Date of Submission

July 2017

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
Mobile Generation Re-Sync at 11kV and 33kV		NIA_SSEPD_0010
Project Licensee(s)	**Project Start Date**	**Project Duration**
Scottish Hydro Electric Power Distribution, Southern Electric Power Distribution	Jun 2015	22 Months

Nominated Project Contact(s)

David MacLeman

Scope

The pole mounted CB to be used is an Intellirupter from S&C Electric, along with a custom designed frame which will be provided to allow it to be installed underneath live ABSs from ground level. Final connections to the overhead line will be made with the line still energized, using hot stick techniques and live line connectors. The CB has an integrated disconnecting switch which can be observed to be open during connection and disconnection operations which along with suitable parking bars for live line connectors, removes the need to incorporate earth switches either side of the CB to make it safe during the erection and removal process. The CB also has capacitive voltage sensing transducers on both sides of the CB and on all phases which can be used to ensure that the phase rotation is the same on both sides of the circuit breaker, prior to starting the synchronising process.

The CB will be connected in parallel with the open ABS and then transmit the relevant data on voltage and frequency from both sides of the CB and the phase angle difference between the two sides to a lap top computer using a wireless communications link. This will present the user with a simplified synchroscope and allow the user to give directions to the operators of the generating units to speed up or slow down the generators and to adjust the voltage on the islanded network to provide the right conditions to allow the island network to be re-synchronised back on to the main network.

When conditions are correct then the lap top will be used to provide a close instruction to the CB via the wireless link. When the CB is closed the ABS can then safely be closed and the CB removed from the circuit using live line techniques from ground level.

This will mean that customer supplies do not need to be interrupted to connect or disconnect temporary generation.

Objective(s)

Prove that the system is safe to install and remove.
Carry out a successful re-synchronising operation on the 11kV and 33kV distribution network

Success Criteria

Determine the technical and operational viability of the proposed methodology
Quantify the savings in CIs and CHLs which could be saved by the use of this technique
Determine the commercial viability of applying this methodology across the SHEPD and SEPD license areas.

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

1. Prove that the system is safe to install and remove.

A safe system of work has been developed and documented. However it was only possible to achieve this for 11kV work using hot glove techniques as SSEN has stopped training and authorisation of long stick working from ground level. This has meant that the techniques developed for long stick at both 11kV and 33kV are no longer viable methods off working and synchronising at 33kV will not be possible. This objective has partly been met and the project is to be closed without attempting to meet the objective for connection at 33kV.

2. Carry out a successful re-synchronizing operation on the 11kV and 33kV distribution network.

Trial synchronisations at 11kV have been successfully carried out. Due to issues with the IntelliRupter and available generators, approval for deployment on site has not been received. This objective has partly been met and the project is to be closed without attempting to meet the objective of synchronizing a large generator on the network

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

There are three modes of operation a mobile generator can be run in.
• Droop which was the standard for most generators and mobile generators and which can be used in an islanded network or as part of a larger grid.
• Fixed frequency and voltage. Only suitable for use in an island network.
• Fixed output power and reactive power. Only suitable for use in parallel with a larger grid.

It had not been foreseen that the mobile generators which had been purchased with droop controls would have been modified to not have these when the control systems were updated. Modifications to generators will involve fitting a switch to move between the different modes of operation and adding knobs to allow voltage and frequency of the output from the generator to be changed to match the voltage and frequency of the main system. This does not impact on project costs particularly but will impact on the cost to apply the technique for general use.

It was not possible to modify a large generator in time to carry out trials on the network. A machine was identified for modifications to be carried out to restore Droop functionality but this was dropped when it became clear that the machine in question has a very short life and is likely to be scrapped during 2017. Attempts are being made out with this project to ensure that all future generators purchased do have droop control as standard.

Lessons Learnt for Future Projects

• The project has shown that it cannot be assumed that something considered standard and sensible in the past, will continue to be viewed in the same way. The dropping of droop controls witnessed in the project implies that the purchasers of the generators may not have considered that the option of bringing two networks into synchronisation across a remote open point would be needed. Instead, reliance on switching off the island network at the end of the job might have appeared to be the only feasible option.
• The above-mentioned issue is not just an SSEN problem. The fact that the two contractors who supply mobile generation had also moved away from having droop control on their mobile generation fleets confirms this finding.
• In order to get to the final arrangement several attempts to make the connections in different ways were trialed on a test/training rig at the rear of Kirkwall power station. In fact most things which were thought of were tried and improved upon or changed altogether. This experience showed that it is vital, if possible, to carry out trials in a testing environment to enable all iterations of tests prior to performing tests in an operational environment
• Several different groups of people had to give approval for parts of this project. Changes in internal processes associated with this significantly slowed progress with the work and ultimately led to the closure of the project without a working system in place.

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 project was closed down at the end of April 2017
• It has been shown that the IntelliRupter pole mounted CB has suitable facilities to allow synchronisation of two electrical networks with controls when remote locations are to be synchronized provided that the smaller network is operating in droop mode and can adjust its output to match the frequency of the larger network
• It has been shown that the device can be connected live line at 11kV allowing synchronisation of a network which has been restored

using emergency mobile generation to the main network without an interruption to supply to customers
• The design of mobile generation control and protection systems needs to be reviewed and changed to make them suitable for use with a remote synchronising unit in the future.

Planned Implementation

• There are currently no plans to deploy this technique within the business
• Attempts are being made to review and modify the requirements for mobile generators for future purchases.
• The IntelliRupter is to be stored for potential re use if the generator issues can be resolved.

Other Comments

N/A