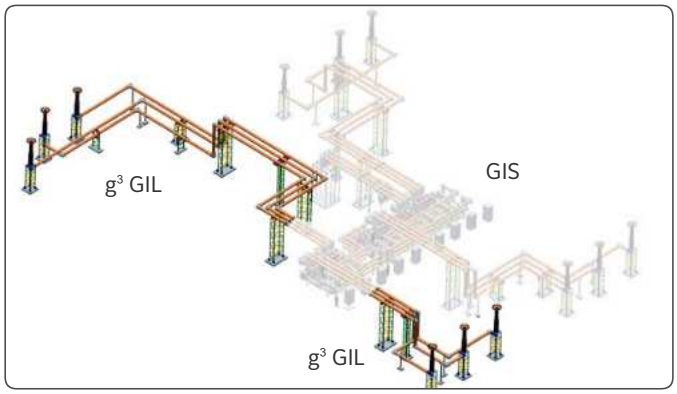


Diagram of the Sellindge 230 meter GIL installation

g^3 Now Available to All Utilities

g^3 is fully type-tested and commercially available for GIS up to 145 kV, GIL up to 420 kV, and live tank circuit breakers up to 145 kV.

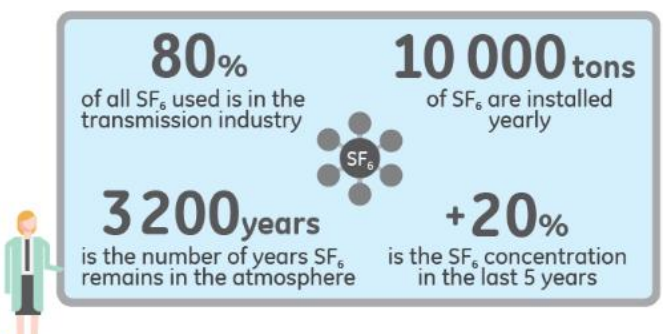
GIL up to 420 kV

GIS up to 145 kV

Live Tank circuit breaker up to 245 kV

To date, already 23 utilities have decided to implement g^3 solutions on their networks, and many others are now considering the new GE solution. The environmental argument for g^3 is staggering – SF_6 remains in the atmosphere for 1,000 years, and its concentration has increased by 20 % in the past 5 years alone.

The time for change has come. Now there is an alternative to SF_6 for HV switchgear. Implementing site applications, and supporting the wider adoption of g^3 technology is all about corporate and social responsibility. It's about doing our part to mitigate global warming, and about improving people's lives.



About g^3

- g^3 (pronounced “g cubed”) is GE ‘s alternative to SF_6.
- g^3 is a proven and ready-to-go alternative insulating gas mixture for high voltage electrical transmission equipment, which provides the same technical performance as SF_6 with a drastically reduced environmental impact - g^3’s impact is a whopping 99% less than SF_6.
- The g^3 gas mixture is blended using mainly Carbon Dioxide and Oxygen with a very low percentage of an additive to optimise performance.
- The gas mixture offers an efficient combination of low global warming potential (GWP) with high dielectric performance and minimum operating temperatures in accordance with the typical Transmission System Operators’ (TSO) needs.

g^3 Benefits

Technical

- g^3 is fully type-tested and commercially available for GIS up to 420 kV, GIL up to 420 kV, live tank circuit breakers up to 420 kV.
- g^3 is applicable in the same environmental conditions and at the same ambient temperature ranges as SF_6.
- g^3 high-voltage equipment feature the same dimensional footprint as state-of the-art SF_6 equipment.
- g^3 falls in the same safety class as SF_6.

Environmental

- g^3 Global Warming Potential represents some 1% of that of SF_6.

Financial

- Utilities can qualify for tax reductions or incentives related to greenhouse gas emissions reduction.

Environmental impact of g^3 vs SF_6

Utilities can adopt best practices in terms of environmental sustainability

Utilities can qualify for tax reduction or incentives related to greenhouse gas emissions reduction

Notes

* Global Warming Potential is a common unit of measure to allow analysts to compare the global warming impacts of different gases, specifically how much energy the emissions of 1 ton of a gas will absorb (over a given time) relative to the emissions of 1 ton of CO_2 (which has a GWP of 1). The larger the GWP, the more that gas warms the earth as compared to CO_2.

** CO_2e is a measurement of carbon footprint to define the impact of different gases in terms of the equivalent amount of CO_2 that would create the same amount of warming. Source: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

*** Calculation based on the following values: SF_6 GWP = 23,500, g^3 GWP = 327, Average car emission per km = 0.14 kg CO_2e, Average distance per car per year = 10,000 km [23,173/.14] -->[165,521/10,000] = 16.5

For more information please contact
GE
Grid Solutions

Worldwide Contact Center

Web: www.GEGridSolutions.com/contact
Phone: +44 (0) 1785 250 070

GEGridSolutions.com