Network Innovation Allowance

Summary Report

1 April 2016 to 31 March 2017

Scottish and Southern Electricity Networks

Scottish Hydro Electric Power Distribution

Southern Electric Power Distribution

FOREWORD

This report summarises the progress achieved by Scottish Hydro Electric Power Distribution (SHEPD) and Southern Electric Power Distribution (SEPD), both which are part of Scottish and Southern Electricity Networks (SSEN), in Network Innovation Allowance (NIA) projects during the period between April 2016 and March 2017. In Electricity Distribution, the NIA incentive has been running since the onset of RIIO-ED1 in April 2015 and is targeted at smaller innovation projects which can deliver value to customers.

SSEN's core value is to provide the energy people need in a reliable and sustainable way. Achieving this core value has been made more challenging by the need for rapid evolution of networks to cater for integration of low carbon technologies and large scale renewable sources of generation. To respond appropriately to immediate challenges and prepare for those that will subsequently arise, innovation has become pivotal to everything we do. Our objectives for making innovation happen were set out in our Innovation Strategy published as part of our RIIO-ED1 Business Plan. We published an update to the strategy in March 2016 to incorporate details about how innovation is delivering value to our customers and wider stakeholders.

As of 31st March 2017, we have a portfolio of twenty seven live NIA projects at various stages in their lifecycles. Twenty one of those projects are led by SSEN with the remainder being led by our collaboration partners. As we head into the third year since the commencement of the RIIO-ED1, our experience of delivering value through NIA funded projects has increased. A measure of this is the number of projects which have been terminated in the last year. After performing stage reviews of the relevant projects, our conclusion was that the value we had envisaged at the conception stages was no longer likely to be delivered in the light of new knowledge and circumstances. Therefore, ending these projects, consolidating our portfolio and focussing on those that could deliver benefits was the right thing to do for customers.

Within SEPD and SHEPD, we believe success in innovation is measured through the benefits delivered from conversion into business as usual. We take any learning from our innovation projects seriously and seek any opportunity to exploit applicable learning. In the same vein, we keep a constant lookout for learning generated by other network licensees to ensure that fast follower implementations can be done whenever feasible. We also continue to engage with our stakeholders and collaborate with other interested parties in the energy supply chain to ensure that our innovation efforts can deliver the best possible value to customers. In the coming year we expect to see an increasing focus on projects focussing on the market and commercial enablers necessary to allow us to transition to a DSO, these will be done in close conjunction with the needs of the ENAs Open Networks Project.

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Scottish and Southern Electricity Networks plc

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1 NIA Project Portfolio

For the year ending 31 March 2017, SSEN has 21 projects funded under the Network Innovation Allowance (NIA). Eight of these projects had completed whilst no new projects had been registered during the year.

A crucial aspect of the ongoing SSEN NIA project portfolio is that it takes into consideration the 20 top innovations identified as part of the RIIO-ED1 Innovation Strategy. Where the projects do not map directly to the top 20 core innovations, each projects still maps onto at least one of the RIIO-ED1 primary outputs.

Table 1 below shows all the RIIO-ED1 primary outputs, the top 20 core innovations and the relevant registered NIA projects associated with each. These targets guide the entire Innovation programme for SSEN including those not funded under NIA. Further details of how other projects are mapping onto our core innovations are covered in the update to the Innovation Strategy that was published in March 2016. The link to the update is provided here:

http://www.yourfutureenergynetwork.co.uk/wp-content/uploads/2016/04/Innovation-Stategy-update-ver-9.pdf

RIIO-ED1 PRIMARY OUTPUT	CORE INNOVATIONS FOR RIIO-ED1	RELEVANT NIA PROJECTS	COMMENTS
Connections	Active network management – generator constraint management		
	Demand side management – thermal energy storage	• NIA_SSEPD_011 ACCESS – Local Constraint Management	
		• NIA_SSEPD_005 33kV Hot Glove Working,	No core innovation is associated with these projects. However, these projects support the associated RIIO-ED1 primary output.
	Local smart EV charging infrastructure	• NIA_SSEPD_0026 Management of Plug-in-Vehicle Uptake on Distribution Networks	

RIIO-ED1 PRIMARY OUTPUT	CORE INNOVATIONS FOR RIIO-ED1	RELEVANT NIA PROJECTS	COMMENTS
Customer service	Advanced distribution automation – network reconfiguration	• NIA_SSEPD_008 PARADE, • NIA_SSEPD_009 Automated Loop Restoration	
		• NIA_SSEPD_003 Network Damage Reporter,	No core innovation is associated with these projects. However, these projects support the associated RIIO-ED1 primary output.
Environment		• NIA_SSEPD_0014 Underground Cable overlay Cost Reduction, • NIA_SSEPD_0016 Alternative Cable Installation Methods, • NIA_SSEPD_0025 Applied Integrated Vegetation Management (IVM),	No core innovation is associated with these projects. However, these projects support the associated RIIO-ED1 primary output.
Reliability		• NIA_SSEPD_029 11kV power electronics providing reactive compensation for voltage control • NIA_SSEPD_007 Field Team Support Tool • NIA_SSEPD_010 Mobile Generator Re-sync at 11kV and 33kV, • NIA_SSEPD_0021 Thermal Imaging Observation Techniques for Underground Cable Networks (TOUCAN) • NIA_SSEPD_0023 Fault Passage Indicators for SEF • NIA_SSEPD_0024 Network Optimization Project	No core innovation is associated with this project. However, this project supports the associated RIIO-ED1 primary output.
	LV network modelling	• NIA_SSEPD_0015 LV Connectivity Modelling	
	LV network monitoring	• NIA_SSEPD_0027 Low Cost LV Substation Monitoring,	
Safety	Conductor sag and vibration monitoring	• NIA_SSEPD_0017 Overhead Line Vibration Monitoring Phase 2, • NIA_SSEPD_0020 Overhead Line Monitoring	
	Live line tree felling	• NIA_SSEPD_0018 Remotely Operated Forestry Mulcher	
		• NIA_SSEPD_0022 Ester Fluid Transformer Re-design	No core innovation is associated with this project. However, this project supports the associated RIIO-ED1 primary output.
Social Obligations	None at present		

Table 1: Mapping top 20 core innovations to registered NIA projects

2 Summary of Progress

2.1 NIA_SSEPD_003 Network Damage Reporter

Start Date: April 2015

Duration: 38 months

Description:
The scope of the project is to produce a smartphone application that is able to work on Android and Apple devices that will allow third parties such as members of the public and the emergency services to easily provide us with reports of damage to our networks.

Expected Benefits:
- Develop new procedures and processes to make use of the data submitted by users, such that the fault report submitted is integrated into the company fault management system.
- Develop a publicity strategy to publicise the availability of the app.
- Enable quicker responses to fault reports after wider uptake of app.

Progress:
The application has been produced and its ability to deliver the necessary detail of network damage and provide a timely response has been demonstrated. At least 100 colleagues have downloaded the application and provided test reports which demonstrated that the expected functionality works in both the iOS and Android versions. The level of interest by the general public is still to be evaluated but a high level of interest was shown in initial discussions with blue light services.

2.2 NIA_SSEPD_0005 33kV Hot Glove Working

Start Date: May 2014

Duration: 34 months

Description:
The purpose of this project is to determine whether work can be safely carried out on live 33kV overhead lines. If it is found that 33kV hot glove working can be carried out in a safe manner, this will then provide the justification required to the HSE to get dispensation to be

able to perform this task and produce the relevant technical, safety and procedural documents associated.

Expected Benefits:

- Financial savings through reduced labour costs
- Financial savings in reduced mobile diesel generation usually needed to provide alternative supplies under outage
- Quicker connection times for customers
- Reduced pollution from diesel generation

Progress:
The project has been terminated prematurely. The safety case for 33kV hot glove working has been produced and presented to the responsible authority. The entire hot glove programme is currently under internal review. Due to the uncertainty around the availability of new guidance, the project had to be closed to release funds for activities with higher priority. The justification for this project still remains and future work at the appropriate time will be necessary to advance the learning on the subject.

2.3 NIA_SSEPD_0007 Field Team Support Tool

Start Date: April 2015

Duration: 30 months

Description:
This is a continuation of an IFI project looking at providing field staff with a tablet device that can hold the necessary documentation, can be updated in real time, and provides a visual display of the power network, overlaid on to a geographic map, or through augmented reality techniques, on live images displayed on screen. This project will further develop the tablet device so that it can be used to report task progress and issues back to supervisors and managers, and to ask for advice and further documentation if necessary.

Expected Benefits:

- Improvements in efficiencies of everyday working thereby cutting down costs
- Improvement in level of customer service through increased productivity and speed of resolution of faults to decrease time off supply.

Progress:
The project is still progressing and so far, user interfaces as the one shown in Figures 1 and 2 below have been developed and tested by field staff. The objective to demonstrate that data can be transferred between the tablet and the server in a standardised and secure format that is immune to external interference has been successfully met with data transfers maintaining integrity using data encryption. In terms of the scalability of the system, over

6000 reports have been handled by the servers without problems in organising and searching of the data. It is expected that the use case currently under development will show a marked increase in the levels of reports received.

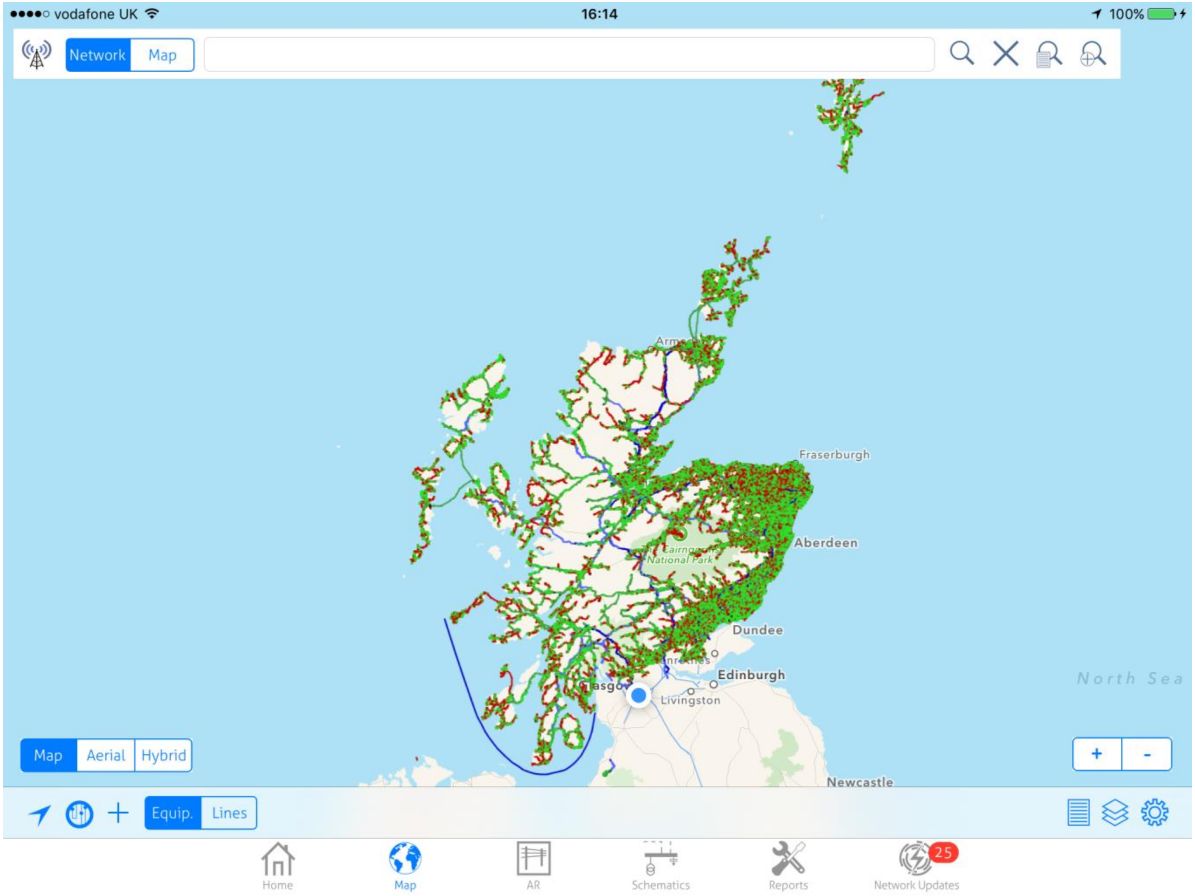

Fig 1: The network map overlaid over the geographical map

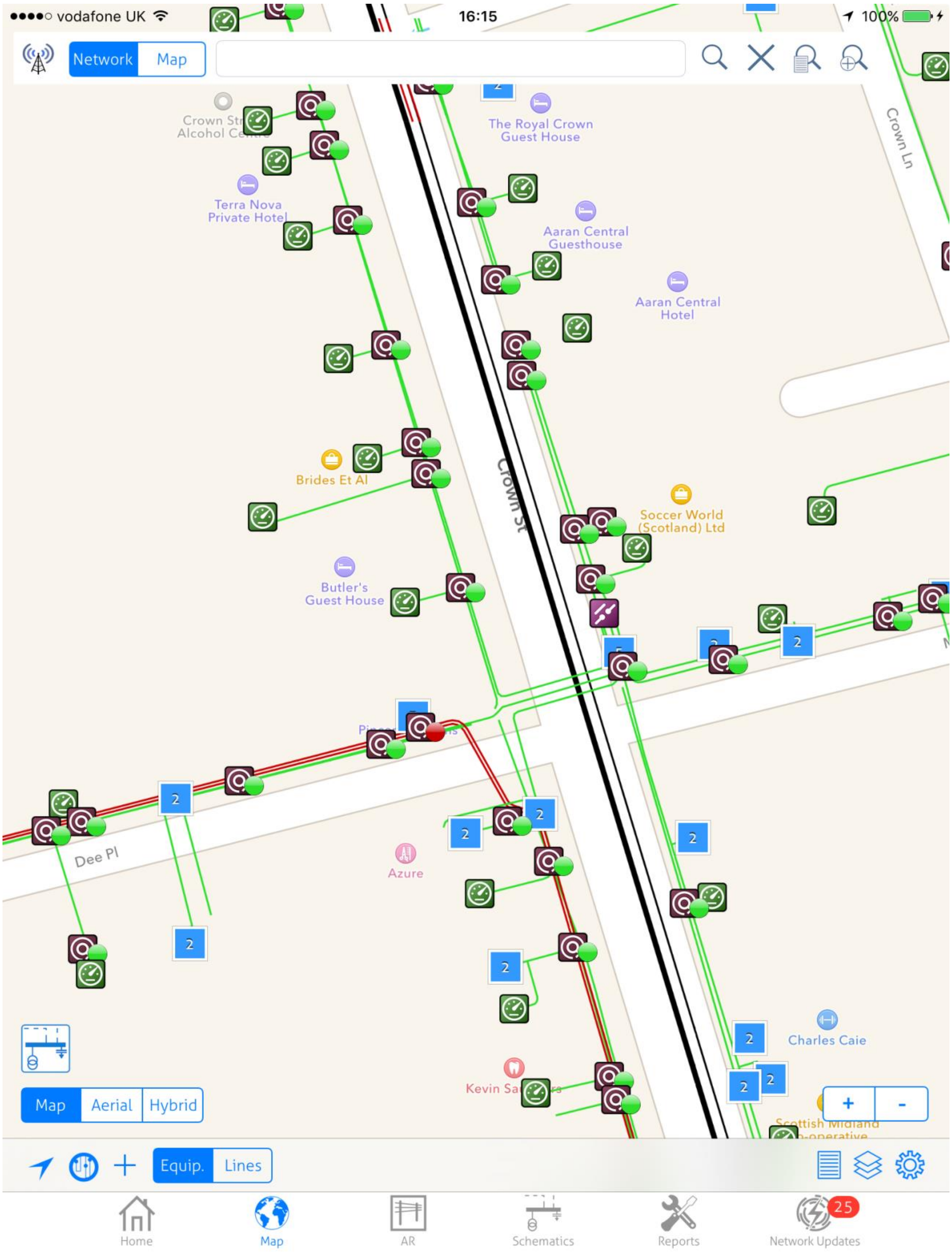

Fig 2: A close in view of the network**.**

2.4 NIA_SSEPD_0008 Pole-mounted Auto-Recloser Automated Distribution Evaluation (PARADE)

Start Date: April 2015

Duration: 24 months

Description:
Thirty two pole-mounted Intellirupter PulseClosers, supplied by S&C Electric, have been installed on eleven distribution feeder lines on the 11kV network on the southern and western half of the Isle of Wight as part of IFI project 2007_07 Distribution Automation. This project will evaluate their advanced functionality, including the Intelliteam automatic post-fault circuit restoration capability which minimises the interruption of supply to customers caused by faults. This phase of work aims to evaluate the technical operation of, and business case for, the Intelliteam distribution automation technology in the SEPD and SHEPD regions.

Expected Benefits:
The method in this project is expected to reduce customer interruptions and customer minutes lost (CI/CMLs).

Progress:
This project has been terminated early. A new radio type was installed on all Intellirupter switch locations, repeater stations and substation nodes. Operation of the mesh radio communications was good and provided some useful learning. However, the ultimate objective to implement the Intelliteam functionality was superseded by the implementation of an alternative system through the Distribution Management System (DMS). This development removed the fundamental justification of the project thereby resulting in its premature termination.

2.5 NIA_SSEPD_0009 Automated Loop Restoration

Start Date: June 2015

Duration: 45 months

Description:
This is an automation scheme for reducing customer interruptions and customer minutes lost (CI/CMLs) by automatically restoring supply to sections of the network initially affected by a fault but not actually having a fault. This project makes use of loop reconnection which does not rely on communication links to transfer data to enable automatic restoration of supplies. Seven pole mounted circuit breakers will be installed on two sections of 11kV overhead line networks on the Kintyre Peninsula to create an overall scheme of eight sections.

Expected Benefits:
The method in this project is expected to reduce CI and CMLs.

Progress:
Equipment for this project has been procured and work has been ongoing to integrate communications between this equipment and the SHEPD control systems. The learning to date shows that there has been significant time spent on integrating the switchgear being used in the trial with the DMS. This has also been compounded by capacity issues with the communication link. The full trial system has not been installed due to ongoing review of live line working processes.

2.6 NIA_SSEPD_0010 Mobile generation re-sync at 11kV and 33kV

Start Date: June 2015

Duration: 22 months

Description:
SEPD and SHEPD are increasing use of temporary mobile generation to allow work to be carried out on distribution networks without supply interruption. Mobile generation can currently be synchronised between the main network and a portion of network to be worked on without interrupting supplies to customers. However, a short interruption is necessary at restoration to the main network as there is currently no provision for synchronising across the switch used for disconnecting the isolated portion of the network. This project involves trial of a pole mounted circuit breaker (Intellirupter) which removes the need for temporary supply interruption during reconnection of an isolated portion of the distribution network.

Expected Benefits:

- Reduction in CI/CMLs
- Reduction in CO_2 emissions through a small saving in fuel consumption

Progress:
This project is now completed. It has been demonstrated that a pole mounted Intellirupter circuit breaker has suitable facilities to enable synchronisation of two electrical networks with controls provided the smaller of the two networks is operating in droop mode and can adjust its output to match the frequency of the larger network. This method will not be implemented immediately in SSEN because mobile generators currently available have no droop functionality to allow the method to work. If this issue is addressed in the future, this method will be reconsidered based on the learning from this project.

2.7 NIA_SSEPD_0011 ACCESS – Local Constraint Management

Start Date: July 2015

Duration: 24 months

Description:
The project involves the creation of a technical and commercial framework to allow generators to manage generation and demand within a pre- determined network area. Specifically, this is intended to link local controllable demand, such as heating systems, with intermittent local generation. This is in response to policy drivers put in place to facilitate locally owned community generators to be used to supply local customers in an attempt to address fuel poverty in rural areas.

Expected Benefits:
The new local demand side management will have the potential to avoid or defer network reinforcement to allow connection of new renewable generation. This is also anticipated to allow increased utilisation of existing assets and reduction of network losses.

Progress:
DNO requirements for local demand side response have been defined and understood with lessons learnt concerning the definition of a set point. A functional specification was also produced at the project inception and has been followed since. Communications with heating elements in over 80 participating dwellings has been proven. The generator load shedding and disconnection schemes in the event of control loop failure have been proven. Work to achieve the other objectives is ongoing.

2.8 NIA_SSEPD_0014 Underground Cable Overlay Cost Reduction

Start Date: September 2015
Duration: 19 months
Description:
Underground cable overlay is the activity through which a certain part of the underground net work is replaced or reinforced. The current method involves open cut trenches which is a costly operation and causes disturbance to the public and businesses due to site activities. The project aims to investigate whether the two identified innovative cable overlay methods could reduce the cost and disturbance caused to the customers due to the cable overlay activity.
Expected Benefits:

- Potential reduction in costs due to avoidance of open cut trenches
- Reduction in disturbance to the public and local businesses
- Improvement in environmental performance

Progress:
The project was terminated early. The learning from the stage 1 field trial showed that further development of the method and its application is essential before network operators and customers can realise the benefits from its use. For this reason, the project had to be terminated without going to the next stage of field trials. Detailed learning from the completed work is included in the project closure report.

2.9 NIA_SSEPD_0015 LV Connectivity Modelling

Start Date: October 2015
Duration: 9 months
Description:
This project will develop a LV connectivity model using software to align meter supply points with local substations so that the links between substation feeders and user premises can be shown. These results can then be compared with the existing LV model, to give a level of confidence in using data analytics for this requirement.
Expected Benefits:
If network connectivity can be determined through data analysis instead of the current labour intensive method then there is potential for significant financial savings.
Progress:
The project has now completed. It delivered a web-based visual representation map that covered low voltage (LV) connections from nine substations in the Bracknell area. The subsequent analysis of the connections from the substation feeders to user premises showed a high level of accuracy. More detailed learning is provided in the closure report.

2.10 NIA_SSEPD_0016 Alternative Cable Installation Methods (ACIM) – Phase 1 (Feasibility Study)

Start Date: October 2015
Duration: 11 months
Description:
The project proposes to identify innovative methods for installing cables either within ducts or direct laid that could offer reduction in cost and could increase the length of cable that can be installed without joints.
Expected Benefits:
It is expected that the cost of cable installation could be reduced through:

- Reduction in number of joint bays
- Reduction in the need for a receiving bay at the end of the route
- Reduction in construction time

Progress:
The project has been terminated early. Six of the eight specific tasks in this project were either fully or partly completed. The task involving site selection for trial of the method showed that the best approach would be to consider site suitability at the design stage. To follow this approach within the project was not possible as it would have resulted in the need for indefinite project duration. The project was therefore halted. The detailed learning gained up until the point of premature termination is in the project closure report.

2.11 NIA_SSEPD_0017 Overhead Line Vibration Monitoring Phase 2

Start Date: October 2015
Duration: 9 months
Description:
This project will complete the development of wire-mounted sensors incorporating electronics for detecting change in angle, wire sag and impact of wire strike. This work commenced in a previous IFI project and in this phase, a sample of the prototypes will be installed on representative sections of live overhead lines and their performance as well as that of the server to which they communicate will be evaluated. The evaluation will be carried out to confirm the suitability of the system for vibration and movement monitoring in a live high voltage environment.
Expected Benefits:
The method in this project is expected to reduce CI and CMLs due to overhead line impacts.
Progress:

This project has now completed. Testing of the sensors and the server were successfully undertaken at the Power Network Demonstration Centre (PNDC). The results showed that the sensors and the associated software can distinguish between different types of scenarios on the line. In addition, it was also demonstrated that the sensors can be applied as an easily maintained system powered by the line current. The figure below shows the architecture of the system as simulated at PNDC.

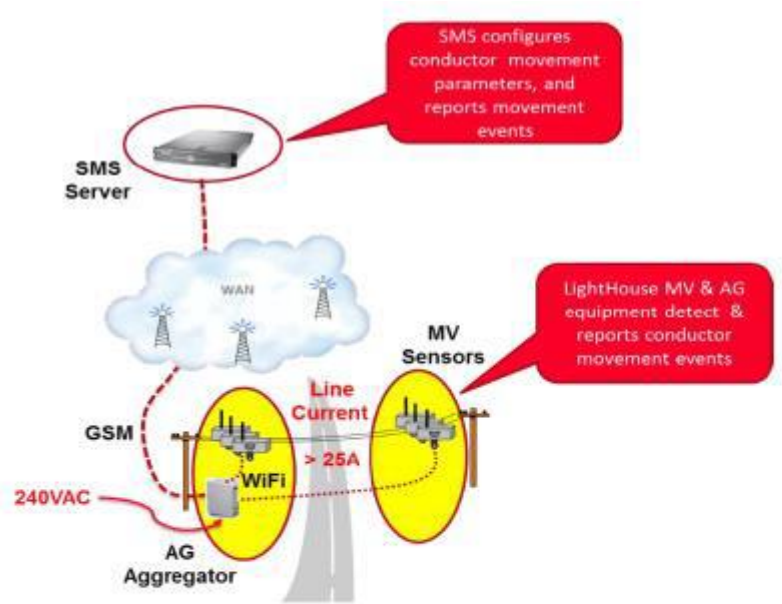

Fig 3. Test simulation set up at PNDC.

2.12 NIA_SSEPD_0018 Remotely Operated Forestry Mulcher

Start Date: November 2015
Duration: 12 months
Description:
The purpose of this project is to investigate if using remotely operated forestry machinery can significantly reduce the cost and the potential for safety incidents during forestry mulching.

Expected Benefits:
The benefits from this project will be in the savings gained through reduction in labour costs as well as an improvement in safety performance.
Progress:
The project has now successfully completed. Remotely operated Bushfighter forestry mulching machines were procured and trialled in both SHEPD and SEPD. Training in the use of these machines was completed. In the SHEPD license area alone, as many as 181 overhead line spans were cleared and the resulting assessment showed a marked

improvement in productivity. Detailed results are covered in the closure report. The picture in figure 4 below shows one of the machines ready for transportation in a trailer.

Fig 4. Remotely operated forestry mulching machine

2.13 NIA_SSEPD_0020 Overhead Line Monitoring System

Start Date: November 2015
Duration: 30 months
Description:
Under IFI project 2014_08 Monitoring of Conductors and Poles, a prototype sensor system, comprising line mounted sensors, and a communications system was developed to operate on overhead lines up to 11kV. This was done to mitigate susceptibility of rural overhead lines to damage by wind debris, inadvertent collision by farm and forestry vehicles, kites etc.
This project will take that work further to produce a production ready system. The newly developed sensors will be encased within environmental protective cases, and are powered by solar panel, which trickle charges a backup battery within the case. They will then be installed on overhead lines in several areas of the distribution network and left for an extended period of time to determine the suitability for use, in terms of effect on the installed infrastructure, ability to withstand weather events, and ability to maintain power on during the winter months

Expected Benefits:
There will be potential cost savings through:

- Reduction in costs due to damage from vegetation
- Reduction in costs due to not undergrounding in high risk areas

There will also be better safety performance through reduction in the risk of safety incidents due to wires drooping close to the ground due to pole movement or collisions with the wires by vehicles.
Progress:
The project is progressing but a modification has been required to deal with the effects of heat generated by the conductor on the sensor. This has resulted in re-design of the sensors. A change request was made for extra time of 15 months to complete the project objectives. Installation of the sensor is due to begin in summer, in preparation for winter trials.

2.14 NIA_SSEPD_0021 Thermal Imaging Observation Techniques for Underground Cable Networks (TOUCAN)

Start Date: January 2016
Duration: 20 months
Description:
This project investigates a technical method using thermal imaging solutions as complementary tools in the context of locating underground cable faults in the power distribution network. Thermal imaging equipment has traditionally been specialised and very expensive but thermal sensing technology has advanced to the point where it is relatively inexpensive to manufacture and is more readily available. Within the context of rapid location of underground cable faults trials and investigations with a range of imaging devices and solutions will be carried out and, if successful, recommendations made for equipping repair operatives and depot staff.
Expected Benefits:
There are potential significant cost savings through reduced time spent locating cable faults and reduced outage times.
Progress:
The project is progressing to plan with several lessons having already been learnt around camera procurement, camera design preference and benefits accruing to the business as usual environment. The outputs of the project are already being rolled out in the rest of SSEN. Benefits being tracked from the business as usual implementation will form part of the learning in the project closure reporting in the next relevant year.

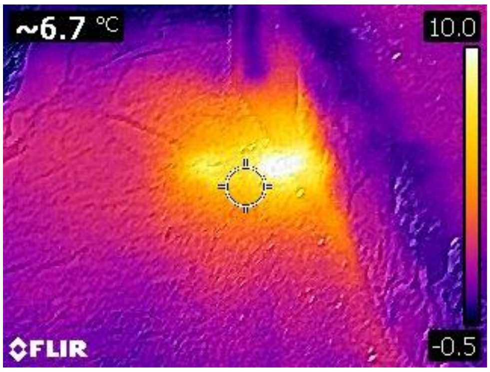

Fig 4. Fault location image from FLIR E5 camera

2.15 NIA_SSEPD_0022 Ester Fluid Transformer Re-design

Start Date: December 2015
Duration: 57 months
Description:
This project seek to investigate the potential of designing power transformers for use at distribution level to IEC 60076-14 limits which will allow the using of an ester-based fluid as an insulating medium at higher running temperatures. Completion of this project should provide a solution which can be used in situations where there are high safety and environmental concerns whilst providing a unit which can be reduced in size and cost.
Expected Benefits:
It is anticipated that the learning from this project would lead to

- A reduction in the cost of using an ester-based fluid transformer so that it is comparable in cost to conventional transformers which use mineral oil insulation.
- Further cost savings can be achieved through the removal of the requirement for new oil containment works on site.

Progress:
The project has been terminated early. As part of stage review of the project, a revised cost benefit analysis (CBA) was performed and it showed that the method being trialled could no longer achieve the financial benefits initially expected. A decision was therefore made to terminate the project. The idea may be revisited if the costs of the technology reduce significantly enough to show positive benefits. More details about the learning gained up to the termination point are in the closure report.

2.16 NIA_SSEPD_0023 Fault Passage Indicators for Sensitive Earth Faults (SEF)

Start Date: December 2015
Duration: 18 months
Description:
The aim of this project is to establish the magnitude of reduction in Customer Minutes Lost (CMLs) achievable by locating SEF faults with a revised fault passage indicator (FPI) supplied by Bowden Brothers and modified to be sensitive to currents as low as 4A through tests at the Power Network Demonstration Centre (PNDC), field trials and a post-trial evaluation.
Expected Benefits:

- Improved customer service through reduction in CMLs
- Reduced costs due to reduction in CMLs

Progress:
The project is progressing. A change request has been made to enable trial of a newer version of the FPI which combines sensitive earth fault detection with normal fault detection

in the same device. 72 sets of the updated device have now been procured and will now be trialled by the field teams to complete the rest of the objectives. So far, the technology has received positive reviews from internal stakeholders hence it is being expedited for business as usual implementation.

2.17 NIA_SSEPD_0024 Network Optimisation Project

Start Date: January 2016

Duration: 9 months

Description:

The project aims to address the problem of undergrounding overhead lines in a trial site. The method proposed will utilise an optimisation tool in order to produce optimal routes for undergrounding the overhead lines. The optimisation tool will optimise routes against a weighted balance of cost, time to construct, social acceptance and other parameters that will be defined during the course of the project.

Expected Benefits:

The anticipated benefit is the reduction in the cost of undergrounding of overhead lines.

Progress:

The project has now completed. The project delivered a data analytics and optimisation tool which demonstrated that the technology could deliver significant capital expenditure (CAPEX) savings in the use case of undergrounding 11kV overhead lines. There is significant support for this method from internal stakeholders and work is now underway to establish how more value can be extracted from the learning so far. More details of the learning from this project can be found in the NIA project closure report.

2.18 NIA_SSEPD_0025 Applied Integrated Vegetation Management (IVM)

Start Date: January 2016

Duration: 87 months

Description:

The project addresses the problem of trees in the vicinity of overhead electricity lines and also ensuring that regulatory standards are met. One of the potential solutions is the use of machine mulchers to clear all vegetation but this is costly and is not desirable from either an ecological or landscape point of view. This project proposes the use of integrated vegetation management (IVM). This is the practice of promoting desirable, stable, low-growing plant communities that will resist the invasion by tall-growing through the use of appropriate, environmentally sound, and cost effective control methods.

Expected Benefits:

- Financial savings through reduction in use of cost-intensive mulching methods

- Environmental benefits due to reduced disruption to protected wildlife species

Progress:
The project is progressing as planned. The completed literature review indicates that IVM can result in significant cost reductions, and improvement in biodiversity of both plant and animal species. The initial trial focussed on a railway path with a variety of plant species. The project has now extended in scope to cover a broadleaf wood site. In the coming year, subject to agreement with the landowner, it may also include a conifer plantation since the learning would be invaluable due to the spread of conifer woodlands across all license areas.

2.19 NIA_SSEPD_0026 Management of plug-in vehicle uptake on distribution networks

Start Date: March 2016
Duration: 22 months
Description:
This project will seek to inform an ENA Engineering Recommendation (or equivalent) for the connection, charging and control of new, large, plug-in vehicle (PIV) load to domestic properties. The focus of this project is on the collaborative approach required to achieve consensus on a solution that can be used to facilitate the roll out of controlled PIV charging.
Expected Benefits:
There are financial savings expected if network reinforcements necessitated by uptake of plug-in vehicles can be deferred based on implementing the monitoring and control methodology proposed in this project.
Progress:
The project is progressing as planned. There has been significant stakeholder engagement activity so far as part of meeting the project's comprehensive staged plan. Details of the learning and outputs to date are covered in the NIA project progress report.

2.20 NIA_SSEPD_0027 Low Cost LV Substation Monitoring

Start Date: March 2016
Duration: 24 months
Description:
This project proposes a technical method to develop and test a quantity of low cost devices from different manufacturers which will measure voltage and current at the outgoing feeders from a number of secondary substations. Data will be transmitted via the GPRS network from each substation to a central data centre where it will be available to the network planners and other relevant licensee staff. This will be in order to allow informed decisions to be made by

network planners and other staff with respect to operational decisions, network planning and customer service.

Expected Benefits:

Improved visibility of the LV network will help in the identification of areas where smart technologies can be implemented. Such technologies will allow deferral of underground cable reinforcement which will result in financial savings.

Progress:

The project is progressing although installation was delayed for some time while working through pre-requisite safety requirements. So far, there have been several installations of the monitoring systems in SHEPD area. Data is being collected and there are initial indications that issues on the network can be readily identified using it. Based on the learning so far, there is a high likelihood of the innovation going on to become business as usual if the cost-effectiveness can be confirmed.

2.21 NIA_SSEPD_0027 11kV power electronics providing reactive compensation for voltage control

Start Date: March 2016

Duration: 24 months

Description:

This project proposes a technical method to deploy a newly developed power electronic reactive power compensation unit of a novel design which operates with a direct connection at 11kV. The aim of the project is to manage voltage changes due to changing customer loads and generation which may go outside of statutory limits in some cases. The device will be tested at Power Networks Demonstration Centre (PNDC) to ensure that it can operate over the full voltage and frequency envelope it is designed for.

Expected Benefits:

The proposed method will trial a new device with ability to quickly respond to voltage changes by supplying or absorbing reactive power. This technology can be retrospectively fitted on existing problematic circuits thereby allowing deferral of transformer, overhead line and underground cable reinforcement which will result in financial savings.

Progress:

The project has faced significant delays during which agreement was being reached by contracting parties. Agreement has now been reached with the testing phase and site deployment now being arranged. The project has so far not produced any significant learning hence the NIA project progress will not be published at this point.

2.22 Collaboration projects led by other Network Licensees

Below is a list of other projects that SSEN is participating in. The projects are led by our collaboration partners hence further details of those projects can be found in their relevant summaries and project progress reports. To provide some indication of where those details can be found, the leading parties are given below next to each project.

- NIA_NGGD0072 Futurewave Phase 3 – National Grid Gas Distribution
- NIA_NGN_142 Project Concur – Northern Gas Networks
- NIA_NPG_001 VONAQ Utility Pole Strength Measurement – Nothern Power Grid
- NIA_SPEN_008 Appeal (Wood preservatives) – Scottish Power Energy Networks
- NIA_WPD_008 Improved Statistical Ratings for Distribution Overhead Lines – Western Power Distribution
- NIA_ENWL003 Review of Engineering Recommendation P2/6 – Electricity North West

Scottish & Southern Electricity Networks

3 Highlights of the year: Areas of significant new learning

3.1 Extracting value from innovation through business as usual conversion

In the last year, we have had swift successes from some of our projects. Our Assessment of Remotely Operated Mulching Methods project kicked off with the overarching aim to investigate if remotely operated forestry machinery can significantly reduce the cost and the potential for safety incidents during forestry mulching. Clearing of woody and bushy growth under overhead lines is one of the most common routine activities on rural networks. However, this is a very hazardous activity with significant manual chainsaw operations and also typically needed in locations with high likelihood of slips, trips and falls. The project trialled the ‘Bushfighter’ tracked vehicle which successfully demonstrated productivity increases by between 2.8 and 3.4 times the traditional method. In addition, by mechanising, the hazards associated with hand cutting were eliminated. This learning had immediate benefits for SHEPD which has a large network of overhead lines over a wide geographical area. It is also anticipated that this learning will be used by other affected network licensees so that more value can be extracted from the innovation.

In addition we are undertaking a full deployment of Light Detection and Ranging (LiDAR) surveying across our Distribution Network, this was a “fast follow” of projects undertaken by UKPN and others. Working with our Transmission Licensee, we will be capturing LiDAR data from low voltage (LV) all the way up to 400kV in a process that is expected to complete in November 2017. The data from the survey will be utilised to prioritise vegetation management and improve the efficiency of overhead line (OHL) design through creation of PLS-CADD files.

One of our major current challenges is how to rapidly and accurately pinpoint LV underground cable faults in order to minimise supply interruption time and repair costs. Our ongoing NIA project, Thermal imaging Observation techniques for Underground Cable Networks (TOUCAN) has so far delivered significant learning related to addressing this challenge. Learning from this project has already been converted to business as usual within SSEN. This learning includes the knowledge that expensive high end cameras are no longer a necessity for this application as the features that attract the higher premium have no direct impact on the heat signature detection capability of the devices. The project team is currently rolling out training and issue of FLIR E5 thermovision cameras which have been established as the most effective for implementing the method. To extend the potential benefits available from adoption of this method, knowledge sharing will be done through a dissemination event and at the next LCNI conference. It should also be noted that SSEN has approved funding for wide scale rollout of thermal imaging cameras to both north and south networks as a direct result of the success of this NIA project.

3.2 Minimising the costs of large scale substation monitoring

The GB energy system is expected to change significantly in the next few years. As homes and businesses get more involved in the provision of distributed energy resources, it becomes important to clearly understand the impact of such changes on the directly connected low voltage (LV) networks and to respond appropriately to manage any consequential effects. However, to do so requires better situational awareness of those networks which also happen to be inherently complex. This complexity makes monitoring the LV networks highly costly. The learning from SSEN's New Thames Valley Vision (NTVV) LCNF project showed that secondary substation monitoring still came at a high premium. The ongoing need to identify ways of bringing the costs down and make wider adoption of secondary substation monitoring a reality motivated the Low Cost Substation Monitoring project. So far, several substations in SHEPD areas of Dundee, Elgin and Aberdeen have had monitoring installed to try and determine the technical and financial viability of new low cost monitoring. Data is already being collected for analysis and there are already indications that the data will readily assist in the identification of system 'hot spots' and loadings. Although the progress so far has not reached a stage at which the reduction in cost can be fully quantified, the reduction in the size of the units used and the labour requirements for installation leads to a justifiable expectation for considerably reduced system costs.

3.3 Calling time on elusive sensitive earth faults (SEF)

Locating faults on overhead lines can be a very daunting task. This is mainly due to the long distances they cover and the need to quickly identify and rectify the fault so as to minimise impact on the customers. Linespersons tasked with such work usually use a portable fault passage indicator (FPI) device that can be strapped onto poles to quickly identify the direction of the fault and hence quickly sectionalise the faulty area. However, this work is made very difficult when the fault in question is a sensitive earth fault i.e. a fault with a very low magnitude of current due to a high impedance break down to earth. Standard available FPIs were not able to detect such low level faults. The Fault Passage Indicators for Sensitive Earth Faults project aimed to tackle that limitation and has been trialling an FPI with the ability to detect very low magnitude currents. After successful testing of this FPI at the PNDC, there was a trial roll out to various teams in SHEPD. This technology proved popular with lines teams as they started to see the benefits it brought. However, as the device could be set for sensitive earth faults or for other types of faults with higher current magnitudes, there was no common understanding about whether to set it up for SEF or for other types of faults while in use. The supplier subsequently modified the FPI to include the ability to measure both types of faults simultaneously on the same device. Based on the learning so far and the support for the technology from internal stakeholders, work is now underway to get the technology rolled out into business as usual in SSEN.

3.4 Delivering savings through optimisation

One of the projects that completed in the last year is the Network Optimisation Project. The project concluded that significant savings could be made by replacing manual based planning with optimisation tools which have the ability to analyse a large quantity of input data. The project developed a data analytics and optimisation tool which was then used in the trial use case of undergrounding 11kV overhead lines. Comparison of the optimal routes designed by the tool with routes designed using the traditional approach indicated that a capital expenditure (CAPEX) reduction of up to 11.33% was achievable.

To broaden the range of potential benefits from implementing this method, SSEN has started to undertake some work based on this project's outcome to assess other areas of operations where value could be obtained. Conclusion of the ongoing work will help inform any changes to business operations as well as potential project work that may be needed to advance the method's technology readiness level to 9 for the benefit of all stakeholders.

Further Information

The complete Innovation Strategy for SEPD and SHEPD can be found on the link below:

http://www.yourfutureenergynetwork.co.uk/12_innovation2014.pdf

Innovation Strategy Update published in March 2016

http://www.yourfutureenergynetwork.co.uk/wp-content/uploads/2016/04/Innovation-Stategy-update-ver-9.pdf

Further information on all of the NIA projects summarised above can be accessed through the following link:

ENA Smarter Networks Portal

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