Sustainability first Viewpoint

The independent charity and think tank shaping sustainability policy and regulatory agendas for UK utilities, for the benefit of consumers, citizens and the environment.

# SF6 : Time to Get Serious

**18 November 2020**

## Introduction

Sulphur Hexafluoride (SF6) is a man-made green-house gas with a warming potential 23,000 times that of carbon-dioxide. Long-lived and potent, it is widely used as an effective insulator in electricity substation switch-gear and circuit breakers. Equipment containing SF6 is found at every network voltage. Also in wind-turbine circuit breakers.

SF6 is controlled via UK implementation of the EU F-Gas Regulations[1]. Broadly, these require :

- Reduced sales of all F-Gases. So, two-thirds lower by 2030 than in 2014. Plus, a likely new EU target beyond 2030.
- A ban of F-Gases in new equipment – provided *less harmful alternatives are widely available*. This has proved a game-changer in reducing F-Gas use in air-conditioners and refrigeration - and also -
- Leak prevention from existing equipment.

Leakage aside, in the 2014 overhaul of the F-Gas regulations, electricity sector switch-gear and circuit breakers that contain SF6 were exempted from rules on phase-down of sales and new-procurement, due to lack of viable alternatives.

Six years on however, an urgent question for companies and regulators is how far viable economic alternatives are now becoming commercially available to the electricity sector ? The European Commission is mid-review on this – with a final view expected late next year.

But irrespective of new EU rules – or how these would be implemented here in the UK – we already have the UK's own 2050 net-zero target. This raises big questions for what to do about electricity sector equipment that might either leak or contain SF6. Clearly, leakage prevention must be a first-order priority.

Two major questions for the companies and regulators to address are where to begin on priorities for *new equipment*. And also for *retrofit before end of useful life*

Setting aside emissions associated with electricity losses, SF6 leakage forms the largest slice of the transmission business carbon footprint (not quite so for distribution). Without action, SF6 stocks and emissions will increase at every voltage – both with new investment in network capacity, and also as assets age.

## Transmission & distribution have different challenges

High-voltage switchgear can contain hundreds of kilograms of $SF_6$, with rules for maintenance, leakage-checks and reporting (inventory, leaks). At medium voltage, so less than 5kg of $SF_6$, the unit is often sealed. So, in general terms units tend to be more 'fit-and-forget'.

In GB, most SF6 sits in transmission equipment[2]. By volume, this represents ~85% of the full network inventory or 'bank'. And almost all leakage recorded is from Transmission - some 97%[3].

[1] https://www.gov.uk/government/collections/fluorinated-gas-f-gas-guidance-for-users-producers-and-traders

[2] Source. ENA Slide Set to ED2 Decarbonisation and Environment Working Group. 19 February 2020.

**GB : SF6 'Bank' –** *using EU boundary medium-voltage definitions for T & D* **>52kV and <52kV**
The total GB bank is estimated at ~1,300 tonnes. Of which Transmission holds 85% and Distribution around 15% (195 tonnes).

[3] And leakage from Distribution equipment at only 3% (<52kV) .

But, when we look across the voltages at the number of switchgear units which contain SF6 this picture reverses. There are over 260,000 of these in GB. Virtually all in distribution networks : some 97%. And most of these equipment items sit at very low voltage – over two- thirds at 11 kV[4].

So, in basic terms : transmission has a big challenge on SF6 leakage – and distribution faces complex network management issues due to their holdings of very many small equipment items.

## Network regulation and SF6

Ofgem's very welcome Decarbonisation Action Plan was published in February 2020 in acknowledgement of the UK's net-zero target for 2050, with an explicit goal of 'decarbonisation at lowest-cost to consumers'[5]. So how does this reflect in Ofgem's expectations for SF6 reduction in the RIIO2 network price control period ? And how in turn might this shape company responses ?

First, transmission networks : these are already financially incentivised in the eight-year RIIO-T1 period, which runs until 2021, to reduce SF6 leakage as a share of their total SF6 stock. In the RIIO-T2 proposals – which will run to 2026 – Ofgem has introduced 'more stretch' on SF6. Transmission companies must have a 'strategy' for their insulation and interruption gases - as a part of their network environmental action plan. Plus a more demanding annual target on leakage – again linked to a financial penalty / reward.

National Grid, with the greatest leakage challenge, is discussing a new scheme in T2 to reduce their SF6 leakage by one-third. This may also involve some early asset replacement, based on life-cycle cost assessment.

In their strategies, the three transmission companies have each committed to procure new high-voltage switchgear with alternatives *where these are commercially available*. And Ofgem suggests that within RIIO2 time-scales the transmission companies will procure new 132kV assets with less warming potential – and even, potentially, at higher voltage.

Second, distribution : under current ED1 arrangements to 2023, DNO action on SF6 is incentivised by a reputational scheme. All DNOs must report their leakage to Ofgem, who publish an annual league-table. For ED2 - to 2028 – Ofgem's draft proposals on SF6 again offer more of the same with a rather weak incentive.

DNOs must commit in their environment action plans to reduce leakage rates and improve management of their $SF_6$ assets in efficient and economic ways, including asset reduction. And there will be a new common DNO methodology for SF6 reporting. All of which is helpful.

But, Sustainability First is doubtful that Ofgem's proposed incentive approach for SF6 in ED2 will truly drive the kind of step-up needed from the DNOs over the next five-years in looking towards net-zero.

No penalty is proposed for leakage – nor a strategy approach to seriously up-the-DNO-game on asset monitoring, leakage or replacement. And the dots will still need to be joined on how DNO actions on SF6 will sit with the new long-run Science Based Targets for net-zero required of them in the ED2 period.

There's also an ongoing discussion with Ofgem about what may happen if new EU or UK regulations end in an outright ban on new SF6 equipment. Or, less likely perhaps, require mass early-retrofit. On this, a price-control 're-opener' is likely. But regardless of a regulated phase-out, SF6 still needs a more pro-active approach in the ED2 period.

[4] 70%

[5] https://www.ofgem.gov.uk/system/files/docs/2020/02/ofg1190_decarbonisation_action_plan_revised.pdf

## SF6 Alternatives

State of play on options for alternative equipment remains somewhat uncertain, both in terms of cost and also long-run resilience. Some alternatives may also contain green-house gases, but with a lower warming potential.

At low voltage it would seem that alternatives are coming to market but these cost more than existing SF6 equipment. And also physically may not be compact enough, or perhaps less well-suited to GB outdoor-sites.

And, at higher voltages, development of alternative switch-gear is slower and considerably higher-cost than current SF6 equipment. This seems a particular challenge, because the urgency sits with trying to stem leakage from ageing high-voltage kit[6].

If SF6 is carefully 'contained', this may buy time for the market to come forward with affordable equipment solutions at different voltages.

But given the transition means more new switch-gear, there is a very significant question for the RIIO2 period. How far should networks install new equipment today with a 40-year life which contains SF6. So, equipment with an asset-life that will extend beyond 2050 and net-zero.

## Next steps ?

For transmission, leakage is critical. And on asset management and procurement, Ofgem see the merit of a strategic approach - including funding well-targeted actions on early replacement.

For distribution, early retirement at scale is perhaps unlikely to be a best outcome for consumers in the near-term – be that in terms of efficient network operation or on cost grounds. Nor necessarily for the environment given challenges of safe-disposal at scale.

But equally the proposed ED2 incentive must send a much stronger signal to the companies to 'gear-up' on SF6 for the longer-term. And the networks – and indeed Ofgem – should not simply await a ban – be that for new equipment – or for retrofit. That feels complacent.

So, what more – with active encouragement from Ofgem - could be done *right now* to get a better handle on the full risks, costs and benefits of SF6 reduction and removal ? Here are three suggestions – which in long-run terms also have a firm eye towards least-cost delivery for consumers:

(1) **Full life-cycle cost appraisal** must tip the balance against new SF6 equipment being installed today where viable commercial alternatives exist[7].

(2) For distribution, Ofgem must require **an SF6 strategy for ED2** - informed by relevant stakeholders - **and also introduce fines for DNO leakage**. DNOs must develop far better data on their SF6-equipment –- and integrate that better insight with their new science-based targets for net-zero.

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6 https://ec.europa.eu/clima/sites/clima/files/news/docs/c_2020_6635_en.pdf
Report from the European Commission. 'Assessing the availability of alternatives to fluorinated greenhouse gases in switchgear and related equipment, including medium-voltage secondary switchgear'. September 2020.

Lower / distribution voltages = 5-20% more expensive (range 0-30%). At high-voltage (145-400kV) – may cost 200% more – and 5 years off.

7 i.e. full lifecycle benefits of non-SF6 equipment must be properly factored into network cost-assessments - including a proper valuation of the green-house gas benefit which uses expected new HMT green-book guidance on net-zero.

(3) **The SF6 challenge is about both Transmission and Distribution.** This demands **a sector-wide approach** to hammer out pathways and priorities: for alternatives, for phase-out, for containment and safe-disposal. This needs senior company commitment – as well as the active involvement of Ofgem, BEIS, DEFRA, the Environment Agency and the Committee on Climate Change. It also necessitates very active support of equipment manufacturers plus the wider supply-chain.

So, at both high and low voltage we need **a more coherent approach** if we are to address the SF6 challenge**.** There's no need either to wait for clarity from the price control process or for future reform of the F-Gas regulations. Net-zero means that work must start right now**.**

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This viewpoint was originally presented to a Utility Week webinar on 5 November 2020 : 'Eradicating SF6 – an essential step towards net-zero emissions'.

## About Sustainability First

Sustainability First is a think tank and charity that works in the energy, water and utility sectors. We have significant experience of consumer and public interest issues, regulation, sustainability and the demand side.

Sustainability First is represented on Ofgem's RIIO2 Challenge Group and has participated in a number of Ofgem working groups aimed at developing the ED2 price control for the electricity distribution networks. Some individual Sustainability First associates are also members of company consumer engagement groups and user groups as part of the RIIO process.

Find out more about our work here – www.sustainabilityfirst.org.uk