Innovation Funding Incentive
and
Registered Power Zone
Report

for period 1 April 2013 to 31 March 2014

Scottish Hydro Electric Power Distribution
Southern Electric Power Distribution

1. Executive Summary

Innovation Funding Incentive

Over the last year, Scottish and Southern Energy Power Distribution (SSEPD) has continued in its commitment to research and development (R&D) activities using the Innovation Funding Incentive (IFI).

During the year ending 31st March 2014, our distribution teams have initiated new projects, and continued IFI projects started in previous years under our two wholly owned subsidiaries: Scottish Hydro Electric Power Distribution plc (SHEPD), and Southern Electric Power Distribution plc (SEPD).

As in previous years, there are a wide range of activities ranging from national collaborations with multiple work packages, to specific projects that address identified problem areas. In particular, we have projects aiming to improve the capability of the distribution network and address the challenges of a low carbon energy future such as growth in electrical demand and the connection of more renewable generation. Wherever possible, we have sought to minimise the cost of R&D activities borne by the customer through seeking complementary funding and forming collaborations.

The total qualifying expenditure for the reporting period of 1st April 2013 to 31st March 2014 for SSEPD was £3,290,000. This total comprises expenditure of:

- £ 2,238,000 by our SEPD business
- £ 1,052,000 by our SHEPD business

Registered Power Zone

One Registered Power Zone (RPZ) scheme was registered for the Orkney Isles in the SHEPD area in 2005/06 and the first two generators were connected in 2009. The RPZ incentive applies for five years to generation projects with a connection start date (as defined in the RIGS) between 1st April 2005 and 31st March 2012. The incentive does not apply to any generation connecting after this period. The RPZ incentive will therefore reduce year on year from now on as existing RPZ generation projects connected between 1st April 2005 and 31st March 2012 reach their respective five year marks.

Although the RPZ scheme has now ended for new generators, SHEPD has continued to use the Active Network Management (ANM) scheme established within the RPZ to connect further distributed generation (DG), bringing the total capacity connected at the 31st March 2014 up to 25.25MW.

2. Introduction

As part of the Distribution Price Control Review (DPCR) effective from 1 April 2005, Ofgem (the regulatory body for the energy industry) introduced two new incentives: the IFI and RPZ. The primary aim of these two incentives was to encourage the Distribution Network Operators (DNOs) to apply innovation in the way they pursue the technical development of their networks. A Good Practice Guide (Engineering Recommendation G85) has been produced by the DNOs and is available free of charge via the Energy Network Association's (ENA's) website: www.energynetworks.org.

The IFI mechanism is intended to provide funding for projects primarily focused on the technical development of the networks to deliver value (i.e. financial, quality of supply, environmental, safety) to end consumers. IFI projects can embrace aspects of transmission and distribution system asset management from design through to construction, commissioning, operation, maintenance and decommissioning. A network operator or owner is allowed to spend up to 0.5% of its Combined Distribution Network Revenue or up to 0.5% of its Base Transmission Revenue (subject to a minimum of £500,000) on eligible IFI projects.

The RPZ scheme was intended to encourage DNOs to develop and demonstrate new, more cost effective ways of connecting and operating generation that would deliver specific benefits to new DG and broader benefits to consumers generally. The RPZ incentive applied to generation connected from April 2005 to March 2012, and lasts for five years after the date of connection. Although this incentive has ended for new connections, SHEPD has continued to connect generation in the RPZ by taking advantage of the additional network capacity available due to the ANM scheme established there.

Open reporting (i.e. available in the public domain) of IFI & RPZ projects is required by Ofgem; this is intended to stimulate good management and promote sharing of innovation good practice. In line with this, we will publish our IFI & RPZ report on the SSEPD website: www.ssepd.co.uk. To enhance accessibility, it will also be available on Ofgem's website: www.ofgem.gov.uk.

To provide an easily accessible and user friendly database, the ENA created the Smarter Networks Portal under the auspices of Ofgem and all GB DNO's. The Smarter Network Portal is a repository for all research, development and demonstration projects carried out by GB DNO's and is publicly available at www.smarternetworks.org

3. Scope

This document contains the reports for SSEPD for our distribution assets under two wholly owned subsidiaries:

- SHEPD
- SEPD

It details activities in the period from 1st April 2013 to 31st March 2014.

Separate IFI regulatory reports on expenditure have been provided for each licence area with a summary listing of all IFI project costs incurred this year along with one set of detailed individual project reports. For the distribution businesses, projects are generally developed for the benefit of both licence areas, reflecting our strategy of running both companies using one common best practice. All reports have been produced in accordance with the Regulatory Instructions and Guidance (RIGs) issued by Ofgem and the ENA Engineering Recommendation G85 Issue 2 – December 2007.

In addition to reporting on activities in 2013/14 we have included information on current projects and an outline of intended future developments.

4. IFI Report

Core to SSEPD is the fundamental belief that innovation is vital to our continued success as a business. Without innovation, organisations are overtaken and become uncompetitive. This belief permeates all parts of our organisation; as a result, innovation comes naturally to many of our staff and is well supported at all levels within the business. The impact of this has been demonstrated through the work undertaken to date within the IFI, RPZ and, more recently, the Low Carbon Networks Fund (LCNF) and Network Innovation Allowance (NIA).

We engage in horizon scanning activities and explore the latest work on future scenarios but, core to our values as a business is the belief that innovation is principally about effective delivery and implementation.

Our programme of IFI projects in 2013/14 consists of a number of projects involving academia as we believe that effective engagement and working collaboratively with a range of academic institutions can both help to inform our overall programme of activities, and tackle specific challenges and opportunities so that we accelerate the rate of learning from our portfolio of research and development projects.

The following lists some of the present academic initiatives in which we participate to support our horizon scanning and project development:

University of Strathclyde Endowed Fellowship

Work to date has delivered benefits by informing the development and application of asset risk management within SSEPD. The current focus of research under this Fellowship is on the themes of LV network analysis and DNO-demand side management. The main achievements to date are: a literature review on LV analysis, distribution load flow, stochastic load flow, and the impact of low carbon technologies on the LV network; development of MATLAB planning tools; the simulation of load data using various case study profiles; a paper published on “The Uncertainties of Probabilistic LV Network Analysis”.

Power Networks Demonstration Centre (PNDC)

We have collaborated with the University of Strathclyde and Scottish Power Energy Networks to establish the Power Networks Demonstration Centre (PNDC), with support from Scottish Enterprise and the Scottish Funding Council. This research, demonstration and testing facility is the first of its kind in the UK, comprising low-voltage laboratories and a realistic, controllable and fully operational distribution network. We believe the pooling of financial and human resources at the PNDC will facilitate the demonstration and deployment of many innovative solutions at a faster rate than could be achieved by any single institution.

IET Power Networks Research Academy (PNRA)

The IET PNRA was established through a strategic partnership agreement between the Engineering and Physical Sciences Research Council (EPSRC), electricity transmission and distribution companies, and related manufacturers and consultants. It funds and supports PhD researchers in power industry-related projects, and helps to maintain and improve the research and teaching capacity in power engineering subjects.

A range of projects are addressed in this programme, including:

- Overhead lines measurement system;
- Application of artificial immune system algorithm to distribution networks;
- Protection issues of inverter-interfaced DG;
- Chemical approaches towards intelligent insulation;
- Electrical network fault level measurement for DG and other applications;
- Reactive power dispatch using DG;
- Influence of oil contamination on the electrical performance of power transformers;
- Alternatives to SF_6 as an insulation medium for distribution equipment;
- Solid state devices for electrical power distribution;

Industry partners, the IET, and academia have all agreed that the projects are beneficial to both the DNOs through potential breakthroughs that could lead to new practices or products and to academia by raising the profile of power engineering.

SUPERGEN

We are an industrial partner in the SUPERGEN-funded HubNet consortium, which also includes eight universities and has the objective of coordinating research in energy networks in the UK. We were also an industrial partner in the previous SUPERGEN-funded asset management and performance of energy systems (AMPerES) project which involved six UK universities. AMPerES ended in 2010 but provides an early and effective example of our participation in multi-party academic collaborations. The subsequent SUPERGEN-funded flexible network technologies (FlexNet) project, which ended in 2011, is a similar example of a major collaborative project which we participated in and which involved universities, network operators, and equipment manufacturers.

EPSRC Grand Challenges

The timescale being addressed by these projects is looking towards 2050. This is out-with the scope of our present R&D activities so we do not engage fully with these projects but are involved via steering committees through which we advise on the projects, and seek to learn from the project outputs when this is possible.

We work with a wide range of external service providers and R&D projects have arisen from our work with companies such as EA Technology Ltd (EATL) and Smarter Grid Solutions (SGS) whilst other projects have originated internally from our own analysis of areas of work which could benefit from an innovative approach.

We continue to see considerable amounts of renewable generation development and connection to our network in the SHEPD area, consisting mainly of wind farms. It is clear that the pressure on networks to facilitate this growth will increase due to the targets set by the UK and Scottish governments. However, network issues and constraints have become apparent at both a distribution and transmission level and this has driven one of the key themes for our R&D strategy.

At distribution voltages, we believe ANM systems, and other innovative methodologies are accepted as viable elements of a distribution network and can be implemented in appropriate areas of the network to allow more generation to be connected to maximise the use of the existing infrastructure. SSEPD are continuing to research and develop further methodologies to maximise the use of the existing infrastructure and reduce the effect of network constraints. Earlier work to deliver an ANM system on Orkney has now matured and this work has also lead to further innovations and the application of ANM systems on other sections of our distribution networks as a business as usual activity.

5. RPZ Report

As of 31st March 2012, the RPZ incentive scheme ceased to apply to any new generation connecting onto the RPZ area of the network on Orkney. Following on from this, further developments in the former RPZ area being reported on via the various IFI projects that continue to be developed to consolidate and improve the Orkney Smart Grid such as the Real-Time Java IFI project. The following sections provide an overview of activities to date in the Orkney RPZ.

5.1 Current Activities

The considerable renewable energy resource on the Orkney Isles has attracted significant levels of wind farm and marine development such that the connection of further renewable energy generation output is constrained by the existing capacity of the distribution network. An ANM scheme was developed in collaboration with the University of Strathclyde and delivered by Smarter Grid Solutions (SGS) in order to maximise the use of the existing infrastructure, thereby providing a quicker and lower cost alternative to network upgrading and reinforcement works. The ANM scheme is expected to enable a total of 72MW or more of generation capacity to be connected onto the Orkney network. At present, 47MW is already contracted on a firm or non-firm basis and a further 28.55MW of new non-firm generation output has been assessed as technically viable for management by the ANM scheme: original estimates considered that somewhere in the order of 15MW would be economically viable but this expectation has been exceeded as contracts have been established for a total of 28.55MW of generation.

Current renewable generation capacity and real time output can now be viewed live on our website anm.ssepd.co.uk. Further background information about the ANM scheme and its development can be found at www.ssepd.co.uk/orkneysmartgrid.

5.2 Development of the ANM scheme

2005-2009

The ANM concept was assessed initially using Department of Trade and Industry (DTI) funding in 2004/05 then developed as an IFI project. Closed-loop system trials were run on the Orkney distribution network during 2006 and the information gained was analysed. The key outcomes from this analysis were the verification of the control logic and an understanding of the response of the participating DG. Additional analysis of wind farm behaviour on Orkney was carried out by the University of Strathclyde to further develop the design of the scheme. Other key outcomes during 2006/07 were the development of logic design rules for the full ANM scheme and creation of a generator constraint analysis tool to calculate the expected curtailment of new DG connecting to the scheme.

During 2007/08, contracts were placed for the development of the necessary software and hardware systems. These systems were developed and factory acceptance testing carried out.

In 2008/09, we made further progress in preparation for the installation of the scheme in 2009/10 to fit with the generation developers' construction programmes.

Commercial arrangements were developed to support the ongoing operation and optimisation of the ANM system with Smarter Grid Solutions.

2009 – 2010

Delays by generation developers in gaining planning consent and finance were outside our control and delayed the full commissioning of this project until 2009 when the first two wind farm developments of 900kW and 2.3MW were connected under the RPZ scheme.

2010 – 2011

The first full year of operation of the scheme enabled us to validate its operation and provided us with valuable learning. We connected a further 4.5MW of DG under the RPZ scheme.

2011 – 2012

A further 4.52MW of generation was connected during this financial year bringing the total DG within the RPZ to 12.22MW. An external review was completed by KEMA to consider the extent to which the project met its original objectives, and identify lessons learnt for applications elsewhere. Although communications links provided by external third parties were identified as not meeting expectations, the overall project was judged to have met or exceeded the original objectives and a number of useful learning points were detailed. The RPZ incentive ended for new generation connections after 31 March 2012.

2012 – 2013

Although RPZ incentive payments are no longer made to the DNO for additional generation connected after 31 March 2012, we have continued to connect further generation, increasing the total DG connected via the ANM technology to 18.49MW. The total amount of renewable generation contracted to connect via ANM has increased to 28.55MW which demonstrates the effectiveness of the innovative commercial and technical approaches deployed in the region.

2013 – 2014

Further to the paragraph above for 2012-2013, we continue to connect distributed generation within the RPZ using the ANM technology and have increased the connected generation to 25.25MW, and a further 3.3MW is contracted to connect.

5.3 Future Activities

Even though the RPZ framework was only valid for new connections up to the end of March 2012, further related works are continuing to take place in the RPZ area. We are continuing to evolve the ANM system on Orkney by ensuring that the system is resilient and scalable and also exploring the addition of further functionality. Our continued work on innovative solutions surrounding the connection of DG onto our Distribution networks will be reported via the individual research projects in this area.

6. Benefits achieved from IFI projects

We are able to identify some of the benefits from the development and implementation of innovative methodologies and equipment.

Active Network Management

We have now connected 25.25MW of DG (13.03MW of which was connected after the RPZ connection deadline on 31st March 2012), as stated above in the RPZ report, and have avoided the conventional reinforcement works which would otherwise have been required to connect these renewable generators.

We have validated the operation of the ANM scheme; including the network monitoring sites where we established new very high frequency (VHF) radio communications links and installed innovative technology on the rural network. Operational experience to date indicates that the ANM technology supplied by Smarter Grid Solutions is robust.

The problems experienced to date have mainly been due to faults on the sections of the communications network where we have not used the bespoke VHF radio system to transport the data which is essential for the operation of the scheme. This problem is being solved by moving over to a microwave communication system and installing a backup for this should there be a fault on the primary system.

To summarise the benefits of the ANM scheme, it has allowed the connection of further renewable generation without the need to upgrade the existing Distribution network on Orkney along with the connections to mainland UK. Due to the ANM scheme, generators have been allowed to connect sooner than would have otherwise been possible, and without the need to fund a third distribution circuit at an estimated cost of £30 million.

Assessment of tree clearance from Geographical Information System (GIS)

SSEPD has a requirement to remove trees from locations that could impact upon our overhead lines (OHL) as stated in the Electricity Safety, Quality and Continuity Regulations (ESQCR) 2006 Resilience Requirements. This innovative project uses Ordnance Survey digital information imagery data within existing GIS applications to assess the tree cutting requirement.

A comparative method of gathering sufficiently detailed information to be able to accurately carry out an office based assessment of the tree cutting requirement would require data to be gathered by ‘Laser Interferometry Detection and Ranging’ LIDAR survey from a helicopter at an estimated cost of £250 per km. For SSEPD this would mean a cost of over £8M to gather data from all of our OHL. Experience within this project to date indicates that we are likely to be able to avoid this level of expenditure and identify the tree cutting requirements for under £500,000.

Live Line Tree Felling

Several thousand trees are due to be felled next to overhead power-lines in Scotland over the next ten years. Under current safety regulations tree felling contractors can only carry out tree felling outside two tree lengths of the overhead line.

When carrying out work within two tree lengths, SSEPD is required to carry out a shutdown of the section of electricity network affected by the nearby trees. This can be time consuming for the working party therefore reducing efficiency and increasing the number of interruptions for customers.

SSEPD strives to reduce customer interruptions, customer minutes lost and we also seek to provide the most cost efficient processes on behalf of our customers. Another objective was the desire to reduce or eliminate extended periods of manual tree cutting within a challenging environment and so reduce the risk of injury to employees and contractors.

Thus, SSEPD set out to investigate and develop methodology which would allow work to be carried out safely and efficiently within two tree lengths by using innovative techniques involving mechanical harvesting equipment. This investigation was a national collaboration between SSEPD, the ENA and the agricultural and environmental consultancy ADAS.

This project has been successfully completed and integrated into ‘business as usual’. To date we have carried out this procedure on a number of sites and confirmed the advantages of this innovative method such that we expect to see benefits of around £400-500k per year in future

7. Financial Summary

The SSEPD R&D activities on distribution voltage level projects are operated from a common perspective across both distribution licence areas: the costs and benefits for these have been taken as applying across both licence areas in proportion to the size of each area as determined by Regulated Combined Distribution Network Revenue. In round terms, this leads to 32% being allocated to SHEPD and 68% to SEPD.

Qualifying expenditure for the reporting period of 1st April 2013 to 31st March 2014 was £1,052,000 for SHEPD and £2,238,000 for SEPD, of which £234,000 and £496,000 relates respectively to internal costs.

Financial information on the IFI projects for the reporting year 1st April 2013 to 31st March 2014 is contained in the individual reports for SHEPD and SEPD as set out in the following sections and listed in Appendix 1.

8. Conclusion

SSEPD recognises the key role that R&D can play in enabling our industry to meet the challenges of an ageing infrastructure, a need for continuous improvement in customer service, and the challenges of a low carbon energy future with the growing importance of distributed energy resources (DERs).

Due to the scale of these challenges, it is important for us to continue to innovate and find new ways of delivering our services.

We are committed to the successful exploitation of our current programme of projects and will develop our portfolio to address areas that will deliver further benefits and add value in the future.

9. Regulatory Reports of IFI & RPZ Activities for April 2013 to March 2014

<table>
<tr><th colspan="2">SHEPD IFI Report</th></tr>
<tr><td>Combined Distribution Network Revenue</td><td>£264.87M</td></tr>
<tr><td>IFI Allowance</td><td>£1,324,000</td></tr>
<tr><td>Unused IFI Carry Forward to 2014/2015</td><td>£272,000</td></tr>
<tr><td>Number of Active IFI Projects</td><td>71</td></tr>
<tr><td rowspan="2">Summary of benefits anticipated from IFI Projects.</td><td>Total net present value (NPV) of SSEPD projects is
approximately £73M</td></tr>
<tr><td>Various customer, safety, and environmental benefits will accrue along with more effective utilisation of existing assets</td></tr>
<tr><td>External Expenditure 2013/2014 on IFI Projects</td><td>£ 819,000</td></tr>
<tr><td>Internal Expenditure 2013/2014 on IFI Projects</td><td>£ 234,000</td></tr>
<tr><td>Total expenditure 2013/2014 on IFI projects.</td><td>£ 1,052,000</td></tr>
<tr><td>Benefits actually achieved from IFI projects to date.</td><td>Generation connected through Orkney ANM avoiding costs in order of £30M

Significant reduction of line survey through GIS tree clearance in excess of £5M.</td></tr>
<tr><td>Regulatory Report for DG incentive, RPZs
and IFI
Reporting year 2013/2014
SHEPD</td><td>£M</td></tr>
<tr><td>IFI carry forward to 2014/15 (£M)</td><td>0.272</td></tr>
<tr><td>Eligible IFI Expenditure (£M)</td><td>1.052</td></tr>
<tr><td>Eligible IFI Internal Expenditure (£M)</td><td>0.234</td></tr>
<tr><td>Combined Distribution Network Revenue (£M)</td><td>264.87</td></tr>
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SEPD IFI Report	
Combined Distribution Network Revenue	£563.10M
IFI Allowance	£2,816,000
Unused IFI Carry Forward to 2014/2015	£578,000
Number of Active IFI Projects	71
Summary of benefits anticipated from IFI Projects.	Total NPV of SSEPD projects is approximately £73M
	Various customer, safety, and environmental benefits will accrue along with more effective utilisation of existing assets
External Expenditure 2013/2014 on IFI Projects	£1,741,000
Internal Expenditure 2013/2014 on IFI Projects	£496,000
Total expenditure 2013/2014 on IFI projects.	**£2,238,000**
Benefits actually achieved from IFI projects to date.	Significant reduction of line survey through GIS tree clearance in excess of £3M.
Regulatory Report for DG incentive, RPZs and IFI Reporting year 2013/2014 SEPD	**£M**
IFI carry forward to 2014/15 (£M)	**0.578**
Eligible IFI Expenditure (£M)	**2.238**
Eligible IFI Internal Expenditure (£M)	**0.496**
Combined Distribution Network Revenue (£M)	**563.10**

SHEPD RPZ Report	
Name of RPZ	Orkney Active Distribution Network Management
DG Capacity	Total DG connected under the RPZ scheme at 31/3/14 is 12.22MW (with an additional 13.03MW generation capacity connected within the RPZ area on a business as usual basis)
Starting Year	2005/06
Description of project and technical details.	New generators accepted under the RPZ scheme are instructed to limit their output to match the available network capacity. Available capacity is derived from real time network measurements and will depend upon the rating of network, the level of Orkney demand and actual output of other local generation
Expenditure for financial year	£ 185,000
Type(s) of innovation involved	Radical
Status (planned, under construction, operational) and operational starting year	Operational in 2009/10
Connection cost	Average of £ 107,000
Expected benefit to customers when project was registered	Ability to connect an additional 15 MW of new renewable generation to the Orkney Distribution network. Avoided reinforcement cost of £ 30M

10. Individual Project Reports

2004_01: STP2 Overhead Networks Module

<table>
<tr><td>Project Title</td><td colspan="4">2004_01 Strategic Technology Programme (STP) 2 Overhead Networks module</td></tr>
<tr><td>Description of project</td><td colspan="4">A DNO research & development collaboration hosted by EATL.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 3,160
External £ 58,800
Total £ 62,960</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £ 45,960
External £ 377,360
Total £ 423,320</td></tr>
<tr><td>Project Cost
(Collaborative + external + SSEPD)</td><td>£329,000</td><td colspan="2">Projected 2014/15 costs for SSEPD:</td><td>Internal £ 5,000
External £ 70,000
Total £ 75,000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">This module aims to optimise overhead network design, improve operational performance, maximise potential benefits, improve financial performance, and minimise risks associated with overhead networks, whilst having due regard for the environment and energy efficiency. The programme also aims to deliver continuous improvement in terms of safety and environmental performance of the overhead network to meet the individual business requirements of member companies. Several of the projects contribute to the industry's knowledge of variation in the potential impact of climate change.
Updated information can be found at :- https://www.stp.uk.net</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental, Tech Transfer, Significant, and Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>16</td><td>9</td><td>25</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Projects in this module will significantly increase the performance and reliability of the network. In certain cases the asset life may also be extended.
If these projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each member DNO to gain benefits including:
• Improvements in network reliability by identifying root causes of faults and developing solutions;
• Safe early detection of potential defects that can then be repaired in a planned and timely fashion;
• Cost effective and early identification of damaged insulators and discharging components, which if not addressed would result in faults;</td></tr>
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<tr><td></td><td colspan="3">
Development of tools, technology, and techniques to reduce risk or cost, as well as to increase speed of capital deployment of member company programme delivery;
A better understanding how OHL assets perform in service which can be used to determine the overall asset management policy;
Reduce levels of premature failure of assets;
Avoid redesign, reconstruction or refurbishment of OHL where this is driven by a perceived need to increase ratings or strengthen lines, and is required to conform with existing standards but which may be unnecessary;
Co-operation between European countries in the development of forecasting methods of atmospheric icing and for the exchange of forecasting tools;
Comparison of new covered conductor with known performance of older types;
Increasing scientific understanding of processes and climatic conditions leading to icing;
Extend the service life of poles and reduce potential levels of failures;
Reduce lifetime costs by the appropriate use of alternative materials;
Improved methodology for determining conductor ratings will provide greater confidence;
Positive impact on environmental performance and many have positive impacts on safety;
Give members a better understanding of novel conductors for new-build or re-conductoring lines that gives lower capital cost, minimum visual impact, and environmental acceptance.
</td></tr>
<tr><td>Expected Timescale to adoption</td><td>1-5 years dependent on project</td><td>Duration of benefit once achieved</td><td>3-5 years dependent on project</td></tr>
<tr><td>Probability of Success</td><td>49-95% dependent on project</td><td>Project NPV = (PV Benefits – PV Costs) x Probability of Success</td><td>Dependent on project</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="3">There are a huge variety of projects within the second tier projects work programme for this module. A number of these projects are scientific based and will require further R&D to achieve improvements in operational performance and integration into the DNO’s business environment.

Projects in these areas are mainly stages of much larger multi-stage projects and require further work to optimise network design, financial</td></tr>
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	performance, and operational performance from which the customer and stakeholders will benefit. Other projects were looking at better ways of improving the operational performance, management, and reliability of Overhead Networks by minimizing the impact on the environment and maximizing the safety of both the operators and the public, in a manner that could be implemented straight away. Collectively, the 13/14 work programme demonstrates the development of innovative products, processes and techniques that improve the management of Overhead Networks; in terms of safety, design, environment, reliability, security, and power quality. STP has delivered a number of notable innovations since its inception.
Project Progress to March 2014	Only a small number of projects or project stages started in the module during 13/14 have been completed since the majority are multi-stage projects that span more than one year. The projects which were completed during the year are: • S2126_7 Monitoring conductor temps- Stage 7: Consistent analysis of 3 years' data • S2156_3 Furthering development of pole leakage detector • S2162_2 Residual strength of wood poles- Stage 2:2nd batch of poles • S2171_2 Wedge clamps comparative tests- Stage 2: With realistic tensions at Deadwater Fell • S2174_2 Participation in Cigré WG B2.43 (OHL rating calculations) Stage 2: Testing • S2177_2 Vib & ice load testing at Deadwater Fell of fibre-wrapped conductor – Stage 2: Testing • S2180_1 Vibration assessment of polymetric long-rod insulators • S2182_1 Field testing screw anchors for pole stays • Other projects have reached an advanced stage and are on track to be completed as per the forecast completion date.
Collaborative Partners	Scottish Power (SP) Energy Networks, Northern Powergrid, Electricity North West (ENW), Central Networks, UK Power Networks (UKPN), Western Power Distribution (WDP)
R&D Providers	EATL

2004_02: STP3 Cable Networks Module

<table>
<tr><td>Project Title</td><td colspan="4">2004_02 STP3 Cable Networks Module</td></tr>
<tr><td>Description of project</td><td colspan="4">A DNO research & development collaboration hosted by EATL.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 3,290
External £ 71,050
Total £ 74,340</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £ 48,710
External £ 436,440
Total £ 485,150</td></tr>
<tr><td>Project Cost (Collaborative + external + SSEPD)</td><td>£374,640</td><td colspan="2">Projected 2014/15 costs for SSEPD:</td><td>Internal £ 5,000
External £ 90,000
Total £ 95,000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The STP Cable Networks programme for budget year 2013/14 was aimed at optimising underground cable network design, improving operational performance, maximising potential benefits, improving financial performance, and minimising risk associated with underground cable networks. This is whilst having due regard for the environment and energy efficiency. The programme also aimed to prevent cable failure modes and to deliver continuous improvement in terms of safety and environmental performance in all aspects of the underground cable network in order to meet the individual business requirements of member companies.

Several of the projects contribute to the industry’s knowledge of variation in the potential impact of climate change.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental, Technology Transfer, Significant, and Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>14</td><td>8</td><td>22</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Projects in this module will significantly increase the performance and reliability of the cable network. In many cases the cable asset’s life may also be extended.

If the projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain the following benefits, including:
• Use of an effective tool to improve the leak management of fluid-filled cable circuits, as well as reducing the risk of potential costly failures;
• Successful and practical methods for sealing ducts containing triplexed cable;
• A test that truly measures the mechanical robustness of a joint with an understanding of the performance between “green” resin-filled joints and conventional polyurethane (PU) filled joints.</td></tr>
</table>

	This could result in significant cost benefits; • Alternatives to current design and installation practices which offer benefits in lower lifetime cost, and higher performance (e.g. increased ratings); • Reduction of risk in environmentally sensitive areas; • A reduction in the number of accidents/incidents so increasing safety of staff and the public; • Reduced excavation required in locating leaks from fluid-filled cables, reducing the time and cost of leak location, and also reducing outage times; • A reduction in digging, causing less disruption to the public, as well as reducing the impact on the environment and avoiding disposal of soil to landfill; • Offsetting future increases in Capital Expenditure (CAPEX) and Operational Expenditure (OPEX); • Customer Interruptions/Customer Minutes Lost (CI/CML) savings per connected customer; • Reduced cable purchase costs; • Enforcing network resilience; • Implementation of strategies for reducing cable failures, resulting from excessive forces; • Reduction in number of cable faults; • Reduced design costs.		
Expected Timescale to adoption	1-2 years dependent on project	**Duration of benefit once achieved**	3-5 years dependent on project
Probability of Success	45-100% dependent on project	**Project NPV = (PV Benefits – PV Costs) x Probability of Success**	Dependent on project
Potential for achieving expected benefits	There are a huge variety of projects within the work programme for this module. A significant number of these projects are interlinked through the development of a scientific Fluid Filled Cable software tool to improve the leak management of fluid filled cable assets. This tool will reduce the risk of potential costly failures. This technical development described above consists of numerous single projects, but is only a part of much larger suite of projects over more than one financial year which require further R&D in order to optimise the financial performance, operational performance, and management of fluid filled cable assets from which the customer and stakeholders will benefit. Other projects were looking at better ways of improving the operational performance, management, and reliability of cable networks by minimizing the impact on the environment, and the safety of both the operators and the public in a manner that could be implemented straight away.		

	Collectively, the 13/14 work programme demonstrates the development of innovative products, processes, and techniques that improve the management of cable networks; in terms of safety, design, environment, reliability, security and power quality. STP has delivered a number of notable innovations since its inception.
Project Progress to March 2014	Only a small number of projects or project stages started in the module during 13/14 have been completed since the majority are multi-stage projects that span more than one year. The projects which were completed during the year are as follows: • S3168_3 Comparing future designs of HV (≥100V to 66kV) and EHV (>66kV up to and including 400kV) polymeric cables-Stage 3: Recommendations for future tests (12/13) • S3175_1 Bentonite grouts for ducted cable circuits (12/13) • S3177_1 Special stabilised backfill: Survey of existing products and potentialities (11/12) • S3207_1 Shrink back of polymeric oversheath materials: Study of type and process (12/13) • S3208_1 Measurement of thermo-mechanical properties of MV and HV Polymeric cables (12/13) • S3210_2 Developing an effective test procedure for testing metallic cable sheaths for integrity: Experimental comparison of techniques (12/13) • S3218_2 Development of a specification for silicone-based filling compounds to be used in EHV cable terminations (13/14) • S3224_1 Extra High Voltage (EHV) outdoor terminations-Additional user requirements (12/13) • S3226_1 Technical Evaluation of On line Testing of HV Cables (12/13) • S3227_1 Assessment of the reliability and performance of Thermo Setting joints (12/13) • S3228_1 Determination of the amounts and types of ground contamination which may affect cable sheaths (12/13) Other projects have reached an advanced stage and are on track to be completed as per the forecast completion date.
Collaborative Partners	SP Energy Networks, Northern Powergrid, ENW, Central Networks, UKPN, WPD
R&D Providers	EATL

2004_03: STP4 Substations Module

<table>
<tr><td>Project Title</td><td colspan="4">2004_03 STP4 Substations Module</td></tr>
<tr><td>Description of project</td><td colspan="4">A DNO research & development collaboration hosted by EATL.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 3,110
External £ 51,430
Total £ 54,540</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £ 51,420
External £ 344,190
Total £ 395,610</td></tr>
<tr><td>Project Cost
(Collaborative + external +SSEPD)</td><td>£332,896</td><td>Projected 2014/15 costs for SSEPD</td><td colspan="2">Internal £ 5,000
External £ 100,000
Total £ 105,000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The STP Substations programme for the budget year 2013/14 aimed to improve operational performance, maximise potential project benefits, improve financial performance, and minimise risk associated with substation assets whilst having due regard for the environment and energy efficiency. The projects aimed to provide cost effective solutions to increase reliability and deliver continuous improvements in terms of safety and environmental performance of existing and future substation assets in order to meet the individual business requirements of Member Companies.

Updated information can be found at :- https://www.stp.uk.net</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental, Tech Transfer, Significant, Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>16.5</td><td>9.5</td><td>26</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Projects within this module will help improve reliability and safety of substations in distribution networks in line with government policy.

If the projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO Member of the programme to gain the following benefits, including:
• Increased reliability and continuous improvement in terms of safety and environmental performance of existing and future substation assets;
• Collaborative evaluation of battery installations and operational practice to ensure a safer and more reliable network;
• CI/CML savings per connected customer;
• Optimising safety and environmental requirements for management of insulating oils and SF_6;
• Technical liaison with International Utilities to share new technology and failure modes;
• Offsetting future increases in CAPEX and OPEX;</td></tr>
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<tr><td></td><td colspan="3">

Development of condition based assessments, or tests, to determine asset condition;
Preventing failures of oil-filled equipment, tap changers, earth switches will improve safety and avoid unnecessary scrapping of serviceable components, which will alleviate environmental impact;
Extending serviceable life of switchgear and transformers;
Further developing technical understanding of protection system maintenance requirements;
Understanding the degradation and failure processes of substation plant and equipment, as well as quantifying the risks associated with those processes;
Further developing technical understanding of operational staff in complex electrical issues;
Mitigating risk to environment;
Increased safety of staff and public by reducing risk of fire and the number of accidents / incidents.
Reduced lifetime costs and improved functionality by the appropriate use of new technology.

</td></tr>
<tr><td>Expected Timescale to adoption</td><td>1-4 years dependent on project</td><td>Duration of benefit once achieved</td><td>1-6 years dependent on project</td></tr>
<tr><td>Probability of Success</td><td>30-95% dependent on project</td><td>Project NPV = (PV Benefits – PV Costs) x Probability of Success</td><td>£32,721</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="3">
There are a huge variety of projects within the 2013/14 work programme for this module. A significant number of these projects are scientific based, researching technical developments in degradation monitoring and understanding the failure processes of substation plant and equipment, whilst quantifying the risks associated with those processes.
Projects in these areas are mainly single stages of much larger multi-stage projects which require further R&D in the areas of condition based assessments, tests, asset management tools, systems, and methodologies in order to optimise the financial, operational performance, and design of Substation plant from which the customer and stakeholders will benefit.
Other projects were looking at better ways of improving substation workings, the performance and reliability of substation plant, maintenance regimes, as well as minimizing the impact on the environment, and the safety of both the operators and the public, in a manner that could be implemented straight away.
Collectively, the 13/14 work programme demonstrates the development of innovative products, processes, and techniques that improve the management of Grid Transformers to enhance Peak Rating, evaluating Battery Monitoring Techniques.
STP has delivered a number of notable innovations since its inception.
</td></tr>
</table>

Project Progress to March 2014	A number of projects or project stages started in the Module during 13/14 have been completed, but some projects span more than one year. The outputs of individual stages which form part of larger multi-stage projects have provided some notable conclusions and recommendations. The projects completed during 13/14 are: • S4185_9: Developing Strategic Asset Management Processes Through Technical Liaisons with European Utilities • S4225_3: Analysis of New BS148, (Reclaimed Oil), and Revised IEC60296, (Unused Oil) • S4237_2: Battery Cabinet Temperature Control-Benefit Evaluation of Battery Performance. • S4269_3: Operational and Environmental Evaluation of SIPP Node Intelligent Bund Pump Technology: Site Trial Other ongoing projects have reached an advanced stage and are on track to be completed as per the agreed completion date.
Collaborative Partners	Electricity North West Limited, ESB Networks, Northern Powergrid, Scottish Power Energy Networks, Western Power Distribution, UK Power Networks
R&D Providers	EATL

2004_04: STP5 Networks for DERs

<table>
<tr><td>Project Title</td><td colspan="4">2004_04 STP5 Networks for Distributed Energy Resources (DERs)</td></tr>
<tr><td>Description of project</td><td colspan="4">DNO research & development collaboration hosted by EATL</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 3,030
External £ 46,800
Total £ 49,830</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £ 61,490
External £ 401,750
Total £ 463,240</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£461,910</td><td>Projected 2014/15 costs for SSEPD</td><td colspan="2">Internal £ 13,290
External £ 42,500
Total £ 55,790</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The aim of the STP Networks for DERs programme for budget year 2013/14 was to maximise potential benefits and reduce costs and risks associated with facilitating the design, development, and operation of networks for the integration of low carbon technologies into future network designs, whilst having due regard for the environment and energy efficiency. The program is currently being reviewed in line with RIIO ED1 regulatory guidelines to ensure all projects comply with the requirements of OFGEM's Network Innovation Allowance (NIA). This will serve to cost-effectively improve the operational efficiency and business performance of Member Companies.
Updated information can be found at :- https://www.stp.uk.net</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Various</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>13.5</td><td>8.5</td><td>22</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Projects within this module will be designed to qualify for DNO funding through the Member Company's Network Innovation Allowances. The objective of these projects will remain as improving the reliability and safety of distributed energy sources within the UK electricity network.
If the findings and recommendations from the projects are implemented, the projects will potentially enable each DNO Member of the programme to gain benefits including:
Investigation of DG connection methods without undue reinforcement, while at the same time improving supply quality by reducing CMLs and improving voltage levels, etc.;
Improvements on environmental performance and potential to develop positive impacts on levels of safety;
Increased understanding between all member companies on technical, commercial, and regulatory issues together with the development of effective solutions to these issues;
Developing an understanding of the implications of connecting low carbon technologies to the distribution network in terms of safety, design, reliability, security, and</td></tr>
</table>

	power quality; • Where possible, optimising the Government's low-carbon strategy and accommodating the growth of embedded DG; • Improved management regarding the implications of connecting distributed resources to the distribution network in terms of the statutory, regulatory, and commercial frameworks; • Investigating low carbon network designs and planning the transition from passive to active networks; • Developing Improvements in power quality issues due to dynamic load change; • Enabling the development of strategies to manage power quality levels and customer expectations; • Reduction in losses for DNOs; • Highlighting the issues and benefits of Smart Grids, Smart Meters, and ANM Systems, ultimately improving CI/CML; • Significant benefits in terms of enhanced knowledge and awareness of overseas best practice in DG system integration, which can be applied as appropriate in the UK; • Ensure that all participants optimise network design, financial, and operational performance as the levels of storage, managed-demand, and DG increase on the distribution networks; Developing emerging DG, demand-side management, and storage technologies in line with relevant NIA requirements.		
Expected Timescale to adoption	1-3 years dependent on project	**Duration of benefit once achieved**	2-5 years dependent on project
Probability of Success	51-100% dependent on project	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	Dependent on project
Potential for achieving expected benefits	There are a variety of projects within the 2013/14 work programme for this module. A number of these projects are scientific based and will require further R&D to achieve improvements in operational performance and integration into the Network Operators business environment. Projects in these areas are mainly stages of much larger multi-stage projects and require further work to optimise network design, financial, and operational performance from which the customer and stakeholders will benefit. Other projects are looking at better ways of improving working and productivity for network planners, in a manner that could be implemented immediately as BaU. Collectively, the 13/14 work programme demonstrates the development of technical understanding in relation to connecting and integrating low carbon technologies onto the distribution network; in terms of safety, design, reliability, security, and power quality. STP has delivered a number of notable innovations since its		

	inception. One of ultimate objectives of all these segments is to draw up the policies required to define how these R&D concepts will be deployed in a BaU format to comply with the requirements of each DNO's NIA.
Project Progress **May 2014**	The majority of projects or project stages started in the module during 13/14 have been completed, but some projects span more than one year and are being re-scoped to ensure compliance with the Network Innovation Allowance criteria for RIIO ED1. The outputs of individual stages which form part of larger multi-stage projects have provided some notable conclusions and recommendations. The 2013/2014 work programme comprises: • S5189_3 Harmonic distortion caused by invertor connected generation (additional funds); • S5231_1 Transformer cyclic ratings for wind generation (additional funds); • S5167_5 Enhanced ratings for OHL connections to wind farms: implementation of outputs / gap analysis of national standards; • S5241_2 Managing the risks associated with multiple points of supply to a customer; • S5236_1 Performance of generation in PV mode (additional funds to monitor 3rd & 4th sites); • S5236_3 Performance of generation in PV mode (dissemination of findings); • S5236_4 Performance of generation in PV mode (additional funds to monitor 3rd and 4th sites); • S5236_6 Performance of generation in PV mode (assessment tool requirements specification); • S5264_1 Consumer voltage optimisation (consumer impact); • S5264_2 Consumer voltage optimisation (network impact); • S5264_3 Consumer voltage optimisation (consumer applications); • S5245_2 Designing Networks with Lower Supply Impedance); • S5267_2 Generation Diversity – Assessing the Minimum Load to be used for Solar & Hydro Connection Assessments; • S5267_3 Generation Diversity – Assessment and Visualisation for Wind, Solar & Hydro; • S5268_1 LV Connections – Phase Detection; • S5243_1 AC Cable Connections – Practical and electrical limits to their length;
Collaborative Partners	SP Energy Networks, Northern Powergrid, ENW, Central Networks, UKPN, WPD
R&D providers	EATL

2004_05: PD User Group

Project Title	2004_05 Partial Discharge (PD) User Group		
Description of project	The PD User group is a technical forum where information on PD-related failures can be discussed.		
Expenditure for financial year 2013/14	Internal £ 770 External £ 1,140 **Total £ 1,910**	**Expenditure in previous (IFI) financial years**	Internal £ 17,100 External £ 21,240 **Total £ 38,340**
Total Project Costs (Collaborative + external + SSEPD)	£72,000	**Projected costs 2014/15 for SSEPD**	Internal £ 0 External £ 0 **Total £ 0**
Technological area and / or issue addressed by project	PD is the primary cause of disruptive failure of HV switchgear. The PD User group is a technical forum where information on PD related failures can be disseminated and the understanding of PD on switchgear can be enhanced through targeted investigative R&D work. This in turn will enhance the way in which HV assets are managed and maintained and make a positive impact on the safety of operators working within substations.		
Type(s) of innovation involved	Significant, incremental		
Expected Benefits of Project	Due to the ageing profile of switchgear and the introduction of air-insulated switchgear designs using cast resin insulation (which is less tolerant to the effects of PD activity unless the condition of switchgear is actively assessed and managed) there is a likelihood of increasing failure rates. The expected benefits of the projects undertaken are: • Continual understanding of the potential PD-related failure points for all types of switchgear; • Ongoing understanding of the surface discharge PD degradation process using recently developed monitoring techniques and time lapse photography. We are monitoring changes in electrical treeing and ultrasonic emissions and analyse these to provide a better understanding of the degradation processes of various polymeric insulation materials and the possibility to determine 'closeness to failure'. The test rig has been completed and data is being collected and will continue to be analysed; • The compilation of a best practice guide based on the feedback from questionnaires completed by members; • Continued research to develop an understanding of the degradation processes of a variety of members' HV components exhibiting PD is being obtained by energising them at EATL. Two types of PU resin are being tested. Health Indices have started, and will be continued for other switchgear populations. This will enable the use of new monitoring and analytical techniques recently developed by EATL to determine end-of-life and current condition estimates (Health Indices) more accurately;		

	• A substation wiki has been set up and data populated. The members are encouraged to continue to populate the database with their own information; PD information, conference papers, presentations, switchgear information, drawings and photographs, and all of the case studies presented to the group by the members over the years. This will improve communication of information between members; • Enhanced interpretation of the results of routine PD surveys; • Better targeting of maintenance teams to switchgear in need of attention; • Preservation or reduction of the low failure rate for HV distribution switchgear; • Better understanding the effect of the environment on the levels of PD activity and condition of switchgear using data from newly available monitoring systems;		
Expected Timescale to adoption	1 to 2 years dependent on project	**Duration of benefit once achieved**	Ongoing
Probability of Success	65 -100% - dependent on project	**Project NPV**	£16,426
Potential for achieving expected benefits	• The ongoing enhancement of the PD Database is expected to realise the identification of likely PD points of failure for all types of switchgear over the coming years. • Our understanding of ultrasonic emissions produced by surface discharge is expected to be greatly enhanced by the research work being undertaken. The successful completion of this work will lead to further targeted research. • It is expected that improved linking between PD activity and the Health Indices of individual components will greatly assist in determining the Health Indices of switchgear and ultimately the substation. This is an ongoing project which is likely to yield valuable outputs. • The substation wiki is already improving information dissemination and will continue to improve as the database becomes more populated. Links are being developed from the PD database to the Substation wiki. • EATL's ability to interpret substation PD survey results has been enhanced by a better understanding of PD degradation processes in the light of new measuring techniques. Using these new techniques will enhance the members' ability to understand their company's PD issues. The new environment measuring techniques (temperature, humidity, air pressure, etc.) employed by the new monitoring systems have already enhanced our understanding of the onset of surface discharge.		

Progress as of March 2014	• There is ongoing consideration and assessment of new systems with member companies. • The substation wiki has been added to on a regular basis. • Work was being done on a best practice guide, a surface tracking rig, along with work on SF_6 CB testing and voltage indicators for use in PD measurements. • PD Database was updated and case studies reviewed with all partners.
Collaborative Partners	SP Energy Networks, ENW, CE Electric, WPD, UKPN, Northern Ireland Electricity, Manx Electricity Authority, Guernsey Electricity, Jersey Electricity, Electricity Supply Board
R&D Providers	EATL

2004_06: Equipment – Protective Coatings Forum

Project Title	2004_06 Equipment – Protective Coatings Forum		
Description of project	The 'Protective Coatings Forum' deals with the specification and testing of approved paint systems for tower lines and plant. It approves paint supplies, provides technical and legislative updates affecting the use of protective coating paint systems and it provides field support to check the quality of contractors work for member companies.		
Expenditure for 2013/14 financial year	Internal £ 2,680 External £ 8,230 **Total £ 10,910**	**Expenditure in previous (IFI) financial years**	Internal £ 40,620 External £ 46,630 **Total £ 87,250**
Total Project Costs (Collaborative + external + SSEPD)	£ 120,000	**Projected 2014/15 costs for SSEPD**	Internal £ 9,210 External £ 9,790 **Total £ 19,000**
Technological area and/or issue addressed by project	European Legislation affecting the use of Volatile Organic Compounds in 'Protective Coatings' and testing of alternative, more environmentally friendly paint systems.		
Type(s) of innovation involved	Incremental		
Expected Benefits of Project	This work facilitates the ongoing testing of paint systems in order ensure compliance with changes in European legislation. It also facilitates the process of monitoring and authorisation of paint suppliers. The work also ensures the maintenance of protective coatings paint specifications, and includes site checks and compliance testing of contractor paint.		
Expected Timescale to adoption	6 Years	**Duration of benefit once achieved**	40 Years
Probability of Success	90%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£ 20,000
Potential for achieving expected benefits	High		
Project Progress March 2014	Laboratory prohesion tests for two- coat urethane alkyd and two-coat vinyl tower paint systems have been completed for two new paints. Samples are being prepared for analysis. Additionally, certain paint products are ready to be trialled and analysed.		
Collaborative Partners	Paint suppliers and other DNOs.		
R&D providers	EATL		

2004_11: Collaborative ENA Projects

<table>
<tr><td>Project Title</td><td colspan="4">2004_11: Collaborative ENA Projects</td></tr>
<tr><td>Description of project</td><td colspan="4">The Energy Networks Association (ENA) represents all the UK network operators. Several projects have been initiated by the ENA R&D Working Group and have been funded through the IFI.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 2,530
External £ 39,750
Total £ 42,280</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £ 45,260
External £ 74,290
Total £ 119,550</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£ 140,000</td><td>Projected 2014/15 costs for SSEPD</td><td colspan="2">Internal £ 5,000
External £ 33,000
Total £ 38,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The projects listed below address issues which have been identified by the ENA working groups as significant – requiring technical investigation and development. There are a number of projects that have been completed and reported in previous IFI years and for that reason these projects are not reported here.

DC Injection: Investigation into the corrosion effects of DC on DNO networks with specific emphasis on assessing the impact of DC flows in the neutral conductors and providing evidence that a max of 20 milliamps as per British Standards is suffice.

Reactive Power (REACT): In the last 2 years, there have been significant difficulties in managing voltage levels during minimum demand periods. Analysis of this issue has shown that the root cause is related to the significant decline in reactive power relative to active power. Whilst minimum active power demands have fallen by around 15% in the last 5 years, reactive power has declined by 50% in this time. Current trends for 2012 show that this reduction is continuing, broadly, across the country. In order to better understand the challenge of manage voltage levels within licence standards and to plan for additional future reactive compensation requirements, a thorough understanding of the reactive power trend needs to be developed.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>6.2</td><td>-10</td><td>16.2</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">These projects have the potential to provide a wide range of benefits. In some cases, they will help to understand key asset-related issues and allow designs to be altered to address them. In other cases they will allow us to better understand risks to our</td></tr>
</table>

	network, whether from climate change or changes in demand. The smart metering project is already having a valuable input to the overall smart metering consultations.		
Expected Timescale to adoption	Year 2	**Duration of benefit once achieved**	10-20 Years
Probability of Success	75%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£ 100,000
Potential for achieving expected benefits	Work on the Harmonic Impedance Modelling (G5/4) will help DNOs understand harmonics issues on distributed networks and produce a revised revision of G5/4. The Earthing Transfer Potential projects will assist transmission operators to understand earthing issues in differing situation. The remaining projects are still in progress and it is hoped they will demonstrate the benefits explained.		
Project Progress March 2014	**DC Injection:** From the review undertaken it is concluded that: Normal corrosion rates in soils for metallic components, typically used in LV circuits can range from < 1 µm/yr up to 0.1 mm/yr in very aggressive conditions. However, in the majority of cases expected corrosion rate in soils would be in the 0.001 to 0.01 mm/yr range. If DC stray current occurs, this could significantly increase the corrosion rate and could lead to early age failures, but this would be dependent on the current density at the point of discharge (i.e. dependent on the level of current and surface area of discharge). Where the current density exceeds 10 µA/cm² (100 mA/m²) on copper and steel components the stray current corrosion will become sufficiently high that a problem could be expected within 10 to 20 years. Higher current densities could lead to problems in shorter period and lead sheath cables are likely to be the most susceptible components. Based on a review of the earthing arrangements typically adopted in the UK (i.e. PME), any problem (if it were to manifest itself) would be expected to occur at LV substations, mainly on the substation earthing arrangement, at additional PME points and on lead sheath cable. Damage to components located at the PV inverter location is unlikely, unless a TT or IT system is utilised. The complex and variable nature of the DC injection from PV systems is such that estimating the actual amount of cumulative DC will be difficult to assess, and either a probabilistic model or worst case assessment will be required. **Reactive Power (REACT):** All Grid Supply Points (GSPs) were analysed considering the active and reactive power during minimum demand recorded by National Grid from 2005 to 2012. Three indices were created to cater for the 2012 Q/P ratio, its decline from 2005, and		

	relative size of the GSP. Finally, the combination of these indices produced the list of the top 10 critical and control GSPs per DNO. The lists of critical and control GSPs are being used to discuss with the DNOs of which final selection of the GSPs that will be modelled in detail. In addition, half-hourly data for these top critical GSPs have also been provided by National Grid for further analysis. Good progress in terms of network modelling, including retrospective modelling.
Collaborative Partners	National Grid, Scottish Power Energy Networks, , Electricity North West, Western Power Distribution, Northern Powergrid
R&D providers	TNEI, Engage Consulting Limited, Imperial College London, Met Office, EA Technology Ltd, Earthing Solutions, KEMA, Redpoint Energy

2005_05: Mobile Sync GVR (MSU)

Project Title	2005_05 Mobile Sync GVR (MSU)			
Description of project	Trial and evaluate the use of an innovative mobile synchronising unit to synchronise mobile generation back onto the network. The GVR will be capable of allowing a portion of overhead line that is fed by mobile generation to be synchronised back to the main network, without the requirement to take customers offline to allow the removal of the generator.			
Expenditure for 2013/14 financial year	Internal £2,940 External £ 17,830 **Total £ 20,770**	**Expenditure in previous (IFI) financial years**	Internal £ 35,480 External £64,550 **Total £ 100,030**	
Total Project Costs (Collaborative + external + SSEPD)	£ 130,000	**Projected 2014/15 costs for SSEPD**	Internal £ 0 External £ 0 **Total £ 0**	
Technological area and/or issue addressed by project	When mobile generation is used there are times that customers are removed from supply before being re-connected to the network. Any interruptions to the customers supply 1. Cost the company money for time lost (CML's and CI's) 2. Reduce our reputation of reliability in supply 3. Customers are affected. T His device aims to solve these issues.			
Type(s) of innovation involved	Incremental	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
		17	0	17
Expected Benefits of Project	If the project is successful it will reduce CML/CI costs and also reduce the number of customers affected when essential work is taking place.			
Expected Timescale to adoption	1 Year	**Duration of benefit once achieved**	15+ Years	
Probability of Success	**85%**	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£ 218,271	
Potential for achieving expected benefits	High			

Project Progress March 2014	The MSU was successfully trialled on site in October 2013. This trial utilised 2 generators and supported 700 customers, none of which were aware of any works taking place. In this instance the outage works had to be extended and this was achieved but running the temporary generation for longer then by using the MSU at the end of the work the customers were unaware of the works as there was no interruption to their electricity supply. As the trial was a success the unit should be taken into business as usual, and a second project should be undertaken to carry out improvements to the device to eliminate / mitigate some safety concerns.
Collaborative Partners	N/A
R&D providers	S&C Electric Europe Ltd

2006_06: Corvid Behaviour Study

Project Title	2006_06 Corvid Behaviour Study		
Description of project	The project is intended to provide information on nesting patterns, crow behaviour and establish deterrent effectiveness. The project is now looking into the benefits of using shrouding, when best to remove nests, and the design of an alternative nesting platform.		
Expenditure for 2013/14 financial year	Internal £ 1,300 External £ 4,070 **Total £ 5,370**	**Expenditure in previous (IFI) financial years**	Internal £ 70,640 External £ 31,240 **Total £ 101,980**
Total Project Costs (Collaborative + external + SSEPD)	£ 115,500	**Projected 2014/15 costs for SSEPD**	Internal £ 0 External £ 0 **Total £ 0**
Technological area and/or issue addressed by project	The issue addressed is CI/CML associated with overhead faults instigated by crows.		
Type(s) of innovation involved	Incremental		
Expected Benefits of Project	Reduction of CI/CML.		
Expected Timescale to adoption	1 year	**Duration of benefit once achieved**	10 years
Probability of Success	40%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£ 24,264
Potential for achieving expected benefits	Low		
Project Progress March 2014	The project is almost complete with the closedown report in the process of being reviewed and approved. As part of the knowledge transfer to the business a document will be produced on how to deal with crows depending on the nesting stage and the time of year.		
Collaborative Partners	None		
R&D providers	University of St. Andrews, Newcastle University		

2007_01: DG and ARM Strathclyde

<table>
<tr><td>Project Title</td><td colspan="4">2007_01 Distributed Generation and Asset Risk Management</td></tr>
<tr><td>Description of project</td><td colspan="4">Sponsored endowment with University of Strathclyde for applied research and development of Distributed Generation (DG) and Asset Risk Management (ARM)</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 5,220
External £ 53,950
Total £ 59,170</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £ 39,130
External £ 293,640
Total £ 332,770</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£247,000</td><td colspan="2">Projected 2014/15 costs for SSEPD</td><td>Internal £ 5,000
External £ 52,880
Total £ 57,880</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Increased and more controlled output from Distributed Generation. Improved management of distribution assets. The current focus of research under this Fellowship is on the themes of LV network analysis and DSO-DSM.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental, significant, technological substitution and radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>10</td><td>0</td><td>10</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Financial project benefits are expected. The benefits will be across a range of areas including construction, maintenance, refurbishment and operation.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>3 years</td><td colspan="2">Duration of benefit once achieved</td><td>40 years</td></tr>
<tr><td>Probability of Success</td><td>25%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£321k</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">Previous work delivered benefits by informing the development and application of asset risk management within SSE Power Distribution.</td></tr>
<tr><td>Project Progress March 2014</td><td colspan="4">Further development of the LV analysis framework in the following areas
• Integration of real smart meter data load forecasts
• Further research and improved modelling of heat pump profiles</td></tr>
</table>

	• Studying the appropriate interpretation of probabilistic network analysis - investigation and application of statistical power quality standards • Developing a new LV optimisation for LCT load to improve the offline probabilistic assessment of demand response requirements • Developing a method to assess network flexibility for LCT load schedules – providing a statistical view of the network capacity to cope with shifting LCT load. • Applying LCT demand response and flexibility functionality to case study scenarios.
Collaborative Partners	None
R&D providers	University of Strathclyde

2007_08: Live Line Tree Felling

Project Title	2007_08 Live Line Tree Felling.				
Description of project	The development of equipment in order to enable trees to be mechanically harvested adjacent to a live network.				
Expenditure for 2013/14 financial year	Internal £ 13,730 External £ 43,500 **Total £ 57,230**	**Expenditure in previous (IFI) financial years**		Internal £ 82,240 External £ 135,980 **Total £ 218,220**	
Total Project Costs (Collaborative + external + SSEPD)	£289,500	**Projected 2014/15 costs for SSEPD**		Internal £ 0 External £ 0 **Total £ 0**	
Technological area and/or issue addressed by project	Development of equipment that can carry out tree harvesting in proximity to live lines, and the compilation of best practice procedures for use of such equipment.				
Type(s) of innovation involved	Technological substitution, Incremental	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**	
		20	0	20	
Expected Benefits of Project	Reduction of CI/CML. More efficient programme for harvesting operations. Reduction of hazardous manual work.				
Expected Timescale to adoption	February 2014	**Duration of benefit once achieved**		Permanent	
Probability of Success	100%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**		£397,600 for the remainder of DPCR5 and £4,009,088 for RIIO-ED1	
Potential for achieving expected benefits	Achieved. All procedures and documentation have been approved and three live line harvesting jobs have been carried out.				
Project Progress March 2014	Further comprehensive trials took place at Easter Lix (adjacent to a live 33kV line) in July 2013 (two days) and Muir of Ord (adjacent to a live 11kV line) in September 2013 (three days).				

	The Muir of Ord trial was used to inform stakeholders on the progress that has been made in this field. Internally representatives attended from the Control Room, Operational Training, Safety, Future Networks, Programmes and Depots. Externally around 100 representatives from HSE, WPD, Forestry Commission and the private sector of the timber harvesting industry visited the site. The stakeholder engagement from the trials allowed further progress with the ENA Engineering Recommendation document which is about to be sent out for final consultation with a view to publishing in July 2014. As a result of all the trial work and extensive internal consultation all procedures were finalized and approved in November 2013. The full set of relevant documents is: WI-PS-1082 (Work Instruction for Red Zone Tree Harvesting) FO-PS-747 FO-PS-748 FO-PS-749 FO-PS-750 TG-PS-779 FO-PS-715 FO-PS-716 WI-PS-1088 Specific operational authorizations for the supervisors and harvester operators were created in agreement with the Training School; these are based on a site assessment of the individual and a written test paper. One Site Supervisor and one Harvester Operator were assessed and authorized in December 2013. A further seven Site Supervisors have been trained on the procedure with a view to carrying out further site training and authorisation when suitable. The first "business as usual" live Red Zone harvesting job was completed successfully at Doune in February 2014. It is estimated that there will be around 20 jobs per year that will be justified and beneficial to be completed using these new techniques. See Appendix 4
Collaborative Partners	ENA
R&D providers	ADAS

2008_03: IET Power Networks Research Academy

Project Title	2008_03 IET Power Networks Research Academy		
Description of project	The IET Power Networks Research Academy has been established through a strategic partnership agreement between the Engineering and Physical Sciences Research Council (EPSRC), electricity transmission and distribution companies, related manufacturers, and consultants. The Academy funds and supports PhD researchers in power industry related projects and helps maintain and improve the research and teaching capacity in power engineering subjects.		
Expenditure for 2013/14 financial year	Internal £ 4,100 External £ 22,910 **Total £ 27,010**	**Expenditure in previous (IFI) financial years**	Internal £ 71,980 External £ 185,470 **Total £ 257,450**
Total Project Costs (Collaborative + external + SSEPD)	£ 1.915M	**Projected 2014/15 costs for SSEPD**	Internal £ 5,000 External £ 6,790 **Total £ 11,790**
Technological area and/or issue addressed by project	A range of projects are addressed in this programme namely: • Enhanced performance of power utility networks with increasing levels of DG; • Reduction of static voltage control requirements in utility's networks; optimise the use of existing distribution assets and facilitate greater in-feed from DG.; • To provide a means by which higher penetrations of DG can be connected to the network; to aid in 2020 renewable generation targets and the UK 2050 grid vision; • Protection of future power systems encompassing DG, converter interfaces and energy storage; • Investigation of sub synchronous resonance phenomenon in AC/DC meshed power networks; • State estimation for active distribution network ; • Overhead lines measurement system (OHMS); • Protection issues of inverter-interfaced DG; • Intelligent insulation systems; • Influence of oil contamination on the electrical performance of power transformers;		

<table>
<tr><td></td><td colspan="4">

- Using power electronics to increase power capacity without changing infrastructure;
- Alternatives to SF_6 as an insulation medium for distribution equipment;
- Reducing the risk of sub-synchronous resonance (SSR) in meshed power networks with increased power transfer capabilities;

Other projects are carried out within the academy with transmission owners.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant, Technological substitution, and Radical innovations</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>9.4</td><td>0.0</td><td>9.4</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">It is expected that the academy will:
• promote a stronger, more active and robust R&D environment in power networks disciplines at UK universities;
• provide capacity and capability to undertake the specialist research needed by industry and wider stakeholders;
• strengthen the teaching capability at those institutions;
• focus on building up the resource and expertise of a number of power research universities;
• facilitate a resource of trained engineering staff with academic capability, who will be capable of tackling electrical power engineering challenges;
• Deliver research output that is industrially relevant;
See online for further information at:
http://www.theiet.org/about/scholarships-awards/pnra/</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2012 onwards</td><td colspan="2">Duration of benefit once achieved</td><td>20 Years</td></tr>
<tr><td>Probability of Success</td><td>25%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£200,000</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">Progress made to date indicates that the project's potential for achieving expected benefits is high.</td></tr>
</table>

Project Progress March 2014	**Reactive Power Dispatch for DG** Several papers have been published and presented at the Power & Energy Society's General Meetings 2013, 2014 and at the Power & Energy Society's PowerTech conference 2013. They present results from a balanced voltage control algorithm and discuss the need for an unbalanced voltage control algorithm which can be utilised in order to maintain network voltages by dispatching reactive power from distributed generators. The algorithms have three significant control actions. Firstly, available reactive power reserves are utilised. Then, if required, distributed generation's active power output is curtailed. Finally, curtailment of non-critical site demand is considered. The unbalanced control algorithm utilises phase dependent reactive control dispatch to control network voltage and to help balance network voltages. This is presented in detail in two drafted papers, which demonstrate for a given island on the Orkney islands individual non-firm generation can increase their active power exports when the networks reactive power is managed by the unbalanced control algorithm. The fundamentally voltage control is demonstrated; furthermore, the ability to aid in network balancing through phase-dependent reactive power is also demonstrated. **Protection of future power systems encompassing DG, converter interfaces, and energy storage** -A new fault location algorithm for double circuit series compensated lines. This algorithm is novel in that it does not require any line parameters. It only requires the synchronised measurement samples of voltage and current and the fixed series capacitor reactance. The algorithm can also be applied to traditional double circuit lines. It is applicable to both transposed and untransposed lines. -The completion of Journal Papers to be submitted to IEEE The work completed as a part of the project is to be submitted to IEEE journals. -Thesis write-up **State Estimation for Active Distribution Network** 1. Transformer taps has been added as an additional state variable in weighted least square (WLS) Algorithm and applied on IEEE 14 bus system to improve the accuracy of the state estimation. 2. The Particle Swarm optimization (PSO) method has been developed for distribution state estimation since the conventional method of WLS cannot handle the non-differential and non-continuous objective function of distribution state estimation caused by nonlinear characteristics of the transformer taps. It has been tested on IEEE 14-Bus test system to estimate the transformer taps values.

3. Hybrid particle swarm optimization (HPSO) technique is developed for Distribution State Estimation (DSE) which can estimate the target system conditions more accurate than other proposed methods of State Estimation (SE) in this study. The feasibility and robustness of the proposed method for SE has been demonstrated on the IEEE 14-bus test system. The results confirmed the potential of the HPSO method and showed its effectiveness in estimation of transformer taps with discrete values
4. The three phase modeling of overhead and underground lines, transformers and spot and distributed loads are studied and the different components of the IEEE-13 bus system have been modelled.

5. The three phase WLS State estimator for unbalanced distribution system has been developed and it has been tested on IEEE 13-Bus test system where it can estimate the Voltage and angle for all the phases in the network.

6. The three phase HPSO state estimator is developed for Distribution State Estimation. The proposed method is capable of estimating the transformer taps with discrete values for three phase SE and has been tested on the IEEE 13-bus test system.

OHMS

The student submitted the thesis and passed the viva examination in December 2012. Between April and December 2012, the prototype system was further developed to the point where two prototypes have been tested and verified in laboratory conditions. Further to this, a journal paper titled "Fault Location using a Multi-Branched Approached" has been submitted. Two further papers are being finalised; one on communication over power lines and one detailing the hardware and technology used to create the prototypes. The project is being continued and field trials are planned.

Protection Issues of Inverter-Interfaced DG

Two industrial deliverables during this period were work surrounding the topics of constant power loads in microgrids, and droop controller behaviour under fault conditions.

Constant Power Loads in Microgrids: This work developed a small-signal stability model of a constant-power load and integrated the model into an existing microgrid network model. An interaction between the active load and the controllers of the inverter-interfaced generation was found from participation analysis of the model. Findings from this research were presented at two

	conferences and published in the journal IEEE transactions on Power Electronics. Resetting of inverter current limits: This work investigated and delivered design-rules on how inverter controllers should reset from current limiting mode to normal operation. An impedance-based method of detecting over-currents and faults for inverter controllers has been developed. This research was published in two papers. The first paper was published in the journal IEEE transactions on Power Electronics and the second paper was presented at the 15th European conference on power electronics and applications. Droop Controller Behaviour under Fault Conditions: The transient stability of droop controllers under fault conditions was investigated and delivered an understanding on the factors that affect the recovery of a droop controlled microgrid when subject to a fault. This research has been submitted to the 16th European conference on power electronics and applications. **Intelligent Insulation Systems** The project has been completed with industrial deliverables of: • Investigation into the viability of a passive dielectric material which provides a visible response to a local electric field; • A study of the behaviour of two classes of liquid crystals under an applied field (in terms of opaque-transparent switching in the presence of an electric field); • Model of a passive multilayer voltage detection system with a focus on effect of material permittivity on sensitivity of equipment; • Discussion of potential materials to fulfil model requirements: additional study of high permittivity micro- and nano-scale fillers included to fulfil high permittivity material requirements. **Influence of wind uncertainty on National Grid's Operating Reserve** Further review of the published literature within the fields of wind power forecasting and integration, power system reliability as well as stochastic and linear programming has been conducted. Based on this, a stochastic unit commitment model was developed and applied to a small test system to better understand the potential and limitations that such methods provide for reserve procurement. Additional literature review related to the current UK electricity market structure and Electricity Market Reform (EMR) was conducted to enable adaptation of the stochastic programming models to reflecting the structure of the UK electricity market. Furthermore, bi-level optimisation models have been developed in order to model the behaviour of generators and storage operators under market power in the electricity markets. This will be used later to model the effect of storage participation in reserve markets.

	Influence of oil contamination on the electrical performance of power transformers The following experimental results on pressboard particle contaminated transformer oil under DC, AC ,and DC biased AC voltages have been performed and presented: 1. Experiments have been carried out with transformer oil contaminated by cellulose particle under the influence of several levels of DC electric field with spherical electrode covered with craft paper. 2. Experiments have been carried out with transformer oil contaminated by cellulose particle under the influence of several levels of DC electric field with kraft paper barrier between bare spherical electrodes. 3. Experiments of cellulose particles with several contamination levels under the influence of AC electric field with different frequencies ranging from 1Hz, 2Hz, 5Hz, 30Hz up to 180Hz have been carried out. 4. Numerical simulation of cellulose particle trajectory under the influence of DC electric field with sphere-sphere and needle-plane electrode systems. **Using Power Electronics to increase Power Capacity without changing Infrastructure** Future connection of electric vehicles (EV), electric heating and distributed generation (DG) will result in increased burdens on the low voltage (LV) distribution network. Power levels will increase with implications for network loading and voltage profiles. The latter will be made worse by EV's with Vehicle-Grid capable chargers and possible reverse power flows from DG. Point of use voltage regulation allows distribution network capacity to be increased by exploiting the full cable AC voltage rating (above 415V line) and removing the need for tight regulation of load voltage profile. The project has evaluated the potential gains in capacity/cable losses that can be achieved through the use of increased distribution voltage with voltage regulation. Potential point of use regulators have been investigated focusing on quantifying the cost and efficiency of these devices; allowing a full system level evaluation to be made. **Alternatives to SF_6 as an insulation medium for distribution equipment** Progress in the period April 2013 – March 2014 has been the utilisation of switch disconnectors, provided by Schneider Electric and Ring Main Units (RMUs) provided by Western Power Distribution to test mixtures of CF_3I-CO_2 as an alternative insulation medium to SF_6.

	Using a novel test rig developed at Cardiff University fundamental lab experiments have been finalised to gas, de-gas and filter the switchgear with CF_3I and CF_3I-CO_2 gas mixtures. Mixtures of CO_2 and CF_3I gas have been investigated and their suitability for HV switching has been explored whilst a comparison was undertaken using the gas SF_6. In particular the rated lightning impulse withstand voltage of the switch disconnectors and RMUs have been tested. The tests have examined the ability of different gas mixtures of CF_3I-CO_2, in comparison to SF_6, to withstand lightning impulses applied to the switchgear. Testing has now been finalised and the submission of the PhD Thesis is soon to be completed. This research has led to the student becoming more familiar with the phenomena involved in gas discharges, electric field theory under the presence of space charge, analytical and numerical computation of electric fields in practical high voltage plant configurations with particular application to existing HV switches for computer simulation purposes. **Reducing the risk of SSR in meshed power networks with increased power transfer capabilities** ▪ Two indices, one for torsional interactions and one for transient torques amplification, were developed to quantify the problem of SSR. Generators in a large network were ranked based on the severity of SSR problem using these indices and results were verified using electromagnetic transient simulations. ▪ A methodology for the risk evaluation of SSR was also developed. This methodology can identify the levels of SSR risk the generators in the network are exposed to, in each contingency considering the probability and severity of SSR problem. ▪ The influence of the voltage-source converter (VSC) HVDC system operating parallel to compensate lines in a large meshed network was also investigated. Studies were performed with different power transfers through the VSC link in various network configurations. ▪ It has been found that in normal network configuration, critically compensated system may become unstable with as low as ±5% uncertainty in the mechanical parameters. The probability of becoming unstable due to mechanical parameter uncertainty stays the same with both type of compensation schemes in the normal network configuration and reduces with asymmetrical compensation in *N-1* and *N-2* contingency
Collaborative Partners	EPSRC, National Grid,, WPD, UKPN
R&D providers	Cardiff University, University of Manchester, Queens University Belfast (QUB), University of Southampton, University of Strathclyde, and Imperial College London.

2009_02: Tree Growth Regulator

<table>
<tr><td>Project Title</td><td colspan="4">2009_02 Tree Growth Regulator</td></tr>
<tr><td>Description of project</td><td colspan="4">Use of hormone root injection to restrict the extension growth of trees, thus reducing the frequency at which tree cutting is required.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 0
External £ 0
Total £ 0</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £ 28,380
External £ 124,570
Total £ 152,950</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£ 297,000</td><td>Projected 2014-2015 costs for SSEPD</td><td colspan="2">Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Hormone root injection can be used on suitable trees of high amenity value or where there is a landowner refusal to restrict their future growth and avoid frequent pruning visits.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technological substitution from different applications</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>14</td><td>-6</td><td>20</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Hormone root injection provides a possible solution to landowner refusals where no other might exist. In addition to this, it could help reduce future costs by reducing or eliminating the amount of re-cutting required. A secondary advantage will be a reduction of the hazard by avoiding the need to carry out future tree cutting on certain sites. Although a valuable tool to provide a solution where few others exist, it is expected that this technique would be used infrequently.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>2013</td><td colspan="2">Duration of benefit once achieved</td><td>2014 onwards</td></tr>
<tr><td>Probability of Success</td><td>75%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£ 847,618</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">High</td></tr>
<tr><td>Project Progress March 2014</td><td colspan="4">Reports produced to date indicate that growth restriction is effective with some species.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">Central Networks, WPD, UKPN</td></tr>
<tr><td>R&D providers</td><td colspan="4">ADAS</td></tr>
</table>

2009_06: Power Network Demonstration Centre

<table>
<tr><td>Project Title</td><td colspan="4">2009_06 Power Network Demonstration Centre</td></tr>
<tr><td>Description of project</td><td colspan="4">Construction of an extensive research facility incorporating actual overhead and underground distribution equipment as used on the utility network infrastructure.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 15,850
External £ 61,990
Total £ 77,840</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £ 73,780
External £ 549,880
Total £ 623,660</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£8,000,000</td><td>Projected 2014/15 costs for SSEPD</td><td colspan="2">Internal £ 8,960
External £ 32,500
Total £ 41,460</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Creating a representative power distribution network where prototype equipment can be installed without the risk of interrupting customers.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>18</td><td>-3</td><td>21</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">There are four strategic and financial benefits from this project:
• The facility will encourage generator connections that contribute to government renewable energy targets;
• Faster adoption of new technology will realise reinforcement savings in the period 2015-2020;
• Reduction in the risks (customer service & operational) from trials of new technology on operational networks;
• A significant enabler to reduce adoption timescales for related IFI projects.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>3 Years</td><td colspan="2">Duration of benefit once achieved</td><td>8 Years</td></tr>
<tr><td>Probability of Success</td><td>50%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£4,986,391</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">High</td></tr>
<tr><td>Project Progress March 2014</td><td colspan="4">The centre has been completed, commissioned and officially opened on the 28th of February 2014. The research programme has commenced and the first projects specifications are being drawn up.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">SP Energy Networks, Scottish Enterprise, Scottish Funding Council, S&C Electric Europe Ltd</td></tr>
<tr><td>R&D providers</td><td colspan="4">University of Strathclyde</td></tr>
</table>

2010_01: ROCOF Protection Alternative: Loss of Mains Protection using Voltage Phasors Transmitted over the Internet

<table>
<tr><td>Project Title</td><td colspan="4">2010_01 Rate of Change of Frequency (ROCOF) Protection Alternative: Loss of Mains Protection using Voltage Phasors Transmitted over the Internet</td></tr>
<tr><td>Description of project</td><td colspan="4">The project aims to transmit phasor measurements via the internet as a secure and reliable replacement for vector shift and ROCOF protection for the detection of loss of mains for use with embedded generators.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 2,720
External £ 510
Total £ 3,230</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £ 36,830
External £ 45,000
Total £ 81,830</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£514,476</td><td colspan="2">Projected 2014/15 costs for SSEPD</td><td>Internal £ 11,400
External £ 18,000
Total £ 29,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The project is related to the area of nuisance tripping of existing loss of mains protection and potential failures to operate due to balanced load conditions</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>17</td><td>-1</td><td>18</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The project benefits will produce a secure loss of mains protection system which will be required to keep generation running during system wide frequency changes. Such a change in system frequency might be expected in the future as the inertia of the system decreases and the largest lost load value is increased in order to allow more renewable and nuclear generation on the system.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2014</td><td colspan="2">Duration of benefit once achieved</td><td>20 Years +</td></tr>
<tr><td>Probability of Success</td><td>50%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£1.36 M</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">The potential is considered high considering the system has been proven in the lab using a motor generator set to provide the islanded LV network. The main challenge now is to reduce costs so that the technique can be deployed as an acceptably priced alternative to RoCoF.</td></tr>
</table>

Project Progress March 2014	15 units have been produced and 7 are installed on site. Communications have been established to 12 sites. The Communications network from 6 sites is working well with data being fed back to QUB on a regular basis. Due to a lack of a permanent researcher at QUB no further development work has taken place during 2012-13 on the GB network. In order to gain further experience of the units a number not yet deployed in GB have been temporarily deployed on the Irish network so that QUB can continue working on the project. The system installed to date has successfully identified changes in phase angle across the GB network and it has proven that the theoretical stability is available from the system during large frequency changes which occurred on the 28th and 30th September 2012. Stephen Abbot has been appointed as a researcher on the project as of the 1st March 2014.
Collaborative Partners	None
R&D providers	Queens University Belfast

2010_03 SUPERGEN Highly Distributed Energy Future (HiDEF)

<table>
<tr><td>Project Title</td><td colspan="4">2010_03 SUPERGEN Highly Distributed Energy Future (HiDEF)</td></tr>
<tr><td>Description of project</td><td colspan="4">The HiDEF programme, funded by the EPSRC, is researching the essential elements of a decentralised system that could be implemented over the period 2025 to 2050, to enable all end users to participate in system operation and real-time energy markets.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 1,410
External £ 20,520
Total £ 21,930</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £ 12,090
External £ 63,170
Total £ 75,260</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£119,000</td><td>Projected 2014/15 costs for SSEPD</td><td colspan="2">Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The programme has 5 workstreams: Decentralised Energy, Decentralised Control, Decentralised Network Infrastructure, Decentralised Participation, Decentralised Policy and Macro Impact Assessment.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technological substitution from different applications</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>14</td><td>-2</td><td>16</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Outputs from the HiDEF workstreams have informed active debates in the industry and enabled the following benefits to be realised:
Models of single and multiple DER (Distributed Energy Resource) units have been developed to assess the thermodynamic analysis, life cycle assessment and environmental cost benefit analysis, providing a quantification of performance
Development of control solutions for single units, cells containing multiple DERs, and multiple cells, with a focus on security and resilience of communications and control
Support and investment guidance for future decentralised network operation through the development of MV/LV architectures and planning tools
Design of a distributed market place, enabling the investigation of market based response, trading contracts and products, defining the components essential to market realisation</td></tr>
</table>

<table>
<tr><td></td><td colspan="3">Inform future policy decisions by reviewing current policy delivery mechanisms in the UK, comparing market structures & examining the potential for alignment with various market aggregations</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2012 onwards</td><td>Duration of benefit once achieved</td><td>20 years</td></tr>
<tr><td>Probability of Success</td><td>5%</td><td>Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£ 699,412</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="3">The project has completed its final year with many examples of completed models and tools, published results, and impact on industry demonstrations and trials. Efforts have been committed to make results more accessible including a final London workshop, updated web resources, and a series of on-line videos.</td></tr>
<tr><td>Project Progress March 2014</td><td colspan="3"> The Decentralised Energy Workstream has completed the realisation of open source models of energy storage, energy conversion and energy demand components. The library of domestic building models has now been complemented with commercial building models featuring hybrid and low carbon systems. These have been used by IEA (International Energy Agency) and Distribution Network Operator (DNO) partners, and formed the basis of community studies to assess aggregated network behaviour. Further progress has been made in the realisation and testing of new cell control solutions, which mainly include the parallel inverter operation in an islanded Microgrid, single-phase single-stage transformer-less grid-connected PV system, use of static balancer for phase unbalance in LV networks, and control of soft normally-open points. All control solutions have been tested within the team's hardware rigs and simulation environments. Furthermore, the coordinated control solution developed for multi-vector energy systems has recently been used in an integrated community energy system project managed by Electricity Corby. The Decentralised Network Infrastructure Workstream has developed a number of new power and energy system analytical techniques and tools, and have applied these to the analysis of industrial case studies. The developed analysis tools have been used to support various Low Carbon Network Fund Projects and various studies assessing the impacts of distributed storage and demand response (Carbon Trust, DECC) on UK distribution networks. The Decentralised Participation team have enhanced further a spectrum of approaches that stimulate active participation from energy 'prosumers'. These include enhancement of novel pricing techniques, business model analysis approach, smart meter and distribution network test platform, and a multi-market simulator. The team have also actively engaged with community projects where some of the models have been tested and refined, and the models </td></tr>
</table>

	are now being utilised in ongoing projects. The Decentralised Policy and Macro Impact Assessment team have continued their assessment of the effectiveness of alternative policy measures including in Glasgow, Brighton & Hove, and Milton Keynes. The ability to conduct macro-economic modelling incorporating both the impact of renewable technologies and advanced generation together with changes in household energy demand has proved useful. The CGE model has been used in economic modelling activity, and supported dialogue with the Scottish Government on household energy efficiency. The value of HiDEF datasets, simulation and analysis tools, and models continue to be appraised with academic partners, industrial colleagues, community groups, and agency staff. Journal and conference publications (including a journal special issue) have supported wider dissemination, as has the last in the series of HiDEF London workshops held in April 2014. The transfer of knowledge and understanding has further been supported by completed PhD students being recruited by utilities and developers.
Collaborative Partners	EPSRC and the following industrial partners: Community Energy Scotland (CES), Delta Energy & Environment, Intelligent Power Systems, National Grid, WPD, SP Energy Networks
R&D providers	University of Strathclyde supported by: University of Bath, Cardiff University, University of Oxford, Loughborough University, Imperial College London.

2010_05: Evaluation of Ford Focus/Tourneo EV on Network

Project Title	2010_05 Evaluation of FORD Focus/Tourneo EV on Network				
Description of project	Installation of charge point infrastructure and measuring equipment supplied by Chargemaster, as part of a larger EV trial, and lease of five electric Ford Tourneos to investigate the impact of EVs on electricity distribution network and evaluate in-service issues of EVs for possible use by our staff.				
Expenditure for 2013/14 financial year	Internal £-9,100 External £ 13,920 **Total £ 4,820**		**Expenditure in previous (IFI) financial years**	Internal £ -135,840 External £ 723,100 **Total £ 587,260**	
Total Project Costs (Collaborative + external + SSEPD)	£1M		**Projected 2014/15 costs for SSEPD**	Internal £ 0 External £ -40,000 **Total £ -40,000**	
Technological area and/or issue addressed by project	Impact of EVs on distribution network and behavioural aspects of EV charging.				
Type(s) of innovation involved	Incremental	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**	
		10	-2	12	
Expected Benefits of Project	Modelling EV demand minimising investment on network.				
Expected Timescale to adoption	5 Years	**Duration of benefit once achieved**		Ongoing	
Probability of Success	75%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**		£ 3.7m	
Potential for achieving expected benefits	High: trials have produced the necessary charging point profiles and local network loading data required, and there is potential to implement learning.				
Project Progress March 2014	Final field demonstration with domestic customers was carried out in 2013/14 and final close down report produced. Projected spend for 2014/15 reflects the final grant from TSB. Project is now complete.				
Collaborative Partners	Ford UK, University of Strathclyde				
R&D provider	Chargemaster, University of Strathclyde				

2010_06: Orkney Active Power Network – Phase 3 Electrical State Estimation

Project Title	2010_06 Orkney Active Power Network – Phase 3 Electrical State Estimation		
Description of project	State Estimation is a system that takes a small number of physical measurement points and, by using power system analysis mathematics, calculates the state of the surrounding network. This project aims to install a distribution state estimator for the Orkney distribution network. It will be located at Kirkwall power station and integrated with the existing Orkney ANM system which manages thermal constraints on the network. The existing ANM scheme is currently run on Programmable Logic Controllers (PLCs). The integrated scheme will operate on a dual server based system rather than PLCs, providing a flexible platform for future developments. There are two key features of this project which will have significant impact on the wider application of ANM and other distributed intelligence methodologies in distribution networks across SSEPD's licensed areas. Firstly, distribution state estimation (DSE) can be applied to any distributed intelligence system, such as ANM, to make the decision making process more robust and resilient, for example by checking for bad data. Secondly, DSE can be applied to improve the ease of observing the network at a significantly lower cost when compared to establishing additional measurement points with the associated communications and data handing costs. DSE can also be more robust than larger numbers of individual transducers. This means control systems which use DSE will be more resilient in operation than those which use a large number of transducers alone.		
Expenditure for 2013/14 financial year	Internal £ 35,870 External £ 3,090 **Total £ 38,970**	**Expenditure in previous (IFI) financial years**	Internal £ 67,750 External £ 154,720 **Total £ 222,470**
Total Project Costs (Collaborative + external + SSEPD)	£514,362	**Projected 2014/15 costs for SSEPD**	Internal £ 25,000 External £ 142,000 **Total £ 167,000**
Technological area and/or issue addressed by project	The ANM scheme in the Orkney RPZ relies on the provision of additional data from nodes on the network. State estimation will improve the robustness of the data used in the ANM process and improve ease of observing the network. This will provide redundancy for critical constraint points on the network during normal operating		

	conditions should the communications or measurement device at a location fail. It will also provide insight into other circuits which, while not currently constraint points, will become so following a fault on one of the three interconnections between Kirkwall and Scorradale. Following proving of the state estimation system, it could be applied to reduce the cost of deployment of ANM schemes, and make them more robust. For parts of the network not being managed by ANM schemes the methodology will improve the quality of information on the network at a reduced cost, leading to better network understanding and operational effectiveness.			
Type(s) of innovation involved	Significant	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
		13	1	12
Expected Benefits of Project	The system will allow power flows on all parts of the Orkney network to be visible and in many cases redundancy will mean that the system is still visible on the failure of a transducer. This will allow the system to be pushed more in terms of loading and make better use of the assets employed on the Orkney 33kV network. It will also allow for physical measurement points that have gone out of range to be detected and accounted for.			
Expected Timescale to adoption	1	**Duration of benefit once achieved**	10	
Probability of Success	**25%**	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£473,926	
Potential for achieving expected benefits	Good			
Project Progress March 2014	Most of the additional measurement points have been installed and tested. Smarter Grid Solutions are developing the algorithms to carry out the calculations necessary.			
Collaborative Partners	None			
R&D providers	Smarter Grid Solutions , Queens University Belfast			

2010_13: Supply Point Monitoring

<table>
<tr><td>Project Title</td><td colspan="4">2010_13 Supply Point Monitoring</td></tr>
<tr><td>Description of project</td><td colspan="4">SSEPD has a requirement for a Supply Point Monitoring Device to support its proposed Thames Valley Vision LCNF and NINES projects. It is proposed that the monitoring device will be installed as a retrofit unit located on the existing service termination equipment (cut out) at appropriate locations in the Bracknell, Shetland and other areas specified by SSEPD. The device will take the form of a replacement fuse carrier which maintains the existing electrical protection (HRC fuse) and incorporates additional functionality/ measurement elements.

It is anticipated that the device will provide a range of customer/ network measurements associated with individual supply points. The scope of this project will cover the development of a small number of pre-production prototype devices.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 1,960
External £ 24,630
Total £ 26,590</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £ 27,310
External £ 264,580
Total £ 291,890</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£378,290</td><td colspan="2">Projected 2014/15 costs for SSEPD</td><td>Internal £ 8,000
External £ 2,000
Total £ 10,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The development of an end point monitor device that can be installed into customers premises for use on the NTVV project. This will allow for more targeted monitoring.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>17</td><td>-2</td><td>19</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">To allow more widespread use of monitoring of customers energy use, to better understand how energy flows around our electrical network and predict what future energy use might look like and help manage the network more efficiently.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>6 months</td><td colspan="2">Duration of benefit once achieved</td><td>20 years</td></tr>
<tr><td>Probability of Success</td><td>90%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£25,018</td></tr>
</table>

Potential for achieving expected benefits	Good
Project Progress March 2014	Testing to BS:7657 ongoing due to be completed in July 2014 See Appendix 3
Collaborative Partners	None
R&D providers	Senical Ltd.

2010_14: Ecoplugs

Project Title	2010_14 Ecoplugs				
Description of project	The application of Ecoplugs to tree stumps. Ecoplugs contain granular glyphosate herbicide which is a systemic weed killer. They can be applied at any time of the year immediately after felling. Minimal PPE and training is required and a high kill rate is expected, resulting in reduced future tree cutting.				
Expenditure for 2013/14 financial year	Internal £ 360 External £ 980 **Total £ 1,340**		**Expenditure in previous (IFI) financial years**	Internal £ 34,600 External £ 47,790 **Total £ 82,390**	
Total Project Costs (Collaborative + external + SSEPD)	£ 100,000		**Projected 2014/15 costs for SSEPD**	Internal £ 0 External £ 0 **Total £ 0**	
Technological area and/or issue addressed by project	Vegetation re-growth prevention to reduce future costs and hazards. The Ecoplug is a new product that is much safer and more reliable than traditional herbicide application methods.				
Type(s) of innovation involved	Technological substitution from different application	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**	
		17	-7	24	
Expected Benefits of Project	By reducing the amount of re-growth, future cutting cycles will have fewer cutting sites and some of those sites will have less vegetation to clear. The obvious benefits are reduced cost and less exposure to risk. Other benefits include a clearer way-leave setup with less access issues and less disruption to landowners. There will also be a reduction in the need for employees to revisit sites that are either difficult to access or are hazardous.				
Expected Timescale to adoption	Adopted	**Duration of benefit once achieved**		Continual benefit	
Probability of Success	75%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**		£ 1.14 M	
Potential for achieving expected benefits	High				

Project Progress March 2014	The project has progressed from a trial in Reading to being implemented as BaU. This has included putting field staff through the relevant pesticide and herbicide application training in order to allow them to apply Ecoplugs. A procedure has been developed (PR-PS-761) for the use of the product. FO-PS-739 Ecoplug Application Form and FO-PS-740 Ecoplug Stock Control Form are used to track the use of this new application. During the 2013/14 maintenance cycle, 103,916 Ecoplugs were used. A case study is now being implemented on resilience tree cutting schemes. This will look at the initial cost to cut and apply Ecoplugs and the cost to carry out the maintenance works on a three year cycle. This will help us to understand the cost savings achieved by our use of this product.
Collaborative Partners	Network Rail.
R&D providers	SSE Utility Services

2010_25: Evaluation of Public Recharging Infrastructure

<table>
<tr><td>Project Title</td><td colspan="4">2010_25 Evaluation of Public Recharging Infrastructure</td></tr>
<tr><td>Description of project</td><td colspan="4">Installation of EV charge point infrastructure and measurement equipment supplied by Chargemaster in order to evaluate the use of public infrastructure and monitor its use compared to domestic infrastructure. This in order to better understand charging behaviours.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 10,430
External £ -20,550
Total £ -10,120</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £ 286,970
External £ 227,010
Total £ 513,890</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£620,000</td><td>Projected 2014/15 costs for SSEPD</td><td colspan="2">Internal £ 2,000
External £ 48,000
Total £ 50,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The key issues to be researched are:
• timing and volume of vehicle recharging events and the potential impact on the distribution network;
• the amount of public recharging using publicly available infrastructure provided in this trial across the range of car parks equipped for EV charging;
This will enable better planning of future EV infrastructure to better support the wide scale adoption of EVs in the future.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>12</td><td>-3</td><td>15</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Improved understanding of EV demand (through the use of modelling), as well as minimising investment in the network.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>5 Years</td><td colspan="2">Duration of benefit once achieved</td><td>Ongoing</td></tr>
<tr><td>Probability of Success</td><td>75%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£10m</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">High: The required charging profiles are coming in from charging points through the computer system that communicates with all the installed charging points therefore we have high expectations of achieving the expected benefits of the project.</td></tr>
</table>

Project Progress March 2014	Use of the network is continues to increase as more EVs become available although no additional infrastructure was installed in 2013/14. The planned rapid chargers will be deployed in 2014/15 to further understand the use of this type of facility.
Collaborative Partners	Chargemaster, NCP Car Parks, Transport for London
R&D provider	Chargemaster

2011_03: LV Connected Batteries

<table>
<tr><td>Project Title</td><td colspan="4">2011_03 LV Connected Batteries</td></tr>
<tr><td>Description of project</td><td colspan="4">SSEPD seeks to understand the benefits of installing electrical energy storage connected via four quadrant power conversion systems on the LV network. The selected storage technology is lithium-ion batteries. The increase in solar PVs and EVs does not currently pose a significant issue for network operators. However, should this trend continue, there is the potential to have reactive power flow issues and thermal and voltage constraints on significant numbers of LV feeder circuits. Energy storage has the potential to manage the reactive power flows and reduce the peak demand/generation through peak lopping. This will reduce the need for traditional cable replacement, thereby stopping the network from becoming a barrier to the deployment of low carbon technologies.

SSEPD is proposing to install three single phase 25 kWh/25 kW peak lithium-ion batteries at strategic points on the LV network. In order to model the effect of the solar PV and peak demand, SSEPD has identified a site with considerable solar generation and EV charging points.

SSEPD will model and analyse the benefits that this form of energy storage can provide to the LV network. This will be done using theoretical cable limits and will not pose any risk to security of supply.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 10,670
External £ 23,990
Total £ 34,660</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £ 77,110
External £ 105,880
Total £ 182,990</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£ 405,000</td><td colspan="2">Projected 2014/15 costs for SSEPD</td><td>Internal £ 3,000
External £ 2,500
Total £ 5,500</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">At present the problem is not a significant issue for DNOs, however with the recent government incentives SSEPD believes that within the next five years this could pose significant issues for all DNOs in the UK.

If there is a high uptake in solar PV and EVs the likelihood is this will be in a concentrated area. Early results from the Tier 1 LCNF project SSET1002: ‘Demonstrating the Benefits of Monitoring LV Networks with embedded PV Panels and EV Charging Point’ have revealed reactive power flow issues. Voltage and thermal constraints on LV feeder circuits are expected. The present solution is to replace the existing cable with one of a larger capacity, the downside being it causes significant disruption to customers, and requires full excavation with associated long lead times and high cost.</td></tr>
<tr><td>Type(s) of innovation involved</td><td>Technological Substitution</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
</table>

	from different application	18	-5	23
Expected Benefits of Project	Energy storage on the LV network could manage reactive power flows and reduce the peaks in demand and generation to keep the cable within thermal limits. It would also keep voltage regulation within supply guidelines. SSEPD wishes to understand the technical benefits of storage on the LV network and whether or not there is an economical case over traditional solutions.			
Expected Timescale to adoption	2 years	**Duration of benefit once achieved**	25	
Probability of Success	75%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£5,749,325	
Potential for achieving expected benefits	The data gathered to date has already helped to inform larger rollout of 31 LV connected batteries under the NTVV Tier 2 project. The potential for further learning is highly dependant upon completion of the test programme.			
Project Progress to March 2014	A suitable site was selected and agreed with SSEPD's property department and subsequently planning permission was granted through Slough council. The initial studies on network location suitability were completed to understand the benefits the batteries could provide to the network. A full safety case was completed to understand the potential hazards installing batteries of this size poses. This included a detailed risk assessment, a review of all standards and an assessment of the fire containment measures/mitigations. During the commissioning period a full and comprehensive report detailing how the batteries performed against the expected results and G59/2 minimum standards was complied using advanced monitoring equipment. Upon completion of commissioning, a detailed safety testing process was completed to ensure communications and fail safe systems functioned as expected. Completion of this stage allowed for the units to go into full operation as part of the agreed test plan. The test plan has almost been completed. Multiple peak shaving scenarios have been demonstrated successfully, voltage manipulation has been proven with both real and reactive power, phase balancing and reverse power absorption have also been investigated. At present there is still some additional scenarios to run and some minor write up work to complete the project.			
R&D providers	EA Technology, S&C Electric Europe Ltd.			

2011_04: PhD Power Networks Asset Management

<table>
<tr><td>Project Title</td><td colspan="3">2011_04 PhD Power Networks Asset Management</td></tr>
<tr><td>Description of project</td><td colspan="3">This is a PHD Project working on the development and methodology for the health and risk assessment of LV and HV distribution network assets.

A key area of interest for SSEPD is in the area of asset management involving asset condition and health. Due to the current asset management system being unable to perform as required, the development of a new methodology can allow SSEPD to improve efficiency of planning and increase compliance with regulatory reporting. This can lead to enhancing asset lifespan, improving network security, and reducing the rate of asset replacement. This project will conduct a critical evaluation of transferable asset management practices from other asset-based industries, including areas of monitoring technologies, data analysis techniques, investment planning, and optimisation techniques.

Appropriate solutions will be developed and integrated within the existing asset management system and allow SSEPD to potentially form a market leading model.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 930
External £ 24,630
Total £ 25,560</td><td>Expenditure in previous (IFI) financial years</td><td>Internal £7,790
External £ 32,530
Total £40,320</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£112,260</td><td>Projected 2014/15 costs for SSEPD</td><td>Internal £ 3,000
External £ 13,260
Total £ 16,260</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="3">To create a monitoring tool in order to gain a better knowledge of asset condition, life expectancy, and risk. This will allow SSEPD to gain a better knowledge of assets and to assess and anticipate the impact of variations in asset condition, performance, and reliability. The project also looks into specific intervention methods on asset condition, and risk of failure.

This will lead to maximising the useful lifetime and performance of assets, enhancing current methods of asset health and risk assessment, as well as improving network reliability.</td></tr>
</table>

<table>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technological substitution</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>23</td><td>4</td><td>19</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Safety: Improvement of asset management techniques which would lead to improved safety for both staff and the public.

Financial: The implementation of this project would improve the general asset management regime and enable increased proactive replacement before plant can fail.

Network Performance: Proactive, rather than reactive, replacement will lead to lower costs, both for the replacement itself, and associated costs such as CI/CML.

Environmental: Improvement of asset management techniques would lead to a reduction in environmental incidences.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>1-2 Years</td><td colspan="2">Duration of benefit once achieved</td><td>40 years</td></tr>
<tr><td>Probability of Success</td><td>90%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£578,520</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">If proven to be successful, the implementation of this method promises to save capital expenditure and improve regulatory and public perception of the company. There is also potential for enhancing asset lifetime, improving network security, and reducing the rate of asset replacement.</td></tr>
<tr><td>Project Progress March 2014</td><td colspan="4">The model has now been almost fully developed for one asset type, namely HV poles. The next step includes developing the other models starting with that for HV Transformers, and to collate the data for these models in an electronic format for feeding into them.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">University of Strathclyde</td></tr>
<tr><td>R&D providers</td><td colspan="4">University of Strathclyde</td></tr>
</table>

2011_07: Assessment of Conducrete

<table>
<tr><td>Project Title</td><td colspan="4">2011_07 Assessment of Conducrete</td></tr>
<tr><td>Description of project</td><td colspan="4">The objective of the project is two fold, firstly to establish whether a Conducrete earthing system is more effective than other systems using:
a) bare earth rods;
b) earth rods encased in traditional Marconite.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 2,730
External £ 1,230
Total £ 3,960</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £ 12,980
External £ 30,410
Total £ 43,390</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£113,186</td><td colspan="2">Projected 2014/15 costs for SSEPD</td><td>Internal £ 10,800
External £ 25,200
Total £ 36,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The scope of this project is to assess the earthing performance and anti-theft capability of Conducrete in power distribution networks which will be achieved by carrying out earthing resistivity tests, thermal shock tests, and mechanical impact tests.
Traditional earthing methods are susceptible to theft and corrosion and due to certain ground conditions such as shale or rocky ground, effective power system earthing can be difficult. To overcome this challenge a conductive concrete compound called “Conducrete” which has a resistivity of approximately four times lower than any other product of this type is to be assessed.
The assessment will be spilt into three parts; the first to assess whether a Conducrete-based earthing system is an improvement over traditional methods currently used; the second is to assess the effects of earth fault current which may flow through an earthing conductor embedded in Conducrete; and the third is to assess whether Conducrete is mechanically strong enough to protect the earthing conductors from theft.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>14</td><td>-8</td><td>22</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">A reduced requirement for copper tape and earth rods in substation earthing installations will lead to environmental and financial benefits.</td></tr>
</table>

Expected Timescale to adoption	2 years	**Duration of benefit once achieved**	20
Probability of Success	50%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£80,189
Potential for achieving expected benefits	The testing will prove or disprove the manufacturer's claims. If these claims are proven to be accurate, the use of Conducrete would commence in areas of poor soil resistivity and should achieve the expected environmental and financial benefits.		
Project Progress March 2014	The testing of the thermal, mechanical, and resistivity characteristics of Conducrete was carried out. Awaiting final reports and a closedown meeting.		
Collaborative Partners	SP Energy Networks		
R&D providers	EATL		

2011_08: Radio Tele-Switching Alternative

<table>
<tr><td>Project Title</td><td colspan="4">2011_08 Radio Tele-switching (RTS) Assessment</td></tr>
<tr><td>Description of project</td><td colspan="4">The project aims to provide an assessment of the costs and benefits of the RTS system, together with the possible impacts of the proposed switch off of the RTS system on the distribution network.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 1,840
External £ 3,030
Total £ 4,870</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £ 55,780
External £ 55,760
Total £ 111,540</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£88,048</td><td>Projected 2014/15 costs for SSEPD</td><td colspan="2">Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Tele-switches are widely used throughout the country, to switch consumers' storage heating and/or hot water on and off dependent on tariff selection.

Properties are split into different time settings, to reduce the load being brought onto the system at any one time. This allows the electricity supply business to control consumers heating and hot water in order to diversify demand. This diversity applied to the SSEPD network avoids the possibility of overloading and assets being damaged.

The time signal is carried on the 1500m long wave radio frequency. The BBC had given notice to the ENA that it intended to switch off this signal in Sept 2013; however this shutdown has been delayed.

This project aims to:
Define the existing benefit that SSEPD gains through use of the RTS system;
Determine a value derived from existing systems that are in place;
Explore the implications of SSEPD being denied access to any load control methods;</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technological Substitution from different applications</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>9</td><td>0</td><td>9</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Gain a good understanding of how the RTS system has been set up and how it is currently used;</td></tr>
</table>

	• Investigate the impact on primary substations, at defined switching times, in different areas across the SHEPD area and how effective the RTS is; • Discover the implications to the distribution network of a full RTS shut down; • The ability to put a value on the benefit of RTS to SSEPD. From substation profiles a value can be put on the load diversification at each primary substation (If there was no diversification, there would be need for upgrading of items of plant such as switchgear, transformers, and cables)		
Expected Timescale to adoption	3 Years	**Duration of benefit once achieved**	20 Years
Probability of Success	50%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£ 2,765, 797
Potential for achieving expected benefits	High		
Project Progress March 2014	The project has investigated the value RTS has to SSEPD. The EATL report summarising the benefits has been produced and a presentation of the findings made to the ENA.		
Collaborative Partners	None		
R&D providers	EATL		

2011_09: Heat Pump Load Profile

<table>
<tr><td>Project Title</td><td colspan="5">2011_09 Heat Pump Load profile</td></tr>
<tr><td>Description of project</td><td colspan="5">The use of heat pumps is becoming more widespread and new housing developments with large numbers of units are being constructed. There is limited knowledge as to the diversity of the compressor starting currents associated with the heat pumps.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td colspan="2">Internal £ 18,260
External £ 8,590
Total £ 26,850</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £ 14,500
External £ 6,090
Total £ 20,590</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td colspan="2">£79,106</td><td colspan="2">Projected 2014/15 costs for SSEPD</td><td>Internal £ 27,650
External £ 12,500
Total £ 40,150</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="5">A survey will be carried out on feeders containing a high number of heat pumps in order to fully understand the load characteristics.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technological Substitution from different application</td><td>Project Benefits Rating</td><td colspan="2">Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>11</td><td colspan="2">0</td><td>11</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="5">It will enable feeders supplying heat pump clusters to be more accurately sized</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">1</td><td colspan="2">Duration of benefit once achieved</td><td>20</td></tr>
<tr><td>Probability of Success</td><td colspan="2">50%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£129,867</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="5">The site survey should identify the diversified load allowing feeder sizing to be re-evaluated.</td></tr>
<tr><td>Project Progress March 2014</td><td colspan="5">A comprehensive network monitor has been installed in a substation in Elgin Morayshire. This substation feeds 123 customers of whom 120 have air source heat pumps. The data from the monitor has been collected and referenced to local weather conditions. The data is being analysed, however due to the relatively mild winter in 2012/2013, data will continue to be collected for another year, with results being produced at the end of February 2015.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="5">None</td></tr>
<tr><td>R&D providers</td><td colspan="5">None</td></tr>
</table>

2011_10: Asset Management of LV Cables

<table>
<tr><td>Project Title</td><td colspan="4">2011_10 Asset Management of LV cables</td></tr>
<tr><td>Description of project</td><td colspan="4">This project will explore the correlation between the number of incipient arc or fault events, and the impact on LV oil impregnated paper insulated cables. This is with the goal of defining criteria and indicators for the circuits that are most likely to fail in service, thus aiding in the asset management of the LV network and life extension decisions.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 2,790
External £ 31,050
Total £ 33,840</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £ 8,910
External £ 2,520
Total £ 11,430</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£154,000</td><td colspan="2">Projected 2014/15 costs for SSEPD</td><td>Internal £ 3,000
External £ 40,000
Total £ 43,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Fault anticipation and detection for asset management and life extension of cables.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technological transfer, Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>18</td><td>1</td><td>17</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Delivery of software and hardware detection and monitoring products which are capable of evaluating the likelihood of the failure of an LV cable.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>4 years</td><td colspan="2">Duration of benefit once achieved</td><td>10 years</td></tr>
<tr><td>Probability of Success</td><td>25%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£321,339</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">Initial investigation and research with Kelvatek shows that this project is feasible and could lead to a product that is commercially viable worldwide.</td></tr>
<tr><td>Project Progress March 2014</td><td colspan="4">Initial testing has been carried out at a fault trough area on a Kelvatek test network, but the possibility to perform work related to the ageing of cables at this fault trough is limited. To enable further testing, Kelvatek have designed a Cable Research Facility to allow premature ageing using heating, cooling, cycling, and water immersion. The project is ongoing with collection and collation of results</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">None</td></tr>
<tr><td>R&D providers</td><td colspan="4">Kelvatek</td></tr>
</table>

2011_11: Subsea Cable Monitoring

Project Title	2011_11 Sub Sea Cable Monitoring				
Description of project	The aim of this project is to develop a system that will remotely monitor the physical features of a cable and detect vibration and movement, as these are the main causes of failure, to allow planned intervention. A monitoring device and sensor system will be produced, supported by a prognostic system to allow the failure of a cable to be better predicted.				
Expenditure for 2013/14 financial year	Internal £ 1,950 External £ 1,830 **Total £ 3,780**	**Expenditure in previous (IFI) financial years**		Internal £ 17,990 External £ 195,520 **Total £ 213,510**	
Total Project Costs (Collaborative + external + SSEPD)	£215,500	**Projected 2014/15 costs for SSEPD**		Internal £ 0 External £ 0 **Total £ 0**	
Technological area and/or issue addressed by project	Preventive maintenance and cable prognosis.				
Type(s) of innovation involved	Incremental, Technological Transfer from another industry, and Significant	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**	
		14	2	12	
Expected Benefits of Project	Reduced cost and time by creating a prognostic system that would detect faults in subsea cables before actual damage.				
Expected Timescale to adoption	5	**Duration of benefit once achieved**	20 years		
Probability of Success	25%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£780,861		
Potential for achieving expected benefits	The system is at the at present undergoing laboratory work and prototype construction therefore it is at an early stage of development. The strong benefits case means that if this project is successful then further resources will be allocated.				
Project Progress March 2014	A prototype was successfully produced and demonstrated in a tank. The second phase will extend the technology by producing a number of prototypes for deployment in the sea.				
Collaborative Partners	Scottish Sensor Systems Centre				
R&D providers	Heriot-Watt University				

2011_12: Harmonics Investigation

Project Title	2011_12 Harmonics Investigation			
Description of project	The project aims are to identify the high frequency voltage distortions caused by modern high power electronic equipment which may be installed in domestic premises, and to understand the propagation and attenuation of these effects on a real LV network installed at Imperial College London. It will also look at the impact of these distortions on customers' equipment and produce information which will allow the calculation of these effects on large LV networks. Ten energy and micro-generator manager (EMMA) units which can handle 3kW each are to be studied on a small network at Imperial College London, comprising 100 metres of mains cable and 16 services arranged to allow balanced and unbalanced loading conditions to be studied.			
Expenditure for 2013/14 financial year	Internal £ 3,860 External £ 49,840 **Total £ 53,700**	**Expenditure in previous (IFI) financial years**	Internal £ 12,710 External £ 11,020 **Total £ 23,730**	
Total Project Costs (Collaborative + external + SSEPD)	£ 151,000	**Projected 2014/15 costs for SSEPD**	Internal £ 9,400 External £ 47,440 **Total £ 56,840**	
Technological area and/or issue addressed by project	The use of high-powered electronic devices in domestic premises and potential interference with other equipment. Also the effect of high penetrations of these devices.			
Type(s) of innovation involved	Incremental	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
		17	0	17
Expected Benefits of Project	The project benefits will be that DNOs have a good understanding of the effects of these high-power electronic devices on their networks and the results can feed into the development of standards with respect to high frequency voltage distortions above those considered by current standards (2kHz for equipment standards and 2.5kHz for DNO planning standards).			
Expected Timescale to adoption	4 years	**Duration of benefit once achieved**	8 years	

Probability of Success	50%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£1.36 M
Potential for achieving expected benefits	Work and research carried out by Imperial College London in this area has been promising so far, leading us to conclude the potential for achieving the expected benefits in this project are high.		
Project Progress March 2014	The project has used the LV network installed at Imperial College to determine the effects of multiple EMMA units on the network and is making progress in developing an understanding of how the interaction of multiple units. It is expected that the practical side of the project will be completed by end June 2014.		
Collaborative Partners	None		
R&D providers	Imperial College London		

2011_13: TellUS GIS

<table>
<tr><td>Project Title</td><td colspan="4">2011_13 TellUS GIS</td></tr>
<tr><td>Description of project</td><td colspan="4">1. To develop a method and create a model to identify limitations on the electrical distribution network (constraints or restrictions) based upon data from the Long Term Development Strategy (LTDS).
2. To enable the upload and analysis of the impact of planned additions to the network in an interactive manner based upon data extracts from the PROMIS database.
3. To develop a method and create a model to apply potential solutions to the limitations on the electrical distribution network. Using an online GIS environment the system will allow different factors and constraints to be manipulated e.g. use of ANM to enable more Distributed Generation.
4. To enable the addition and removal of a range of site characteristics and contextual data to the map e.g. Flood maps, proximity to schools as appropriate.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 5,290
External £ 2,680
Total £ 7,970</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £13,810
External £52,780
Total £66,590</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£99,476</td><td>Projected 2014/15 costs for SSEPD</td><td colspan="2">Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Use of GIS technology and SSEPD datasets to identify potential network constraints and the impact that new connections could make on it. It could then lead to the identification of suitable network solutions to address any imbalance.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technological Substitution from outside industry</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>16</td><td>-1</td><td>17</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Cheaper, quicker connections that would otherwise await a network reinforcement solution.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>3 years</td><td colspan="2">Duration of benefit once achieved</td><td>10 years</td></tr>
<tr><td>Probability of Success</td><td>35%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£11,634</td></tr>
</table>

Potential for achieving expected benefits	Limited
Project Progress March 2014	The project and the closedown report has been completed
Collaborative Partners	None
R&D providers	University of Manchester

2011_14: Hybrid Generator

Project Title	2011_14 Hybrid Generator				
Description of project	This project is aimed at investigating the use of hybrid generators for fault duty and as a temporary and alternative power supply during routine maintenance or delayed connections.				
Expenditure for 2013/14 financial year	Internal £ 19,640 External £ 95,050 **Total £ 114,690**		**Expenditure in previous (IFI) financial years**	Internal £ 13,410 External £ 148,290 **Total £ 161,700**	
Total Project Costs (Collaborative + external + SSEPD)	£186,200		**Projected 2014/15 costs for SSEPD**	Internal £ 20,000 External £ 71,310 **Total £ 91,310**	
Technological area and/or issue addressed by project	To provide an alternative to diesel generators which have high fuel inefficiency, running costs, and CO_2 emissions.				
Type(s) of innovation involved	Incremental innovation, technological substitution	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**	
		10	-2	12	
Expected Benefits of Project	Reduced cost, reduced CIs and CMLs, and reduced CO_2 emissions.				
Expected Timescale to adoption	6 Months	**Duration of benefit once achieved**	20 Years		
Probability of Success	**50%**	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£21,580		
Potential for achieving expected benefits	High				
Project Progress March 2014	Due to the testing on the Mark 2 version at the PNDC it has allowed for further development and refinements in the fuel efficiency of the mark 3. The Mark 3 is currently going under its final round of testing. The development has allowed the generator to be upgraded to 30KVA rather than the 23KVA of the mark 1 and 2.				
Collaborative Partners	Off-Grid Energy Ltd				
R&D providers	PNDC and Off-Grid Energy Ltd				

2011_15: Phase Identification

Project Title	2011_15 Phase Identification			
Description of project	To investigate the suitability of using phase identification equipment to identify the electrical phase of an individual property without physical connection to the network or removing fuses from a feeder pillar.			
Expenditure for 2012/13 financial year	Internal £ 17,320 External £ 1,750 **Total £ 19,070**	**Expenditure in previous (IFI) financial years**	Internal £ 8,930 External £ 51,450 **Total £ 60,380**	
Total Project Costs (Collaborative + external + SSEPD)	£133,380	**Projected 2013/14 costs for SSEPD**	Internal £ 0 External £ 0 **Total £ 0**	
Technological area and/or issue addressed by project	Phase identification of an LV supply.			
Type(s) of innovation involved	Technological Substitution	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
		14	4	18
Expected Benefits of Project	Reduced cost and time in phase identification.			
Expected Timescale to adoption	0 years	**Duration of benefit once achieved**	20 years	
Probability of Success	90%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£15,174	
Potential for achieving expected benefits	High			

Project Progress March 2013	The unit has been successfully tested in an office environment to ensure it functions as intended – this was successful. The unit was next tried in block of flats with multiple meter points on different phases – this functioned as it should. The final stage was to trial the device in a large scale rollout. 10 x 11kV to LV substations were selected and the device was used to capture the phase information from over 2000 properties. The device performed as it should and successfully captured phase information without the need for an electrical connection. The phase information data recorded was completed 3 times to ensure accuracy and then a random sample of sites were checked against exiting records. The device proved to be very accurate and is an efficient way of determining large samples of phase information. See Appendix 2
Collaborative Partners	None
R&D providers	Origo

2011_16: Advanced Radio Control

Project Title	2011_16 Advanced Radio Control			
Description of project	The aim of this project is to trial a new and bespoke radio solution to replace the existing communications to the 'Intellirupter' project on the Isle of Wight. SSEPD will document the success of the product and provide analysis against the original radio signalling method and available competitive solutions, and hence determine whether the system could be used in other areas of the SSEPD network.			
Expenditure for 2013/14 financial year	Internal £ 47,990 External £ 56,010 **Total £ 104,000**	**Expenditure in previous (IFI) financial years**	Internal £ 55,370 External £ 443,580 **Total £ 499,270**	
Total Project Costs (Collaborative + external + SSEPD)	£ 500,000	**Projected 2014/15 costs for SSEPD**	Internal £ 10,000 External £ 30,000 **Total £ 40,000**	
Technological area and/or issue addressed by project	As part of the intellirupter project that SSEPD have implemented on the Isle of Wight, the existing communications method currently does not provide sufficient bandwidth for the devices to communicate between each other and back to the central control hub. As a result, the existing radio communications periodically fails under certain network situations; this effectively limits the intellirupter CBs functionality to less than is required to achieve the auto-reconfiguration of the network.			
Type(s) of innovation involved	Incremental	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
		17	-7	24
Expected Benefits of Project	The bespoke radio solution will facilitate the Intellirupter equipment to function as intended and therefore it will lead to a saving in outages, and savings through CML and CI payments. The radios have the potential to offer a robust high bandwidth communication solution to various smart grid applications in areas where hard-wired communications is not a feasible or economic option. The intellirupter can function in a limited way to restore a faulted network without communications. Allowing the communications between the intellirupters will allow the autonomous sectionalising of parts of the network under fault conditions thereby improving performance.			

	The Intelliteam software can be configured to maintain supplies to strategic customers whilst leaving low risk customers without supply where there is a conflict of load management.		
Expected Timescale to adoption	1 Year	**Duration of benefit once achieved**	15 Years +
Probability of Success	35%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£290,359
Potential for achieving expected benefits	Medium		
Project Progress March 2014	The SpeedNet radios have been purchased and the basic functionality has been tested by the real time systems team in SSEPD aided by the manufacturer. The basic testing has proved the radios can operate under perfect conditions. During the last financial year around half of the radios were deployed with the remainder to be installed early in the next financial year In addition, SSEPD wishes to understand the potential the radios have to provide communications to 'smart' devices installed in the field. To complete this evaluation SSEPD has enlisted the services of Dan & Adam Ltd, experts in the area of communications. The evaluation will consist of a preliminary report on the potential of the radios and an in-depth assessment of the radio performance on the Isle of Wight. A full island survey of every piece of equipment has been completed and recorded with pictures, condition details, and all the communications IP addressing. This was completed as it was necessary to understand the present state of play on the island. Dan & Adam Ltd have completed an independent review of the radio system and 2 final reports have been produced – these are available to GB DNOs on request. The project has installed new radios in 32 Intellirupter sites and 12 repeater sites across the island. Despite the success of the physical install it has not been possible to make connection to every device on the island. This has unfortunately prevented the implementation of the full IntelliTeam functionality. However one feeder has been commissioned successfully and completed the Site Automation Test. The intention is that we will go live with this team in 2014.		
Collaborative Partners	None		
R&D providers	S&C Electric Europe Ltd, Dan and Adam Ltd.		

2012_01: Cryogenic Storage Technology Review

Project Title	2012_01 Cryogenic Storage Technology Review		
Description of project	This project aims to undertake a small-scale technological investigation in order to determine the suitability of integrating cryogenic energy storage into the re-powering of the Shetland Isles. The technology is known to have a number of advantages over existing advanced battery energy storage solutions in terms of cost, saleability, and the ability to independently size the charging rate, output, and capacity. SSEPD wishes to understand the benefits this technology could provide, how it could utilise the waste heat from the new power station, or link into the existing district heating scheme to effectively produce power from the heat (at times when there is greater wind generation than heating demand).		
Expenditure for 2013/14 financial year	Internal £ 4,540 External £ 710 **Total £ 5,260**	**Expenditure in previous (IFI) financial years**	Internal £ 10,820 External £ 18,520 **Total £ 29,340**
Total Project Costs (Collaborative + external + SSEPD)	£50,000	**Projected 2014/15 costs for SSEPD**	Internal £ 0 External £ 0 **Total £ 0**
Technological area and/or issue addressed by project	The project consists of an independent review of the Hghview process, along with a high-level review of supply chain and component availability. The test programme design for Highview Pilot Plant at Slough will also be peer reviewed. The independent review of the Highview cryogenic energy storage system technology will be conducted by Costain, at the request of SSEPD, as the first stage of a development programme, the overall intention of which is to develop a fully engineered design for a cryogenic (liquid air) energy storage project on Shetland. It is anticipated that this project will enable the recovery of power from stored hot water (from a CHP plant) and provide a back-up power load for increased renewable energy sources. The review will consider the following aspects of Highview technology: • overall round-trip efficiency;		

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efficiency of conversion of heat to power in the temperature range of 75 – 90 °C;
separation and storage of heat and cold;
plant operability (including start-up and ramp times), availability and lifetime projections, as well as associated costs;
supply chain and component availability.

</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>14</td><td>-6</td><td>20</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The potential benefits of energy storage on the network are well documented. The particular benefits of liquid air storage could allow the Shetland network to operate more efficiently when integrated with a thermal power station and combined with the waste heat. In addition, there is also significant potential for linkage with waste heat at HVDC converter stations that may be constructed in the future.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>5</td><td colspan="2">Duration of benefit once achieved</td><td>15 years</td></tr>
<tr><td>Probability of Success</td><td>75%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£301,498</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">The basis of the findings to-date have provided the necessary data required to make an informed decision as to whether or not this technology is viable in Shetland and the islanded network there.</td></tr>
<tr><td>Project Progress March 2014</td><td colspan="4">The work has been completed in the form of a detailed report by Costain based on studies completed on site at the Highview Power demonstration, and information provided by the team at Highview. Upon completion of the report a dissemination session was held between the different parties to go through each part of the work step by step. The report has now formed the basis of potential future work in the area of liquid air/bulk energy storage system connected to the distribution network. The final report is available to GB DNOs on request.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">Highview Power</td></tr>
<tr><td>R&D providers</td><td colspan="4">Costain</td></tr>
</table>

2012_02: Aberdeen Hydrogen Feasibility Study

Project Title	Aberdeen Hydrogen Feasibility Study		
Description of project	Hydrogen has the potential to be a key element in the process of displacing fossil fuels for our future energy needs. As hydrogen is not a freely occurring element in nature, a process is required to release it, one of which is by electrolysis. It is proposed in this project to investigate the risks and opportunities from the connection of electrolysers to the distribution network. This will inform the development of a subsequent project which would, in conjunction with a range of partners, connect an electrolyser and wind turbine to the local network and produce hydrogen for transport applications. The expected benefits are in the reduction of potential reinforcement costs and the potential to create new generation capacity on constrained sections of network.		
Expenditure for 2013/14 financial year	Internal £ 28,760 External £ 67,930 **Total £ 96,690**	**Expenditure in previous (IFI) financial years**	Internal £ 66,700 External £ 32,450 **Total £ 99,150**
Total Project Costs (Collaborative + external + SSEPD)	£257,817	**Projected 2014/15 costs for SSEPD**	Internal £ 0 External £ 0 **Total £ 0**
Technological area and/or issue addressed by project	This project provides the initial analysis to understand the opportunities and risks that exist for DNOs from the uptake of hydrogen technologies. Analysis from the UK H_2 Mobility Project gives potential uptake figures of 1.6m hydrogen fuelled vehicles by 2030. In this scenario annual hydrogen consumption would be 254,000 tonnes, with a little over half of this coming from electrolysis. This would represent between 350-800MW of new demand being connected to the electricity network. This demand would potentially require significant and expensive network re-enforcement, but it also introduces a new demand which has substantial potential for flexible operation. This project is developing learning in the following areas: • Identification of appropriate learning and baseline data from other hydrogen electrolyser, DSM, and ANM projects; • From the projects identified in above, extraction and collation of useful assessment criteria and baseline data sets;		

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From the projects identified above, identification of ‘lessons learnt’ which would influence the potential uptake of this approach and inform a proposed trial;
Understanding of the technology which could be used for this application and a commercial arrangement for utilising the service to remove network constraints;
Potential operational profiles for a demonstration system which would utilise the above learning and provide quantifiable evidence of system performance.

</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>3</td><td>7</td><td>-4</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">It is expected that this project will provide learning which would be applicable to all DNOs on the costs of uncontrolled electrolyser operation, and operational profiles for controlled operation. It is expected that controlled operation could significantly reduce network reinforcement costs and potentially create additional capacity for generation to connect.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>5 years</td><td colspan="2">Duration of benefit once achieved</td><td>25 years</td></tr>
<tr><td>Probability of Success</td><td>10%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£585,429</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">Over the past year there have been developments in the UK H_2 Mobility Project which has increased the number of partners and reported on the expected uptake profile. A number of other projects have commenced which are looking at opportunities for hydrogen blending in the gas network. This has increased the probability that the connection of electrolysers is likely on the distribution network and that the learning from this project will therefore provide real savings.</td></tr>
<tr><td>Project Progress March 2014</td><td colspan="4">Significant work has been done on applicable learning and comparison data from other projects. Operational profiles and cost analysis have been created which could be used for a demonstration system. A draft commercial arrangement for the contracted service model has also been developed.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">BOC, Scotia Gas Networks (SGN), Stagecoach, First Group, Element Energy, AREG, Aberdeen City Council (ACC)</td></tr>
<tr><td>R&D providers</td><td colspan="4">BOC, Hydrogenics, SGN</td></tr>
</table>

2012_03: High-Medium Voltage Primary Substation Protection

<table>
<tr><td>Project Title</td><td colspan="6">High-Medium Voltage Primary Substation Protection</td></tr>
<tr><td>Description of project</td><td colspan="6">This project will install Locamation's HMV protection solution at one of SSEPD's primary substations in order to investigate its capability in terms of detecting faults on the distribution network.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td colspan="2">Internal £ 24,790
External £ 34,310
Total £ 59,100</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £ 9,060
External £ 64,460
Total £ 73,520</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td colspan="2">£134,520</td><td colspan="2">Projected 2014/15 costs for SSEPD</td><td colspan="2">Internal £ 2,500
External £ 10,000
Total £ 12,500</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="6">Reduction in hardware required for full substation protection, whilst moving the protection system to a more centralised digital solution.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td colspan="2">Project Benefits Rating</td><td colspan="2">Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td colspan="2">12</td><td colspan="2">1</td><td>11</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="6">A new style of protection will be available for use on our distribution system, with the potential to reduce hardware costs, and allow centralised access to all items of plant from a remote location.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">3 years</td><td colspan="3">Duration of benefit once achieved</td><td>20 years</td></tr>
<tr><td>Probability of Success</td><td colspan="2">75%</td><td colspan="3">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£115,759</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="6">High</td></tr>
<tr><td>Project Progress March 2014</td><td colspan="6">Full system was installed and commissioned on site in February 2014. Site trials are now ongoing to ensure the protection sees real faults that are cleared by the existing relays. These trials will run for a period of 1-2 years depending on the number of faults that occur in the vicinity of the substation. Currently in the process of installing an ADSL line for remote SCADA purposes.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="6">None</td></tr>
<tr><td>R&D providers</td><td colspan="6">Locamation</td></tr>
</table>

2012_04: Mobile Diesel Generation with Battery Storage

Project Title	2012_04 Mobile Diesel Generator with Battery Storage			
Description of project	This project is aimed at evaluating the use of hybrid battery/generator option as opposed to conventional diesel generation to provide power to small islands and communities.			
Expenditure for 2013/14 financial year	Internal £ 17,990 External £ 52,580 **Total £ 70,570**	**Expenditure in previous (IFI) financial years**	Internal £ 14,610 External £ 24,450 **Total £ 39,060**	
Total Project Costs (Collaborative + external + SSEPD)	£ 123,060	**Projected 2014/15 costs for SSEPD**	Internal £ 20,000 External £ 122,620 **Total £ 142,260**	
Technological area and/or issue addressed by project	A cost-effective and environmentally friendly mobile hybrid battery/generation unit for use during repairs of submarine cables to small islands and communities.			
Type(s) of innovation involved	Technological substitution	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
		11	-2	13
Expected Benefits of Project	Cost effective and environmentally friendly solution for providing temporary power to small islands and communities.			
Expected Timescale to adoption	1 Year	**Duration of benefit once achieved**	20 Years	
Probability of Success	**75%**	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£76,157	
Potential for achieving expected benefits	High			
Project Progress March 2014	A prototype unit comprising a 325kVA generator with 200kWh storage via lead acid battery storage. The unit has been tested at the PNDC. These tests have led to the refinement of multiple technologies. This has increased our understanding and knowledge in this field. HV test are still to be carried out.			
Collaborative Partners	None			
R&D providers	PNDC and Generator Power			

2012_05: Markets for DSM and Storage - Phase 1

Project Title	2012_05 Markets for DSM and Storage - Phase 1		
Description of project	This project is aimed at developing a number of options for market models that could be used to provide the commercial arrangements for the sustainable operation of demand side response in a number of network scenarios. In particular it will provide recommendations for market models that will allow sustainable operation of the technical demand side response implementations that are being implemented in Shetland under the Northern Isles New Energy Solutions (NINES) project. The project will reduce the number of potential market models for a variety of GB network scenarios (Shetlands, Thames Valley, and Isle of Wight) down to a shortlist: this will be based on feasibility, driven by factors to be agreed with key stakeholders. This work will also generate a set of recommendations to enable the simulation and testing of various market operating models, which could be implemented in a later project.		
Expenditure for 2013/14 financial year	Internal £ 1,350 External £ 0 **Total £ 1,350**	**Expenditure in previous (IFI) financial years**	Internal £ 24,950 External £ 102,660 **Total £ 127,610**
Total Project Costs (Collaborative + external + SSEPD)	£143,000	**Projected 2014/15 costs for SSEPD**	Internal £ 0 External £ 0 **Total £ 0**
Technological area and/or issue addressed by project	The production of commercial market models to support the technologies deployed in Shetland under the NINES project with the ability to transfer this knowledge to the rest of GB.		

Type(s) of innovation involved	Incremental, significant	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
		10	5	5
Expected Benefits of Project	Production of market models as described above, the input into the integrated plan for Shetland, and the ability to transfer learning to other parts of GB.			

Expected Timescale to adoption	1 year	**Duration of benefit once achieved**	20 Years

Probability of Success	10%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£325,563
Potential for achieving expected benefits	As the project is an incremental set of steps each of which are well understood, the delivery of the stated outputs is highly likely. What cannot be ascertained at this time is the performance of the market models that will be recommended.		
Project Progress March 2014	Project work during this financial year was associated with reviewing the project and ensuring it was ready to be closed down.		
Collaborative Partners	None		
R&D providers	Wipro Technologies Limited and Engage Consulting Limited		

2012_06: Orkney Sub-50kW

Project Title	2012_06 Orkney Sub-50kW				
Description of project	One of the guiding principles of installing the Orkney ANM system was that generators could gain confidence in the long-term financial viability of their project through a constraint study completed during the connection process. These studies gave financiers the confidence to invest in a project as they had an understanding of what the long-term generation profile would be. However these figures are being eroded by sub-50kW generators connecting on Orkney as they do not require approval to connect but do have an impact on the export of the larger wind farms. The aim of this project is to investigate what can be done to reduce this erosion and to allow sub-50kW generators to connect in a fair and sustainable manner.				
Expenditure for 2013/14 financial year	Internal £ 12,470 External £ 19,030 **Total £ 31,500**	**Expenditure in previous (IFI) financial years**	Internal £ 10,910 External £ 21,520 **Total £ 32,430**		
Total Project Costs (Collaborative + external + SSEPD)	£ 190,000	**Projected 2014/15 costs for SSEPD**	Internal £ 24,535 External £ 100,400 **Total £ 124,935**		
Technological area and/or issue addressed by project	The project aims to address the erosion of the generation capacity available to the existing Orkney ANM generators by sub-50kW generators.				
Type(s) of innovation involved	Incremental	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**	
		10	-4	14	
Expected Benefits of Project	**Financial** - Deferment of reinforcement leading to a saving of capital expenditure; **Knowledge Transfer** - Transfer of how to incorporate a low cost control option into an ANM system to control small-scale generators. The method, impacts, and benefits of this will be transferred in full; **Environmental** - A small increase in the amount of small-scale renewable generation that can export to the SSEPD network.				
Expected Timescale to adoption	1 year	**Duration of benefit once achieved**	20 years		
Probability of Success	35%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£3,629,043		

Potential for achieving expected benefits	Low/Medium, with the security of the viable method of communication with these sub-50kW generators posing a technical issue.
Project Progress March 2014	Work completed during this financial year revolved around trying to reconcile the customer owned communications networks with the requirements of SSEPD IT Security. This has resulted in a possible BT supplied solution and the design of this is in progress.
Collaborative Partners	None
R&D providers	Smarter Grid Solutions Ltd

2012_07: RPZ Phase 2

Project Title	2012_07 RPZ Phase 2		
Description of project	The Orkney Islands are a rich source of renewable energy and as a result, all capacity for conventional connection of generation was exhausted in 2003. Due to the smaller scale of the generators and the high cost for conventional connection, circa £30M, another method for connecting generation needed to be developed to unlock the full renewable energy potential. Using an intertrip scheme, a further 21MW was allowed to connect which was quickly taken up by generators. However, there was still a strong desire from generators to get access to the Orkney network but this was insufficiently strong to cover the reinforcement cost. To allow further connection, an ANM system was designed and installed that took into account the difference between the minimum and maximum demand on the islands and the diversity amongst the connected generation portfolio. The ANM scheme monitors the identified network constraint points and dynamically controls the new non-firm connected generators' output to ensure that the operating limits at the constraint points are not breached. This aim of this project is to improve the resilience of the ANM system so that it effectively manages the connected generation and is ready for transfer to BaU. This will allow more widespread use of the learning from this project and ensure that the ANM methodology can be applied to other network constraints by SSEPD and other DNOs. The scope is to assess the system, define how to improve its resilience, and ensure it is ready to transfer the technical and associated commercial systems over to the main business including the operation and maintenance of the ANM system.		
Expenditure for 2013/14 financial year	Internal £ 72,590 External £ 112,340 **Total £ 184,930**	**Expenditure in previous (IFI) financial years**	Internal £ 39,770 External £ 149,490 **Total £ 189,260**
Total Project Costs (Collaborative + external + SSEPD)	£517,760	**Projected 2014/15 costs for SSEPD**	Internal £ 15,980 External £ 127,590 **Total £ 143,570**
Technological area and/or issue addressed by project	This project will assess the ANM system as it currently stands and identify where amendments are required to bring it in line with company and UK standards. With this complete, the system will be handed over from R&D to BaU to allow the system to be rolled out across SSEPD's networks.		

Type(s) of innovation involved	Radical	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
		7	1	6
Expected Benefits of Project	Allow ANM systems to be applied across SSEPD networks which will realise the following benefits: **Financial** - Deferment of reinforcement leading to a saving of capital expenditure; **Knowledge Transfer** - Transfer of knowledge of how to implement an ANM system into BaU which will also help with understanding how to transfer an R&D project into BaU; **Environmental** - An increase in the amount of renewable generation that can export onto SSEPD's distribution network.			
Expected Timescale to adoption	1 year	**Duration of benefit once achieved**		20 years
Probability of Success	90%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**		£2,991,373
Potential for achieving expected benefits	High			
Project Progress March 2014	In order to maximise the value of Active Network Management (ANM) to the UK customer SSEPD held a dissemination event on Orkney to allow relevant stakeholders to better understand the ANM system and it's context. The event saw 46 delegates from the UK Europe and North America come together on Orkney to see and experience for themselves the challenges in making an Active Network Management (ANM) system implementation a business reality. Delegates were given the opportunity to tour the island, examine the hardware in Kirkwall Power Station and take part in interactive tutorial sessions. The project is nearing completion with the majority of the work having been completed with the outstanding work being a single communications link. The support structure is in place with an ANM responsible party in place and a handover pack now with the lead technical support diagram explaining all facets of the ANM system. This project has led to the application of ANM to a second location in North Eastern Scotland.			
Collaborative Partners	None			
R&D providers	Smarter Grid Solutions and Cable & Wireless Worldwide			

2012_08: Esprit Network Trial

<table>
<tr><td>Project Title</td><td colspan="4">2012_08 Esprit Network Trial</td></tr>
<tr><td>Description of project</td><td colspan="4">Esprit consists of an energy monitoring/ control device and an intelligent socket with communications between the two. The communication medium between the monitoring & control device and the intelligent socket will confirm which sockets are being used for EV' charging and it will allow the monitoring and control device to switch the sockets off/on dependent upon the demand on the low voltage circuit. Project Esprit will delay, and in some cases avoid, the need for additional electrical infrastructure to accommodate the forecast increase in EV's.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 670
External £ 21,000
Total £ 21,670</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £ 8,360
External £ 2,520
Total £ 10,880</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£31,000</td><td>Projected 2014/15 costs for SSEPD</td><td colspan="2">Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Peak demand of EV charging on LV network</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Direct control of EV charging</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>18</td><td>0</td><td>18</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The Esprit Smart Controller has the potential to increase the peak thermal and voltage limits of the low voltage cable without the need for an upgrade. This will allow additional connection of low carbon technologies, in this case, electric vehicles, heat pumps etc. without requiring traditional upgrades. The devices will have no effect on the security of supplies</td></tr>
<tr><td>Expected Timescale to adoption</td><td>1 year</td><td colspan="2">Duration of benefit once achieved</td><td>25 years</td></tr>
<tr><td>Probability of Success</td><td>75%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£6.4m</td></tr>
</table>

Potential for achieving expected benefits	Good
Project Progress March 2014	Trials have been conducted in Chalvey, Slough, on the Zero Carbon Homes and recently in Bramley. The first trial was held on Mon 4th March. This trial saw successful communications and control between the Monitor-Controller located at the S/S and all bar one of the smart sockets, the one at No10 was in communications but could not be controlled. On 22nd March, AND TR repeated the tests of the 4th with the same results, they then connected an additional socket at the S/S this proved to provide the slight increase in signal (by repeating) that was needed to communicate with No10. AND TR measured the cable distance between S/S and No10 to be just over 250m which is right on the limit of what can be expected in terms of reliable communications, normally AND TR would like to see a repeat socket installed nearer to the S/S; also AND TR detected noticeably more noise on the phase (Blue) which No10 is connected to. When multiple sockets are installed on the same phase they form a network that can repeat signals and so overcome the constraints of distance and noise, therefore the more smart sockets on a network the less the risk of not being able to communicate.
Collaborative Partners	AND Technology Research
R&D providers	EA Technology

2012_09: Real-Time Java

<table>
<tr><td>Project Title</td><td colspan="3">2012_09 Real-Time Java</td></tr>
<tr><td>Description of project</td><td colspan="3">The original Orkney ANM scheme (developed through other IFI projects as detailed in this report) was deployed on PLCs and consists of Smarter Grid Solutions Smart Grid platform, SGcore, the real-time power flow management application, SGi and their CommsHUB product.

The next generation of the SGcore platform and SGi algorithms, SGcore Java has now been developed by Smarter Grid Solutions. SGcore Java makes use of leading edge real-time systems software in the form of Real Time Java which should allow the SGi Java algorithm to exhibit the same determinism and reliability as that of SGi PLC.

The real-time specification for Java is concerned with providing the capability to perform mission-critical control within defined time periods and has found application in defence and process control industries. When deployed on Orkney, this project will represent the first deployment of the Real Time Java to manage an ANM system in the UK.

The deployment of this software platform to perform ANM provides additional benefits to SSEPD in that a more powerful computing platform will exist that can undertake more advanced computational tasks and has significant scalability and interoperability that cannot be provided within a PLC-based environment.

The successful conclusion of this project will facilitate the wider roll-out of this technology. This project will also be used for the further development of the Orkney Smart Grid: projects 2009_11 Distribution Dynamic Line Ratings, 2010_02 Orkney Active Power Network-Voltage Control, and 2010_06 Orkney Active Power Network-Phase 3 Electrical State Estimation depending on the hardware provided.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 109,610
External £ 137,740
Total £ 247,350</td><td>Expenditure in previous (IFI) financial years</td><td>Internal £8,270
External £157,330
Total £165,600</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£ 529,760</td><td>Projected 2014/15 costs for SSEPD</td><td>Internal £17,000
External £100,000
Total £117,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="3">The ANM system architecture will be improved to offer a more scalable and interoperable system configuration that will benefit future smart grid projects.</td></tr>
</table>

Type(s) of innovation involved	Technological Substitution from outside industry	**Project Benefits Rating**		**Project Residual Risk**	**Overall Project Score**
		10		1	9
Expected Benefits of Project	**Financial** – Deployment of this system to help further defer reinforcement works; **Knowledge Transfer** – It is highly probable that ANM schemes in the future will operate within a real-time Java (RTJ) environment. This project will allow SSEPD to gain knowledge in the implementation of a RTJ-based ANM scheme in a very low risk manner; **Environmental** – This will allow an increase in renewable generation; **Network Performance** – There may be network performance benefits as this type of ANM scheme is applied elsewhere on the network and integrated with advanced distribution-automation functions.				
Expected Timescale to adoption	1 year	**Duration of benefit once achieved**		5 years	
Probability of Success	**25%**	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**		£984,231	
Potential for achieving expected benefits	Medium				
Project Progress March 2014	The Linux servers for real time processing and the Windows servers for communications have been installed in Kirkwall, using standard IT procedures to maximise resiliency. Phase1, where the Linux servers carry out processing, and are compared with the PLC system completed satisfactorily. Phase 2, where the Linux servers took over from the PLC system, and carried out all of the processing for the ANM system has been operating highly satisfactorily for 3 months. Phase 3, where the communication servers take over communication with the generators from the PLC system, is due to start in May 2014.				
Collaborative Partners	None				
R&D providers	Smarter Grid Solutions				

2012_10: Methanation

Project Title	2012_10 Methanation				
Description of project	CO_2 as a feedstock for synthetic natural gas and energy storage / Hydrogen Gas Injection: Feasibility Study. This is an engineering feasibility study split into two strands: Strand 1 intends to investigate and provide a route for exploitation of periods in the electricity generation cycle during which there is excessive supply on the UK power network; this occurs for a number of reasons including response generators being brought on line early and remaining on after demand has dropped. Research will answer the question of whether it is economically feasible to install strategically located electrolyser stock to absorb this spare capacity, by generating a substantial volume of hydrogen, and to evaluate the most efficient and profitable way to implement the plan. This is TSB 48% funded. Strand 2 is to establish the technological, financial and operational issues of the methanation process and it's applicability to CCS from industrial sources, its role as a demand side management technology for managing renewable curtailment, and the potential as a means of scalable energy storage. This is a DECC 50% funded Research Project which SEPD will support with resource and local information.				
Expenditure for 2013/14 financial year	Internal £ 1,240 External £ 1,300 **Total £ 2,540**		**Expenditure in previous (IFI) financial years**	Internal £ 10,640 External £ 2,390 **Total £ 13,030**	
Total Project Costs (Collaborative + external + SSEPD)	£135,800		**Projected 2014/15 costs for SSEPD**	Internal £ 0 External £ 0 **Total £ 0**	
Technological area and/or issue addressed by project	Managing renewable curtailment				
Type(s) of innovation involved	Radical	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**	
		18	-1	19	

<table>
<tr><td>Expected Benefits of Project</td><td colspan="3">The project is innovative in a number of ways.
It seeks to complete an engineering feasibility study to establish the technological, financial and operational issues of the process to create substitute natural gas using CO_2 from industrial processes and CCS using renewable hydrogen (zero carbon emitted from production or transport) produced from the electrolysis of water as a means of utilising carbon from industrial and power generation process, thereby avoiding its transport or storage.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>1</td><td>Duration of benefit once achieved</td><td>25</td></tr>
<tr><td>Probability of Success</td><td>75%</td><td>Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£6.4m</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="3">High</td></tr>
<tr><td>Project Progress March 2014</td><td colspan="3">Strand 1 (hydrogen gas inject)- Performance wind data gathered for identified wind farm sites. Report completed on the Technical & legal challenges according to different injection scenarios. Written report with main learning’s from existing plant created, and all research has led to model of hydrogen injection being created and subsequently refined with economic and environmental analysis completed.
Strand 2 (methanation)- work done to identify sites where CO_2 source, wind farm and methane consumer can be co-located, decided wind farm not needed as controllable load anywhere in Scotland would be beneficial. Further calculations carried out and analysis concluded.
Final reports completed by ITM Power can be provided to GB DNOs on request.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="3">SGN, Kiwa GASTEC at CRE, Logan Energy, Shell</td></tr>
<tr><td>R&D providers</td><td colspan="3">ITM Power</td></tr>
</table>

2012_11: Grid Integration of Marine Energy

Project Title	2012_11 Grid Integration of Marine Energy		
Description of project	This project is aimed at studying the integration of marine energy with the grid and other variable energy sources. This project will look at the specific problems associated with the integration of generation from wave energy with the established wind generators in the Western Isles of Scotland.		
Expenditure for 2013/14 financial year	Internal £ 1,320 External £ 260 **Total £ 1,580**	**Expenditure in previous (IFI) financial years**	Internal £ 8,050 External £ 2,520 **Total £ 10,570**
Total Project Costs (Collaborative + external + SSEPD)	£50,200	**Projected 2014/15 costs for SSEPD**	Internal £ 0 External £ 0 **Total £ 0**
Technological area and/or issue addressed by project	Integration of marine energy to the grid.		

Type(s) of innovation involved	Significant	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
		10	-1	11

Expected Benefits of Project	Marine energy is expected to increase significantly over the next two decades. This project will identify the implications of connecting marine energy sources to the grid and also propose mitigation measures to specific problems that will arise from such connection. It is anticipated that the project would improve system planning and allow integration of more renewable energy sources to remote networks.		
Expected Timescale to adoption	4 Year	**Duration of benefit once achieved**	10 Years
Probability of Success	**10%**	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£245,503
Potential for achieving expected benefits	High		

Project Progress March 2014	This project studied the prospect of wave energy integration into SHEPD networks through modelling of wave energy datasets based on the Aquamarine Oyster device power curve and measured wave data (for example period, amplitude, and direction information). The wave power dataset is for a full year in the waters off the Western Isles, an area of significant interest for wave energy development in SHEPD territory. SHEPD has supported this project to enable an assessment of wave energy network integration implications. Network capacity as well as voltage quality (fluctuations resulting from fluctuating power output from wave devices) have emerged as the grid integration challenges. The Western Isles distribution network has significant wind power connection interest so wind data sets for this area have also been collated. The University of Strathclyde has undertaken the studies to date in partnership with the University of Highlands and Islands with their wave energy resource measurement expertise. This has now been completed and a report detailing its findings is available. The project has produced models of wave and wind energy around the Western Isles. This has been benchmark against the load profile of the island. The results are there is a possibility of matching generation and demand. There has been a study carried on the network capacity with similar results found by our own planning team. In this study the fluctuations resulting from fluctuating power output from wave devices has not been included.
Collaborative Partners	None
R&D providers	University of Strathclyde

2012_12: GENDRIVE

<table>
<tr><td>Project Title</td><td colspan="4">2012_12 GENDRIVE</td></tr>
<tr><td>Description of project</td><td colspan="4">The distribution network controlled using transformers and tap-changing has proven reliable, however controllability of voltage is limited at best and faces the greatest challenge in remote and rural areas.
An active series voltage regulator is proposed to provide a more stable and smarter local supply. The unit proposed will in effect prevent or at worst delay the cost of reinforcing problematic distribution circuits.</td></tr>
<tr><td>Expenditure for 2012/13 financial year</td><td colspan="2">Internal £ 2,720
External £ -42,730
Total £ -40,010</td><td>Expenditure in previous IFI financial years</td><td>Internal £ 12,690
External £ 92,690
Total £ 105,380</td></tr>
<tr><td>Total Project Cost
(Collaborative + external + SSEPD)</td><td colspan="2">£ 227,720</td><td>Projected 2014/15 costs for SSEPD</td><td>Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">Voltage control on the LV network where voltage control through primary transformer tap changers is no longer sufficient. I.e. locations where there are high levels of load or distributed generation</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Tech Transfer</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>12</td><td>-3</td><td>15</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">• The Creation of a system that can control the voltage on an LV feeder
• Will be able to balance voltage across the phases
• Will be able to correct power factor on each phase
• Will reduce Total Harmonic Distortion
• Neutral currents will be regulated and controlled</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">2years</td><td>Duration of benefit once achieved</td><td>20 years</td></tr>
<tr><td>Probability of Success</td><td colspan="2">10%</td><td>Project NPV = (PV Benefits – PV Costs) x Probability of Success</td><td>£76,055</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">The first stage of the project identified the limitations of the initial GenDrive approach which would have had limited ability to achieve the benefits sought. However a second design has been created that exceeds these. There is a good level of optimism that this project will deliver the technical benefits sought.</td></tr>
</table>

Project Progress to March 2014	The project had successfully been completed to the end of stage 2 and stage 3 was due to commence however the company was placed in Administration in March 2014. As a result the project was placed on hold and no further work has been carried out. Various options are being investigated to determine of the project can continue..
Collaborative Partners	SPEN, UKPN, ENWL, NPG, EIC
R&D Providers	GenDrive Ltd supported by EATL.

2012_13: Gnosys Self Healing Cables

<table>
<tr><td>Project Title</td><td colspan="4">2012_13 Gnosys Self Healing Cables</td></tr>
<tr><td>Description of project</td><td colspan="4">There is a recognised need in the UK electricity distribution network for extruded polymeric cables to be cable of self-repair if the protective outer sheath is damaged during installation or operation.

An initial study will be undertaken to review, rank and lab trial a number of candidate material technologies that may be able to support self-repair. This will be followed by laboratory trials on one or more of these technologies. If successful commercial development of an improved performance MV cable system could follow in collaboration with one or more cable manufacturers.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 2,560
External £ 61,600
Total £ 64,170</td><td>Expenditure in previous IFI financial years</td><td colspan="2">Internal £ 8,610
External £ 29,320
Total £ 37,930</td></tr>
<tr><td>Project Cost

(Collaborative + external + SSEPD)</td><td>£ 226,910</td><td>Projected 2014/15 costs for SSEPD</td><td colspan="2">Internal £ 7,500
External £ 40,000
Total £ 47,500</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">This project addresses the need for a cable system that can self-repair sheath damage thus removing a significant source of faults in cables.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>15</td><td>-2</td><td>17</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Gnosys have identified a number of chemistries that have the potential to create the desired blocking effect when a fluid leak is present. These chemistries will be advanced through further stages and experimentation. There has been a good level of engagement with the ENA fluid filled called working group and their experience has been valuable. There is confidence that the chemistries identified will be able to provide the benefits identified at the start of the project.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>4years</td><td>Duration of benefit once achieved</td><td colspan="2">25 years</td></tr>
</table>

Probability of Success	10%	**Project NPV = (PV Benefits – PV Costs) x Probability of Success**	£13,040
Potential for achieving expected benefits	Stage one of this project has been completed to date and has delivered some significant findings. The view thus far is positive.		
Project Progress to March 2014	• 4 specific repair technologies have been identified and tested • A number of cable manufacturers have shown significant interest in the project including the provision of material samples and cable samples • Several material supplies have engaged positively in the project including the provision of material samples • 3 test rigs have been built and used for testing • The project has made good progress and identified further work with a new stage 4 to be carried out. This will look at the merging of two different repair technology classes to gain the best possible self-repairing mechanisms.		
Collaborative Partners	SPEN, Energy Innovation Centre, GnoSys Ltd		
R&D Providers	GnoSys Ltd		

2012_14: Radio Tele-Switching Phase 2

Project Title	2012_14 Radio Tele-Switching Phase 2			
Description of project	This project is building on the conclusion of a previous project 2011_08 RTS and will investigate the time shifting of electric storage and water heating to remove overloads or potential overloads.			
Expenditure for 2013/14 financial year	Internal £ 6,820 External £ 1,870 **Total £ 8,680**	**Expenditure in previous (IFI) financial years**	Internal £ 9,040 External £ 8,890 **Total £ 17,930**	
Total Project Costs (Collaborative + external + SSEPD)	£176,500	**Projected 2014/15 costs for SSEPD**	Internal £ 36,450 External £ 19,240 **Total £ 55,690**	
Technological area and/or issue addressed by project	Network overloading due to water and storage heating.			
Type(s) of innovation involved	Incremental	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
		9	-3	12
Expected Benefits of Project	Improved reliability by avoiding network peak loads, and reduced cost by deferring network reinforcement.			
Expected Timescale to adoption	3 years	**Duration of benefit once achieved**	20 years	
Probability of Success	90%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£332,026	
Potential for achieving expected benefits	High			
Project Progress March 2014	Three areas will be investigated in detail: Inveraray, Islay, and the Western Isles. The trial in Inveraray has been completed and shows a peak load reduction of around 10%. The other two areas will be investigated over the course of this year.			
Collaborative Partners	None			
R&D providers	SHEPD			

2013_01: Community Energy Coaching Programme

<table>
<tr><td>Project Title</td><td colspan="4">2013_01 Community Energy Coaching Programme</td></tr>
<tr><td>Description of project</td><td colspan="4">The Programme is an intensive 3 year local engagement initiative to embed Community Energy Coaches within ‘at risk’ communities to (a) deliver measurable behaviour change in terms of energy consumption (b) foster innovation in load reduction and renewables generation and (c) develop the innate capacity of local communities to sustain ongoing, positive change in reducing energy consumption.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 3,170
External £ 860
Total £ 4,020</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £ 4,750
External £ 20,910
Total £ 25,660</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£50,000</td><td colspan="2">Projected 2014/15 costs for SSEPD</td><td>Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Load reduction in areas where network identified as needing upgrading to sustain growth, innovative approach to community engagement, education and empowerment of communities and authorities on SSEPD objectives.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>18</td><td>2</td><td>11</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">a) Load reduction within a specified area to reduce/remove the need for expensive network upgrade in that area, b) SSEPD to be seen as community sponsor improving company reputation, and c) increased level of stakeholder engagement within affected areas giving support of OFGEM submission against broader measure targets.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>3 years</td><td colspan="2">Duration of benefit once achieved</td><td>7-10 years</td></tr>
<tr><td>Probability of Success</td><td>10%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£299,110</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">Medium</td></tr>
<tr><td>Project Progress March 2014</td><td colspan="4">The project has now closed following the successful feasibility study; the potential benefits of the programme will be further researched and proven as part of the SSEPD Solent Achieving Value through Efficiency (SAVE) project which has received LCNF funding.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">EIC</td></tr>
<tr><td>R&D providers</td><td colspan="4">Neighbourhood Economics Ltd.</td></tr>
</table>

2013_02: Community Energy Scotland Knowledge Transfer Partnership

Project Title	2013_02 CES Knowledge Transfer Partnership			
Description of project	Community energy schemes will continue to grow in number, individual capacity and aggregate capacity in the coming years aided by government support, as well as regulatory and incentive arrangements. This growth will make community energy a greater consideration in distribution network planning and operations with its potential upsides and downsides. This project is aimed at evaluating new approaches (technical and commercial) to manage barriers to grid connection and operation for community energy schemes, and to exploit potential network services that communities can offer for network operations through flexible generation and demand.			
Expenditure for 2013/14 financial year	Internal £ 16,070 External £ 11,570 **Total £ 27,640**	**Expenditure in previous (IFI) financial years**	Internal £ 1,320 External £ 20,790 **Total £ 22,110**	
Total Project Costs (Collaborative + external + SSEPD)	£80,625	**Projected 2014/15 costs for SSEPD**	Internal £ 16,660 External £ 12,630 **Total £ 29,290**	
Technological area and/or issue addressed by project	Integration of community energy schemes with the grid.			
Type(s) of innovation involved	Significant	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
		4	-8	12
Expected Benefits of Project	**Environmental :** this project will facilitate an increase in renewable energy generation from community-based energy systems **Knowledge Transfer:** the partners will exchange ideas and insights on the applicability of technical, commercial, and regulatory innovations that support community-based energy systems. **Network Performance:** development of new mechanisms to enable the connection of community energy schemes through the use of new and traditional technology in conjunction with new commercial and regulatory solutions. **Financial** : this project will evaluate the commercial viability of different solutions that will promote community energy integration			

Expected Timescale to adoption	1 year	**Duration of benefit once achieved**	1 year
Probability of Success	75%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£-61,739
Potential for achieving expected benefits	High		
Project Progress March 2014	Project progress to date has included: • Identification of sites for monitoring of the distribution network to understand what an area wide 'smart solution' might look like to reduce community generator curtailment, • Engineering Policy assessment of two separate units to judge whether they are suitable to be deployed on the SSEPD network, and • Assessment of what would be required to setup a DSM signal to be passed to the community generator so that they can enact DSM to reduce their own curtailment as allocated by the Orkney ANM scheme.		
Collaborative Partners	Community Energy Scotland		
R&D providers	University of Strathclyde		

2013_03: Vehicle to Grid

Project Title	2013_03 Vehicle to Grid			
Description of project	With consumer and governmental pressure to reduce transport CO_2 emissions, automotive manufacturers are spending vast sums of money on developing alternatively-fuelled vehicles. EVs and associated hybrids have seen a number of manufacturers' products launched or about to be launched. One of the additional benefits of having increasingly large numbers of EVs is the potential to assist the grid in load and frequency management. The aim of this project is to investigate the potential of battery-powered vehicles to use their excess rechargeable battery capacity to provide power to the grid in response to peak load demands.			
Expenditure for 2013/14 financial year	Internal £ 17,630 External £ 192,350 **Total £ 209,980**	**Expenditure in previous (IFI) financial years**	Internal £ 1,590 External £ 136,140 **Total £ 137,730**	
Total Project Costs (Collaborative + external + SSEPD)	£653,000	**Projected 2014/15 costs for SSEPD**	Internal £ 20,000 External £ 0 **Total £ 20,000**	
Technological area and/or issue addressed by project	EV integration with the grid.			
Type(s) of innovation involved	Significant	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
		14	-1	15
Expected Benefits of Project	If successful, DNOs will be able to control EVs in a manner that helps to mitigate the effects of EV charging on peak demand and hence ensure EVs can be connected without the need for network reinforcement.			
Expected Timescale to adoption	3 years	**Duration of benefit once achieved**	20 years	
Probability of Success	35%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£1,313	

Potential for achieving expected benefits	High, due to the significant potential of this technology as a form of energy storage to complement the increasing development of renewable technologies. In addition, the desire to delay or avoid the construction and operation of fossil fuel powered plant increases the potential for this technology to be implemented.
Project Progress March 2014	The batteries required for testing have been procured. All parties are now in place to begin the first phase laboratory trials to prove the technology. Significant work / time has been spent to get the legal documents signed between all parties (DNOs, multiple suppliers and academic bodies). This has taken significantly longer than originally anticipated. Despite the time spent on the legal side the project is still progressing as intended. The laboratory at Southampton university has been set up and is expected to begin performing test schedules on the different battery packs in June 2014. The project management is controlled by Future Transport Systems and work is progressing well with all the required suppliers on board to build the individual parts to create the communications / integration / control system.
Collaborative Partners	SP Energy Networks, ENW, WPD, UKPN
R&D providers	Future Transport Systems

2013_04: Isle of Wight Losses Project

<table>
<tr><td>Project Title</td><td colspan="4">2013_04 Isle of Wight Losses Project</td></tr>
<tr><td>Description of project</td><td colspan="4">The aim of the project is to study, model, and evaluate different techniques that could be used on a distribution network to reduce losses and provide an evaluation of the benefits to GB DNOs. The outputs of this study will pave the way for a DNO to run actual network trials of different techniques, hence saving money on equipment that will not make a significant contribution to network losses.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 15,420
External £ 77,180
Total £ 92,600</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £ 1,320
External £ 75,330
Total £ 76,650</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£200,000</td><td>Projected 2014/15 costs for SSEPD</td><td colspan="2">Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Reduction in network losses.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant, Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>15</td><td>-4</td><td>19</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Financial: this project will find efficient ways to permanently reduce losses which would result in financial savings each year;
Performance: identification of efficient methods to permanently reduce losses it will increase the network performance and hence reduce costs to the customer.
Environmental: if losses are at 2% this means that for every GW of energy generated, 20MW is lost: this becomes significant over a year of consumption. By reducing this figure we begin to see how much could be saved across the GB network: a reduction in losses means a reduction in generation and hence reduced carbon emissions.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>2 years</td><td colspan="2">Duration of benefit once achieved</td><td>15 years</td></tr>
</table>

Probability of Success	5%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£2,215
Potential for achieving expected benefits	There is currently a limited understanding of the new and innovative ways to manage and hence reduce losses on the 11 and 33kV distribution networks. The work being conducted is in the form of desk-based studies and reports; the outcomes and findings will be used to influence live trials. If the findings are negative, the project will still be considered successful, meaning time and money that would have been spent on the trials will be saved for a more worthy leading edge project.		
Project Progress March 2014	The project has completed the initial stages of work. Detailed engagement with SSEPD's GIS and mapping services team has allowed the network data (such as cable types, lengths, and plant information) to be transferred to S&C Electric Europe Ltd. This data has been inputted into the analysis tool Power Factory and initial results produced. In addition, the University of Bath have been engaged to begin initial work on the economic case and hence research the financial benefits. The project work has been completed on time / budget has demonstrated the techniques which benefit losses and those that do not – from a theoretical point of view. The work has then examined the costs of the positive techniques and provided a CBA over 45 years. The results of the work completed to data are captured within a stage 1 & stage 2 report. In addition the work from this project is to be taken forward as part of SEPDs LCNF Tier 2 bid for this year.		
Collaborative Partners	None		
R&D providers	S&C Electric Europe Ltd, University of Bath		

2013_05: Subsea Desktop Study Tool

<table>
<tr><td>Project Title</td><td colspan="4">2013_05 Subsea Desktop Study Tool</td></tr>
<tr><td>Description of project</td><td colspan="4">Sub-sea cables have among the lowest asset life expectancy of any asset in SSEPD's infrastructure, the reason for this being the harsh environment in which they are placed. SSEPD has in excess of 100 sub-sea cable links most often to remote islands of Scotland where strong tidal currents damage the cables quickly. The current regime for predicted lifespan is based around the use of Remotely Operated Vehicles (ROVs) or via dive inspections. Both of these are costly and time consuming and result in a snapshot view of the cable's condition.

The aim of this project is to develop a desk top tool which is based on the parameters of cable construction, tidal flow, sea bed conditions etc. Experience has shown that cables primarily fail due to abrasion caused by tides and currents which make the cable move along the seabed. With time abrasion causes erosion of cable armouring with the eventual breaching of insulation leading to cable failure. If locations where cables are susceptible to this failure mechanism are known, the mechanism can be profiled to establish a predictive system that would indicate remaining life or expected failure time. This desktop study tool would make it possible to make the prediction and hence enable planned rather than reactive replacement. Such methodology will circumvent the consequent effect of long lead time in obtaining replacement cable and the use of costly diesel generation on the affected islands until the fault is cleared.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 7,490
External £ 67,180
Total £ 74,670</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £ 1,080
External £ 65,790
Total £ 66,870</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£170,000</td><td colspan="2">Projected 2014/15 costs for SSEPD</td><td>Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The desktop tool will help improve asset management of subsea cables through continuous assessment of asset health</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technological Substitution from outside industry</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>14</td><td>2</td><td>12</td></tr>
</table>

Expected Benefits of Project	**Financial** – Based on recent experience where a single cable failure resulted in costs in excess of £4M there is a potential for use of the desktop tool to lead to significant financial savings **Knowledge Transfer** – Development of the system is by Heriot Watt University but there is SSEPD input. Knowledge transferred to SSEPD is in the form of learning by operations, maintenance and system planning teams who will apply the tool to assess asset health prior to maintenance or replacement **Environmental** – Most cable failures have an impact on the surrounding sea-bed environment. Preventative repair or replacement of cables reduces environment impact to the local area more so as a minority of sub sea cables are oil filled. **Network Performance** – The desktop tool system design allows for planned outages whose durations can be adequately controlled thereby improving network security than if outages are due to unplanned faults.			
Expected Timescale to adoption	1	**Duration of benefit once achieved**	20
Probability of Success	**10%**	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£331,677
Potential for achieving expected benefits	Possible		
Project Progress March 2014	The first version of the desktop tool has now been delivered. It is now undergoing detailed technical tests to ensure that it meets all the expected performance criteria. Once all necessary debugging is complete and the tool is acceptable for use by cable specialists, a review will follow to determine if it can be implemented in business as usual.		
Collaborative Partners	None		
R&D providers	Heriot Watt University		

2013_06: Green Running Load and DG detection

Project Title	2013_06 Green Running Load and DG detection				
Description of project	The pressure on LV resources and capability will be growing continually in the years ahead. The ability to understand the nature of loads on the network as well as smaller scale DG will become increasingly important in informing network reinforcement decisions, outage planning, and reconfiguration This project seeks to prove whether a technology developed for the building energy management profession can work successfully in identifying network loads and energy sources on the distribution network				
Expenditure for 2013/14 financial year	Internal £ 4,460 External £ -81,140 **Total £-76,680**		**Expenditure in previous IFI financial years**	Internal £ 0 External £ 0 **Total £ 0**	
Project Cost (Collaborative + external + SSEPD)	£ 167,460		**Projected 2014/15 costs for SSEPD**	Internal £ 10,000 External £ 0 **Total £ 10,000**	
Technological area and / or issue addressed by project	Load and DG detection, being able to identify types of load on a network from their signatures.				
Type(s) of innovation involved	Tech Transfer	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**	
		15	1	14	
Expected Benefits of Project	• The Creation of a system that can identify the types and size of loads and DG on a network.				
Expected Timescale to adoption	3years		**Duration of benefit once achieved**	20 years	
Probability of Success	25%		**Project NPV = (PV Benefits – PV Costs) x Probability of Success**	£414,561	
Potential for achieving expected benefits	The system has been used in building management settings already and is seeking to develop their prototype for DNO so there is a good level of confidence the system will be successful.				
Project Progress to March 14	The prototype system has been installed in a number of substations and has provided some promising results. Full details will come with post analysis of the data gathered from these sites.				
Collaborative Partners	SPEN, EIC				
R&D Providers	Green Running				

2013_07: BMW Active E

Project Title	2013_07 BMW Active E		
Description of project	The operation of the BMW Active E EV is in the final development stage with regards to the drive train and charging equipment prior to commercial launch of the production EV. The aims of the project are to achieve the following: • The installation of next generation charging facilities to new European Standards to test usability and reliability; • Use of the domestic charging facilities using a Mode 2 interface (a power controller charger that limits the power being drawn through a socket with a lower rating) rather than dedicated high power charger; • The new design of public charge points because the previous designs of EV charging infrastructure suffered unreliability due to signal failure causing user dissatisfaction, and less propensity to purchase an EV. The new design has facilities for credit card payment and is promised to be more reliable.		
Expenditure for 2013/14 financial year	Internal £ 2,750 External £ 9,030 **Total £ 11,780**	**Expenditure in previous (IFI) financial years**	Internal £ 690 External £ 2,490 **Total £ 3,180**
Total Project Costs (Collaborative + external + SSEPD)	£31,600	**Projected 2014/15 costs for SSEPD**	Internal £ 0 External £ 0 **Total £ 0**
Technological area and/or issue addressed by project	Learning regarding the practical use of Mode 2 Charging unit, and development of public charging using advanced payment systems.		

Type(s) of innovation involved	Incremental, Tech Transfer, Significant, Radical	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
		7	-10	17

Expected Benefits of Project	Understanding charging behaviour with easier to use systems.		
Expected Timescale to adoption	5 Years	**Duration of benefit once achieved**	Ongoing
Probability of Success	75%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£146,290

Potential for achieving expected benefits	High, due to increasing numbers of EVs coming to the market.
Project Progress March 2014	Trials continued through to December 2013 and final report produced. The project is now complete
Collaborative Partners	BMW
R&D provider	SSEPD

2013_08: Electric Bus for Glasgow

<table>
<tr><td>Project Title</td><td colspan="4">2013_08 Electric Bus for Glasgow</td></tr>
<tr><td>Description of project</td><td colspan="4">Electrification of public transport has the potential to reduce CO_2 emissions from transport, and improve air quality in cities. However, pure electric buses have range limitations so this project is for an inductive recharge range extended hybrid bus. It is planned to demonstrate this early in 2014 on a suitable route in Glasgow. The inductive recharge equipment recharges the bus at the ends of the route to recharge the batteries to allow EV only running. However, the inductive technology is at an early stage of development and may impact power quality on the distribution network. The key research elements of this project from a networks perspective will be focussed on the demand profiles and power quality issues (voltage and harmonics) to ensure that a wider roll out of this technology can be done with minimum impact. The project will also test technologies for billing bus operators for use-of-system via the charging infrastructure.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 12,930
External £ 154,250
Total £ 167,180</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £ 1,730
External £ 540
Total £ 2,270</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£185,000</td><td>Projected 2014/15 costs for SSEPD</td><td colspan="2">Internal £ 12,000
External £ 0
Total £ 12,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Inductive charging systems for high power transfer, rapid charging of batteries, power quality with inductive charging, safety implications of electromotive forces emitted while operating inductive charger, and testing of bus operator billing methods.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental, Tech Transfer, Significant, Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>12</td><td>-3</td><td>15</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Understanding the impact of electric bus routes and high power chargers on the distribution network.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>5 Years</td><td colspan="2">Duration of benefit once achieved</td><td>Ongoing</td></tr>
</table>

Probability of Success	75%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£-24,700
Potential for achieving expected benefits	Medium		
Project Progress March 2014	Charging point installed at the PNDC demonstration centre and tested.		
Collaborative Partners	Alexander Dennis Ltd, Johnson Matthey, BAE Systems		
R&D provider	University of Strathclyde		

2013_09: Copper Theft Detection

<table>
<tr><td>Project Title</td><td colspan="5">2013_09 Copper Theft Detection</td></tr>
<tr><td>Description of project</td><td colspan="5">Facilitating the development of and trialling a copper theft detection system that monitors and detects the theft of substation site earthing.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td colspan="2">Internal £ 4,410
External £ 34,760
Total £ 39,170</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td colspan="2">£148,400</td><td colspan="2">Projected 2014/15 costs for SSEPD</td><td>Internal £ 19,110
External £ 8,130
Total £ 27,240</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="5">Detection of theft of copper earthing from a substation site.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td colspan="2">Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td colspan="2">15</td><td>0</td><td>15</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="5">The benefits include the quicker detection of earthing removal from substation site, allowing the possibility of intervention of thefts which has the benefits of limiting the damage to the site and acting as a deterrent to people carrying out similar acts in the future. It also brings a safety benefit by highlighting earthing removal at an earlier stage than would otherwise be the case, allowing for more immediate remedial works to remedy this otherwise unsafe network operating condition.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">2 years</td><td colspan="2">Duration of benefit once achieved</td><td>Ongoing</td></tr>
<tr><td>Probability of Success</td><td colspan="2">50%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£148,805</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="5">Medium: the concept surrounding the separate alarm components are in the latter stages of development, the remaining challenge being to get to a position where the components can all be combined into a single product that can be interfaced with SSEPD's systems.</td></tr>
<tr><td>Project Progress March 2014</td><td colspan="5">Initial trial testing the copper theft detection capabilities of the device is set up and underway, modifications ongoing to produce outputs for the anti-tamper alarms and modify the communications setup of the device in order to be compatible with communications protocols of SSEPD.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="5">Scottish Power Energy Networks</td></tr>
<tr><td>R&D providers</td><td colspan="5">Cresatech</td></tr>
</table>

2013_10: Establish the Affordability of ADR

Project Title	2013_10 Establishing the Affordability of Automated Demand Response (ADR)			
Description of project	Distribution networks are traditionally designed with an in-built capability to deal with the credible worst-case operational conditions. ADR is envisaged to establish a paradigm change, since it can mitigate network constraints through real-time control of consumers' demand. Consequently, the reinforcement of network assets can be deferred or avoided, with significant economic benefits for DNOs. The real-time controllability of ADR can also yield improvements in operational aspects of distribution networks. These include the level of network losses, as well as the reliability and quality of supply.			
Expenditure for 2013/14 financial year	Internal £ 3,510 External £ 45,370 **Total £ 48,890**	**Expenditure in previous (IFI) financial years**	Internal £ 690 External £ 26,940 **Total £ 27,630**	
Total Project Costs (Collaborative + external + SSEPD)	£91,800	**Projected 2014/15 costs for SSEPD**	Internal £ 0 External £ 0 **Total £ 0**	
Technological area and/or issue addressed by project	Identification of optimal combination of ADR deployment and conventional network reinforcement, by balancing relevant network investment and ADR costs and benefits; quantification of the value of ADR by comparing across different future scenarios.			
Type(s) of innovation involved	Significant	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
		15	-7	22
Expected Benefits of Project	Work in this area will reveal benefit streams from ADR for the DNO and to parties responsible for balancing services.			
Expected Timescale to adoption	2 years	**Duration of benefit once achieved**	2 years	
Probability of Success	35%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£334,288	

Potential for achieving expected benefits	Medium
Project Progress March 2014	Start and subsequent follow-up meetings have been held, and note/action logs recorded. Data is now being gathered and analysis has begun using initial data provided to Imperial College London. This data is in the final stages of analysis and will shortly be presented back to SSEPD highlighting areas invested such as the Theory of Least Regret to analyse the affordability of ADR.
Collaborative Partners	None
R&D providers	Imperial College London, EATL

2013_11: DISCERN Knowledge Transfer

Project Title	2013_11 DISCERN Knowledge Transfer		
Description of project	The primary focus of this IFI project is Knowledge Transfer. Experience gained from SSEPD's New Thames Valley Vision (NTVV) project together with broader knowledge of the UK DNO operational and regulatory frameworks will be fed into the DISCERN European Union Seventh Framework Programme (FP7) project to shape the outcomes and recommendations made by this major EU funded project. Participation in the project provides access to knowledge and experiences gained by collaborating DISCERN partners for further dissemination to UK DNOs. The DISCERN (Distributed Intelligence for Cost-Effective and Reliable Distribution Network Operation) project itself draws together complementary demonstration projects established by DNO partners from across Europe to investigate innovative technological solutions for the enhanced monitoring and control of distribution networks. Additional project partners include research organisations and consultancies that are able to build on the findings from the demonstration trials though software simulation and analysis. DISCERN will investigate the different technologies, architectures and operational methodologies required to support the reliable and efficient operation of MV and LV distribution networks as they adapt to meet changing demands. Knowledge will be shared through workshops, structured questionnaires and interviews, reports and web based portals, with work streams progressing fewer than ten different Work Packages. This £250k IFI project facilitates participation in the DISCERN project to leverage SSEPD's NTVV project to access wider knowledge and experience and to shape the development of smart grid solutions in Europe. By leveraging the NTVV project SSEPD will draw on the €7.9m DISCERN project, for which 60% funding is provided from the European Commission via the FP7 framework with the remaining cost being met by the DISCERN partners. The IFI project will have a duration of three years in line with the DISCERN project itself. Further details of the DISCERN project, including project deliverables, can be found at www.discern.eu/index.html.		
Expenditure for 2013/14 financial year	Internal £ 16,260 External £ 120 **Total £ 16,380**	**Expenditure in previous (IFI) financial years**	Internal £ 0 External £ 0 **Total £ 0**
Total Project Costs (Collaborative + external + SSEPD)	£248,751	**Projected 2014/15 costs for SSEPD**	Internal £ 114,170 External £ 0 **Total £ 114,170**

<table>
<tr><td rowspan="1">Technological area and/or issue addressed by project</td><td colspan="4">SSEPD's involvement in DISCERN will contribute to all project objectives, including:
• Development of an assessment framework based on KPIs that allows the comparison of technical solutions for monitoring and controlling the distribution network
• Identification, assessment and comparison of the technological (technical, operational, organisational & ICT infrastructure) options for monitoring and control systems in the distribution network
• Testing and validation of optimal technological solutions in various countries and circumstances by means of both field tests and computer based simulations
• Knowledge exchange between innovative European DNO projects trialling various smart grid functionalities relating to network monitoring and control
• Development of recommendations for the cost-effective application of advanced distributed sensors, monitoring and control systems to increase the intelligence of electricity distribution networks
• Development of the Smart Grid Architectural Model (SGAM) concept and supporting software tools for the enhanced communication and comparison of technological solutions for achieving smart grid functionalities
• Identification and mapping of relevant standards to contribute to European standardisation activities.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental, Tech Transfer, Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>20</td><td>-3</td><td>23</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Through this IFI project, information obtained from SSEPD's NTVV project will be combined with learning from four further European demonstration projects in addition to software based simulations and analysis.
Participation in the DISCERN project will provide access to data collected on the technological, financial and operational issues and benefits associated with monitoring MV and LV networks, the requirements for optimal monitoring and the potential benefits of proposed monitoring systems which have been validated in differing deployment situations.
SSEPD's knowledge and experience will influence the development of recommendations, standards and supporting systems architecture methodologies to be provided to the European Commission via the DISCERN project. Such deliverables will inform the EC's future plans and guidance issued to European DNOs, and the development of</td></tr>
</table>

	supporting standards by European standards organisations. The outputs from DISCERN will also provide information and guidance for DNOs wishing to implement various smart grid functionalities, with findings available for dissemination to UK DNOs.		
Expected Timescale to adoption	2 - 5 years dependent on Work Package / project deliverable	**Duration of benefit once achieved**	Continual Benefit
Probability of Success	35% - 90% dependent on Work Package / project deliverable	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	<£3,505,451 (from PID) / dependent on Work Package / project deliverable>
Potential for achieving expected benefits	Various monitoring systems, including enhanced communications and control algorithms, have already been installed in trial locations on the MV and LV networks of the DISCERN DNO project partners. This project will look to build on these implementations by cataloguing information on the systems available, investigating the ability to replicate and scale of the solutions implemented, investigating the costs associated with optimal solutions, making recommendations and providing communication tools to facilitate duplication of the solutions. The collaborative nature of the project and range of solutions deployed provides a wealth of information from which to draw, and mitigates the risks associated with issues which may arise in any individual project. Further, the use of simulations provides an increased base of information to support further assessment, analysis and comparison. As such, participation in DISCERN has the potential to provide significant additional knowledge over and above that obtained from SSEPD's NTVV project alone with regard to the enhanced monitoring of MV and LV networks in an optimised and cost effective manner. As the DISCERN project itself reports to the European Commission, the recommendations on standards, supporting systems architecture methodologies and other frameworks required for the successful future implementation of smart grids across Europe will reach those responsible for decision making and issuing guidance to DNOs within the EU.		
Project Progress March 2014	The DISCERN project itself is well underway, with the first periodic review report submitted to the EC. A number of early project deliverables have now been published. SSEPD continues to actively participate in all ten Work Packages. Key		

	contributions over the past year relate to: • The choice and suitability of the smart grid functionalities to be investigated within DISCERN • The formation of appropriate assessment KPIs • Preparation of a comprehensive Use Case & SGAM representation for the NTVV project, for communication and comparison in a common language amongst project participants • Trialling of the SGAM and Use Case Management Repository software tools under development • Work on the CIM (Common Information Model) semantic model mapping & extension • Assessment of the replication & scalability of various monitoring solutions • Informing the development of scenarios to be simulated, and provision of NTVV network data for use in simulation work • Peer review through preparation of an external experts workshop • Participation in workshops across the various work packages, both teleconferenced and face to face • Participation in the project steering Technical Board Meetings and General Assembly • Reviewing & commenting on draft deliverables prior to publication • Contribution to the 1st Periodic Report provided to the European Commission • Preparation of a presentation on SGAM to the UK Smart Grids Forum.
Collaborative Partners	RWE, ABB AB, CIRCE, IBERDROLA, DNV GL, KTH, OFFIS, UNION FENOSA, VATTENFALL, ZIV
R&D providers	SSEPD

2013_12: ATSD

<table>
<tr><td>Project Title</td><td colspan="5">2013_12 Analysis of Transmission Solutions for Distribution networks</td></tr>
<tr><td>Description of project</td><td colspan="5">The aim of this project is to model innovative and existing equipment used on the GB transmission network and determine if there would be a benefit to installing this kit at lower voltages on the distribution network</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td colspan="2">Internal £ 9,530
External £ 25,570
Total £ 35,110</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td colspan="2">£ 85,000</td><td colspan="2">Projected 2014/15 costs for SSEPD</td><td>Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="5">The project is focusing on the benefits of multiple devices such as Quadrature Boosters, series / shunt Reactors, Fault Current Limiters, Statcoms etc. The analysis of these devices has considered the benefits at two different SSEPD sites.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td colspan="2">Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>10</td><td colspan="2">-1</td><td>11</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="5">The project should provide an understanding of the potential of use of these unproven solutions and the benefits to network operators.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>1 Year</td><td colspan="3">Duration of benefit once achieved</td><td>15 Years +</td></tr>
<tr><td>Probability of Success</td><td>35%</td><td colspan="3">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£100,677</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="5">Medium</td></tr>
<tr><td>Project Progress March 2014</td><td colspan="5">The project has completed 3 main studies incorporating the use of innovative solutions and equipment in use of the transmission network.

The first study considered the different ways to increase the capacity on two different rated subsea cables. A report was produced by PB Power and considered changes to settings on the AVC schemes up to installation of quad boosters and reactors. The findings were also linked</td></tr>
</table>

	to cost to implement against additional capacity that each solution could produce. The second study considered the use of a fault current limiter at a 132kV to 33kV site in the SHEPD licence area, Braco. A detailed report was produced by ASL with costs comparing the new solution to a traditional overhead line upgrade. A final report considered the benefits of a fault current limiter or similar solution in the SEPD licence area, Camberley. Again this report provided information on different configuration options and the benefits over a traditional circuit breaker upgrade. The reports are available on request to GB DNOs.
Collaborative Partners	None
R&D providers	PB Power Ltd / Applied Superconductor Ltd

2013_13: SF6 Leak location and Oxifree Coatings

Project Title	2013_13 SF6 Leak location and Oxifree Coatings		
Description of project	Sulphur Hexafluoride (SF6) gas is extensively used in switchgear as an insulator medium and arc quenching medium. It is also a green house gas with a Global Warming Potential (GWP) that is 23,900 times that of Carbon Dioxide (CO2) if emitted into the atmosphere. Every year, small amounts of SF6 gas are inevitably lost through leaking switchgear but due to the gravity of its environmental impact, all practicable measures have to be taken to reduce these emissions to as low as possible. Typical measures include invasive repair and replacement of problematic switchgear. However, both methods are financially costly and time intensive. If a switchgear item is identified as having SF6 gas leakage, the first step in mitigation is to identify the source of the leak to enable repairs. It is a difficult process which requires outages with some impact on network security and tends to be inconclusive. This project involves trial of a non-contact means of pin-pointing leaks together with a non-invasive method of reducing identified gas leaks. The trial for non-contact means of pin-pointing SF6 leaks makes use of FLIR infrared gas detection cameras which are capable of visually detecting SF6 gas from a distance and showing it on a display as a dark smoke plume. After each pin-pointing exercise, a non-invasive method of reducing the leak is tried through encapsulation of the switchgear component with Oxifree TM198 resin, a new product which is currently utilised mainly for corrosion protection. This methodology is expected to be more cost effective than current practice and to result in significant environmental benefits.		
Expenditure for 2013/14 financial year	Internal £ 37,290 External £ 139,370 **Total £ 176,660**	**Expenditure in previous (IFI) financial years**	Internal £ 0 External £ 0 **Total £ 0**
Total Project Costs (Collaborative + external + SSEPD)	£216,663	**Projected 2014/15 costs for SSEPD**	Internal £ 22,190 External £ 15,520 **Total £ 37,710**
Technological area and/or issue addressed by project	Reduction of SF6 emissions from switchgear will reduce the environmental impact of power systems.		

Type(s) of innovation involved	Technological Substitution	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**

	from outside industry	15	0	15
Expected Benefits of Project	**Financial** – On the basis that SF6 has Global Warming Potential (GWP) of 23900 times that of Carbon Dioxide and considering the Department of Energy and Climate Change's carbon valuation guidelines, each tonne of SF6 not emitted represents a financial saving of £693,000. **Knowledge Transfer** – Training on the techniques for use of optical gas imaging for maintenance staff is provided as part of this project, this knowledge transfer will completely remove the need for investigation visits by repair companies. Avoided outages will save money and minimise environmental impact. **Environmental** – There is an expectation of a marked reduction in total SF6 emissions should the method prove successful. With the potency of SF6 gas being that high, any reduction in emissions has a high corresponding improvement in environmental performance. **Network Performance** – Use of gas detection cameras enables inspection on live equipment from a safe distance. Sources of gas leakage can therefore be pin-pointed without investigation outages. Oxifree coating is non-invasive hence it can be rapidly deployed thereby reducing outage times further.			
Expected Timescale to adoption	1	**Duration of benefit once achieved**	40	
Probability of Success	**90%**	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£4,188	
Potential for achieving expected benefits	Possible			
Project Progress March 2014	Several leaks have so far been identified using Flir SF6 gas detection cameras. Work continues to establish the optimum conditions for detecting gas leakage. Oxifree coating has been applied on some items of switchgear to curtail SF6 leaks. Work is still ongoing to identify more switchgear in diverse environments for application of Oxifree coating and monitoring performance. See Appendix 5			
Collaborative Partners	None			
R&D providers	Internal Suppliers: Acute Sales and Oxifree UK			

2013_14: Remote Access Solutions

Project Title	2013_14 Remote Access Solutions		
Description of project	A number of Future Networks R&D projects have required 3rd party suppliers, academics, and /or joint venture partners to have access to the SSEPD networks. Some of the requests for access have been unacceptable to IT Security, and workarounds have had to be found, often at short notice, in order for the projects to continue. There are especial issues in allowing external connectivity to SSEPD's Scada networks, because of the sensitivity and function of the devices on this network. There are risks in allowing 3rd parties access to SSE's networks, for example: Exposure and loss of function of Control Systems, Financial Loss, Exposure of Confidential Information, Outage of Grid Equipment, and Curtailment of Contracted Generators, are some of the most severe. The resultant financial and / or reputational loss could be measured in Millions of £. This project is being set up in order to protect the networks, whilst at the same time allowing necessary access. The project is looking at standardising remote access to the SSEPD data network taking into account all of the latest IT Security policies and procedures, and by having the solution penetration tested, it will demonstrate the level of cyber security that has been achieved so that the results can be presented to IT Security for approval. Following the approval of the IT Security Manager, then the solution will be available for R&D project managers to incorporate into their project plans to accommodate current and future requests from 3rd parties.		
Expenditure for 2013/14 financial year	Internal £ 25,150 External £ 19,210 **Total £ 44,360**	**Expenditure in previous (IFI) financial years**	Internal £ 0 External £ 0 **Total £ 0**
Total Project Costs (Collaborative + external + SSEPD)	£176,500	**Projected 2014/15 costs for SSEPD**	Internal £ 34,500 External £ 65,000 **Total £ 99,500**
Technological area and/or issue addressed by project	Ensuring secure access to the data network such that exposure to cyber attack is minimised.		

Type(s) of innovation involved	Technology component and/or basic sub-system validation in relevant environment	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
		13	-6	19
Expected Benefits of Project	Third party access via a secure system that minimises the attack vectors on the SSEPD Data networks.			
Expected Timescale to adoption	1 year	**Duration of benefit once achieved**	5 years	
Probability of Success	35%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£129,029	
Potential for achieving expected benefits	Good			
Project Progress March 2014	Level 0 Architecture produced, and monitoring software evaluation underway. Hardware procured and installed in secure area.			
Collaborative Partners	None			
R&D providers	SSEPD			

2013_15: ZeEUS

Project Title	ZeEUS				
Description of project	Demonstration of high power inductive transfer systems on electric bus route. This project builds on an earlier project to include more buses and an additional charge point to prove the technology in a commercial environment, and higher power transfer taking the technology to the next TRL level.				
Expenditure for 2013/14 financial year	Internal £ 2,170 External £ 120 **Total £ 2,290**	**Expenditure in previous (IFI) financial years**	Internal £ 0 External £ 0 **Total £ 0**		
Total Project Costs (Collaborative + external + SSEPD)	£362,000	**Projected 2014/15 costs for SSEPD**	Internal £ 2,000 External £ 360,000 **Total £ 362,000**		
Technological area and/or issue addressed by project	Network impact of high power inductive transfer systems on the power network for a scheduled bus route. The key research elements of this project from a networks perspective will be focussed on the demand profiles and power quality issues (voltage and harmonics), and safety issues regarding the emf's.				
Type(s) of innovation involved	Incremental, Tech Transfer, Significant, Radical	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**	
		10	-1	11	
Expected Benefits of Project	Successful implementation would lead to increased electrification of urban transport, leading to higher network utilisation, and put SSEPD at the forefront of inductive charging technology				
Expected Timescale to adoption	2	**Duration of benefit once achieved**	20		
Probability of Success	50%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£60,590		
Potential for achieving expected benefits	Medium.				
Project Progress March 2014	Collaboration agreement signed and project funding is in place. Planning continues to evaluate the best location for the second charger (first already agreed for Buchanan St Bus Station)				
Collaborative Partners	Alexander Dennis Ltd (ADL), Strathclyde Partnership for Transport (SPT) , Transport Research Laboratory (TRL)				
R&D providers	TRL				

2013_16: Network Damage Reporter

<table>
<tr><td>Project Title</td><td colspan="4">2013_16 Network Damage Reporter</td></tr>
<tr><td>Description of project</td><td colspan="4">During Storm events it can be difficult to keep track of where and how much damage is occurring to the overhead network, due to the prevailing weather conditions. This project is to develop and introduce a smart phone application that can be used by members of the public, the Emergency Services, as well as company staff to record damage sites, and report them back to a central repository. This allows for quicker network damage recording by opening up the reporting of damage to a much wider constituency. By speeding up the recording the damage to the network, a quicker response can be implemented reducing the CMLs, by getting customers back on supply quicker.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 2,620
External £ 40,120
Total £ 42,740</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Total Project Costs (Collaborative + external +SSEPD)</td><td>£228,000</td><td colspan="2">Projected 2014/15 costs for SSEPD</td><td>Internal £ 36,000
External £ 150,000
Total £ 186,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Improves customer engagement by allowing them to report accurate network issues. Provides a communication methodology that should allow a speedier response to network issues by DNO repair teams.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technology component and/or basic technology sub-system validation in laboratory environment.</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>19</td><td>-1</td><td>20</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Reduction in CML of 0.01% through accurate network issue reporting and speedier response by repair teams.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>1 year</td><td colspan="2">Duration of benefit once achieved</td><td>10 years</td></tr>
<tr><td>Probability of Success</td><td>25%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td>£805,821</td></tr>
</table>

Potential for achieving expected benefits	Good
Project Progress March 2014	Network data and GIS data has been delivered to OGS, and is being converted ready for install on back end servers. Apple smart phone application is almost ready, and Android application development has started.
Collaborative Partners	EIC, ENW
R&D providers	Open Grid Systems

2013_17: Orkney ANM Critical Circuits

<table>
<tr><td>Project Title</td><td colspan="4">2013_17 Orkney ANM Critical Circuits</td></tr>
<tr><td>Description of project</td><td colspan="4">The Orkney Active Network Management (ANM) Scheme has been operational on the Orkney islands since 2009. In 2012 the project was sufficiently demonstrated to allow the process of handing it over to the Business to commence. This roll out across other relevant areas would allow PD to get maximum value for their customers through using the ANM concept. As part of the handover the system was analysed to make sure that it fitted within company process and policy. As part of this review it was decided to automate some of the functionalities of ANM when responding to 33kV network configuration changes, which as a current practice is currently completed manually.

Whilst completing this work it was discovered, due to the proliferation of the micro generators, that more than just the ANM controlled generators were required to reduce their export during certain network outage conditions. As such the decision was taken to incorporate the intertrip scheme that controls the tranche of generators installed prior to the deployment of ANM. This incorporation will allow the network to stay within its operational limits, whilst at the same time ensuring that a maximum amount of generation can be allowed onto the network in a co-ordinated manner.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td colspan="2">Internal £ 2,080
External £ 14,090
Total £ 16,170</td><td>Expenditure in previous (IFI) financial years</td><td>Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td colspan="2">£72,270</td><td>Projected 2014/15 costs for SSEPD</td><td>Internal £ 21,415
External £ 34,685
Total £ 56,100</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Managing network within operational limits in a real time manner</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>14</td><td>-4</td><td>18</td></tr>
</table>

Expected Benefits of Project	**External Benefits:** The solution should reduce the chance of a fault occurring due to overload conditions on the main 33kV network, which could have a significant impact on the generators operating under the control of the ANM system. **Knowledge Transfer:** Solution will be developed in conjunction with an external party to fit onto an SSEPD owned and operated system allowing SSEPD to understand how to apply this elsewhere **Network Performance:** The network will not be subjected to overload conditions following certain reconfigurations and as such will be better managed		
Expected Timescale to adoption	0.5 year	**Duration of benefit once achieved**	10 year
Probability of Success	90%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£819,056
Potential for achieving expected benefits	High		
Project Progress March 2014	Project progress to date has included: • Requirements gathered for what solution must deliver • Monitoring points identified and system architecture defined • Design & Test specifications approved		
Collaborative Partners	None		
R&D providers	Smarter Grid Solutions Ltd		

2014_01: Overhead Line Vibration Monitoring

Project Title	2014_01 Overhead Line Vibration Monitoring		
Description of project	Overhead lines are susceptible to inadvertent contact by vehicles, fishing rods and even kites, depending on where they are situated geographically. The most likely locations for a hazardous situation involving an overhead line are road or track crossing points, next to rivers/lakes/lochs and next to playing fields. Where overhead lines are close to, or cross these areas, the locations are known as critical crossings. The danger is that a 33KV, 11Kv or LV overhead line could be struck by an object that could result in serious injury or a fatality of the person or person involved in the incident. This project is working on the assumption that it is possible to discriminate between incidents where the circuit needs to be de-energised, and remain so until checked, and those incidents where no action is required. The intention is to have a device created, installed and tested to prove that the assumption is correct. If it can be shown that it is possible to discriminate between inadvertent cable strikes by members of the public and natural hazards, then a further phase of the project may be initiated to develop prototypes of such devices for further testing.		
Expenditure for 2013/14 financial year	Internal £ 3,790 External £ 95,120 **Total £ 98,910**	**Expenditure in previous (IFI) financial years**	Internal £ 0 External £ 0 **Total £ 0**
Total Project Costs (Collaborative + external + SSEPD)	£710,000	**Projected 2014/15 costs for SSEPD**	Internal £ 35,000 External £ 510,000 **Total £ 545,000**
Technological area and/or issue addressed by project	The detection of overhead line collisions by vehicles so that automated reclose mechanisms can be over-ridden and avoid fatalities.		

<table>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td colspan="2">Overall Project Score</td></tr>
<tr><td>18</td><td>1</td><td colspan="2">17</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="5">Reduction in injuries and fatalities due to electrocution by coming into contact with overhead lines.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>1 year</td><td colspan="2">Duration of benefit once achieved</td><td colspan="2">10 years</td></tr>
<tr><td>Probability of Success</td><td>35%</td><td colspan="2">Project NPV=(PV Benefits-PV Costs) x Probability of Success</td><td colspan="2">£722,562</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="5">Good</td></tr>
<tr><td>Project Progress March 2014</td><td colspan="5">Initial proof of concept device has been developed and is awaiting testing on an overhead line. This is planned for April 2014.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="5">None</td></tr>
<tr><td>R&D providers</td><td colspan="5">Tollgrade Inc</td></tr>
</table>

2014_02: Field Team Support Tool

<table>
<tr><td>Project Title</td><td colspan="4">2014_02 Field Team Support Tool</td></tr>
<tr><td>Description of project</td><td colspan="4">During Storm events it can be difficult to keep track of where and how much damage is occurring to the overhead network, due to the prevailing weather conditions. It may be several days after the storm that helicopters are able to be flown to trace damage.

The GridView system as developed by Open Grid is a network schematic lain over a geographic map of the area. These are combined by taking the Network schematic from the SCADA system, and combining it with Google maps. There is potential for the resulting map of the network to be delivered to field teams handheld tablets and also for the field operatives to photograph and send damage reports back to the central database for insertion into the SCADA system.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 4,960
External £ 249,620
Total £ 254,580</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td>£ 630,000</td><td>Projected 2014/15 costs for SSEPD</td><td colspan="2">Internal £ 45,500
External £ 334,000
Total £ 375,900</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Improvements to provision of documentation to field staff, and reduction in the requirement for paper maps and forms.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technology system / subsystem model or prototype demonstration in a relevant environment</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>16</td><td>-1</td><td>17</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Improved provision of Data to field staff, more effective response to Storm events.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>2 years</td><td colspan="2">Duration of benefit once achieved</td><td>10 years</td></tr>
</table>

Probability of Success	50%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£540,963
Potential for achieving expected benefits	Good		
Project Progress March 2014	The project started on 19th Feb 2014, and OGS have received several forms from SSEPD which have been converted ready for inclusion into the client app. Network data for the trail area has been provided, and conversion work to incorporate into a base level CIM is underway. Client hardware for the initial 3 month trial has been procured.		
Collaborative Partners	None		
R&D providers	Open Grid Systems		

2014_03: Fault Passage Indicator Consolidation

<table>
<tr><td>Project Title</td><td colspan="4">2014_03 Fault Passage Indicator Consolidation</td></tr>
<tr><td>Description of project</td><td colspan="4">Fault Passage Indicators (FPI), as a stand alone device has been commercially available for a number of years to the UK DNO population. They work by monitoring the electric and magnetic fields surrounding overhead lines and by understanding what will happen to these fields, following a fault, they can detect whether fault current has past them or not. In this way Customer Minutes Lost (CMLs) could be reduced as circuit restoration would be more efficient.

The scope of this project is to consolidate the learning from SSEPDs previous FPI projects involving communicable FPIs, as well as learning from other UK DNOs, to inform the business case for the mass roll out of FPIs.

If the decision is taken to roll out FPIs in a large scale programme then SSEPD 'Business as Usual' (BaU) resources will be used.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td colspan="2">Internal £ 3,550
External £ 7,770
Total £ 11,320</td><td>Expenditure in previous (IFI) financial years</td><td>Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Total Project Costs (Collaborative + external + SSEPD)</td><td colspan="2">£63,065</td><td>Projected 2014/15 costs for SSEPD</td><td>Internal £ 36,495
External £ 15,250
Total £ 51,745</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Better identification of fault locations on the distribution overhead network</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>12</td><td>1</td><td>11</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">External Benefits : Fault outages should be reduced and it will help in all fault environments, i.e. one off and storms

Knowledge Transfer: Solution will inform policy for how, when and how to apply overhead FPIs

Network Performance: Project looks to deliver a sustainable improvement on the pin pointing of faults and thus reduce the CMLs</td></tr>
</table>

	experienced by SSEPD customers.		
Expected Timescale to adoption	0.5 year	**Duration of benefit once achieved**	10 year
Probability of Success	90%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**	£214,812
Potential for achieving expected benefits	Medium		
Project Progress March 2014	Project progress to date has included: • Commencement of analysis in SHEPD area • Investigation into other DNO & SSEPD previous FPI projects and the outcomes from them		
Collaborative Partners	None		
R&D providers	Nortech		

2014_04 Data Matching for Smart Registration

Project Title	2014_04 Data Matching for Smart Registration					
Description of project	To trial novel ways to match data required for registration with the DCC with internal data and the arbitration rules associated with improving the quality of data matches. By matching UPRN with MPAN data we will for the first time be able to align MPAN with GIS. The alignment of geospatial data will allow for better future network connectivity models. More accurate network connectivity models are crucial in management of the forecasts for increase in LCTs on the distribution network.					
Expenditure for 2013/14 financial year	Internal £ 2,250 External £ 22,120 **Total £ 24,370**		**Expenditure in previous (IFI) financial years**		Internal £ 0 External £ 0 **Total £ 0**	
Total Project Costs (Collaborative + external + SSEPD)	£33,370		**Projected 2014/15 costs for SSEPD**		Internal £ 9,000 External £ 2,500 **Total £ 11,500**	
Technological area and/or issue addressed by project	Customers address data verification, and allocation of unique identifiers.					
Type(s) of innovation involved	Incremental	**Project Benefits Rating**		**Project Residual Risk**	**Overall Project Score**	
		7		1	6	
Expected Benefits of Project	More accurate and unique customer address identifiers.					
Expected Timescale to adoption	3 months	**Duration of benefit once achieved**			10 years	
Probability of Success	25%	**Project NPV=(PV Benefits-PV Costs) x Probability of Success**			£40,334	
Potential for achieving expected benefits	Medium					
Project Progress March 2014	Project raised, and 3rd party consultancy agreed					
Collaborative Partners	None					
R&D providers	X88					

2014_05: Cable Core Temperature Sensor

Project Title	2014_05: Cable Core Temperature Sensor				
Description of project	This project is to validate a concept for an easily retro-fitted sensor for measuring and/or deducing the temperature of the core of a 3-phase electricity network power cable. Using cable temperature to infer the current in a cable offers the possibility to use this approach to provide a lower cost, more easily installed alternative to current transformers. It also provides a retro-fit alternative to fibre-optic cable temperature sensing. Additionally the measurement of the core temperature can be used to gauge when a cable reaches its temperature tolerance levels independent to the power being transferred.				
Expenditure for 2013/14 financial year	Internal £ 1,380 External £ 41,320 **Total £ 42,700**	**Expenditure in previous (IFI) financial years**	Internal £ 0 External £ 0 **Total £ 0**		
Project Cost **(Collaborative + external +SSEPD)**	£334,276	**Projected 14/15 costs for SSEPD**	Internal £ 7,750 External £ 0 **Total £ 7,750**		
Technological area and / or issue addressed by project	The problem being addressed by this project is to measure the cable core temperature at regular intervals using a sensor attached to the outer sheath of a cable. The sensor ideally is to be small, easily retro-fitted and will be of relatively low cost to manufacture. Two potential methods of temperature measurement were to be under consideration as follows: Direct temperature measurement of the cable sheath with a computational model inferring a virtual temperature sensor at the cable core. The computation would be based on a cross-sectional thermal model of the cable components and materials. Direct heat flux measurement to quantify the amount of heat exiting the cable, using the thermoelectric effect - also known as the Peltier and Seebeck effects depending on the direction of conversion between heat and electricity.				
Type(s) of innovation involved	Technological, Substitution		**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
			12	0	12
Expected Benefits of Project	It is expected that the development of such a sensor would give the networks the increased ability to manage peak currents. The sensors would improve the understanding of the network condition to help with network utilisation and deferral of capital expenditure (by extending the life of cables through peak temperature management), potentially also reducing the costs of outages.				

Expected Timescale to adoption	3 Years	**Duration of benefit once achieved**	25 Years
Probability of Success	10%	**Project NPV = (PV Benefits – PV Costs) x Probability of Success**	£82,278
Potential for achieving expected benefits	Stage 1 work has shown that cable core temperature can be predicted with reasonable accuracy from easily accessed measurements of the cable exterior, and there may be techniques to improve the impacts of thermal lag so that a temperature sensing method can provide a range of useful measures to assist with network management.		
Project Progress to March 2014	The project started in January 2014. Stage 1 the analytical and experimental proof of principle has been completed. The direct temperature measurement technique has been adopted as the favoured method.		
Collaborative Partners	SPEN, ENWL, NPGs, UKPN, Energy Innovation Centre		
R&D Providers	The Technology Partnership Ltd		

2014_06: RPAS Operational Requirements & Specifications for Aerial Inspections BVLOS

<table>
<tr><td>Project Title</td><td colspan="4">2014_06 RPAS Operational Requirements & Specifications For Aerial Inspections BVLOS</td></tr>
<tr><td>Description of project</td><td colspan="4">The use of helicopters to inspect overhead line assets is an expensive exercise and significant cost savings could be realised by the deployment of unmanned aerial systems. One or two of the UK DNOs are already successfully using unmanned aerial systems (UAS) for inspection tasks. However these systems are not suited to Beyond Visual Line Of Sight [BVLOS] operations.

To achieve this demanding goal of BVLOS, requires an expert approach to addressing the following three critical issues for electricity overhead-lines:

• Clearly defining BVLOS operations for which Civil Aviation Authority Approval [CAA] can be sought and secured.

• A financial analysis that can provide a clear indication as to where categorized BVLOS operations will provide the best Return On Investment [ROI] for the DNOs and be viable for current and/or as yet undefined future operations.

• Specifying a Remotely Piloted Aerial System [RPAS] that can provide a long endurance capability and fly BVLOS as well as meeting CAA regulatory requirements.</td></tr>
<tr><td>Expenditure for 2013/14 financial year</td><td>Internal £ 1,380
External £ 69,450
Total £ 70,830</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Project Cost
(Collaborative + external +SSEPD)</td><td>£416,000</td><td colspan="2">Projected 2014/15 costs for SSEPD</td><td>Internal £ 7,900
External £ 0
Total £ 7,900</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The goal of this project is to be able to define an industry standard electricity specification for Remotely Piloted Aircraft Systems operating Beyond Visual Line Of Sight for electricity distribution network aerial inspection operations, confirmed by the UK Civil Aviation Authority. By the end of the project, the industry will be in a position to decide whether it wants to invest in such systems and if affirmative, fund acquisitions or development as necessary and with the goal of starting to introduce such systems into service for BVLOS operations in a stepwise manner, in close co-operation with and as agreed by the CAA.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>18</td><td>2</td><td>20</td></tr>
</table>

<table>
<tr><td>Expected Benefits of Project</td><td colspan="3">A UAS offers significant cost savings when compared to helicopter deployment. Being able to operate beyond the visual line of sight will result in significantly more circuit kms being surveyed during inspection periods.

Other benefits that unmanned aerial systems will bring include:
• Minimising environmental impact with greatly reduced fuel consumption.
• Minimised disruption to land owners, livestock and local residents during inspection.
• Reduced risk to life and limb by using un-manned apparatus to retrieve data.
• Reduced Civil Aviation restrictions in the vicinity of airports, chemical plants, MOD land etc.
• Limit the effect of stand down time due to bad weather or strong winds.

Reduced numbers of “missed towers” by not having to avoid motorways, railways or housing estates etc.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>3 Years</td><td>Duration of benefit once achieved</td><td>30 Years</td></tr>
<tr><td>Probability of Success</td><td>10%</td><td>Project NPV = (PV Benefits – PV Costs) x Probability of Success</td><td>£128,728</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="3">The approach of this project is designed to address the CAA requirements at every stage in order increase the potential for achieving expected benefits.</td></tr>
<tr><td>Project Progress to March 2014</td><td colspan="3">Project kick off meeting held in March. Stage 1 to commence at the start of April</td></tr>
<tr><td>Collaborative Partners</td><td colspan="3">UKPN, Northern Powergrid Limited, Northern Gas Networks, Scotland Gas Networks plc., Southern Gas Networks plc.</td></tr>
<tr><td>R&D Providers</td><td colspan="3">VTOL</td></tr>
</table>

2014_07: Ultrapole

Project Title	2014_07 Ultrapole		
Description of project	There are currently several invasive instruments on the market for detecting wood rot in wooden poles used by the distribution network operators (DNOs) which are based on both acoustic (hammer in nail, tap and listen) and ultrasonic (slice shadow) technologies. Current products on the market adopt a variety of techniques but all are restricted to detecting rot in very close proximity to the point at which the measurements are being taken. To satisfy the DNOs objective of assessing the condition of their pole assets, there is a need for an instrument that is easy to use in the field, takes non- intrusive measurements, and has the ability to operate at ground level over the entire length of the pole. Such an instrument would prevent the need for digging around the base of the pole disturbing previously good ground conditions, or climbing the pole to make measurements at height. This project is to conduct a study into the feasibility for such a device.		
Expenditure for 2013/14 financial year	Internal £ 1,380 External £ 15,120 **Total £ 16,500**	**Expenditure in previous (IFI) financial years**	Internal £ 0 External £ 0 **Total £ 0**
Project Cost **(Collaborative + external +SSEPD)**	£90,120	**Projected 14/15 costs for SSEPD**	Internal £ 5,000 External £ 0 **Total £ 5,000**
Technological area and / or issue addressed by project	Ultrasound can be used to detect changes in wood density which results in an acoustic path impedance variation between different wood densities. This change can be caused by rotted fibres within the pole, or other features such as drilled holes etc. This density change produces a discernible energy reflection at the boundary which can be analysed and visualized in an instrument. Current techniques use ultrasound to analyse cross sections of the pole, 'slices', which are normally at ground level. This project aims to develop a technique to use ultrasound longitudinally and thus from one point access the top and bottom of the pole.		

Type(s) of innovation involved	Significant, Technological substitution	**Project Benefits Rating**	**Project Residual Risk**	**Overall Project Score**
		16	-3	19
Expected Benefits of Project	This project will prove whether ultrasonic's can be used to access the condition of the complete wooden pole. If achievable it will give the DNOs a tool that will allow them to access wooden poles without having to climb the pole or dig below ground level to do this assessment. This will be a safer and more cost effective method.			

Expected Timescale to adoption	3 Years	**Duration of benefit once achieved**	25 Years
Probability of Success	10%	**Project NPV = (PV Benefits – PV Costs) x Probability of Success**	£802,753
Potential for achieving expected benefits	Project started in April 2013, potential for achieving expected benefits as per above probability of success.		
Project Progress to March 2014	The project started in April 2013. Initial kick off meeting completed. Supply of test material established and test equipment ordered.		
Collaborative Partners	SPEN, ENWL, NPGs, UKPN, Energy Innovation Centre		
R&D Providers	Acuity Products Ltd		

Appendix 1: Summary Listing of IFI Project Costs

Distribution Projects:

Reference	Project Title	SSEPD Internal	SSEPD External	SSEPD Total
2004_01	STP2 Overhead Line Module	£3,160	£58,800	£61,960
2004_02	STP3 Underground Cable Module	£3,290	£71,050	£74,340
2004_03	STP4 Plant Module	£3,110	£51,430	£54,540
2004_04	STP5 Networks for DER Module	£3,030	£46,800	£49,830
2004_05	PD User Group	£770	£1,140	£1,910
2004_06	Equipment Coatings Forum	£2,680	£8,230	£10,910
2004_11	ENA Collaborative Projects	£2,530	£39,750	£42,280
2005_05	Mobile Sync PMR	£2,940	£17,830	£20,770
2006_06	Crow Control Orkney	£1,300	£4,070	£5,370
2007_01	DG&ARM Endowed Fellowship	£5,220	£53,950	£59,160
2007_08	Live Line Tree Felling	£13,730	£43,500	£57,230
2008_03	Power Networks Research	£4,100	£22,910	£27,010
2009_02	Tree Growth Project	£910	£18920	£19,830
2009_06	PNDC	£15,850	£61,990	£77,840
2010_01	Phasor Measurement Units	£2,720	£510	£3,230
2010_03	SUPERGEN HiDEF	£1,410	£20,520	£21,930
2010_05	Ford Electric Car	£-9,100	£13,920	£4,820
2010_06	Orkney RPZ State Estimation	£35,870	£3,090	£38,960
2010_13	Supply Point Monitoring	£1,960	£24,630	£26,590
2010_14	Ecoplugs	£360	£980	£1,340
2010_25	Plugged in Places	£10,430	£-20,550	£-10,120
2011_03	LV Con'd Energy Storage	£10,670	£23,990	£34,660
2011_04	PHD Power Net Asset Man	£930	£24,630	£25,560
2011_07	Assessment of Conducrete	£2,730	£1,230	£3,960
2011_08	Radio Tele-Switching Alt	£1,840	£3,030	£4,870

2011_09	Heat Pump Load Profile	£18,260	£8,590	£26,850
2011_10	Asset Man Of LV Cables	£2,790	£31,050	£33,840
2011_11	Sub Sea Cable Monitoring	£1,950	£1,830	£3,780
2011_12	Harmonic Investigation	£3,860	£49,840	£53,700
2011_13	Tellus GIS	£5,290	£2,680	£7,970
2011_14	Hybrid Generator	£19,640	£95,050	£114,690
2011_15	Phase Identification	£17,320	£1,750	£19,070
2011_16	Advanced Radio Control	£47,990	£56,010	£104,000
2012_01	Cryogenic Storage Technology Review	£4,540	£710	£5,230
2012_02	Aberdeen Hydrogen Feasibility Study	£28,760	£67,930	£96,690
2012_03	SASensor HMV Primary Substation Provider	£24,790	£34,310	£59,100
2012_04	Mobile Diesel Generation with Battery Storage	£17,990	£52,580	£70,570
2012_05	Markets for DSM and Storage-Phase 1	£1,350	£0	£1,350
2012_06	Orkney Sub 50kW	£12,470	£19,030	£31,500
2012_07	Orkney RPZ Phase 2	£72,590	£112,340	£184,930
2012_08	Esprit Network Trial	£670	£21,000	£21,670
2012_09	Real Time Java	£109,610	£137,740	£247,350
2012_10	Methanation	£1,240	£1,310	£2,550
2012_11	Grid Integration of Marine Energy	£1,320	£260	£1,580
2012_12	GENDRIVE	£2,720	£-42,730	£-40,010
2012_13	Gnosys Self Healing Cables	£2,560	£61,600	£64,160
2012_14	Radio Teleswitch Phase 2	£6,820	£1,870	£8,690
2013_01	Community Energy Coaching	£3,170	£860	£4,030
2013_02	CES KTP	£16,070	£11,570	£27,640
2013_03	Vehicle to grid	£17,630	£192,350	£209,980
2013_04	Isle of Wight losses project	£15,420	£77,180	£92,600
2013_05	Sub-Sea Desk Top Study Tool	£7,490	£67,180	£74,670
2013_06	Green Running Load and DG Detection	£4,460	£-81,140	£-76,680
2013_07	BMW ActiveE	£2,750	£9,030	£11,780

2013_08	Electric Bus Project for Glasgow	£12,930	£154,250	£167,180
2013_09	Copper Theft Detection	£4,410	£34,760	£39,170
2013_10	Establish the Affordability of ADR	£3,510	£45,370	£48,880
2013_11	DISCERN	£16,260	£120	£16,380
2013_12	ATSD	£9,530	£25,570	£35,100
2013_13	SF6 Leak Location and Coating	£37,290	£139,370	£176,660
2013_14	Remote Access Solution for FN	£25,150	£19,210	£44,360
2013_15	ZeEUS	£2,170	£120	£2,290
2013_16	Network Damage Reporter	£2,620	£40,120	£42,740
2013_17	Orkney ANM Critical circuits	£2,080	£14,090	£16,170
2014_01	Overhead Line Vibration Monitoring	£3,790	£95,120	£98,910
2014_02	Field Team Support Tool	£4,960	£249,620	£254,580
2014_03	FPI Consolidation	£3,550	£7,770	£11,320
2014_04	Data Matching for Smart Registration	£2,250	£22,120	£24,370
2014_05	Cable Core Temperature Sensor	£1,380	£41,320	£42,700
2014_06	RPAS Operational Requirements & Specifications for Aerial Inspections BVLOS	£1,380	£69,450	£70,830
2014_07	Ultrapole	£1,380	£15,120	£16,500
	Total	**£728,570**	**£2,561,630**	**£3,290,200**

NB: Negative costs shown in the above table are the result of income received from grants that apply to certain projects being approved and designated in this financial year.

Appendix 2: Phase Identification

The objective of the Phase Identification project was to create a portable hand held unit, capable of identifying the phase of an individual property without physically connecting to the network or putting fuses into a LV feeder pillar. In avoiding these physical processes, the phase identification units save valuable time and money. New innovative technology allows the phase attribute, of any energised conductor, to be determined by using a GPS timing signal.

The project was split into two parts:

Part 1: The device was tested to ensure the various pieces of equipment were safe to use from an electrical point of view. This was deemed necessary as the kit was imported from the U.S. and was not CE marked. The devices passed the PAT testing and a basic single phase identification test was completed within an office environment. The device appeared to function as intended however it was not possible to confirm the phase returned was correct.

Part 2: The second part of the testing was employed at a distribution substation and 6 meter points within a block of flats. The device successfully identified the 3 different phases from the busbars on the low voltage side of the transformer. This test was completed a number of times to gain confidence and the correct results were returned on each occasion. The device was then tested within the metering cupboard of the flats and was able to successfully identify the different phases for each customer. It was noted that it was difficult to obtain a GPS signal on the hand held device from inside a building – the solution was to obtain satellite connectivity outside, the device then holds the data and does not require a constant signal to complete the readings.

Figure 2.1 Phase ID Field Unit Model 1500

How this may be integrated in future:

This new system will be used to take simultaneous measurement of a phase, at a reference location and at a field location (by use of a field probe). For every GPS second the base station measures a reference phase using any standard 240V outlet. The base station stores this phase and its characteristics along with the GPS second at which it was taken, in a data file on the base station PC. When the field probe touches an energised conductor or is brought close to one, a phase measurement is taken at the next GPS second. This is concurrently encoded along with the GPS second at which it was taken, and stored into a 9-digit sequence. When the 9-digit sequence is entered into the base station PC it retrieves the 240V outlet phase taken at the same GPS second, compares it to the field reading, and then determines the field location phase attribute.

Future Work:

The work completed has laid the foundations for the NTVV project. This is progressing and will continue for the next 4 years. Upon completion of the Tier 2 project there will be a direct understanding of the benefits and potential for use within a DNO as business as usual.

Appendix 3: Supply Point Monitoring

SSEPD has collaborated with Senical to create a dynamic domestic monitoring solution. The Supply Point Monitor (SPM) replaces fuse carriers as a retrofitted distribution tool, with the initial protection originally associated with the fuse intact, and functional, but also incorporates various quantification devices capable of assessing the power quality of the distributed supply. Supplementary to this, the device can also be used to indicate faults and detect any attempts at tampering. The device can be monitored and updated wirelessly, if and when firmware updates are required.

This project will enable rapid installation of SPM systems and grant SSEPD an early understanding of Smart Metering Technologies.

The Project was split into several stages:

The first unit was created by adapting a 25A Senical unit to a 100A unit capable of Ambient Monitoring, Temperature Recording, Timing, Ascertaining Dielectric Strength and primarily metering the supply. This unit was then replicated so that there were ten trial units ready for testing.

The testing was more rigorous than the original suppliers of the units had expected as, in addition to the EN61010-1 Safety requirements, SSEPD asked Senical to further test the SPM device to standards required by BS 7657:2010 Specification for cut-out assemblies up to a 100 A rating.

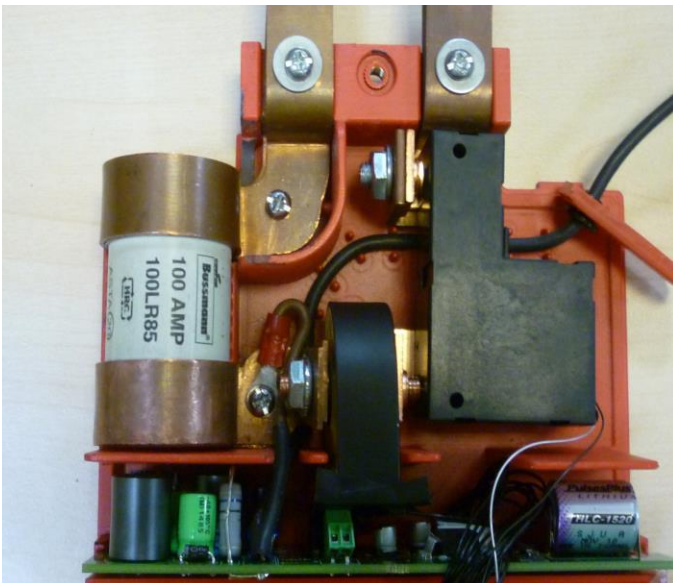

Figure 3.1: Internal view of Supply Point Monitor

The purpose of the additional testing was to increase our understanding of how the SPM unit would perform in various environments and assess if the results of the testing show that the SPM unit would be safe to use in that environment. The device was trialled on its ability to observe dielectric properties including the following:

- RMS and CT current (rated up to 100A with accuracy of +/- 0.5%)
- RMS voltage values (valued at 230 volts with a range of +10%/-6% and accuracy of +/- 0.5%)
- Power (at less than 1 Watt with accuracy of +/- 0.5%)
- Temperature of storage (-30°C to 70°C) and of the device (-25°C to 55°C) to within +/- 1°C

Other aspects of testing involved: mechanical endurance tests; and overloading.
The devices passed all of these assessments as summed up in this extract from Senical Test Results:

"In addition to the relevant BS 7657 standards passed by the SPM unit, BS EN 61010, EN 301-489-7, EN 301-489-17, EN 62052-11:2003 tests have also been carried out and passed.
Senical believe that the SPM unit has undergone a far more rigorous testing routine than would be expected of a standard fuse cut-out, and that the testing carried out has proven the Supply Point Monitor is "fit for purpose" and is supported in this belief by the statement in the ERA Interim report."

The device is now undergoing a second round of testing to ensure that it adheres to all of SSEPD's department guidelines, with the outcome looking positive.

The penultimate aspect of this project is in gathering and utilising the data obtained from such the Supply Point monitors in the future. As the units only transmit information, a new IT architecture system will be created to collate data so that it may be modelled, analysed, and support future trials. Finally, 200 units will be purchased for use on the NTVV project with the proviso that the device satisfactorily completes all testing.

The Expected Benefits:

The project, if successful, will produce workable, certified supply point monitors capable of revolutionising the collection of distribution data. The device will have been vetted and checked in accordance with conventional regulation standards to ensure that its various components will act safely and effectively. The device will be capable of being implemented in domestic premises to send DNO's data and information on the quality of the electricity supply provided. This will be used to fill in "data gaps" in the future smart metering infrastructure. Overall the project will enable SSEPD to have a more in-depth understanding of the capabilities of 'smart metering' devices which will better prepare the distribution infrastructure.

Figure 3.2: External view of a Supply Point Monitor

Future Work

These devices were created and trialled to increase our understanding and awareness of smart meter technology, as the data that they collect will help to improve our understanding of energy flow on our network. The devices will be trialled as part of the New Thames Valley Vision LCNF Tier 2 project once the device has successfully completed our internal approvals process. It is through this that the greatest gains, for both company and consumer, are observed with the aimed incorporation of these devices into the network pending their performance in larger trials.

Appendix 4: Live Line Tree Felling

It is estimated that there may be as much as 110,000 cubic meters of timber per annum to be harvested within felling distance of the SHEPD overhead network. Under current safety regulations, timber harvesting contractors can not carry out tree felling within falling distance of a live overhead line so work often requires switching off sections of the electricity distribution network causing outages. These can be inconvenient for the contractor, SSE and customers. This is what SSE aims to change.

Discussions between HSE, Forestry Commission Scotland and Scottish and Southern Energy Power Distribution resulted in a provisional agreement for work at variance with the guidelines. This raised the possibility of live line felling in certain circumstances (and given suitable training and appropriate risk assessment). This situation provided the climate in which alternative approaches to live line felling can be explored with a view to identifying a safe and cost effective approach to harvesting of trees alongside the distribution network.

This project proposed that suitable methods could be developed to allow mechanised harvesting of trees adjacent to a live network. This would allow sections of the network that would previously have been turned off to remain live, thus negating the reputational, financial and safety concerns.

This aim was accomplished in several steps:

Firstly: GIS (Geographic Information System) was used to locate and categorise trees, along with their individual characteristics (size, species, age, etc), within 30 metres of live High and Extra High Voltage connections. This allowed the scope of the issue to be defined.

Secondly: An investigation was launched into the ability of different species of tree to act as a barrier to falling trees. This is essentially a safety assessment, used to ascertain the potential of different species of tree to support falling trees. Due to the large number of variable factors in a tree crop it was not possible to define a systematic methodology to assess barrier suitability. Tests instead confirmed previous theories that it is feasible to use a barrier as a control measure but there are a number of factors that can only be assessed subjectively such as species, spacing, number of rows and the health of trees. It is likely that the use of barriers as a control will be limited.

Thirdly: Evaluations of felling options were compiled, aimed at maximising the effectiveness of mechanically harvesting different tree species. Earlier studies were observed with the emphasis on the advantageous modifications to the tree feller: a fixed head; a feller buncher; and an oversize grapple head on a track base.

Finally: The initial trial was undertaken in Argyll during April 2011 to asses the suitability of the equipment and techniques at that time. The conclusion was that while the current technology and harvesting procedures were adequate there was room for improvement, such as the newer protocols for edge trees and selecting equipment that would provide benefits to safety.

Figure 4.1: Live Line felling equipment

Adapting from the first trial; a second trial to investigate the performance of timber harvesters (Tigercat base with a Logmax headpiece (see figure 4.1)), on two different species of felling trees, was undertaken in Perthshire at the end of October 2012. The trial was intended to assess the potential suitability of mechanical harvesting techniques for felling trees in proximity to overhead power lines.

Both machines were monitored assessing the machines capabilities to deal with tree height, tree diameter, calculated volume, ground conditions, weather, and hydraulic circuit pressure and slewing force. The tests proved successful with the machines operating within their capacities, a maximum controlled felling of trees was attained at approximately 80% of the rated capacity.

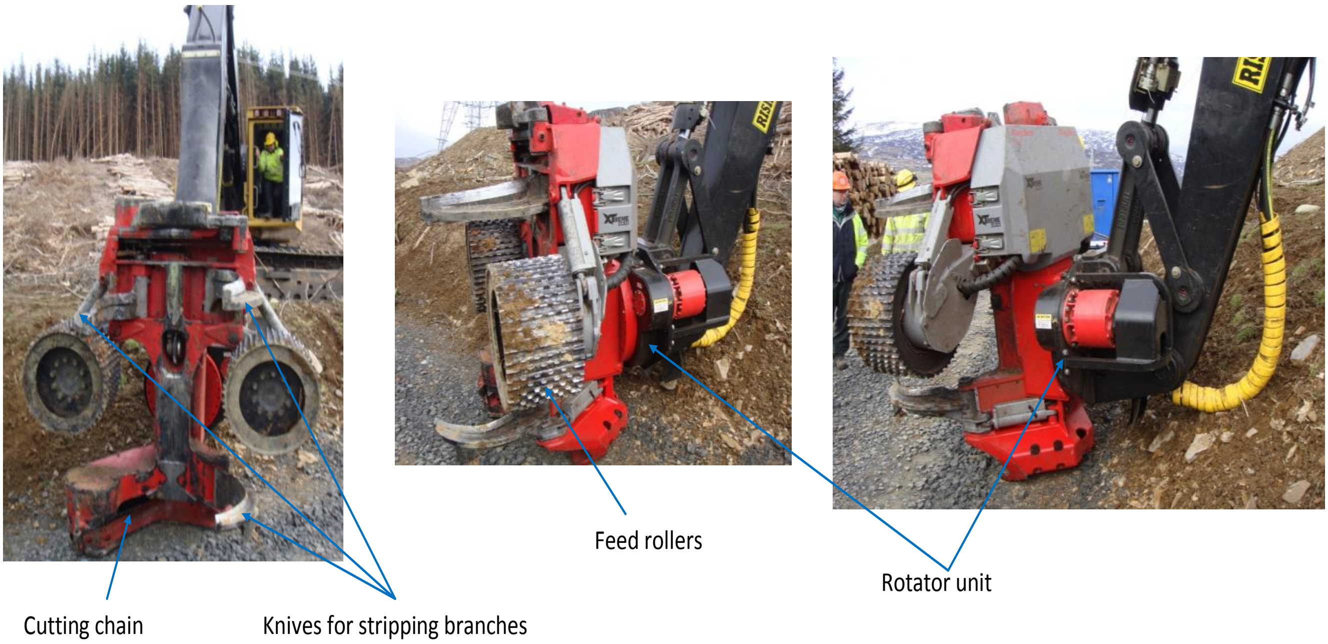

Figure 4.2: Main elements of the innovative rotating harvesting head

Results of Trials:

A full suite of documentation has been developed and approved which is now held in the SSEPD document library.

The trials produced two distinct methodologies that will be employed in any future tree felling projects undertaken by SSEPD:

Mechanical:

Initially the project was used to investigate the use of a conventional dangle-top headpiece connected to a base unit via a universal joint. Although usable, the headpiece did not offer a great degree of control over the direction or rate of fall of a tree. This technique was found to present a safety risk to staff and to the network with a greater degree of skill required by the machine operators to perform the felling operations.

The Logmax 7000c head was then selected as preferred to conventional dangle-type harvesting heads as it provides a much greater degree of operator control over motions of the felled tree. This facilitated a greatly reduced risk to operators, and the network, from falling trees. The innovated harvesting head allows for the trialled felling techniques mentioned below:

- The feed rollers grip the tree;
- The cut is made using the cutting chain at the bottom of the harvesting head (a double cut is made when required in the case of trees with a larger circumference);
- The cut tree is lifted slightly off the stump;
- The whole harvesting head rotates to bring the tree to the ground in a horizontal position. The head provides the flexibility for this rotation to take place in a plane parallel to the base unit (i.e. side-to-side rotation) or a plane perpendicular to the base unit (i.e. forward-back rotation);
- The feed rollers move the tree horizontally such that the knives indicated in figure 4.2 strip the branches off the tree;
- The grippers/rollers move the tree horizontally for the cutting chain to cut the tree into timber sections of a pre-specified length;
- The timber sections are stacked at least 10m from any conductors, allowing safe extraction to roadside.

Trees as a Barrier:

The “barrier felling” process is where a specified barrier of trees is used as a control measure to prevent any tree falling towards the network, this is only a partial solution as the remaining barrier trees still need to be dealt with in a conventional manner.

Benefits:

The innovation will enable the safe removal of trees within a potentially hazardous range of overhead lines. Due to the abilities of the device, it can be operated next to live networks; this will reduce or negate any outages that may have been experienced. The cost of implementing an outage itself is quite high, not only in regards to CI and CML penalties but also labour and generation costs. This cost saving production will negate these costs and the various infrastructures needed to maintain a local network during outages.

Supplemental to this, where in the past, the overhead line was disconnected to perform felling, any delays during felling were directly affecting the down time of the network and consequently customer. Now, however if there are any felling delays, the line is still active leaving customers unaffected.

The previous method for tree felling, while expensive also produced safety concerns as trees were scaled manually and felled by chainsaw, incurring risks on the . The created device performs to the extent that such risk and exertion are unnecessary as trees can be mechanically harvested with tried practices and established safe-working methods.

As such the Live Line Tree Feller was referred for ‘Business as usual’ with the first company usage performed on the 14th of February on the Doune Estate.

Appendix 5: SF6 Leak Location and Oxifree Coatings

Sulphur Hexafluoride (SF6) gas is extensively used in switchgear as an insulator (and arc quenching) medium. It is also a green house gas with a Global Warming Potential (GWP) that is 23,900 times that of Carbon Dioxide (CO2) if emitted into the atmosphere. Every year, small amounts of SF6 gas are inevitably lost through leaking switchgear but due to the gravity of its environmental impact, all practicable measures have to be taken to reduce these emissions to as low as possible. Typical measures include invasive repair and replacement of problematic switchgear. However, both methods are financially costly and time intensive. If a switchgear item is identified as having SF6 gas leakage, the first step in mitigation is to identify the source of the leak to enable repairs. It is a difficult process which requires outages with some impact on network security and tends to be inconclusive.

It was found that an infrared gas detection camera (FLIR GF306 (See figure 5.1)) now existed for pinpointing SF6 leakage sources. Such a camera can be used to capture video clips and still images like a standard camcorder however the captured clips and images can be transferred to where they are needed for analysis in standard video and image formats as well as utilising other viewing functions. Since the camera can be used from a safe distance, it means that pinpointing of the gas leakage source can be done without the need for an outage. This project also requires that a cost effective solution to treat the SF6 leaks was found and trialled.

Oxifree TM198 is a resin based coating material currently applied to encapsulate the metallic surfaces of pipes for corrosion prevention. It was anticipated that applying some adhesive putty and/or an Epoxy bandage and then encapsulating with a shroud of Oxifree TM198 would provide a stable seal against pressurised gas and one free from the adverse effects of exposure to the elements. This method would not require switchgear to be degassed hence the work would be done without the need for expertise in gas handling, resulting in finance and time saved.

To link up the two main project objectives, SF6 leaks identified by the camera were then subjected to treatment by this new Oxifree solution.

How the Project is Progressing:

FLIR infrared gas detection:

Two FLIR GF306 cameras were purchased. After delivery of training, an analysis of SSE site data (from PLACAR and Power-on-Fusion) was done to identify items of switchgear which had a history of SF6 gas leakage. Based on the rate of leakage, a priority list was created of which sites should be inspected to effectively trial the cameras. The cameras were then taken round various sites to see if they could be used to identify the sources of various leaks.

Figure 5.1: FLIR GF306 Camera

The trials can be summed up in this case study of Chichester C6H0:

CHHE C6H0 is an HG36 circuit breaker manufactured in 1989 by South Wales Switchgear (now Hawker Siddeley Switchgear). It has had a number of leaks since 2009 and has been repaired in the past. In previous attempts at pinpointing the source of leakage, the audible Dilo sniffer used always picked up the presence of SF6 gas within the mechanism cubicle near the pressure switch manifold and also along the whole edge under the hooded top surface of the mechanism cubicle. This appears to be explained by the fact that SF6 gas has higher density than air such that once it escaped; some gas got trapped in the right angled edges of the cubicle. Although a sniffer always detected this gas with the same intensity along the edge, it had the limitation of not showing the exact point of leakage among the components. Even the use of soapy water was not practicable in this case. (Soapy water is applied to the circuit breaker as any bubbles formed show the locations of leeks)

On 02/04/14, a camera inspection was made on C6H0 and it revealed that the leak was emanating from the cable termination of one of the density monitors. The video clip collected was provided to the manufacturers to enable them to come and repair the circuit breaker.

Oxifree coating:

The project methodology aimed to establish how quick the Oxifree TM198 could be deployed, how effective it would be in stemming SF6 gas leakage and the range of equipment on which the solution could be applied. On most of the switchgear where leaks were pinpointed in the sample, it was realised that the Oxifree coating would not be feasible to apply due to the fact that the parts of equipment identified as leak sources did not have large enough continuous surface areas to enable rings of encapsulation to be made.

Figure 5.2: Oxifree coating applied to a leaking section of pipe.

A typical example of the Oxifree coating in action is:

Bournemouth Grid A420 circuit breaker

This is a Reyrolle CB 145 SPM circuit breaker manufactured in 1993 which had a number of leaks since 2009. Through previous investigations, the circuit breaker was known to have two sources of leaks, one on the base flange of the blue phase stack and the other in the mechanism box. After initial engagement, Oxifree UK were able to turn up on site within 3 days of being asked. The cost of the coating was slightly under £1500. After the coating, a review of the project has been carried and the deductions made are as follows.

Between 03/06/13 and 02/06/14, PLACAR records show that A420 was topped up exactly 10 times and with a total of 5.8kg of SF6 gas. From 03/06/13 up to the time of application of Oxifree coatings on the insulator stack on 09/10/13, the circuit breaker had been topped up 7 times and with 4.5kg of gas. In the 8 months since the installation of Oxifree coatings, the circuit breaker has been topped up only 3 times with 1.3kg of gas. The results show a 78% reduction in the frequency of top-ups between the two periods and hence a significant reduction in the number of outages taken to top up. Between the two periods, there was an 86% reduction in the quantity of SF6 gas that has been used. Although some of the leakage curtailment may be attributable to repairs in the mechanism box of the circuit breaker by the manufacturer in March, the drastic reduction in leak rate was observable soon after the coating.

Results of the trials:

FLIR infrared gas detection solution:

In the South, the camera successfully pinpointed SF6 leakage at Fort Widley, Shaftesbury, Slough, Chichester and Drayton. In the North, leakage sources have been identified at Peterhead, Shin and Dunbeath. As the cameras have been used in a wide range of prevailing conditions, different lessons have emerged as to the optimum conditions for obtaining best results. So far, the best results have been established in partly overcast conditions at temperatures ranging between 13°C and 19°C. It was discovered that under windy conditions, the SF6 gas is harder to pick up on camera as it becomes more interspersed within the air.

Figure 5.3: An FLIR camera on tripod

Although the camera looks and feels like a standard camcorder, it became clear that if sustained focussing on a particular item was necessary, manual handling would soon become an issue. This problem was mitigated by retrospectively purchasing carbon fibre tripods on which the cameras could be mounted see figure 5.3. A further benefit of the use of tripods is that it resolved the problem of stability. Some users may find it difficult to hold the camera still due to natural shaking and this may make gas detection more difficult, especially if a leak is only miniscule.

The cameras therefore appear to be the best quick portable solution for regular monitoring on different items of equipment. It is anticipated that if inspection units make use of the cameras during routine inspections, SF6 gas leakage can be picked up before alarms go off.

Oxifree coating solution:

These coatings have not been tested on a great number of items due to the infeasibility of the solution for most of the sampled equipment. However, where used so far, the evidence shows noticeable immediate reduction in SF6 gas emissions. The longevity of the coatings is yet to be assessed since the project only commenced towards the end of last year. From the work done thus far, Oxifree UK have demonstrated a very fast turnaround time from being engaged and their coating has been at a reasonably economical price. Although the repair method has not yet been verified as a permanent solution, it appears to be a viable means of slowing down leakage. Even if it turns out that the method is not permanent, it is reasonable to apply the coatings as a temporary measure while awaiting permanent repairs.

Based on the assumptions and the foregoing cost benefit analysis, the use of Oxifree coatings appears to be cost-effective as a speedy mitigation for curtailing SF6 gas leakage. Since lead times for permanent repairs are usually very long and gas may continue to get emitted into the atmosphere, this method should be considered in business as usual even as a temporary solution to repairing suitable switchgear whilst either permanent repairs or replacement are being considered. Since it is now known that future SF6 emissions will attract hefty penalties, it appears that the potential of this method to make further savings in avoided fines cannot be overstated.

Future Work:

Both the FLIR infrared camera and the Oxifree coating have received overwhelmingly positive outcomes. As such, both have been recommended to business as usual for future use within SSEPD.

So far, GF306 cameras appear to have improved pinpointing of leaks when used on their own or in combination with sniffers. Precise pinpointing is a vital pre-requisite to effective mitigation. It would make sense to include inspection with the camera as part of switchgear commissioning as this project has shown that leaks can be identified promptly and more economically treated as a result. It appears that if the cameras are used as part of routine inspection then the lack of online monitoring can be mitigated to some extent.