National Grid's "Bramford to Twinstead" Project

Statements Supporting a SuperConducting Cable Option

(A Further Response to the Planning Inspectorate)

Summary

The present NG ESO approach to the Bramford to Twinstead line has suppressed a superconducting cable option and should be refused.

Recent Background

In 2021, in connection with National Grid's (NG) Bramford to Twinstead (B to T) reinforcement project, it was suggested that NG consider a superconducting cable option which (superficially) appeared available and superior in many ways to either overhead 400kV lines or multiple trenched XLPE cables at 400kV.

NG's reply, in summary, was that whilst they had experience of superconducting cable technology in other parts of their network (eg the USA), for technical and economic reasons (which they detailed) it was not suitable for Bramford to Twinstead.

However, NG's statements are completely at odds with statements of capability from at least one cable manufacturer that can be studied (Nexans), and others are known to be in this field as well.

The Blockage in UK Legislation

Realistically, it is only NG and manufacturers such as Nexans who will be able to determine whether a superconducting cable solution could now be an option for B to T. However, the communities affected can legitimately take great exception to the emphasis given to overhead lines in the present legislative framework under which NG ESO operates, which effectively allows NG ESO to supress the serious consideration of other technical options. Whilst the Secretary of State does ultimately have the power to override the legislative "presumption" for overhead lines, that provision is clearly not designed to facilitate alternative more appropriate options to be brought forward in the first instance - which they should have been.

Fortunately, perhaps just in time to avoid the start of East Anglia being permanently changed from a rural to an industrial landscape, such an option appears now to have reached technical maturity: the superconducting cable.

If the B to T route was able to be engineered with superconducting cable, the avoidance of immense landscape degradation and environmental destruction would be the highly desirable (and legally required) result.

Under this logic, even though the impact on the East Anglia environment as a whole with 400kV lines could be massively reduced through superconducting cable technology, NG ESO appear bound by (or are interpreting) their current licence conditions as precluding it when in fact it is not precluded

.

The original intention of the legislation that has framed past UK grid development for decades can never have been to deny the UK the benefits of new technology as it becomes available, and when, as now, those benefits are so sorely needed.

What follows sets out the rationale for thinking there exists a greatly preferable option to either overhead 400kV lines or multiple trenched XLPE cables at 400kV – ie, the superconducting cable at some suitable voltage, not necessarily 400kV.

A SuperConducting Cable Option for B to T

The following statements are taken from a project **led by NG Electricity Transmission (NGET)** undertaken jointly with Nexans and reported in a paper entitled "Superconductors for Cities" dated 21st March 2022 [ref 1]. As the paper makes clear, whilst cable congestion in cities might represent an early call for their replacement with superconducting cables, the technology is equally applicable for nationwide transmission – which is what we need for B to T.

NGET and Nexans say:-

> *"…you can channel the power of three nuclear power stations through a superconductor just 17cm in diameter."*
>
> *"…corridors for superconductors are up to ten times narrower than those for conventional cables and lines."*
>
> *"Trenches not tunnels – [superconducting] cables do not require special infrastructure and they can be run just about anywhere…"*
>
> *"Fewer substations – superconductors make it possible to transmit electricity at lower voltages, but with the same power. So instead of supplying electricity at 400kV through copper, you can use 132kV superconductors instead."*
>
> *Power without limits – there is no length limitation with superconducting cable systems. This makes them the perfect solution for both citywide distribution and nationwide transmission."*

What are we to make of these simple statements? They surely have to be taken at face value, but, whereas they should result in a life-enhancing improvement in grid design for the 21st century, in fact NG ESO is (incorrectly) choosing to supress this option by citing the legal "presumption" for overhead lines of pylons.

Our next source of reference is a Nexans "White Paper" of 2022 entitled "Superconductors for Electricity Grids" [ref 2] – we note the term "Electricity Grids" is now in the title, not just "Cities". Much of what this paper says confirms and restates the earlier NGET/Nexans paper, but there is a bit more explanation too.

This is what Nexans says in its White Paper:-

> *"… a single cable can handle more than 3GW – enough to power a large city".*
>
> *"Minimal land take … Fewer cables are required and there is no need for space between phases. This reduces the need for permitting, minimises disruption to the public and contributes to lower costs."*
>
> *"Energy savings – superconducting cables are ultra-efficient conductors [whereas] conventional long-distance transmission systems using aluminium or copper conductors experience power losses of around 10% [which] in Europe alone [would be] enough to power three cities."*
>
> *"Zero heating … superconducting cables do not emit heat … can be direct buried in the ground, can be buried deeper than conventional ones, have no soil drying effect and can be run in proximity to other cables."*
>
> *"One of the major benefits of superconducting cables is that they are capable of transmitting enormous amounts of electrical energy in a remarkably narrow corridor – typically only one metre wide."*
>
> *"[Since] today's wind, solar and hydropower generation assets are typically sited far away from the populations they serve … finding ways to minimise grid losses is a priority."*
>
> *Superconducting cable systems offer high-efficiency bulk power transmission over long distances, with none of the resistive losses encountered in conventional high-voltage lines and cables. High-voltage DC (HVDC) superconducting cable systems are particularly suited to this application. Nexans has qualified a 320kV DC superconducting cable for currents of up to 10kA with a 3.2GW power transmission capability … ."*
>
> And yet again, Nexans emphasises:-
>
> *The use of [superconducting] cable systems eliminates the need for visually-intrusive overhead line infrastructure. Furthermore, the rights of way required for the new [superconducting] cables are narrow- typically, corridors are only a metre wide. Cables are direct-buried, with no need for pipes or tunnels."*
>
> Nexans then provides answers to some questions:-
>
> *"Can Superconducting cable systems save money? – Yes."*

> *"What is the optimal length for [superconducting] cables? – drum lengths of about 500m to ease handling on site."*
>
> *"Do I need new expertise to manage superconducting cables once installed? – Managed much the same way as a conventional cable system. Cooling system maintenance usually provided by the cryogenic system manufacturer while the cable continues to operate."*
>
> *"How durable are superconducting cables? -[Virtual] absence of heating results in life extension which is likely to be equal to or potentially greater than that of [conventional] cables."*
>
> Nexans then presents four case studies in this paper which support the above statements.

This was all back in 2022 but even then the clarity of these statements is surely sufficient to have expected NG ESO to be offering a superconducting proposal as a serious option for B to T. But they have not done that despite participating with Nexans and others in the 21st March project [ref 1] cited above. One wonders why.

A Way Forward

If "…*there is no length limitation with superconducting cable systems* …" and if they provide sufficient capacity, then surely it is obvious that they do in fact provide a **third** option to either overhead lines or multiple trenched XLPE cables whether at 400kV or at some lower more suitable voltage?

It is surely no coincidence and highly significant that in March 2023 [ref 3], Nexans published a paper that amounts to a very thinly-disguised sales leaflet entitled "Superconductivity" which very strongly promotes their latest product. In huge bold type they proclaim:-

> **3.2GW** Transmission Capacity of a Single HTS [superconducting] Cable
>
> **+/- 320kV** Voltage Level for HVDC Cables
>
> **>30 Years** Experience in Cryostat Design [which is the cable's outer envelope that maintains the inner core at about minus 200ºC].

This leaflet is supported by the same claims as referenced above, ending up with the statement:-

> *"Our unique capabilities in R&D, innovation, testing, manufacturing and deployment mean that we are perfectly placed to assist our customers as they prepare to take advantage of the opportunities offered by superconducting systems."*

Isn't this exactly what we want for B to T? Since NG already uses superconducting cables in its network outside the UK, one assumes they would have no difficulty in offering this for the UK grid if they were being encouraged legislatively to do so.

The introduction of superconducting technology into B to T as a vital **third** alternative to the present two has the capacity to very considerably reduce the wildlife and landscape destruction associated with present transmission technology and provide an ideal "test bed" for wider introduction into the grid elsewhere.

Conclusions

B to T needs an up-to-date technical solution which could be superconducting cable technology. This now claims very high capacity and no length limits.

NG ESO knows all about this through a joint study with Nexans and others but is not offering it.

Nexans manufactures several superconducting cable options, one of which, prima facie, could be ideally applicable for the B to T project.

East Anglia (and elsewhere) could soon be massively degraded as regards its wildlife and its visual landscape unless superconducting cables can be introduced into the grid on a very large scale, starting with B to T..

NG already makes use of superconducting cable technology in other parts of its operation worldwide and there is no reason to suppose it would wish to resist its introduction into the UK grid.

By greatly reducing power losses, the superconducting cable option would significantly contribute to the UK's climate obligations by making B to T truly "green" over its lifetime which, with either of NG ESO's present offerings, it will not be.

The superconducting cable option exists now and cannot be ruled out for B to T until it has been properly considered from a cost and technical point-of-view.

The available grid technology is apparently (but unnecessarily) being seriously restricted by present UK legislation: but with this in place, the choice for B to T is being restricted to 400kV pylons and heavily concreted 80m swathes of 18 parallel cables in two approximately 4km sections, none of which is appropriate.

ooOoo

References/Sources

These are the chosen references/sources, but there are many others that could have been cited, particularly from Nexans, as any google search will reveal.

1. Superconductors for Cities dd 21st March 2022, by Jean-Maxime Saugrain, available at, <https://www.nexans.com/en/nexans_blog/nexans_blog_posts/superconductors-for-cities.html>.

2. Nexans Superconductors for Electricity Grids, White Paper 2022, available from Nexans, <superconductors-for-electricity-grids-white-paper-2022-nexans.pdf>

3. A Nexans paper, "Superconductivity," available from Nexans, <https://www.nexans.com/en/markets/power-distribution/superconductivity.html>

ooOoo