Bandweaver Dynamic Cable Rating increases potential capacity of windfarm by 20%

THE SCENARIO

Scottish Power connected three windfarms at 33kV to East Kilbride South 275/33kV substation in an area where there is significant windfarm activity.

The project involved the installation of a DTS fibre optic system concurrently with the installation of the underground power cables of four windfarms connected at 33kV from East Kilbride South substation, namely Dungavel, Calder Water, West Brown Castle and Ardoch & Over Enoch windfarms.

In order to minimise costs the three cable connections shared a common trench for the initial 10.7km length from the substation and they are also in close proximity to two existing Whitelee windfarm 275kV cables..

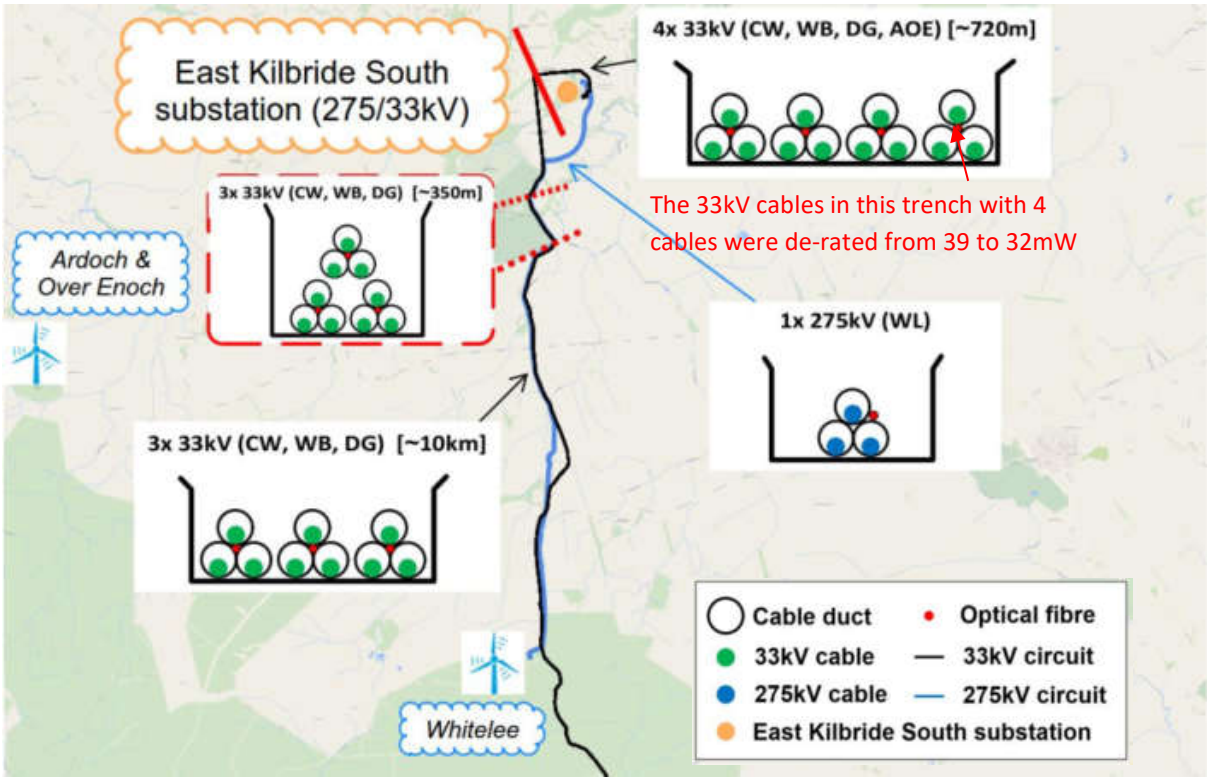

Figure 1 - Overview of windfarm layout and trench configuration

CLIENT REQUIREMENTS

Given the close proximity of the three 33kV windfarm cable circuits each has been de-rated to 32.2MW, based on standard design principles. The windfarm developers were looking to increase their generation capacity in the future and wanted to know what spare headroom capacity could be available

Figure 2 Example of cable and duct installation

The scope of the project was determining dynamic cable ratings for three cable circuits (3 - 33kV) and assessing the impact the renewable generation from the three windfarms on these circuits. From this analysis the prospect of further network capacity being available will be determined.

WHAT DID WE DO?

Bandweaver supplied the dynamic cable rating (DCR) system for this project, which was based on Distributed Temperature Sensing (DTS) technology. Since the proposed DTS system monitors the temperature of the optical fibre and not that of the 33kV cables themselves, appropriate algorithms and thermal modelling were deployed in order to calculate the DCRs of each of the cables.
The DTS system monitors the optical fibre temperatures at 30-minute intervals for every 1m of the optical fibre. The DCR algorithms are also run every 30 minutes upon receiving the updated fibre temperature data.

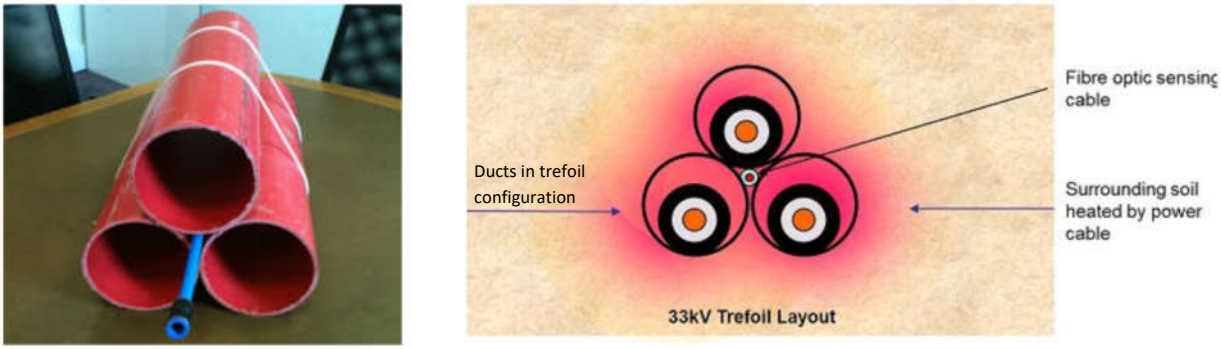

Figure 3 - Position of fiber and micro-duct in relation to other duct

The DCR methodology is based on an electrical-thermal analogy model, where the thermal characteristic of each layer between the optical fibre and the power cable core is modelled. The DCR algorithms were designed according to IEC 60853 and IEC 60287 and can take into account specific environments and different cable constructions and sizes.

BENEFITS TO THE CLIENT

The results showed that 20% additional capacity can be unlocked in the existing circuits.
This calculation was based on a 12 month period of DCR data and the overall system performance were analysed. By comparing historic windfarm outputs against calculated DCR Short Term Permissible Loadings (STPL is an indicative parameter that shows the available capacity headroom on a real-time basis) against a simulation of the thermal behaviour of the circuits for a hypothetical increase in windfarm outputs, to calculate the maximum permissible circuit loading if the conductor temperature should remain with the 78°C limit.

References

- *SP Energy Networks – Network innovation closedown report – August 2017 – NIA_SPEN0003*
- *SP Energy Networks - Temperature monitoring windfarm cable circuits Tier 1 LCNF Project SPT1005 – July 2015*