Network Innovation Allowance

Summary Report

1 April 2016 to 31 March 2017

Scottish and Southern Electricity Networks

Scottish Hydro Electric Transmission

Scottish & Southern Electricity Networks

FOREWORD

This report summarises the progress achieved by Scottish Hydro Electric Transmission plc (SHE Transmission) in Network Innovation Allowance (NIA) projects during the period between April 2016 and March 2017. NIA has been running since the onset of RIIO-T1 in April 2013 and is targeted at smaller innovation projects which can deliver value to network customers.

SHE Transmission, like all the other networks that are part of Scottish and Southern Electricity Networks, has a core value to provide the energy people need in a reliable and sustainable way. The ongoing shift towards lower carbon technologies and proliferation of large scale renewable sources of generation are placing pressure on network infrastructure within and outside Great Britain (GB). SHE Transmission is no exception to this evolution and the associated challenges. To respond appropriately to immediate challenges and prepare for those that will subsequently arise, innovation has become pivotal to everything we do. Our culture of innovation is summed up in our Innovation Strategy document which outlines our stakeholders' views about what they expect from us and the seven objectives which are a statement of how we intend to address those stakeholder expectations.

As of 31 March 2017, we have a portfolio of eight live NIA projects at various stages in their lifecycles. Within our NIA project portfolio, each project addresses at least one of the seven objectives which are summarised in this report and covered in greater detail in our Innovation Strategy. This approach ensures that we can deliver on our core purpose and help us prioritise the relevant challenges faced by our networks as well as those of the entire GB electricity sector.

This is the fourth year since the onset of RIIO-T1. Our level of experience in delivering NIA funded projects has continued to grow year on year. Correspondingly, we are getting much better placed to exploit any new learning that we get from our projects, be it those closed or those in flight. Within SHE Transmission, we take the learning from our innovation projects seriously. In the same vein, we keep a constant lookout for learning generated by other network licensees to implement innovations as a fast follower 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 our customers.

Stewart A Reid
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1 SHE Transmission Innovation Strategy

SHE Transmission's Innovation Strategy document sets out the priorities for innovation based on seven main objectives identified as part of the RIIO-T1 submission. Each of SHE Transmission's innovation projects is motivated by at least one of the seven objectives to ensure that the need and aspirations of our stakeholders are addressed. This enables us to meet our core purpose of providing the energy which people need in a reliable and sustainable way. The seven objectives shaping our innovation activities are outline below:

1) Accelerate network development and connections including the integration of increasing amounts of renewable generation

Historically the priority of SHE Transmission has been to ensure that electricity supplies are available with minimal interruptions; to 'keep the lights on'. Over the years we have supported innovative practices in this area to improve our overall performance.

In recent years the challenges faced by our networks have significantly changed, driven by the UK's move towards a low carbon economy. Our transmission network is evolving from delivering energy from a small number of large generation sources to a large number of customers, to a more complex situation where it must accommodate bi-directional power flows created by an influx of new renewable generators, both large and small. Such demand for new connections is unprecedented. The transmission network, a large part of which was built 40-50 years ago, was not designed to accommodate the collection of energy from such geographically disparate source locations. The rate of increase in demand for such connections was not previously matched with innovative funding, disallowing us to meet the new challenges created by the needs of developers in innovative ways. This is an area which will benefit greatly from new innovation investment.

2) Minimise the cost of providing network capacity

Whilst it is clear we need to act swiftly and effectively to provide the capacity required by our customers, we must ensure that in meeting this demand we minimise the costs of the work required.

Our ultimate stakeholder is the GB electricity consumer; people who pay electricity bills have a legitimate interest in how they are made up. Given that transmission costs are a contributor to energy bills, it is important that we minimise the cost of building and running our transmission network. Our electricity connections customers and other stakeholders with an interest in the availability of grid capacity, have a direct interest in the costs associated with the development and operation of the transmission system. They wish to see costs minimised, but at the same time wish for the network to provide capacity quickly and easily to allow them to pursue their plans.

The need for SHE Transmission to ensure the costs are kept to a minimum is illustrated in quotations from two stakeholder organisations with a direct interest in the matter. These and other quotations from our stakeholders can be seen in SHE Transmission's Innovation Strategy which can be accessed by following this link; Transmission Innovation final .

3) Maximise the use of existing assets to deliver capacity and speedy connections

Widely favoured by our stakeholders, one of the most efficient ways to swiftly provide capacity for new renewable energy developments is to 'make the most of what we have' – to maximise the efficiency with which we use current assets. Transmission networks have capacity which is traditionally reserved to provide security of supply. This is known as system redundancy, an as yet largely untapped resource which could provide capacity for generation connections, reduce waiting times for connections and lower costs.

4) Maintain and improve safety and environmental performance

SHE Transmission's primary responsibility to its stakeholders – including employees, contractors and customers – is to ensure their safety. Safety is the number one value of our company where we pride ourselves on 'doing everything safely or not at all'.
In keeping with our commitment to sustainability, SHE Transmission's target every year is to achieve zero environmental incidents. These priorities are shared by our stakeholders who have expressed their desire for safety and sustainability to be identified as priorities in a number of ways.

5) Maintain and improve network performance

The past performance of our transmission network has been excellent. As the UK's energy infrastructure evolves to accommodate more widespread generation sources, we must adapt to ensure this high standard of performance is maintained. It is notable that customers appear to take this aspect of SHE Transmission's responsibilities as 'a given'. This is reflected in the infrequency that system reliability was mentioned as a priority by our stakeholders. In contrast we strongly believe that in line with our company's core purpose of providing the energy people need in a reliable and sustainable way, this should remain a focal point for our future development. As such, maintaining and improving network performance is one of our innovation objectives.

6) Provide more accurate information on the short and long term asset condition information to allow more informed decision making

Key to operating sustainably is making the most of existing assets. If we continue to replace assets in line with a standard, age-related programme, rather than a system where maintenance and replacement are condition dependent, it is likely that many hundreds of network components would be replaced earlier than required. Similarly, heavily-used assets may fault before scheduled work is undertaken, posing a threat to electricity supplies.

We have assets exposed to some of the harshest environments in the UK, with improved monitoring we can be better informed of the conditions that they are exposed to.

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7) Remain at the forefront of innovation to maintain our record of providing the highest standards of service at the lowest possible cost

New ideas, improvements to process and design, and innovation have been key to SHE Transmission's success to date and are fundamental to our ability to adapt to the challenges of the future. To deliver the changes and improvements our stakeholders desire, we must

maintain a strong culture of innovation within SHE Transmission, by actively promoting and supporting new idea generation to provide the feedstock for tomorrow's innovations. We are building on our underlying innovative flair and will utilise the Network Innovation Allowance (NIA) to push the boundaries and accelerate the rate and effectiveness of innovation on the network.

2 Update to the SHE Transmission Innovation Strategy

As part of our ongoing review of evolving challenges and priorities, we have recently published our new Transmission Innovation Strategy for the next relevant years. The new strategy outlines our vision for a value driven innovation culture and confirms our intention to be able to respond to the changing demands of future requirements. In future years, our projects' progress will be reported against the new strategy. A link to this new strategy is provided at the end of this report.

3 NIA Project Portfolio

In the year to 31 March 2017, 13 projects were funded under SHE Transmission's NIA. 5 of these projects closed whilst 3 were registered during the year.

An important feature of SHE Transmission's NIA projects is that each satisfies at least one of our Innovation Strategy objectives.

Table 1 below shows all the registered NIA projects for the relevant year and how each maps onto our Innovation Strategy objectives.

		Objective 1	Objective 2	Objective 3	Objective 4	Objective 5	Objective 6	Objective 7
Project Number	**Project Name**	**Accelerate development and connections**	**Minimise new capacity costs**	**Maximise use of existing assets**	**Safety and Environment**	**Network Performance**	**Accurate Asset performance**	**Innovation leaders**
NIA_SHET_0004	Dynamic Line Rating – CAT1	●	●	■	●	●	●	●
NIA_SHET_0009	DC/DC Converter		●			■		●
NIA_SHET_0011	Lightning Protection		●			■		●
NIA_SHET_0013	Modular Approach to Substation Construction	■	●					●
NIA_SHET_0014	Partial Discharge Monitoring to Reduce Safety Criticality			●	■		●	●

NIA_SHET_0015	Controlled Backfill for Peatland		●			■		●
NIA_SHET_0016	Alternatives to Wood Poles	●				■		●
NIA_SHET_0017	Pole Reclassification System Evaluation			●		■		●
NIA_SHET_0018	Transformer Intrascope Phase 2			■	●			●
NIA_SHET_0019	Automatic Thermovision Surveys (ACTS)					●	■	●
NIA_SHET_0020	Remote Asset INertial Monitoring & Alerting Network (RAINMAN)			●		●	■	●
NIA_SHET_0021	Composite Core (ACCC) Inspection	●		●		●	■	●
SPT 1603	Trialling Long-Lasting Tower Paints			●	■	●		●

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KEY: **Primary Objective** **Relevant Objective**

4 Summary of Progress

4.1 Strategy Objective 1: Accelerate network development and connections

4.1.1 NIA_SHET_0013 Modular Approach to Substation Construction (MASC)

Start Date: April 2014

Duration: 33 months

Description:
This project is aimed at researching the potential market, developing a functional specification and engaging with manufacturers for the design development of a permanent substation using a modular approach to substation construction.

Expected Benefits:

- Reduce costs for substation design, construction, installation and operation;
- Increase speed of deployment;
- Develop lower cost options for increasing substation capacity to give increased flexibility;
- Allow substations to be better matched to the anticipated connection – especially for renewables – and to provide flexibility to;
    - increase capacity;
    - Reduce consenting times;
- Reduce the overall carbon footprint of the development.

Progress:
The project has now completed. A functional specification for modular substation has been developed based on SHE Transmission standards for substations. The project has concluded that the main benefits of a modular approach to substation construction are smaller substation footprint, shorter build timescales and lower environmental impact in the surrounding area of permanent location. More details about the learning from this project are included in the Project Closure Report and in the accompanying special report entitled ‘NIA MASC Due Diligence Report’ which is also available on the learning portal.

4.2 Strategy Objective 2: Minimise new capacity costs

4.2.1 NIA_SHET_0021 Composite Core (ACCC) Inspection

Start Date: December 2016

Duration: 15 months

Description:
This project is a technical method to develop a carbon fibre inspection prototype. This is the first stage in the eventual development of a tool that can be incorporated into on-conductor travelling devices for routine inspection of strung Aluminium Conductor Composite Core (ACCC) in commission. The ultimate aim of the project is to provide confidence to network licensees to adopt and leverage the potential benefits of using ACCC in the sustainable and cost-effective unlocking of much needed network capacity.

Expected Benefits:
A tool for validating the integrity of the ACCC composite core at commissioning and in service will provide the following benefits:

- There will be less likelihood of conductor failure in service due to preemptive intervention thereby ensuring reliable network performance
- It will enable wider adoption of ACCC and unlock the benefits offered by the conductor such as:
    - Quicker circuit capacity uprating without need for reinforcing weight bearing components
    - Potential capital expenditure (CAPEX) savings through reduced numbers of structures on new line designs
    - Potential life cycle cost savings through reduced losses in operation

Progress:
The first deliverable of this project has been completed. In the completed stage, a non-destructive testing (NDT) technique known as Laser Shearography has been identified as the most effective technique for detecting defects on the exposed ACCC composite core. The images below show some of the results from using the technique on a sample of composite core with simulated defects.

Figure 1 Wrapped and Unwrapped images of impact damaged core

4.3 Strategy Objective 3: Maximise the use of existing assets

4.3.1 NIA_SHET_0004 Dynamic Line Rating CAT-1

Start Date: April 2009

Duration: 108 months

Description:
The project is aimed at evaluating an innovative system with potential to provide real time monitoring of overhead line networks. The method involves measuring tension and sag on the line in conjunction with known line characteristics to obtain accurate rating values for the line at any moment.

Expected Benefits:

- Securement of Transmission line outages, given increased confidence in current carrying ability of the rest of the network under fault conditions;
- Increased generation output hence allowing further generation connections to the 132kV network;
- Advance warning of impending clearance violations through sag monitoring;
- Matching of line ratings to load and weather conditions.

Progress:
From the CAT-1 field units that have been supplying data, there is evidence that there is some extra capacity available on the trial line. Ongoing activities will quantify how much spare capacity there is and when. In addition to identifying all the possible uses of dynamic line ratings, there is also a focus on establishing the impact of pushing the system harder and any potential TOTEX savings arising.

Figure 2: CAT-1 load cell

4.4 Strategy Objective 4: Provide more accurate information on the short and long term asset condition information to allow more informed decision making

3.3.2 NIA_SHET_0020 Remote Asset INertial Monitoring & Alerting Network (RAINMAN)

Start Date: July 2016

Duration: 32 months

Description:

This project is trialling a new alert system to establish if timely, reliable and accurate warnings can be provided for sudden and small incremental movements of poles. The project also aims to demonstrate the viability of low power wide area wireless communications for hostile, hard to reach areas. In addition, a resilient autonomous power source will be developed to provide lasting power for the sensors installed on the poles.

Expected Benefits:
This project has the potential to address the challenge of limited situational awareness that exists on aging wood pole lines which are exposed to harsh environmental conditions and are located in hard to access areas. SHE Transmission has a circuit in the Western Isles which fits that scenario and would specifically benefit from a successful outcome of this project. One of benefits for circuits with the same challenge is that gradual pole movements can be addressed before they cause permanent failure. In addition, where sudden pole movement is detected and needs immediate intervention, response teams will be able to quickly identify which poles are affected and get to them quickly rather than have to rely on sectionalising and line patrols. In both cases, there is potential to significantly minimise the impact of outage.

Progress:

The project has made progress and the following objectives have been fully met:

- System requirements have been defined
- A study successfully proved that the concept was feasible
- Pole movement sensors have been developed and demonstrated at a trial site
- An autonomous power supply system has been developed and demonstrated
- A low power wide area communication system was also demonstrated under simulated conditions

There is now ongoing work to roll out the system as part of a field trial on the aforementioned SHE Transmission circuit on the Western Isles.

4.4 Strategy Objective 4: Safety and Environmental Performance

4.4.1 NIA_SHET_0014 Partial discharge monitoring to reduce safety criticality

Start Date: January 2015

Duration: 46 months

Description:
The scope of this project is to install online trial Partial Discharge (PD) monitoring systems incorporating alternative technologies and suppliers at selected sites and integrate with SHE Transmission's SCADA system in order to collect, store and analyse output PD event data to

establish if this can be used to improve the management of safety critical plant. Learning from this project will also be used for further work to incorporate PD failure precursors into control and protection schemes.

Expected Benefits:
The most significant benefit from this project is safety. If equipment is isolated from the network prior to disruptive failure then the risk to safety will be minimised. Furthermore, where assets have been earmarked for replacement just as a result of their being identified as having high safety criticality, deferring their replacement through the continuous monitoring method proposed in this project will have a financial benefit.

Progress:
So far, installation and commissioning of two independent PD monitoring systems has been completed at three nominated sites. The last and most recent installation faced some delays because of access issues due to system security requirements. This has led to a change to extend project duration to enable completion of Supervisory Control and Data Acquisition (SCADA) integration as well as data analytics.

Figure 3 Cable sealing end with Transient Earth Voltage (TEV) and High Frequency Current Transformer (HFCT)

4.5 Strategy Objective 5: Improve network performance

4.5.1 NIA_SHET_0009 DC / DC Converter

Start Date: September 2013

Duration: 42 months

Description:
The scope of the project comprises:

- Design and develop the software models of high power DC/DC converter;
- Study DC/DC converters, DC hubs and their integration with HVDC systems

- Optimize the design of a DC/DC converter;
- Produce conclusions and recommendations on the design of DC/DC converters and their use integrating HVDC systems.

Progress:
The project has now completed and successfully delivered four reports which have been reviewed and accepted by SHE Transmission. A journal article has also been published in a leading international journal and a conference paper has been presented at an international conference. The four reports produced are available on request and their titles are:

- High Power High frequency Modular Multilevel Converter (MMC) designed and tested in PSCAD;
- DC/DC converter with MMC bridges designed and tested in PSCAD;
- DC Hub with MMC bridges designed and tested in PSCAD; and
- DC hubs integration with HVDC study

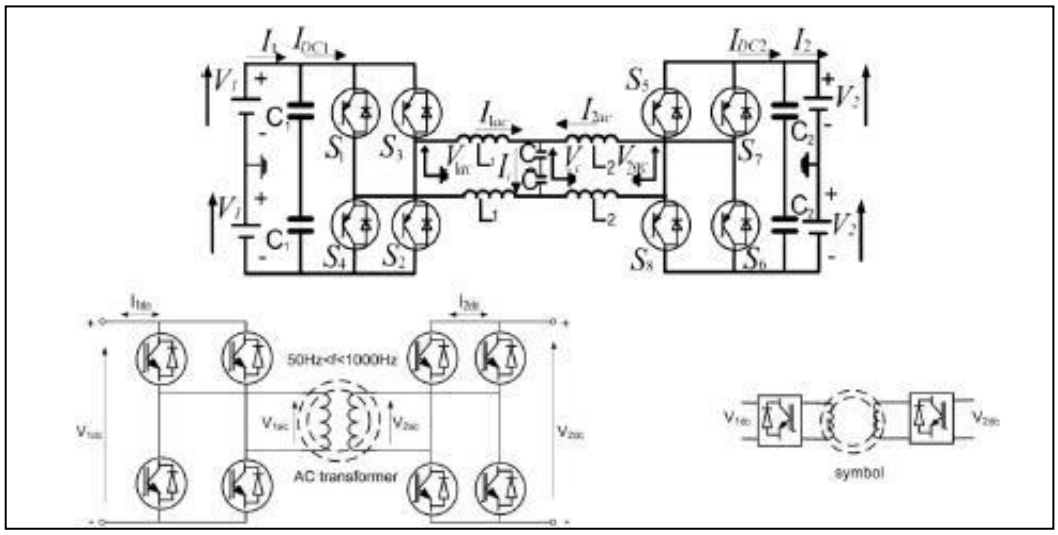

Figure 4: DC-DC converter **Source**: University of Aberdeen, PhD research project

4.5.2 NIA_SHET_0011 Lightning Protection

Start Date: December 2013

Duration: 36 months

Description:
This project involves building and verifying simulation models of lightning strikes on lines at 132kV and above with towers that have high footing resistances. This will enable

investigation of protection options which will inform decisions on lightning protection approaches.

Expected Benefits:
This project's aim is to optimise the design of lightning protection for towers with high footing resistance in order to cut costs. At the moment, the choices are limited and the process is largely based on trial and error until the resistance is acceptable. This project, if successful, might avail alternative options and the ability of informed decision making. It is therefore envisaged that savings of up to £30k may be made per tower with high footing resistance.

Progress:
The PhD thesis produced as part of this project is now complete and is being reviewed in SHE Transmission. The thesis and other papers presented to conferences will become available once the review is over. After that, recommendations from the project will be taken into consideration in the design of new Transmission overhead line circuits.

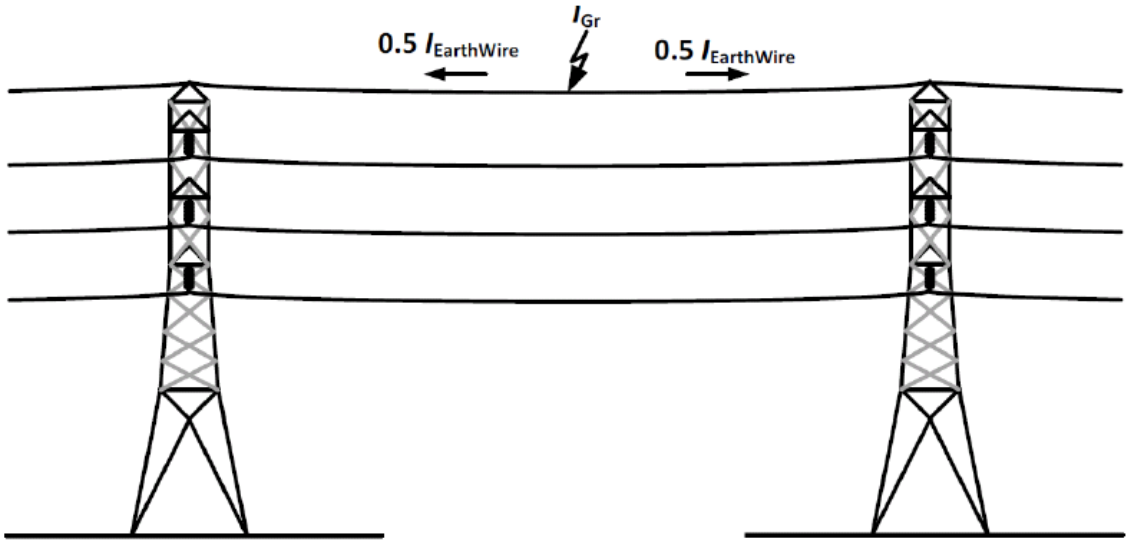

Figure 5: Simplified illustration of travelling waves from lightning strike

Source: Heriot Watt University, PhD research project report

4.5.3 NIA_SHET_0015 Controlled Backfill for Peat Land

Start Date: March 2015

Duration: 18 months

Description:
To find suitable alternative backfill materials, conduct Thermal Resistivity (TR) tests in the lab and in close HV cable proximity in order to identify the material which is most technically suitable, environmentally friendly and cost-effective for use in peat land.

Expected Benefits:

- Reduced cost - through identifying a controlled backfill material which is more economical than Cement Based Sand (CBS);
- Reduced cost of cable installations in peat land by designing projects with appropriate cable ratings and economic use of cable sizes;
- Improved power flows due to increased cable ampacity gained by lowering the backfilling TR;
- Increased cable lifetime by lowering the risk of cable damage or faults due to overheating;
- Improved environmental performance by using a solution that is friendly to the peat land habitat

Progress:
Initial tests were performed on a sample of peat in a high voltage lab. However, the proposal for the field test could not meet the specified requirements in terms of cable loading and temperature which were required to reliably compare the actual performance of the backfills. This was because the target site which met those conditions could not be available during the duration of this project. The options explored for the field test were unsuitable hence any further work could not continue after the project reached its natural end. Project funds got re-allocated to other priorities.

4.5.4 NIA_SHET_0016 Alternative to Wood Poles

Start Date: July 2015

Duration: 11 months

Description:
During this project, SHE Transmission will undertake a literature review of the available composite, laminated and modular pole alternatives to wooden poles. These alternative poles have not been used in the UK but have been successfully used in North America. A desk top review will be undertaken to ascertain all the potential benefits and costs of these alternative methods through the full product life cycle from procurement, installation, maintenance through to disposal. In addition, the safety case and product specifications will be reviewed to ensure that they will meet the required UK standards

Expected Benefits:
The project will seek to:

- Improve the variability of currently understood costs and benefits of available composite, laminated and modular pole alternatives;
- Identify the appropriate applications for available composite, laminated and modular pole alternatives in the UK;

- Identify the costs and benefits of available composite, laminated and modular pole alternatives and develop a detailed cost benefit analysis case which will support a clear recommendation for their deployment across the SHE Transmission area.

Progress:
The project has now completed and the feasibility study is available. The report covers the following subjects:

- A review of the current application of wood poles performed and the presented modes of failure.
- An overview of the different technologies of non-wood poles and the production processes used by their manufacturers

The project makes recommendations for how the technology can be progressed to a higher technology readiness level

4.5.5 NIA_SHET_0017 Pole Reclassification System Evaluation

Start Date: November 2015

Duration: 6 months

Description:
The purpose of this project is to ascertain if the strength of wood poles in service can effectively be improved through the use of the Pole Reclassification System (PRS) produced by Laminated Wood Systems at a lower cost than replacement with new poles of the relevant class.

Expected Benefits:
If this system is viable, it will be a cost-effective intervention for strengthening existing wood poles to withstand adverse weather conditions. If vulnerable poles are strengthened using this method then the weather induced faults which will be averted will result in improved network performance.

Progress:
This project is now complete. A Trident line was successfully constructed offline with similar attributes to a line being considered to be a use case for the proposed method. A demonstration to show the installation of PRS using different tools available was then subsequently held in the presence of relevant stakeholders. Stakeholder feedback has indicated that more work is needed to address the earthing requirements of the PRS in order to get the technology type registered for business as usual use.

Figure 6: Trident line pole with lower PRS sections installed

4.5.6 NIA_SHET_0019 Automatic Thermovision Surveys (ACTS)

Start Date: April 2016

Duration: 15 months

Description:

The project is trialling a fully automated live thermal imaging system at a supergrid substation. The aim of the project is to develop a continuous monitoring system for temperature hot spots in the substation which would raise alerts centrally to enable timely intervention prior to permanent failure.

Expected Benefits:
This project's method will be able to identify developing faults on equipment such as Static Var Compensators which are inaccessible during routine thermovision surveys performed using hand-held cameras. If unplanned outage is avoided through proactive management of developing faults, better reliability of the network will be realised.

Progress:
The project is nearing completion. So far, the camera system has been installed and commissioned. Work is ongoing to address some of the problems that have been identified as part of putting the system to the test.

4.6 Strategy Objective 6: Accurate asset information

4.6.1 NIA_SHET_0018 Transformer Intrascope Phase 2

Start Date: December 2015

Duration: 24 months

Description:
The transformer intrascope system has been developed in phase 1 of this project as an asset management tool to assist with the condition assessment of internal paper winding insulation within electrical power transformers. It is in the form of a controllable probe which can be inserted through the hatch of a defective transformer to analyse the chemical composition of the Kraft paper insulation to assess the health of the asset in situ.

This project seeks to improve upon and overcome the limitations of the phase 1 design to allow for better access, physical range, positional control and visual imaging capability, whilst accepting any improvements that can also be made to spectroscopic measurements. The scope of the project is to have a fully refined, assembled and functional intrascope probe system which has been both mechanically and functionally proven within a laboratory-based environment and via field trials.

Expected Benefits:

- Correlation with and increased confidence in using existing methods such as dissolved gas analysis of insulation oil for condition assessment of power transformers;
- Maximising the operation of existing transformer assets by delaying expensive asset replacement;
- Collection and storage of retrievable, reliable and potentially improved condition information of our existing fleet of transformer assets;
- The system can be used as a lower cost tool for investigation of commissioned, faulted and decommissioned out-of-service transformer assets compared with conventional off-site transformer de-tanking;
- Increased confidence in the condition of transformer assets connected to the network.

Progress:
The project has made progress with an imaging system having been manufactured and modified to address deployment issues identified after a stage review by SHE Transmission. The next phase of the project will be to perform field trials on some real transformers.

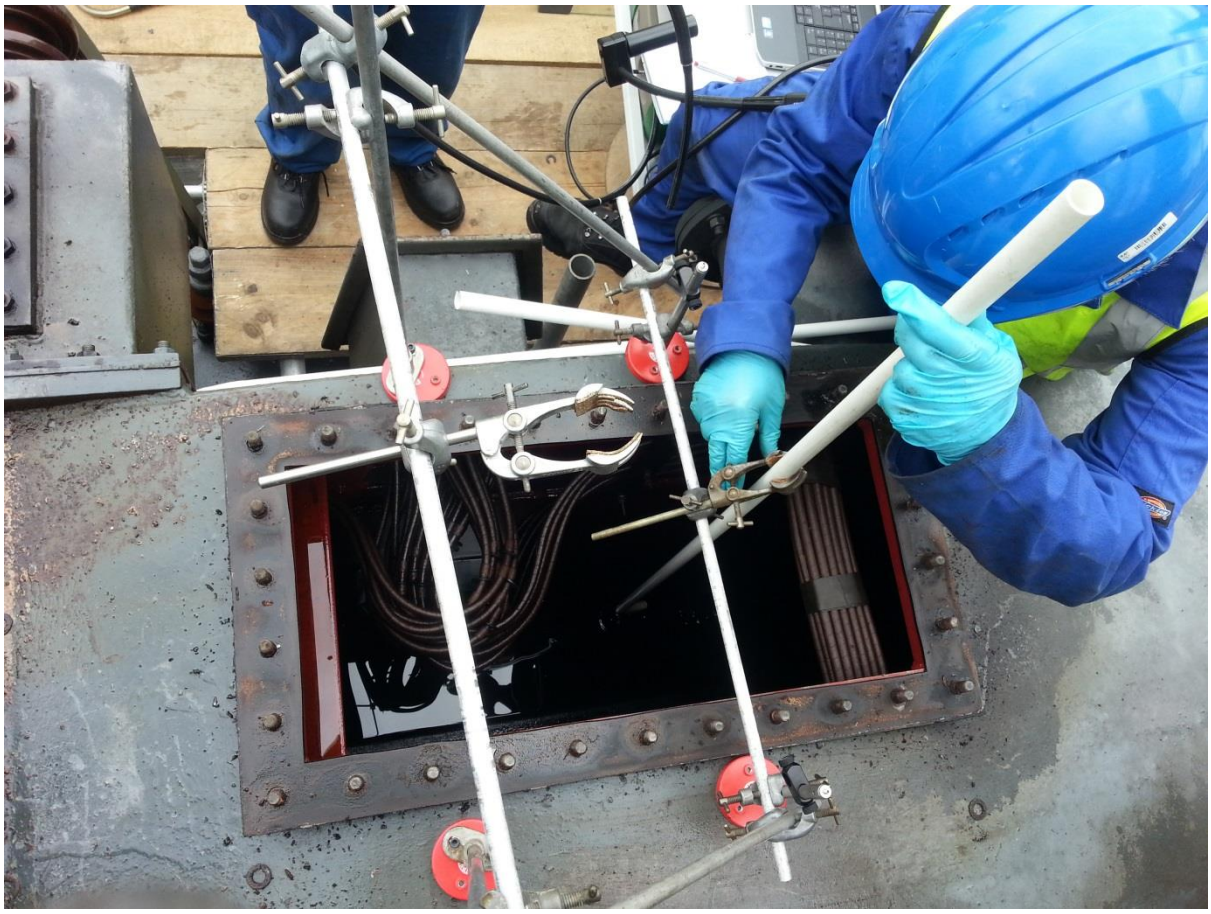

Figure 7: Accessing transformer windings with Phase 1 intrascope prototype

4.7 Strategy Objective 7: Remain at the forefront of innovation

This is an overarching objective which motivates all SHE Transmission NIA projects. Improvements are constantly being sought to ensure that great value can be delivered to our customers. The projects summarised in this document are a reflection of the culture of innovation in SHE Transmission and SSEN as a whole. Our focus on innovation complements our work in research and development, where new processes, services, products and technologies are created, which will enable us to remain a successful company in the future. We are also collaborating with our peers in the industry to ensure that we expedite the delivery of benefits that accrue from an innovative culture. One such collaboration is in a project we are co-funding and is led by Scottish Power Transmission (SPT), entitled “Trialling Long-Lasting Tower Paints”. The description, benefits and progress of the project can be found on the online learning portal and is summarised in SPT’s annual summary.

5 Highlights of the year: Areas of Significant New Learning

5.1 Achieving value through multipronged approach to problem solving

Our major challenge at the moment is how to address the issue of limited supply of wood products for EHV overhead lines due to the pole classes encountered at that level. This is exacerbated by the fact that we have a wood pole overhead line circuit which has recently become exposed to unprecedented adverse weather events. This has led to a particular focus on investigating different options of addressing the challenge. Our 'Pole Reclassification System Evaluation' project proposed a potential short term solution which can be provided on the most exposed poles on the circuit to increase their strength and prevent breakages that have happened in the past. In the medium term, online monitoring is going to be implemented on all poles of the circuit in the 'RAINMAN' project. The observability gained through the project will provide an ability to pre-empt developing issues as well as reduce the time it takes to identify affected poles on the circuit in the event of unforeseen failure. In the long term, engineered structures are deemed to be the most sustainable approach. Our project, 'Alternatives to Wood Poles' has kick-started the process towards replacement of wood poles with longer lasting and more resilient alternatives. Technologies such as laminated wood and composite materials have been assessed and their flexibility to be designed to meet specific requirements promises to unlock benefits brought by approaches such as probabilistic line design.

The three projects mentioned above were motivated by the experiences from one of our wood pole lines. However, each of them brings extra learning that addresses other aspects of challenges faced by networks in GB. The portfolio has also enabled effective sharing and use of knowledge and resources thereby introducing efficiencies in NIA project delivery and accelerating the realisation of benefits.

5.2 Breaking the ground by taking the important first step to realising future value

SHE Transmission has closed several NIA projects in the last relevant year. Some of the projects completed are not yet ready for wide deployment but they have provided vital learning. The DC/DC converter project has completed with several recommendations that will advance the knowledge in the area of high voltage direct current (HVDC). Although the method still remains at low technology readiness level, the learning from the project provides a good starting point which may encourage concrete action to be taken on new ideas on the subject. For instance, the newly opened National HVDC Centre, successfully delivered as part of the NIC Multi-terminal Test Environment (MTTE) project, seems to be the natural test ground for extending the learning from this project and advancing the networks' knowledge of the subject and its benefits. The MASC project has completed and made recommendations that are relevant since the emergence of renewable sources continue to compel networks to find much needed network capacity without impacts to the aspects that stakeholders hold dear, such as the environment. The Alternatives to Wood Poles feasibility study has set the

scene for trials by providing a reference that can be consulted to help in deciding which approaches to consider based on each network's existing constraints.

5.3 Keeping an eye out for quick wins

Other than the closed projects stated in the last section, any useful learning that is gained from projects in flight is recommended for use in business as usual without the need to wait for natural project completion. Any lessons gained from our current portfolio of projects so far or between now and the 2017 LCNI conference will strongly feature in the conference presentations to ensure that all GB network licensees can make informed choices about whether to exploit the learning for their own networks.

We also pay great attention to the activities of our peers and 'fast follow' any new learning that we deem to deliver value. To that end and in conjunction with our Distribution Licensee, we have recently implemented a 5 year framework agreement with NM Group Ltd to complete an aerial Light Detection and Ranging (LIDAR) survey of our entire SHE Transmission and SHEPD network areas. The survey will include all voltages from 400kV down to LV and utilises a combination of fixed wing aircraft and helicopter flights to obtain the maximum efficiency. The capture will be complete in November 2017 with all data processed by March 2018. The data will be used to prioritise vegetation management and improve the efficiency of overhead line (OHL) design through creation of PLS-CADD files from the surveyed LiDAR data.

The following section provides links to relevant documents referenced in this report. In addition, a link to the learning portal where associated NIA project progress and closure reports are published is provided.

Further Information

The complete SHE Transmission Innovation Strategy can be found on the link below:

Transmission Innovation final

The newly published SHE Transmission Innovation Strategy can be found on the link below:

Innovation at Work

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

ENA Smarter Networks Portal

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