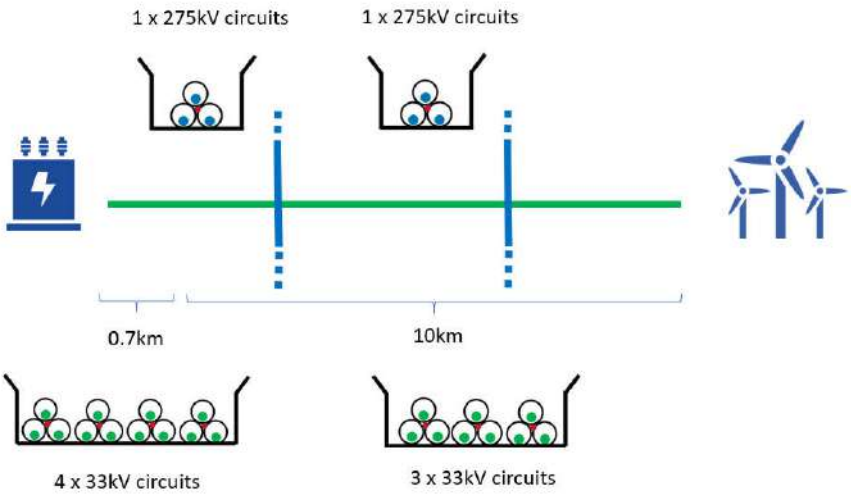
Kifta Dynamic Cable Rating enables cable cyclic cable rating enhancements of 35%

THE SCENARIO

The case study is based on a project carried out by Scottish Power and consists of four 33 kV wind farm cable circuits connecting to East Kilbride South 275/33 kV substation in Scotland.

The circuits were installed in separate ducts arranged in a trefoil formation. The ducts have an outer diameter of 160 mm and inner diameter of 150 mm. The four circuits share a common trench for the first 0.7 km from the substation. Circuits 1-3 continue to share a trench for the next 10 km until these circuits separate. These 3 circuits are crossed by two 275 kV circuits which connect another wind farm to the grid.



CLIENT REQUIREMENTS

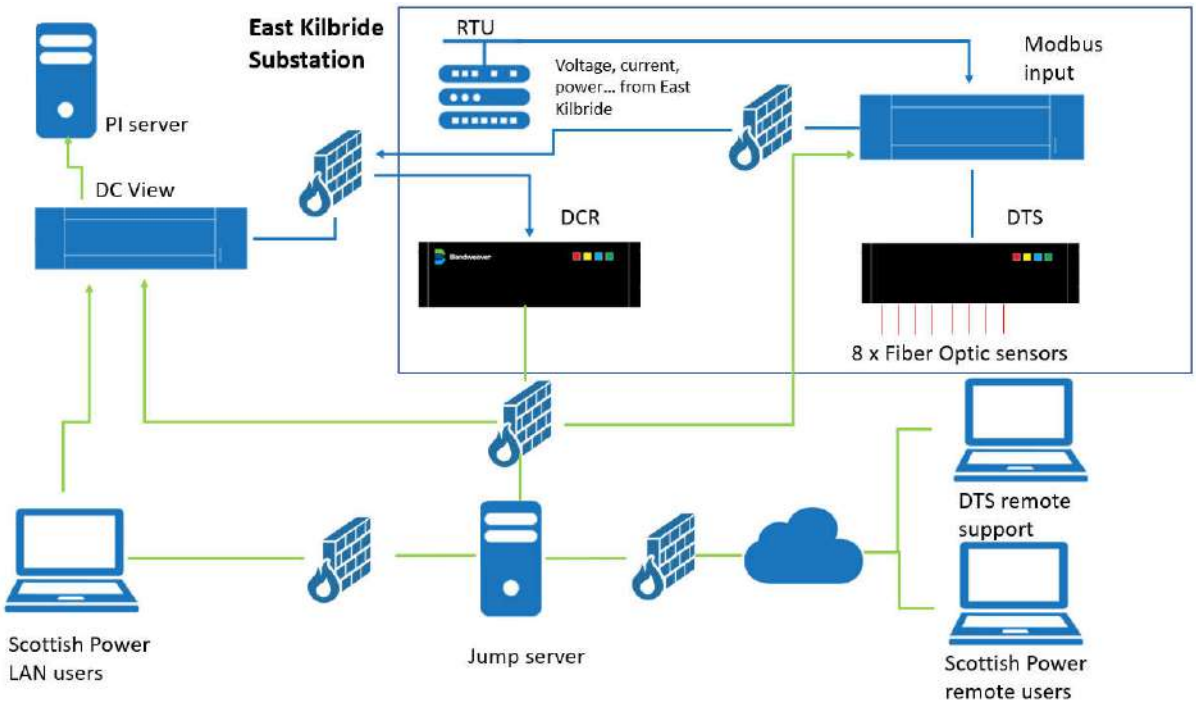
There is an ever growing number of windfarms in the UK as the driver towards greener energy continues . These can be remote installations (>20km from the substation) and the cost of the cable can be a significant proportion of the overall project cost. The size of the cable is the biggest factor in this cost and increases both the material costs and the installation costs. The size of a cable is defined by its current rating and so there is incentive to optimise the cable rating and reduce cable size.

The current rating of the cable circuits is typically based on conventional continuous rating methodologies, such as IEC 60287. This methodology does not take into account that wind power is intermittent and there can be extended periods when the cable operating temperatures are much lower than the conventional limits. The client wanted to use real time dynamic cable ratings (DCR) as a cyclic rating method but as these are not accounted for in conventional IEC ratings they needed to adopt an alternative methodology

WHAT DID WE DO?

Kifta 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.



The first stage of the analytical process was for the DTS to identify the hotspots along the cable. To give an idea of magnitude some of the hotspots were at 39°C which was 22°C above the average temperature of 17°C. As a result of the DTS information, 5 hotspot locations were identified. It was also discovered that the hot spot locations can move during seasons and so there is a strong argument for installing DTS for permanent monitoring of the circuits.

The second stage of the calculation was to design a cyclic rating method that using wind resource data to estimate cable current or preferable using actual real circuit load data and also to use existing IEC calculations. Basing the calculations on IEC60853, Scottish Power performed analysis based on the DTS and DCR outputs.

BENEFITS TO THE CLIENT

By adapting the existing IEC60853 calculation, the client was able to assess the cyclic rating without the need to solve long duration transient models. In the case studies considered they were able to enhance cable ratings significantly with rating enhancements in the range of 25-35%. This was particularly the case for deep buried cables.

The client provided a strong recommendation that DTS and DCR should be installed in wind farms where the circuits have been designed using the IEC60287 methodology.

Conventional cable ratings based on IEC60287 + DTS combined with DCR = Rating enhancements of 25-35%

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*
- *CIRED 24th International Conference 2017 – Cycling rating of wind farm cable connection – R Chinppendale, J Pilgrim, A Kazerooni, D Ruthven*