Scottish and Southern Energy
Power Distribution

Date of Submission

July 2014

Network Innovation Allowance Closedown Report

Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form.

Network Licensees must publish the required Project Progress information on the Smarter Networks Portal by 31st July 2014 and each year thereafter. The Network Licensee(s) must publish Project Progress information for each NIA Project that has developed new learning in the preceding relevant year.

Project Closedown

Project Title		Project Reference
Insulated Cross Arms – Lecht & St Fergus Trials		NIA_SHET_0006
Project Licensee(s)	**Project Start Date**	**Project Duration**
Scottish Hydro Electric Transmission	Jan 2010	5 Years

Nominated Project Contact(s)

David MacLeman

Scope

The scope of this project is to design and build prototype Insulated Cross Arms, and conduct mechanical and electrical trials.

Objective(s)

Design and build prototypes for the uprating of 132KV tower lines

Install protoype 132KV models in a harsh weather environment test area - The Lecht

Install current L3 prototype models in a coastal trial site to evaluate the effects of salt and other pollutants on the insulation – St Fergus

Success Criteria

Installing and monitoring the Lecht and St Fergus trials for the Insulated Cross Arms

Performance Compared to the Original Project Aims, Objectives and Success Criteria

The project has been completed successfully. The latter trial at St Fergus has been operational for over a year and will continue for the foreseeable future to provide further knowledge about the prototype performance. The expected benefit of this solution is to upgrade existing tower lines to operate at higher voltages, thereby increasing the available network capacity of existing infrastructure, and removing the need for a full tower line rebuild.

Objective: Design and build prototypes for the uprating of 132kV tower lines

The insulated cross arms were developed by Arago Technology, a company which was incorporated in 2010 following collaboration between EPL Composite Solutions and the University of Manchester. This development process had been carried out with some help from National Grid. Mechanical and electrical testing had been carried out on the cross arms, and the testing proved the prototypes met operational and safety requirements. Four prototypes were available for installing at the Lecht.

Objective: Install prototype 132KV models in a harsh weather environment test area - The Lecht

The Lecht was chosen as it is exposed to some of the most extreme weather conditions on the GB transmission network. Four cross arms were installed on a de-energised transmission line at the Lecht in the eastern Cairngorms over a period including two winters with high winds and heavy snowfall, with monitoring equipment installed to record the weather conditions and monitor the mechanical performance of the cross arms. Cameras were also placed on two of the towers to monitor the ice and snow build-up on the cross arms.

The weather data gathered went some way to showing the extreme conditions the cross arms had to cope with over the two winters they were installed on the towers. They had to deal with winds as strong as 150 mph, and periods of very heavy snowfall. The installed cameras recorded a significant build up of snow and ice on the cross arms during the periods of heavy snowfall. Importantly, however, the traditional glass insulators on the tower showed a similar build up.

The analysis of the data gathered from the trial allowed for the development of an improved cross arm design. The design changes were based on the data recorded during the extreme weather events.

Objective: Install current L3 prototype models in a coastal trial site to evaluate the effects of salt and other pollutants on the insulation – St Fergus

The newly improved insulated cross arm prototype, as a result of the successful mechanical testing at the Lecht trial, was installed at St Fergus substation on a purpose built, small lattice tower. The two cross arms were connected by a section of conductor at 400kV, which was connected to a transformer. The purpose of this trial was electrical testing in a high pollutant coastal environment. This trial has been operational for over a year and will continue for the foreseeable future to provide further knowledge about the prototype performance. During testing the site has run continuously, with the only interruptions being a result of issues on the 11kV distribution feed to the transformer, and the 6-monthly inspections. The data recorded by monitoring devices is relayed back to the University of Manchester in real time, where it has been analysed periodically. Analysed data from the first year of the trial indicates the cross arms are working as expected. Unexpected leakage currents haven't been recorded, however they have shown to be affected by the weather.

The reason for keeping the trial running beyond its original lifetime is to allow for increased knowledge on the ability of the cross arms. The trial has proved the electrical properties of the cross arm. This test has allowed for the installation of a small number of cross arms to be installed in a real network environment, on a 132kV circuit.

Required Modifications to the Planned Approach During the Course of the Project

None

Lessons Learnt for Future Projects

Improvements were made to the design of the cross arms following analysis of the data gathered from the Lecht trial and prior to installation for the St Fergus trial. This included introducing an incline to horizontal members to improve water run off, and an improved manufacture process to seal the core and prevent the possibility of air voids.

Further testing will be required prior to BAU adoption of this innovative solution, including demonstration of the cross arm on one or more real operational 132kV circuits.

Note: The following sections are only required for those projects which have been completed since 1st April 2013, or since the previous Project Progress information was reported.

The Outcomes of the Project

The main output from this project is the proving of the insulated cross arms mechanical and electrical properties. The prototypes produced for trialling at the Lecht had been tested in a laboratory environment, but they hadn't been tested in the harsh environments that can be experienced on the GB network.

This project comprised trials of the mechanical and electrical properties of insulated cross arm prototypes in environments that are representative of extreme conditions encountered on the GB transmission network.

Trialling the cross arms in the extreme weather of The Lecht proved their mechanical suitability, and also resulted in an improved design for the cross arms.. For example, the monitoring cameras recorded a significant build up of snow and ice on the cross arms during the periods of heavy snowfall; the traditional glass insulators on the tower showed a similar build up. The St Fergus trial in a coastal, pollutant location proved the ability of the electrical properties of the cross arm in a harsh environment. These trials have led to design improvements as well as confirming the mechanical and electrical properties of the cross arms in harsh weather environments. The St Fergus trial in a coastal, pollutant location proved the ability of the electrical properties of the cross arm in a harsh environment.

This project corresponds to a change in technology readiness level from 3 to 5.

Planned Implementation

This project has provided subsystem validation in a relevant environment, thereby progressing this innovative solution towards use for up-rating selected sections of transmission networks in GB. In these instances, network capacity could be increased without the need for more costly rebuilding of transmission lines. However, demonstration of the cross arm on one or more real operational 132kV circuits will be required prior to BAU adoption of this solution.

There are also some issues still to be resolved if retrofitting insulated cross arms to existing towers to upgrade a particular circuit. At present there is not a design for insulated cross arms to be installed on tension towers, and thus new tension towers would be required to be built in any retrofit upgrade using insulated cross arms. There is also the issue of earthwire shield angles being reduced after the installation of Insulated cross arms, which requires further research in order to resolve the issue.

Other Comments

The success of this project has led to the installation of six insulated cross arms on two consecutive operational 132kV towers on the SHE Transmission network. This installation has been registered as NIA project, NIA_SHET_0007.