electricity north west

Bringing energy to your door

Smart Fuse
Summary Report

LCN Fund
Low Carbon Networks

KELVATEK

In the early 2000s there was significant debate in the electricity industry regarding smart grids and the potential impact on electricity distribution networks.

In particular we noted that low voltage networks could become more important if the potential for domestic scale renewable energy generation was to be realised as a key element of the transition to a low carbon economy. It was also recognised that we would need greater reliability of low voltage networks if the planned migration to electric heating and transport, powered by renewable electricity generation, was to take place.

At Electricity North West we recognised that radical new technology would be required to ensure that low voltage electricity distribution networks could deliver the required step change in performance. As a result we developed the Smart Fuse project.

Background

In 2006, together with our technology partner Kelvatek, we initiated the IFI-funded Fuse Restorer project. The aim of the project was to develop a device capable of carrying two low voltage fuses in a standard size fuse carrier. The device was designed to automatically insert a secondary fuse into a circuit following a transient fault to restore supplies to our customers and send an alarm to a nominated contact. Kelvatek delivered the final device in November 2010 which subsequently became known as the 'Bidoyng Smart Fuse'.

We installed three smart fuses on our network in Wigan, Lancashire which successfully operated to restore supplies to over 100 customers following a transient fault at 11.30pm on 12 November 2010. Following this success, the Smart Fuse project, funded under the First Tier of the Low Carbon Network Fund was launched in December 2010. The purpose of this second project was to facilitate the deployment of smart fuses across a number of feeders to gather a range of network performance data and to attempt to make a positive impact on customer restoration performance. The ultimate aim was to move the smart fuse through design, development and deployment to business as usual, and provide real data to further develop the original financial cost and benefit projections.

Process

The smart fuse was developed between 2006 and 2010 in response to a specification developed by Electricity North West. The original specification contained a range of performance and safety parameters that ensured the device could be utilised within a distribution network operator environment. It broadly described the method of insertion and removal into a fuse board and the type of latching and visual indication methods that would be acceptable. The initial designs created by Kelvatek went through a number of iterations before being subjected to a rigorous testing regime.

The smart fuse has been designed to provide a high specification voltage and load profiling platform with full communications capability and a range of fault analysis applications. The project was intended to provide the data needed to develop the network load modelling and profiling algorithms to support the optimisation of our low voltage network.

The project consisted of three specific objectives:

- Purchase and install 200 smart fuses, 100 to be used in response to faults and moved around the low voltage network as required, and 100 to be installed in a fixed location to monitor loads
- To gather data regarding the performance of low voltage networks, particularly in light of the significant amount of domestic solar photo voltaic (PV) panels that were installed in 2009 and 2010 in response to feed-in tariffs
- To improve customer service by reducing the time to restore supplies following a fault. When a fault occurs on an underground low voltage circuit, a fuse at the distribution substation operates and disconnects customers on the faulty circuit from the network. The first response is to replace the fuse protecting the individual circuit with a new fuse. For approximately 80% of faults, supplies are restored with no further fault activity. These types of faults are known as 'transient' faults. The aim of the smart fuse is to automatically perform this fuse restoration action within the first few minutes of the fault occurring which restores supplies to (80% of) customers.

Several hundred smart fuses are now installed on our low voltage network as a standard means of addressing faults, helping to restore supplies to our customers every day.

Key findings

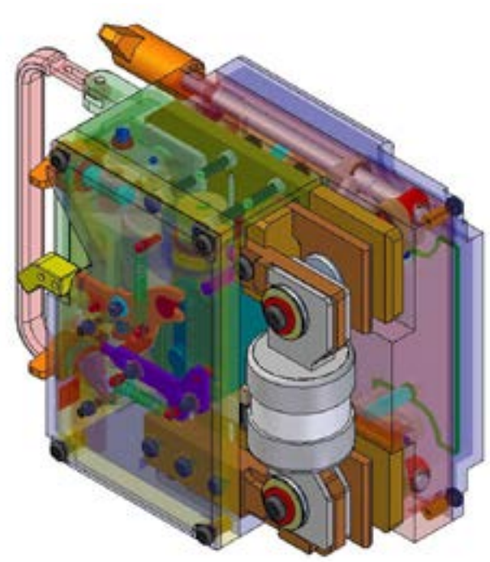
Analysis of load data was performed by the Durham Energy Institute at Durham University by PhD students under the guidance of Dr Neal Wade and Professor Phil Taylor. The analysis showed the limits of domestic PV that could be accommodated on a typical low voltage circuit without causing any impact on voltage levels supplied to customers. A very large data set was gathered during the project which is available on request from Electricity North West.

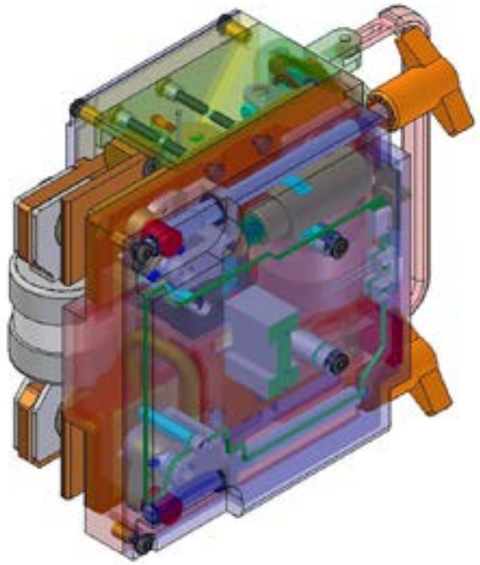
A specific objective of the project was to improve our quality of supply performance. The original IFI project was driven by an analysis of performance during 2006 which highlighted the need to address the number of transient faults affecting low voltage networks. As automation is rolled out across higher voltage levels, the impact of faults (particularly transient faults) on low voltage networks becomes more apparent. In 2006 it was understood that new technology would eventually be needed to complement better organised workforces. The results from the early use of the smart fuse clearly showed a positive impact on low voltage transient fault management. A comprehensive analysis is included in the project closedown report.

Conclusion

The smart fuse is now fully developed and has the technical and support structure in place that would be expected of any commercially available product. We have published internal codes of practice and policy documents to support its integration into business as usual. Several hundred smart fuses are now installed on our low voltage network as a standard means of addressing faults, helping to restore supplies to our customers every day.

For more details see our closedown report at **electricitynorthwest.co.uk/tier1**





Smart fuse original prototype designs

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