Innovation Funding Incentive Reports

Scottish Hydro Electric Power Distribution

Southern Electric Power Distribution

for period 1 April 2007 to 31 March 2008

Contents

1. Executive Summary

Over the last year, the Innovation Funding Incentive (IFI) has become more established within SSE Power Distribution (SSEPD). Our experience of the distribution network activities carried out within the IFI scheme has made a significant contribution to a greater recognition within SSEPD of the importance of research and development (R&D) activities along with the successful deployment of innovations.

During the year ended 31 March 2008, Scottish Hydro Electric Power Distribution plc (SHEPD) and Southern Electric Power Distribution plc (SEPD) have initiated new projects and continued IFI projects started in previous years.

As in previous years there are a wide range of activities ranging from national collaborations with multiple work packages to specific projects to address identified problem areas. Wherever possible we have sought to minimise the cost of research and development (R&D) activities by seeking complementary funding and forming collaborations.

The total qualifying expenditure for the reporting period of 1 April 2007 to 31 March 2008 has been £1,475,259 for SSEPD which includes both SHEPD and SEPD.

This is a substantial increase on the total qualifying expenditure for the previous year which was £1,018,000; demonstrating the importance that SSEPD places on R&D and innovation.

The addition of a Transmission category to the IFI mechanism has allowed the evolution of a new portfolio of projects which are being taken forwards by Scottish Hydro Electric Transmission Ltd. – the transmission licensee within SSEPD

2. Introduction

As part of the April 2005 Distribution Price Control Review (DPCR), Ofgem (the regulatory body for the energy industry) introduced an Innovation Funding Incentive (IFI). The primary aim of this incentive was and is to encourage network operators to apply innovation in the way they pursue the technical development of their networks. A Good Practice Guide (Engineering Recommendation G85 Issue 2 – December 2007) has been produced and is available free of charge via the website of the Energy Networks Association (ENA): www.energynetworks.org.

The IFI mechanism is intended to provide funding for projects primarily focused on the technical development of networks to deliver value (i.e. financial, supply quality, 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 is allowed to spend up to 0.5% of its Combined Distribution Network Revenue on eligible IFI projects.

Open reporting (i.e. available in the public domain) of IFI 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 reports on the SSEPD website: www.ssepd.co.uk. To enhance their accessibility, they will also be available on Ofgem's website: www.ofgem.gov.uk

SSEPD welcomes this initiative as a positive measure to further improve customer service, enhance safety, address environmental issues and reduce costs.

3. Scope

This document contains the reports for the two electricity distribution licensees within SSEPD:

Scottish Hydro Electric Power Distribution plc (SHEPD)
and
Southern Electric Power Distribution plc (SEPD).

It details activities in the period from 1 April 2007 to 31 March 2008.

Separate summary reports have been provided for each licence area with one set of detailed individual project reports as projects are generally developed for the benefit of both licence areas, reflecting our strategy of running both companies using one common best practice. The reports have been produced in accordance with the Regulatory Instructions and Guidance (RIGs) issued by Ofgem and ENA Engineering Recommendation G85 and G85 Issue 2.

The individual project reports are in the format required by G85 Issue 1 as the projects commenced prior to the release of G85 Issue 2 in December 2007.

In addition to reporting on activities in 2007/08 we have included information on current projects and intended developments.

4. Overview of current IFI Activity

Our programme of projects in 2007/08 is made up of a combination of projects which have originated as a result of collaborative work with external organisations in academia such as the University of Strathclyde and service providers such as EA Technology Ltd (EATL) in addition to projects which have originated internally. The latter have emerged from our own analysis of areas of work which could benefit from an innovative approach such as the development of new techniques to replace underground cables.

We continue to see considerable amounts of renewable generation development in the SHEPD area. Given the international and national targets to increase the quantity of our electricity generated from renewable resources it is clear that the pressure on networks to facilitate this growth will increase. The apparent network issues and constraints have provided one of the key themes for our R&D strategy. We believe active network management systems and other methodologies can be developed to allow more generation to be connected to the existing infrastructure. SSEPD are progressing research to reduce the impact of these constraints. Earlier work has been developed as an ongoing IFI project and resulted in Ofgem registering our application for the Orkney network as SSEPD's first Registered Power Zone in 2006 - see separate RPZ annual report for details. This work continues towards imminent commercialisation and involves the University of Strathclyde who are an acknowledged UK leader in the field of electrical and electronic engineering with particular involvement in active networks.

We have and are continuing to investigate other engineering approaches to facilitate the connection of Distributed Energy Resources.

It is also expected that useful development and demonstration projects will result from work in various forums such as SUPERGEN 5, SUPERGEN Flexnet, the ENA, and EATL.

Strategic Technology Programme

SSEPD has continued its existing partnership with EATL. This research and development company has worked with the DNOs for a number of years and produced significant and successful initiatives which have contributed to improvements in all areas of DNO activity. SSEPD subscribes to, and plays an active role in, each of the four EATL Strategic Technology Platform (STP) modules: overhead lines; underground cables; substation plant; and distributed generation. This partnership will continue in 2008/09.

Met Office Project on Climate Change

SSEPD has also participated in the Met Office project EP2 – The Impact of Climate Change on the UK Energy Industry, a year long project to develop the tools and methods required to understand the impact of climate change on the energy industry and to develop new data resources to address gaps in underpinning information.

As the decision was taken to fund the subscription to this collaboration from the SSE corporate R&D budget this project has not been reported as an individual IFI project.

SUPERGEN V AMPERES

Following Engineering and Physical Sciences Research Council (EPSRC) approval in February 2006 of a programme of work proposed by a consortium of universities, SSEPD has engaged with SUPERGEN V – Asset Management and Performance of Energy Systems.

SUPERGEN is the EPSRC's flagship initiative in Sustainable Power Generation and Supply. This collaboration between industry and universities is structured to enable interaction both between academics and also between academic and industrial participants.

SUPERGEN 5 has attracted strong industrial participation from the DNOs. This consortium is a good example of effective engagement between industry and academia which can provide some learning points for other collaborations and SSEPD supports the renewal of this project.

SUPERGEN Flexnet

SSEPD has also participated to some extent in the work of SUPERGEN 1 – FlexNet. This large EPSRC supported consortium, involving seven universities, is researching the future form of the electricity network. EPSRC agreed in October 2006 that the consortium should take forward its challenging research agenda for a further four years commencing in October 2007, in a £7m project to deliver energy that is secure, clean and affordable. FlexNet will put in place a substantial body of work that will build on the achievements of FutureNet and lay out the major steps, technical, economic, market design, public acceptance and others, that will lead to flexible networks, including starting to showcase these so that they can be taken up by the commercial sector, Government and Regulators for practical implementation.

SSEPD recognise the importance of this work and although our level of engagement this year has been limited, it is intended that we will more fully engage with this programme once the commercial arrangements have been finalised.

Power Electronics Voltage Regulator

The installation of a power electronics voltage regulator in a situation where a customer was experiencing high volts has seen the customer terminal voltage brought back into regulation within a tolerance of +/- 1%. A benefit of this trial installation has been avoidance of an outage on the HV network to alter the transformer tap position. Further more extensive trials are proposed with applications having been identified for network configurations including micro generation sites along with traditional voltage complaints. It is hoped that this device can be fully adopted into our business practices leading to a reduction in capital spend on network reinforcement.

Assessment of Tree clearance from GIS

SSEPD has a requirement to remove trees as a requirement of ESQCR (2006) Resilience Requirements from locations that could impact upon our overhead lines. 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 LiDAR survey from a helicopter at an estimated cost of £250 per km. For SSEPD this would mean a cost of over £10M to gather data from all of our overhead lines.

Experience within this project to date indicate that we are likely to be able to avoid this level of expenditure and identify the tree cutting requirements for under £500,000.

5. Benefits achieved from previous IFI projects

Now that the IFI programme has become established we are able to identify some benefits from the deployment of innovative methodologies and equipment.

Mole plough
A significant reduction in the capital cost of installing underground cable has been achieved through the use of the mole plough. This innovative methodology was highlighted in our IFI report for last year.

One example where the plough was used extensively was on a wind farm project where approximately 90% of the cable contract was installed using the cable plough. The plough team was on site for around 50 days and installed in the order of 50km of three 33kV cables, earth wire and fibre optic cabling. Therefore a remarkable average rate of cable circuit installed of around 1000m / day was achieved in terrain consisting of arable, grazing, silage and forestry with a number of water course and access track crossings.

The plough is environmentally friendly and has been used with favourable results on Sites of Special Scientific Interest and Natural Heritage Sites.

Other advantages are:

- Plough rates are very competitive against conventional methods.
- 8 to 10 times quicker than open cut methods.
- No requirement to fence off fields in advance of works.
- No excavation of cable track.
- No stripping of top soil.
- Very little reinstatement of track or reseeding costs.

To date, approximately 120km of cable have been installed using the cable plough. There are a considerable number of factors which affect the rate per metre to install underground cabling but we have estimated that on a typical project, where the terrain is suitable for the plough, the differential between the cost of conventional open cut techniques and the plough is around £60 per metre. Therefore we have reduced the cost of cable installation to date by an estimated £7.2M.

In addition to the financial saving it is also worth highlighting the environmental benefits from the reduction in excavated soil sent to landfill, the reduction in imported backfill material and the reduction in heavy construction traffic associated with the movement of these materials.

SSEPD endorses the use of cable plough for cable works in suitable terrain as the reduction in time to carry out the work, the comparative cost savings, the environmental benefits and reduction in land damage claims can be considerable.

Bowden MK10 FPIs + GSM

Feed back to date has shown encouraging progress has been made with these devices. Fault location is simplified as notification of operation of a device is very quickly sent via a text message to the local operative giving the location of the operated device thus avoiding the requirement to visit each device following a protection operation. Fault handling from remote locations is also possible with these devices with office based, or home based, fault management having been possible with field staff directed to the appropriate location by the fault handler. Typical time savings on applicable faults are reducing fault location times by at least a half.

This can make a significant contribution to reducing cost and improving quality of supply through improved fault location as illustrated by this overhead fault.

We experienced a lightning storm in our North East Depot which started affecting the network at 15.40hrs when a PMR tripped due to lightning activity in the area, affecting 61 customers on the 11kV network.
After sectionalising, the fault was found to be in the first section of the circuit. A set of solid links controlling a long spur were removed and the MK-10-GSM Pathfinders were fitted at strategic positions along this first circuit section. The PMR did not trip when the circuit was re-energised so further old style Pathfinders were placed on the suspect spur and the links replaced.
Again the PMR did not trip, so at 22.00hrs the fault controller set off for home. He had just arrived home approximately 70 miles away from the faulty network when the PMR tripped again. The PMR reclosed successfully but this time he was able to use the information received via mobile phone to establish which transformer was faulty.

This fault location was made more difficult due to the earth fault clearing itself from the LV winding of the faulty transformer. The MK-10-GSM pathfinders provided the fault controller with the ability to be able to guide the linesmen to the fault from 70 miles away.

Dataloggers + GPS

All benefits in the original business case have been realised,
The reduction in time required to gather the data has been offset by gathering of more condition monitoring data to improve the selection of circuits for refurbishment by including condition data as well as performance data.

A significant advantage is the ability to prove the attendance of our patroller at a particular site. This was a key factor in demonstrating to the HSE that our systems were robust following a recent incident.

The back office savings were originally underestimated as the volume of ESQC related data is significantly higher than expected, it is fair to say were we to have retained a paper system and run it effectively a back office at least five times larger than currently used would have been required in addition to a significant amount of space to store the physical records for the required 10 years.

CRATER
This underground cable rating method developed by EA Technology has been adopted within SSEPD. Two examples of the application of this technique are: consideration of the continuous loading of LV solidal cable feeding a factory as the cable rating was not readily available so by the use of CRATER it was able to determine that the cable needed to be uprated ; consideration of a 66kV cable overlay where four cables are to be laid over and existing cables - different configurations can be calculated by the use of CRATER.

HUDDIG
The HUDDIG is the product name for an articulated backhoe loader from a Swedish company and this project was intended to trial and evaluate the use of innovative overhead line construction methodologies using this multi purpose mechanical aid. The project was successfully completed and the main benefits realised have related to improved safety on site due to eliminating the manual handling of the pole. In addition the mobile elevating work platform access has been better than previous non tracked options which have proved to be limited as other vehicle designs are primarily aimed at the building site market.
Our experience of this machine has been that the reliability has been good and on a par with less complex items of plant. The main limitations have been access to soft terrain and management issues relating to "traditional" teams accepting new techniques and methods. We have set a more stringent standard than strictly necessary by declaring that the operative has to be a HGV license holder and this has limited flexibility to some degree but this is a short term issue while staff and teams are fully trained.

Benefits achieved to date include reduced CAPEX, deferred CAPEX, reduced OPEX, generation of intellectual capital, improved safety, improved quality of supply (CIs/CMLs) or environmental benefits.

6. Financial Summary

As research and development activities are operated from a common perspective across both distribution licence areas; the costs and benefits have been taken as applying across both licence areas in proportion to the size of each area as determined by Combined Distribution Network Revenue. In round terms, this leads to 33% being allocated to SHEPD and 67% to SEPD.

Qualifying expenditure for the reporting period of 1 April 2007 to 31 March 2008 has been £491,261 for SHEPD and £983,998 for SEPD, of which £63,703 and £127,597 relates respectively to internal costs. The overhead costs associated with the employment of full time R&D Manager and Project Manager have been apportioned across the portfolio of projects.

Financial information on the IFI projects relevant to the reporting year 1 April 2007 to 31 March 2008 are contained in the individual reports for SHEPD and SEPD set out in the following sections and listed in appendix 1.

Adoption costs have not been included at this stage but will be evaluated and taken into consideration as individual projects progress and application to the business can be more accurately assessed.

7. Conclusion

SSEPD recognises the importance of the role that research and development can play in enabling our industry to meet the challenges of an ageing infrastructure, the need for continuous improvement in customer service and the challenges of a changing generation mix with recognition of the growing importance of distributed energy resources.

We are committed to the successful exploitation of our current programme of projects and will develop our portfolio to provide further benefits and add value.

Section 8

Scottish Hydro Electric

Power Distribution

IFI Report

for period

1 April 2007 – 31 March 2008

Scottish Hydro Electric Power Distribution IFI Report

Summary report of IFI project activities: – April 2007 – March 2008

Combined Distribution Network Revenue	£163.6m
IFI Allowance	£818,000
Unused IFI Carry Forward to 2008/2009	£327,000
Number of Active IFI Projects	28
Summary of benefits anticipated from IFI Projects.	PV of benefits is £2,055,000 Reduction in capital costs of installing undergound cable
External Expenditure 2007/2008 on IFI Projects	£427,558
Internal Expenditure 2007/2008 on IFI Projects	£63,703
Total expenditure 2007/2008 on IFI projects.	**£491,261**
Benefits actually achieved from IFI projects to date.	Reduction in capital cost of installing undergound cable of £2.4M Improvement in quality of supply and reduction in fault location costs

Regulatory Report for DG incentive, RPZs and IFI Reporting year 2007/08 Scottish Hydro Electric Power Distribution plc	**£m**
IFI carry forward to 2008/09 (£m)	**0.327**
Eligible IFI Expenditure (£m)	**0.491**
Eligible IFI Internal Expenditure (£m)	**0.064**
Combined Distribution Network Revenue (£m)	**163.6**

Section 9

Southern Electric Power Distribution

IFI Report

for period

1 April 2007 – 31 March 2008

Southern Electric Power Distribution IFI Report

Summary report of IFI project activities: – April 2007 – March 2008

Combined Distribution Network Revenue	£392.9m
IFI Allowance	£1,964,500
Unused IFI Carry Forward to 2008/2009	£980,000
Number of Active IFI Projects	28
Summary of benefits anticipated from IFI Projects.	PV of benefits is £4,116,000
External Expenditure 2007/2008 on IFI Projects	£856,401
Internal Expenditure 2007/2008 on IFI Projects	£127,597
Total expenditure 2007/2008 on IFI projects.	**£983,998**
Benefits actually achieved from IFI projects to date.	Reduction in capital cost of installing undergound cable of £4.8M Improvement in quality of supply and reduction in fault location costs

Regulatory Report for DG incentive, RPZs and IFI Reporting year 2007/08 Southern Electric Power Distribution plc	**£m**
IFI carry forward to 2008/09 (£m)	**0.980**
Eligible IFI Expenditure (£m)	**0.984**
Eligible IFI Internal Expenditure (£m)	**0.128**
Combined Distribution Network Revenue (£m)	**392.9**

Section 10

Scottish Hydro Electric Power Distribution

Southern Electric Power Distribution

Individual IFI Project Reports

for period

1 April 2007 – 31 March 2008

Overhead Network Module: – April 2007 – March 2008

Description of project	Strategic Technology Programme Overhead Network Module		
Expenditure for financial year	Internal = £5,900 External = £43,010 Total = £48,910	Expenditure in previous financial years	£96,025
Technological area and / or issue addressed by project	The STP overhead network programme for budget year 2007/8 aimed to reduce costs and improve performance of overhead networks by increasing understanding of issues that have a negative impact on costs and performance. The programme is expected to also have a positive impact on safety and environmental performance. The projects all address real problems that have been identified by the module steering group members as significant and which require technical investigation and development. The projects within the programme aimed to: • S2126_3 – Completion of long-term monitoring of conductor temperature by obtaining and analysing 12 months trial data. • S2126_4 – Monitoring overhead line conductor temperature at two trial sites at constant current. • S2136_3 - Continued participation in European Project COST 727: Measuring and forecasting atmospheric icing on structures. • S2140_2 – Field trials of techniques for checking the foundations of newly installed poles. • S2143_2 – Feasibility study to detect in-situ degradation of aluminium overhead line conductors. • S2146_2 Undertake torsion testing to evaluate possible limits for composite tension insulators. • S2148_1 – Re-appraisal of ACE104 methodology.		

	• S2150_1 Evaluation of TDR for assessment of tower foundations using actual field data. • S2151_1 – Investigate alternatives to wood poles. • S2152_1 – Evaluate performance of ice recording solution at severe weather test site. • S2154_1 – Experimental investigation of ice loading of novel conductors. • S2155_1 – Comparative performance of available pole-top shrouds.
Type(s) of innovation involved	Technical Substitution / Radical
Expected Benefits of Project	Due to the age profile of system equipment it is inevitable that, unless significant new technology is used to extend asset life, CAPEX and possibly OPEX will need to increase significantly to maintain the present level of network reliability and safety. If these 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 benefits including: • avoid redesign, reconstruction or refurbishment of overhead lines 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; • reduce levels of premature failure of assets; • provide more cost effective and early identification of damaged insulators and discharging components, which if not addressed would result in faults; • confidently extend the service life of towers and reduce potential levels of tower failures; • Reduce lifetime costs by the appropriate use of alternative materials.

Expected Timescale to adoption	Range 1-5 years - dependent on project	Duration of benefit once achieved	Range 3-7 years - dependent on project		
Estimated Success probability (at start of project)	Range 2-20% - dependent on project				
PV of Project Costs	£43,010 (nb. This is identified early stage cost. It does not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive.)	PV of Project Benefits	£85,917	NPV of Project	£42,907
Commentary on project progress and potential for achieving expected benefits	Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure which, if successfully addressed, would enable the expected benefits to be achieved. The second phase of monitoring overhead conductor temperatures at steady rated current was carried out during the year. The data have yet to be analysed. In contrast to the first phase, when four different types of conductor, all with similar ratings, were monitored at a single location, phase two monitored two different-sized conductors of the same type (so different design temperatures for the same current) simultaneously at two very different locations, one near sea level and one high up in the Scottish Highlands. Phase 1 found that day time ratings could probably be increased; hopefully analysis of the Phase 2 data will provide confirmation of this and possibly find other location-dependent benefits.				

	An experimental investigation of live-line jumper cutting was carried out to determine whether or not it was acceptable to cut 11kV jumpers carrying load. The work is likely to lead to changes in working practices and may lead to time and cost savings for DNOs. Three projects were carried out at our severe weather site on Deadwater Fell, all concerned with icing of conductors. Two “novel” conductors with higher ratings than conventional conductors (one with a gap between core and conducting strands, the other with a carbon-fibre based composite core) have been monitored for ice loading alongside a conventional aluminium alloy conductor. Preliminary analysis indicates little difference in ice loads but big differences in creep between the three conductors. At the same time, two ice meters have been tested, one as a stand-alone STP2 project and the other as part of a European project on conductor icing. The former performed very well and could provide DNOs with real-time information on ice build-up on exposed conductors. A non-destructive device for detecting defects in concrete has been assessed for its applicability to HV tower foundations. Subsequent excavations of the tested foundations indicated that the device is a useful and sufficiently accurate tool for assessing foundation integrity. Its use could result in significant time and cost savings for DNOs. A study of alternatives to wood poles for HV OH lines, looking at the advantages and disadvantages, and the practical applicability within UK DNOs, indicated that there were benefits to be gained from using concrete poles in certain situations. A test rig has been designed to investigate the practical problems of erecting and working on lines mounted on concrete poles.

Cable Networks Module: – April 2007 – March 2008

Description of project	Strategic Technology Programme Cable Networks Module		
Expenditure for financial year 2005/06	Internal = £5,900 External = £52,117 Total = £58,017	Expenditure in previous financial years	£96,025
Technological area and / or issue addressed by project	The STP cable network programme for budget year 2006/7 aimed at identifying and developing opportunities to reduce the costs of owning cable networks. The reduction of whole life cost through greater reliability and improved performance of cables and associated accessories comes under the remit of Module 3. Where appropriate, Module 3 worked with other Modules to achieve common goals. The projects undertaken within the programme during 2006-07 aimed to: • S3132_10 – Further development in cable ratings to address gas compression cables. • S3132_12 - Further development in cable ratings • S3140_3 – Develop best practice for the installation of Ducted Cable systems. • S3144_2 & 3 – Comparison of processes for the treatment of redundant fluid filled cables. • S3151_1, 2 & 3 – Understanding and controlling thermo-mechanical forces in cable systems. • S4152 – Separable connectors and cable compartments in 11kV switchgear. • S3159_1 - Investigation of current ratings of triplexed cable in plastic ducts. • S3157_1 – PD testing of MV cable systems to provide asset risk management data. • S3163_1 – On-going testing of sensors for cable fluids		

<table>
<tr><td>Type(s) of innovation involved</td><td colspan="5">Technical Substitution / Radical</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="5">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:
offset future increases in CAPEX and OPEX;
CI/CML savings per connected customer;
increased safety of staff and public by reducing the number of accidents / incidents.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Range 1-3 years - dependent on project</td><td colspan="2">Duration of benefit once achieved</td><td colspan="2">Range 3-5 years - dependent on project</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">Range 2-50% - dependent on project</td></tr>
<tr><td>PV of Project Costs</td><td>£52,117
(nb. This is identified early stage cost. It does not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive.)</td><td>PV of Project Benefits</td><td>£82,068</td><td>NPV of Project</td><td>£29,951</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="5">Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure which, if successfully addressed, would enable the expected benefits to be achieved.</td></tr>
</table>

	In 2007/08 projects were completed to allow the calculation of current ratings of crossing cables (S3132_7), gas compression cables (S3132_10) and dynamic ratings (S3132_12). This almost finishes the creation of a comprehensive suite of cable rating tools for network designers and cable engineers. The outputs are of particular benefit in solving difficult multi-circuit problems. Without them there are risks of overloading the circuits. The cable rating work is being extended to the accurate modelling and calculation of technical losses in cable networks. The S3148 project has delivered a tool for comparing the merits of cross-bonding and solid bonding of MV polymeric cable systems, including outputs of annualized energy losses, as well as current ratings, circulating currents and elementary section length. Further work on the economic and environmental impacts of losses is continuing in the 2008/09 STP programme. Work is ongoing to assess the mechanical and thermal integrity of plastic ducts (S3155). This builds on previous experimental work carried out within the STP to underpin conduit specification, vital to ensure that the Electricity Industry is not faced with a serious problem of duct collapse in the future. Trials have been arranged to compare the effectiveness of three different processes for the treatment of oil filled cables at end-of-life. This work (S3144) on oil removal has been held up by difficulties in obtaining suitable sites and persuading all parties to take part, but the problems have now been resolved. The outputs of the project should allow DNOs to select the best and most cost effective process, ensuring that long term impact on the environment of redundant oil filled cables is minimised. Significant progress is being made in determining the most effective system (on-line and off-line) for Partial Discharge (PD) testing of MV cable systems (S3157). When complete it should give the DNOs useful asset risk management data.

Substation Module: – April 2007 – March 2008

Description of project	Strategic Technology Programme Substation Module		
Expenditure for financial year 2005-06	Internal = £5,900 External = £38,081 Total = £43,981	Expenditure in previous financial years	£42,825
Technological area and / or issue addressed by project	Issues with the age profile of substation assets within the UK electricity distribution system are well known. Also, both regulatory and shareholder pressures preclude substantial investments of the large scale that was seen in the 1950's to 1970's. The challenge is to constantly review and innovate new solutions to monitor and define asset condition thereby allowing risks to be clearly defined and sound investment decisions to be taken The programme of projects which were approved for funding from the STP substations module budget and were undertaken in 2007/08 encompass both developing new innovative asset management processes and practices and developing innovative diagnostic techniques. The aim is to develop already well established themes such as life extension of aged assets within legal and heath and safety constraints, examination of new technologies, developing an understanding of, and innovative solutions for, the impact on substation assets of increasing levels of distributed generation on networks and condition monitoring techniques. Eighteen new projects were approved during the year: • S4164_4 – On load tap changer monitor – develop and install trial systems • S4176_3 – Assessment and inspection of substation earthing systems • S4181_2 - Transformer Post Mortems. • S4185_2 - AM Forum membership. • S4212_1 - Dissemination Seminar to ensure wider		

	appreciation of STP module outputs • S4219_1 – Management of substation batteries • S4220_1 – Management of 145kV Disconnectors • S4221_1 – Investigate Out of Phase Switching • S4222_1 – Explore Alternatives to ENATS 35-1 Transformers • S4223_1 – Review of Underground Substation design • S4225_1 – Assessment of BS148 and IEC60296 Insulating Oils • S4228_1 - Investigate Alternative Measuring Techniques for Insulation Materials • S4234_1 - Exploration of Ferroresonance Issues		
Type(s) of innovation involved	Incremental / Significant / Technological Substitution / Radical		
Expected Benefits of Project	Due to the age profile of the current system assets it is inevitable that unless significant new technology is used to extend asset life, CAPEX and possibly OPEX will need to increase significantly to maintain the present level of network reliability and safety. 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 benefits including: • Offset future increases in CAPEX and OPEX • Increased safety of staff and public by reducing the number of accidents/incidents; • Both preventing disruptive failures of oil-filled equipment to reduce land contamination and avoiding unnecessary scrapping of serviceable components will alleviate environmental impact.		
Expected Timescale to adoption	1-2 years - dependent on project	Duration of benefit once achieved	1-10 years - dependent on project
Estimated Success probability (at start of project)	5-50% - dependent on project		

PV of Project Costs	£38,081 (nb. This is identified early stage cost. It does not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive.)	PV of Project Benefits	£63,649	NPV of Project	£25,568
Commentary on project progress and potential for achieving expected benefits	Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure which, if successfully addressed, would enable the expected benefits to be achieved. The wide ranging projects intended to provide numerous benefits, both in terms of safety, knowledge sharing, network performance, mitigation of risks to plant and minimising effects to the environment. The majority of projects have not only resulted in essential knowledge transfer, they have enabled skills to be developed between STP 4 Members and also European partners. Key examples of this were the participation in the AM Forum, (S4185_3), the sponsoring of the Ferro-Resonance Seminar, (S4234_1), the Out Of Phase Workshop, (S4221_1) and the Substation Maintenance Seminar, (S4212_1). Each of which has contributed significantly to developing better understanding of electrical plant, its application, utilisation, performance and life cycle. These projects have resulted in the creation of further supplementary projects for 2008/2009. Additional key development and technical projects have also been undertaken. The On –Load Tap Changer Monitor, (S4164_4) and the Programme of Transformer Post Mortems, (S4181_2), for instance, could each lead to a reduction in potential multiple				

	fatalities, together providing mitigation of multiple potential incidents. Condition based monitoring and the prediction of end of life of plant, will lead to an improvement in network performance, providing a clearer understanding of degradation and the failure processes, which will provide the ability to identify and predict end of life, providing many years benefit. This will enable assets to be replaced in a controlled manner, within agreed timescales, minimize disruptive failures and the implications associated with them, in terms of safety, cost, CI's and CML's.

Distr. Energy Resources Module: – April 2007 – March 2008

Description of project	Strategic Technology Programme Networks for Distributed Energy Resources Module		
Expenditure for financial year 2006/7	Internal = £5,900 External=£51,238 Total = £57,138	Expenditure in previous financial years	£42,825
Technological area and / or issue addressed by project	The projects undertaken through budget year 2006/7 were aimed at enabling cost effective connections and ensuring techniques are in place to plan, operate and manage networks with significant amounts of generation. Most projects also had positive impacts on safety and environmental performance. The projects all addressed real problems that had been identified by the module steering group members as significant and which required technical investigation and development. Fifteen new project stages were approved during the year. These projects aimed to: • S5147_4 – Monitoring of Microgenerator Clusters • S5147_5 – Analysis of Microgenerator Cluster monitoring results • S5147_7 – Reporting of Microgenerator Monitoring • S5149_5 – Explore Active Voltage Control • S5142_4 – Generator Data and Structure for DG Connection Applications • S5151_4 – Network Risk Modelling • S5152_3/4 – Latest developments in the connection of distributed generation • S5157_3 – Evaluate the Performance of Small Scale Reactive Power Compensators • S5161_2 – Standard risk assessment approach to DNO protection • S5167_1 – Assessment of enhanced ratings for overhead lines connecting windfarms • S5170_1 – Explore low cost design options for		

	connecting DG to overhead line networks • S5171_1 - Investigate the use of inverter connected DG to alleviate fault level contribution • S5172_1 - Optimum power factor to support a low carbon economy • S5173_1 - Alternative techniques for temperature connected demands • S5174_1 – Assessment of the potential for DSM from small customers • S5176_1 – Assessing the impact of high penetrations of micro-generation on cable networks • S5182_1 – Treatment of distribution network losses • S5185_1 - Assessment of the potential for DSM from larger customers • S5186_1/2 – Investigate effects on network of proposed ban on incandescent light bulbs
Type(s) of innovation involved	Incremental / Significant / Technological Substitution
Expected Benefits of Project	With government policy driving significant increases in generation connection to distribution networks the members need a range of innovative solutions to connection and network operation issues that are cost effective and which maintain the present level of network reliability and safety. If the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain benefits including: • Reducing the probability of voltage supply limit excursions resulting from increased distributed generation (eaVCAT interface to IPSA software tool); • Improving quality of supply and reducing risk of component failure (by understanding the effect and optimising use of impedance in the system); • A better understanding of the risk presented by the distribution assets when considered as a network rather than discrete components;

	• Greater use of distributed generators to meet current DNO obligations (by assessing, from a DNO perspective, the implications of pending Distribution Code provisions relating to distributed generation); • Reducing the amount of reinforcement needed (by use of dynamic ratings to allow network components to be used to their full capability) - the use of dynamic circuit ratings is a vital step in the move towards ANM.				
Expected Timescale to adoption	1-5 years - dependent on project	Duration of benefit once achieved	1-10 years - dependent on project		
Estimated Success probability (at start of project)	10-30% - dependent on project				
PV of Project Costs	£51,238 (nb. This is identified early stage cost. It does not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive.)	PV of Project Benefits	£80,744	NPV of Project	£29,506
Commentary on project progress and potential for achieving expected benefits	Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure which, if successfully addressed, would enable the expected benefits to be achieved. During 2007/08, Northern Ireland Electricity joined the Module, bringing the number of full members to eight A total of thirteen reports and briefing papers were delivered during the year, including a review of CIRED 2007 for all Modules; this was an efficient and cost-effective means of disseminating information				

	and trends from the event, enabling STP members to identify areas of future research and development relevant to the UK context. The year also saw the completion of twelve months monitoring of the microgenerator cluster in Manchester, a network with a high penetration of microgeneration where the houses are new build (i.e. well insulated with a relatively low heating requirement). Laboratory tests on compact fluorescent light bulbs were undertaken to examine the network effects of the proposed ban on incandescent bulbs and a follow-on stage was approved to monitor whole house performance under typical mixed loads with measurements concentrating on the harmonic effects.

PD User Group: – April 2007 – March 2008

Description of project	Partial Discharge User Group The PD User group is a technical forum where information on partial discharge related failures can be discussed		
Expenditure for financial year	Internal = £3,900 External = £5,954 Total = £9,854	Expenditure in previous financial years	£11,807
Technological area and / or issue addressed by project	Partial discharge is the primary cause of disruptive failure of HV switchgear. The PD User group is a technical forum where information on partial discharge related failures can be disseminated and the understanding of partial discharge on switchgear can be enhanced through targeted investigative, research and development 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	Incremental, Significant,		
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 partial discharge 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 during FY07 are: • Understanding of the potential partial discharge related failure points for all types of switchgear. • 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. • Understanding the effect of the environment on the levels of PD activity and condition of switchgear.		
Expected Timescale to adoption	Range 1 - 3 years - dependent on task	Duration of benefit once achieved	Ongoing benefit

Estimated Success probability (at start of project)	Range 50 - 100% dependent upon projects				
PV of Project Costs	£11,000 (nb. This is cost of running the user group and carrying out the projects. It does not reflect the likely full costs of implementation of any ideas / techniques resulting from the work).	PV of Project Benefits	£13,000	NPV of Project	£2,000
Commentary on project progress and potential for achieving expected benefits	Work Completed 2007/08 • PD Measurements Database – The new database has been issued and allows for the incorporation of drawings, failure records, sound files etc, which will enhance the incident reporting capabilities. • Ultra TEV Alarm – Systems installed at a number of sites, with great success. Monitoring is ongoing at a number of sites • Ultra TEV + - Available to Purchase • VMX Long Term Test Rig – The investigation in to the different failure modes has been published to all members. • Nox Testing – After trialling a number of different sensors, it was found that more investigation was required. This will be undertaken within the new financial year.				

Protective Coatings Forum: – April 2007 – March 2008

Description of project	Protective Coatings Forum		
Expenditure for financial year	Internal = £4,900 External = £6,000 Total = £ 10,900	Expenditure in previous financial years	£10,853
Technological area and / or issue addressed by project	Effective Protective Coatings for Plant and Overhead Line Towers: Quality Control and Consultancy services EA Technology has been actively involved in work on surface coatings for overhead line towers and substation plant for a number of years, primarily sponsored by the DNOs and the National Grid. Specifications for tower and plant paint systems have been produced for use by the sponsoring companies. For overhead line towers, most companies currently use two-coat paint systems based on urethane alkyd or modified vinyl resins, manufactured to specifications produced by EA Technology and the National Grid. To ensure satisfactory quality control throughout the industry, a batch certification scheme has been set up and paint samples from manufacturers and painting contracts are checked on a regular basis. As a result, problems relating to paint application have been largely eliminated and the performance of the paint systems has been much improved. Other services provided include troubleshooting, evaluation of various new products and special purpose paint systems, surveys of coatings on new plant and general guidance on surface coatings. In recent years, European legislation has been introduced with the aim of reducing emissions of Volatile Organic Compounds (VOCs), such as the solvents in paint systems, to the atmosphere. The Process Guidance Note PG6/23 (97): Coating of Metal and Plastics, introduced the concept of EPA Compliant Coatings and proposed alternative approaches for surface coatings to reduce VOC emissions. In July 2003, a draft revised version of PG6/23 was issued for consultation, PG6/23A. The main change is the inclusion of requirements specified in EC Directive 1999/13/EC, known generally as the Solvent Emission Directive (SED). The aim of the SED is to reduce emissions of VOCs from specified industrial processes. Full implementation of SED is required by October 2007. This will not immediately affect the use of the solvent based paints currently used for painting towers and plant, because the directive is applicable only to factory applied coatings and does not include coatings applied to outside installations, such as bridges, refineries, towers etc.		

	However, The European Commission and EU Member States have recognised that they need to do even more to improve air quality, and hence two new directives are being prepared. One refers to ozone. The other, the future National Emissions Ceiling Directive will require Member States to reduce their emissions of several air pollutants including VOCs to lower levels from 2010. These directives may well lead Member States to require the Protective Coatings sector to further reduce emissions arising from the use of its products. This suggests that current tower paints may be acceptable until 2010. However, the availability of suitable low solvent paint systems as substitutes for the currently used solvent based systems must be seen as a priority for all users of large quantities of paints. In anticipation of the proposed legislation, EA Technology developed an environmentally friendly water based tower paint system as part of the NORUST project, part funded by the Commission of European Communities, in conjunction with a paint manufacturer, a resin manufacturer and an overseas (Spanish) utility company. Field trials were carried out on overhead line towers in six UK DNOs. These were completed in 1998, and one of the tasks of the project is to continue to monitor the field performance of the paint system, with a view to ensuring a smooth transmission to environmentally friendly paint systems as demanded by legislation. Other VOC compliant paint systems, which have been evaluated, through laboratory test programmes and field trials, have included water based and high solids two-pack epoxy coatings. A stated task within the project is to continue to assess VOC compliant paint systems which may be suitable for painting towers and substation plant.
Type(s) of innovation involved	Development of VOC compliant coatings (in conjunction with manufacturers) Testing and evaluation of new products
Expected Benefits of Project	It is anticipated that the majority of overhead lines will be needed along existing routes for the foreseeable future. Present lines will remain in service as long as the structures can be maintained economically. Currently, the National Grid owns and operates some 7000 route-km of 400kV and 275kV transmission lines with approximately 28,000 towers. The DNOs operate and maintain the 132kV system which comprises approximately 48,000 towers in total. Current paint systems are expected to last for 10 to 12 years provided the towers have been previously well maintained and the steelwork is in good condition. Life expectancy of the paint systems on rusty substrates will be lower, possibly 5 years.

<table>
<tr><td></td><td colspan="5">It is essential that any new VOC compliant paint systems proposed for use on overhead line towers should perform at least as well as the currently used solvent based systems, since they are likely to be more expensive, although material costs account for a relatively small proportion of total contract costs. For a typical DNO, a small improvement in performance would generate financial benefits in the region of £10,000 per annum, together with associated environmental benefits.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">Range 3 - 5 years - dependent on legislation</td><td colspan="2">Duration of benefit once achieved</td><td>Ongoing benefit</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">50% - 100%.</td></tr>
<tr><td>PV of Project Costs</td><td>£11,000</td><td>PV of Project Benefits</td><td>£13,000 Based on new paint systems performing better than current solvent based systems.</td><td>NPV of Project</td><td>£2,000</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="5">Some high solids two-pack materials, which are VOC compliant, have been identified which have the potential to replace the solvent based systems, and may be applied as a single coat. However, application of these products in the field can present difficulties with mixing, pot-life and H&S.

Water-based systems have performed well on galvanised and steel surfaces in good condition, but not as well as solvent based systems on rusty substrates. Composite systems, comprising solvent based primers, with water based top coats, which may comply with SED requirements, offer an alternative solution.

The potential for achieving the expected benefits is considered to be fairly high.</td></tr>
</table>

ENA Projects: – April 2007 – March 2008

Expenditure for financial year	Internal = £3,900 External = £5,570 Total Cost =£9,470		Expenditure in previous financial years	£19,457	
PV of Project Costs	£190,000	PV of Project Benefits	£282,045	NPV of Project	£92,045

Electricity Supply Fault Level Instrument

Description of project	An ENA co-ordinated project the objective of which is the development of an on-line instrument that can successfully measure / estimate fault level on a distribution network with repeatability and reliability.		
Technological area and / or issue addressed by project	The device will connect to the network, and establish the network source impedance from small-scale disturbances / perturbations resulting from transformer tap changer operation, etc. This impedance can accurately be correlated to a true network fault level for that location, providing near real-time information to network control and planning engineers alike.		
Type(s) of innovation involved	Incremental and Significant innovation types are involved.		
Expected Benefits of Project	The developed unit will allow the DNOs to accurately assess fault infeed levels and design distribution networks appropriately. The particular benefits of this project are seen to be: • Provide a real-time and consistent estimation of fault level • Accurately take into account all connected network elements (e.g. Motors); • Facilitate the connection of distributed generation by providing a standardised methodology for the assessment of network fault levels • Enable an ongoing assessment of the effects of connected distributed generation to be made; • Provide reassurance to generator developers that decisions to upgrade networks are not subjective but based on objective measurement.		
Expected Timescale to adoption	3 years	Duration of benefit once achieved	10 years
Estimated Success probability (at start of project)	25%		
Commentary on project progress and potential for achieving expected benefits	A number of activities have been pursued by both EA Technology and the University of Strathclyde in the progression of this project. These are summarised as: • **Experiment & Laboratory Investigation** – The performance of the previous Fault Level Monitor was tested against the known parameters of the University of Strathclyde's microgrid. In general a reasonable level of agreement was achieved.		

	• **Algorithm Validation** – The algorithms from the Fault Level Monitor coded within Matlab were tested using a network model in Matlab/Simulink to provide the sampled data to the algorithm. The results were compared to values of source infeed and motor infeed calculated directly from the parameters of the disturbances used. This resulted in an assessment of the potential accuracy of the instrument under a variety of load and disturbance conditions. At the power factor and load disturbance conditions which were most likely to be experienced in a real power system the results were not within the required accuracy band. • **Comparison of Real Site** – In contrast to the results obtained under the algorithm validation section, comparison of measurements made on a real network with the Fault Level Monitor exhibited a much closer agreement with the results expected
	To progress to stage 2 of the project as originally defined the results obtained from stage 1 had to support a statement that it was technically feasible to develop a Fault Level Measuring Instrument capable of deriving answers within ±5% of the actual Source and Motor Infeed values. The Algorithm Validation work has cast some doubt over the achievability of that goal. The good agreement of the existing Fault Level Monitor with expected values does however offer some signs that the results obtained in the algorithm validation phase are not unequivocal. The proposed testing of the existing Fault Level Monitor within a defined third party test network has not been pursued at this time since although this might provide further data supporting the instrument's capabilities it would not answer the question as to why the differences exist between the apparent capability of the existing instrument and the performance of the algorithms implemented in Matlab. As the results of Stage 1 do not support an unequivocal statement that it is technically feasible to develop a Fault Level monitor with the required degree of accuracy this project will conclude at Stage 1. Proposals are being prepared for consideration to carry out further work to resolve questions about the apparent differences in performance of the existing Fault Level Monitor and the Fault Level Monitor Algorithms implemented in Matlab.

ENA Earthing Project

Description of project	To develop new techniques to assess the impact of lower voltage earth electrodes on higher voltage 'hot zones', and to measure the resistance of distribution substation earth systems.
Technological area and / or issue addressed by project	a. The advantage of this work will be that if successful the project will deliver a clear rationale describing the correct location of LV earth electrodes with respect to HV earth electrodes. This will have potential benefits in improving understanding of the safety of the earth installations. ESQC Regulation 8(2) (b) requires that HV electrodes are installed and used in such a manner so as to prevent danger in the LV network due to a fault in the HV network. Currently the safety of the LV electrode is assured by maintaining a separation between the HV and LV earth electrode such that the LV earth electrode is situated outside the 430V Rise of Earth Potential (ROEP) contour. This is based on longstanding requirements to ensure that the LV electrode has <430V imposed upon it under HV fault conditions. b. All designs for earthing systems consider the effects of touch and step potentials under fault conditions. However the quantity of concern is actually the current flowing through a human body when in contact with metalwork subject to this potential and the time the current flows for. An electrode simply sited in soil which has a surface potential cannot be regarded as presenting the same hazard as metalwork with a direct metallic connection to the earth fault current return path. However there exists at this time no methodology for assessing the either the hazard posed by such an earth electrode or the possible effects of the earth when connected to a distributed system on the ROEP contours. c. This project will if successful determine these effects and provide a means to provide cost effective safe earthing systems without the need for extensive separations between HV and LV electrodes which in a PME system may be impractical to achieve and maintain.
Type(s) of innovation involved	Incremental
Expected Benefits of Project	The project will determine the effects of LV earth systems on HV systems. The results of this should determine the means to provide cost effective, safe earthing systems without the need for extensive separations between HV and LV electrodes which in a PME system may be impractical and costly to achieve and maintain.

Expected Timescale to adoption	2 years.	Duration of benefit once achieved	Lifetime of asset. – 10 years
Estimated Success probability (at start of project)	75%		
Commentary on project progress and potential for achieving expected benefits	High. The results from tests and simulations can be used to propose a recommended procedure for measuring transfer potential between HV and LV systems, suitable for inclusion in a DNO policy document.		

DG and ARM Projects: – April 2007 – March 2008

Description of project	Sponsored endowment with Strathclyde University for applied research and development of Distributed Generation (DG) and Asset Risk Management (ARM)				
Expenditure for financial year	Internal = £3,900 External=£40,699 Total = £44,599		Expenditure in previous financial years		£42,028
Technological area and / or issue addressed by project	Increased and more controlled out put from Distributed Generation. Improved management of distribution assets.				
Type(s) of innovation involved	All innovation types involved (incremental, significant, technological substitution and radical)				
Expected Benefits of Project	Financial project benefits are expected. The benefits will be across a range of areas including construction, maintenance, refurbishment and operation. This funding provides close links with a noted academic organisation and will promote rapid transfer of new technology and ideas into existing business areas.				
Expected Timescale to adoption	3 years.		Duration of benefit once achieved		Lifetime of asset. – 40 years
Estimated Success probability (at start of project)	Success probability is expected to be 20% overall on the whole programme of projects.				
PV of Project Costs	£80,000	PV of Project Benefits	£82,000	NPV of Project	£2,000
Commentary on project progress and potential for achieving expected benefits	Projects currently on target.				

Supergen 5: April 2006 – March 2007

Description of project	This is a 4 year major multi party collaborative project. The research programme is split into 6 work packages & 25 activities. Most of the research will be carried out by the universities. An SSE Energy representative has been identified for each work package so that research can be stirred toward delivering benefits to the DNO's.				
Expenditure for financial year	Internal = £3,900 External = £25,000 Total = £28,900		Expenditure in previous financial years		£51,853
Technological area and / or issue addressed by project	WP1: Programme delivery, outreach and implementation; WP2: Enhanced network performance and planning; WP3: New protection and control techniques that adapt to changing networks; WP4: Infrastructure for reducing environmental impact; WP5: Ageing mechanisms; and WP6: Condition monitoring techniques				
Type(s) of innovation involved	Radical innovation				
Expected Benefits of Project	The expected aims of the project are: • To deliver a suite of intelligent diagnostic tools for plant: • To provide platform technologies for integrated network planning and asset management • To progress plans to develop and implement improved and reduced environmental impact networks; and • To develop models and recommendations for network operation and management				
Expected Timescale to adoption	7 years		Duration of benefit once achieved		20 years
Estimated Success probability (at start of project)	25%				
PV of Project Costs	£120,000	PV of Project Benefits	£192,000	NPV of Project	£72,000
Commentary on project progress and potential for achieving	The project is now fully resourced in all the universities (PhD and RAs). A number of demonstrators have been identified and are being implemented ahead of schedule. The high-level work to develop optimal asset replacement and network expansion methodologies is progressing well, and it has				

expected benefits	been agreed that this project should become a demonstrator, the form of which is being agreed by the Steering Group. More physical demonstrators are being built at both distribution and transmission substations. The initial evaluation of techniques is complete and machine learning techniques have been selected for implementation. The more fundamental work on ageing of plant which is necessary to underpin the more applied activities is also progressing according to plan, with development of methods to characterise ageing plants being developed. To date 14 reports and 38 publications have arisen from this work. Technical documents produced: • Loss of Mains Detection and Amelioration on Networks • Loss-of-Mains detection by differential ROCOF Protection using internet protocol. • Interim report on protection and control of distribution networks with synchronous islands. • Reducing the Environmental Impact of Electrical Plant - Annual report • First report on use of high temperature conductors on distribution networks. • Final report on high temperature low sag conductors. • Report on ICSD 2007 • Report on literature on non-power frequency ageing in dielectrics • Condition monitoring -State of the art report version 2 27 technical publications have been submitted or published since in the last year. Technology & trials: The following demonstrator projects are presently being implemented in both Transmission (due to finish mid-June) and Distribution substations: • Monitoring of two 275/132kV National Grid transformers. • Monitoring of 6 Scottish Power Substations. • Processing of Partial discharge data from EDF Energy substations. These will be used to prove data acquisition technology and develop interpretation tools. The above has been extracted from the full Supergen V annual report.

Collaborative Partners	National Grid, Scottish Power, Scottish and Southern Electric, Electricity North West, Western Power Distribution, Central Networks, CE Electric UK, NIE, Advantica & EDF Energy Networks.
R&D Provider	Universities of Manchester, Southampton, Edinburgh, Liverpool, Strathclyde and Queens (Belfast).

Orkney ANM: April 2007 – March 2008

Description of project	Development of Active Network Management (ANM) scheme for Orkney. This project is integral to establishing a Registered Power Zone on Orkney.		
Expenditure for financial year	Internal = £5,900 External= £73,000 Total Cost = £78,900	Expenditure in previous financial years	£122,721
Technological area and / or issue addressed by project	The amount of Distribution Generation allowed to connect to the Orkney distribution network is currently limited by network constraints. An increase in renewable energy generation is commonly accepted to be an important part of the plan to meet UK and international emissions reductions targets. Renewable resources are often located in remote areas where the connection to the national grid will be via weak distribution networks requiring substantial network infrastructure reinforcement. Theoretically, networks may be filled to capacity with contracted renewable generation but, due to diversity, the actual real time contribution can be significantly less than the contracted capacity. If renewable resources are to have their full potential realised then a combination of new network technologies and advances in system planning and operation are required. The Orkney Isles are an area of abundant renewable resource with several wind farms and the European Marine Energy Centre. Orkney is connected to the mainland network by two 33kV submarines cables and analysis shows that the active network management scheme may be capable of releasing capacity for DG connections by up to three times the firm capacity of the existing distribution network.		
Type(s) of innovation involved	Radical		
Expected Benefits of Project	Financial project benefits are derived from comparing the cost of the active network solution with the cost of extensive conventional reinforcement. This project will allow connection of further distributed generation on Orkney by use of novel techniques		
Expected Timescale to adoption	Short - within three years.	Duration of benefit once achieved	10 years
Estimated Success probability (at start of project)	Low - 10%		

PV of Project Costs	£280,000	PV of Project Benefits	£675,000	NPV of Project	£423,000
Commentary on project progress and potential for achieving expected benefits	An online closed-loop trial has successfully been completed and full implementation is progressing. The software and hardware has passed the factory acceptance testing and deployment of the multi node, multi generator system on Orkney is planned. Delays being experienced by developers in gaining planning consent and finance have delayed the progress of this project and are outwith our control. To enable active management of the power flows on Orkney, the network has been segregated into control zones. Control logic has been designed to regulate the output (trim) or trip the New Non Firm Generation (NNFG) as required. The inputs to the control logic are status indications from generators and network components, and analogue representations of power flows at zone intersections or 'pinch points'. Each zone will have its own control logic. Measurement of power flows at zone intersections and other critical points will inform the decision making process performed by the control logic. Participating generators are approached for curtailment on a last-in first-off basis. Measurement of the export power flow to the Scottish mainland breaching a pre-determined threshold will result in the NNFG on Orkney being approached for curtailment. If an overload is measured between a zone and the Orkney 'Core' then the NNFG in the zone will be regulated. The principles of operation for the ANM scheme hold for other situations where the thermal capacity of radial distribution networks is under utilised or acts as a barrier to the connection of new DG units. The scheme is therefore expected to be applied to other parts of the UK network in the event of a successful trial and full roll-out. **Generator Constraint Analysis Tool** NNFG wishing to connect to the Orkney network require an indication of the likely curtailment to be experienced and the annual MWh of energy produced. This information, in addition to the costs associated with the electrical connection and communication requirements (which are likely to be site specific), will be used by prospective NNFG developers to assess their connection offer. A tool has been developed utilising existing profiles of generation and load from 2005-2006. Microsoft Excel, with a flexible front-end built in Visual Basic for Applications, was used to create this tool.				

Arc Suppression Coil: – April 2007 – March 2008

Description of project	Introduction of new technology solution using self tuning arc suppression coils as an alternative to traditional resistance earthing methodology.				
Expenditure for financial year	Internal = £4,900 External=£28,456 Total = £33,356		Expenditure in previous financial years		£0
Technological area and / or issue addressed by project	Understanding of design installation and maintenance requirements of self tuning arc suppression technology along with improved fault location measurement.				
Type(s) of innovation involved	Incremental, significant and technological innovation solution.				
Expected Benefits of Project	Reduction in Customer Interruptions and Customer Minutes Lost. Production of design, installation and maintenance specifications with required changes to operational practices which may be required.				
Expected Timescale to adoption	3 years.		Duration of benefit once achieved		Lifetime of asset. – 40 years
Estimated Success probability (at start of project)	Success probability is expected to be 50% overall.				
PV of Project Costs	£352,968	PV of Project Benefits	£500,844	NPV of Project	£158,079
Commentary on project progress and potential for achieving expected benefits	System studies have been completed on chosen circuits along with cost benefit analysis. A strategic review of arc suppression technology will also be carried out prior to deployment. Project remains on target.				

Distribution Network Analysis: April 2007 – March 2008

Description of project	Distribution Network Analysis using advanced statistical modeling techniques to better predict the effects of weather events on the network.		
Expenditure for financial year	Internal = £5,900 External=£35,788 Total = £41,688	Expenditure in previous financial years	£34,854
Technological area and / or issue addressed by project	The aims of the project are; ➢ to develop effective statistical models which will enable accurate advance warning to be provided of power line faults arising from climatic or weather conditions ➢ to develop predictive models which can enable preventive measures to be taken which will reduce the incidence and duration of weather related power supply disruption. ➢ to reduce costs by responding faster to weather induced circuit failures and by enabling pre-emptive actions to reduce the likelihood of failure caused by storm conditions. The activities of the project will include; ➢ Manipulate data in SSEPD fault records database, clean data, and apply regression and trend analysis. Develop a model based on line fault data. ➢ Obtain and manipulate historic weather and climatic data identify factors impacting on line faults e.g. wind, rain, snow etc. ➢ Develop a model of line faults with respect to weather and climatic factors. Define confidence limits. ➢ Carry out a cost benefit analysis based on the application of the model to engineer mobilisation in advance of line faults. ➢ Carry out a cost benefit analysis based on the application of the model to power cut-off under severe storm conditions. ➢ Carry out trials and tests as required and support implementation as appropriate. ➢ Develop systems and train staff in statistical analysis of fault and climatic data, embed systems for use and development in the future. Application of the developed predictive model will lead to improved reliability of the power distribution network. Allocation of resource on the basis of the model will decrease the response time for repair of the network, increasing efficiency and minimising frequency and duration of interruption to supplies .		
Type(s) of innovation involved	Technological Substitution		

Expected Benefits of Project	Financial and Quality of Supply				
Expected Timescale to adoption	Short – 3 years		Duration of Benefit once achieved		10 years
Estimated Success probability (at start of project)	Medium 50%				
PV of Project Costs	£143,000	PV of Project Benefits	£144,000	NPV of Project	£1,000
Commentary on project progress and potential for achieving expected benefits	An associate has now been employed under a Knowledge Transfer Partnership with St Andrews University. The associate has successfully completed inductions for both SSEPD and University of St Andrews. The project is currently on target with data sources having been identified for collation of data. Statistical modelling techniques are currently being studied with a view to moving to the development of initial models for analysis of data.				

Integrated Vegetation Management: – April 2007 – March 2008

Description of project	Integrated Vegetation Management (IVM) is a management system being developed for reducing the risks to supply due to vegetation. Lengthening clearance times (i.e., reducing the frequency of maintenance) and reducing maintenance costs.		
Expenditure for financial year	Internal = £5,400 External=£52,000 Total = £57,400	Expenditure in previous financial years	£0
Technological area and / or issue addressed by project	The Integrated Vegetation Management project will consist of three work packages with the following content. WP1 This will involve a review of IVM techniques & technologies in four key areas: • Management process • Machinery and mechanical issues • Live line techniques • Herbicides The output of Work Package 1 will be a short report for each of the four areas, summarising the identified IVM approaches in each. An estimate of the cost and pay-back period associated with each identified technique will be provided. WP2 Work Package 2 will involve assessing each of the techniques and technologies identified by Work Package 1 in the context of SSE's network and current practices. This will be done through a critical review of each technique and technology accounting for cost, pay back period and compatibility with existing SSE management systems and processes. The output of Work Package 2 will be to refine the list of techniques and technologies to identify those that have the greatest potential for SSE to consider implementing, accounting for efficiency, cost and pay back time. WP3 The potentially useful techniques brought forward from Stage 2 will be worked up into a field guide that will enable SSE staff to identify in the field which techniques should be adopted at a particular site, accounting for: • Cost • Clearance time • Reducing risk to supply A key feature of SSE's approach to network maintenance is that decisions are made in the field by maintenance staff. The guide must therefore be practical and easy to use, and use flow charts and decision trees to direct SSE staff to the correct decision. These will be backed up by text where appropriate, such as instructions on selecting herbicide type and application method.		

Type(s) of innovation involved	Incremental and significant solution to reduce the incidence of Customer Interruptions (CI's) and resulting Customer Minutes Lost (CML's)				
Expected Benefits of Project	Reduction in Customer Interruptions and Customer Minutes Lost. Production of field manual to assist operatives in the decision process whilst engaged in vegetation management.				
Expected Timescale to adoption	3 years.		Duration of benefit once achieved		Lifetime of asset. – 40 years
Estimated Success probability (at start of project)	Success probability is expected to be 25% overall on the whole programme of projects.				
PV of Project Costs	£1,019,530	PV of Project Benefits	£1,143,990	NPV of Project	£133,048
Commentary on project progress and potential for achieving expected benefits	Project is currently on target for production of the field guide during 2008.				

Live Line Tree Felling: – April 2007 – March 2008

Description of project	Carry out a desk top review of potential methods and techniques to carry out tree felling next to live lines. Methods and techniques will be assessed and ranked according to their potential for success. Proposals and costs for further detailed research including field works to develop a live line tree cutting method will be presented.				
Expenditure for financial year	Internal = £5,400 External=£2,750 Total = £8,150		Expenditure in previous financial years		£0
Technological area and / or issue addressed by project	Several thousand trees are to be cut during the next ten years which will require the development of a procedure and process to enable felling of trees safely within traditional safety zones by contractors				
Type(s) of innovation involved	Incremental and significant solution to reduce the incidence of Customer Interruptions (CI's) and resulting Customer Minutes Lost (CML's)				
Expected Benefits of Project	The ability to fell trees without the need for an outage will save significant time and money. The initial scoping report will save time and resources by focusing further research work on the areas that are most likely to be successful.				
Expected Timescale to adoption	3 years.		Duration of benefit once achieved		Lifetime of asset. – 40 years
Estimated Success probability (at start of project)	20%				
PV of Project Costs	£72,400	PV of Project Benefits	£115,840	NPV of Project	£43,440
Commentary on project progress and potential for achieving expected benefits	Scoping report has been produced with project. The project is on target with agreement having been reached on the content of the work packages for the project.				

Power Electronics Regulator: April 2007 – March 2008

Description of project	Power electronics voltage regulator				
Expenditure for financial year	Internal = £3,900 External = £75,885 Total Cost = £79,785		Expenditure in previous financial years		£5,853
Technological area and / or issue addressed by project	Development of a single phase power electronics voltage regulator to be deployed on LV networks to provide a cost effective fast means of addressing voltage compliance for over and under-voltage situations. The project will also evaluate the use of the regulator in areas where Micro Generation has been installed to provide effective voltage regulation. Innovative method of dealing with voltage regulation in areas which traditionally would require system reinforcement.				
Type(s) of innovation involved	Technological substitution.				
Expected Benefits of Project	Financial benefits are expected from a reduction in network reinforcement works. Capability of providing both permanent and temporary solutions for voltage complaints. Reduction in voltage fluctuations in applications where Micro Generation has been installed.				
Expected Timescale to adoption	Short - three years.		Duration of benefit once achieved		20 years
Estimated Success probability (at start of project)	Success probability is assessed as 50%				
PV of Project Costs	£104,000	PV of Project Benefits	£166,000	NPV of Project	£62,000
Commentary on project progress and potential for achieving expected benefits	Initial trials using a single unit have been completed with the next stage to evaluate a more significant number of units located in various environmental and operating situations. The project is currently on track to produce output from the extended trial during 2008/9				

Crow Control: April 2007 – March 2008

Description of project	Crows have continuously caused problems in areas where nesting sites are scarce. The project will evaluate overhead line construction design methods which may reduce the likelihood of nest building, along with deterrents on existing lines. Alternative nesting site provision will also be evaluated.				
Expenditure for financial year	Internal = £14,900 External = £ 5000 Total Cost = £19,900		Expenditure in previous financial years		£6,414
Technological area and / or issue addressed by project	Prevention of flashovers and outages attributed to nesting crows. The objectives addressed are suitable monitoring techniques for different types of trials; financial benefit derived as well an improvement in quality of supply.				
Type(s) of innovation involved	Technological substitution				
Expected Benefits of Project	Financial and Quality of Supply.				
Expected Timescale to adoption	Short - within three years.		Duration of benefit once achieved		Lifetime of asset.
Estimated Success probability (at start of project)	Low - 25%				
PV of Project Costs	£15,000	PV of Project Benefits	£17,000	NPV of Project	£2,000
Commentary on project progress and potential for achieving expected benefits	Project currently on target. Evaluation of a deterrent which uses a hazing effect from stored sunlight which is released for several hours following sunset to deter the nesting and perching of birds. Shrouding of conductors and insulators on transformers and disconnectors which have historically been used as nest sites is also being evaluated. Also deployment of Firefly bird diverter. The current work within this project is structured to consider short term solutions and evaluate their benefit. Consideration will be given to transformer specification modifications that will eliminate the potential for nesting to occur. Discussions are underway to set up a collaborative project with Edinburgh and Newcastle Universities.				

GIS Tree Clearance: April 2007 – March 2008

Description of project	Geographic Information System (GIS) to support tree cutting				
Expenditure for financial year	Internal =£14,900 External=£39,000 Total Cost =£53,900		Expenditure in previous financial years	£31,354	
Technological area and / or issue addressed by project	This project aims to develop trial and evaluate an innovative application using Ordnance Survey Imagery data within existing GIS application to assess tree cutting requirements. This is in line with ESQCR regulation regarding Avoidance of Interference with or Interruption of Supply caused by trees. A GIS operator will be able to measure the length of affected o/h line requiring tree clearance by feeder.				
Type(s) of innovation involved	technological substitution				
Expected Benefits of Project	Quality of Supply and Financial				
Expected Timescale to adoption	Short - within three years.		Duration of benefit once achieved	10 years	
Estimated Success probability (at start of project)	25%				
PV of Project Costs	£143,000	PV of Project Benefits	£412,00	NPV of Project	£288,000
Commentary on project progress and potential for achieving expected benefits	Development and testing using pilot data has been completed. At present the project is 25% completed with over 303 networks from a total of 1200 inspected on desktop. Data has been supplied to the field operatives with very positive results to date. The project remains on target.				

LV Sure: April 2007 – March 2008

Description of project	To develop an automatic LV network reconfiguration system based upon the "SignalSure" system currently installed on the rail network. By embedding a number of autonomous points of isolation at strategic locations which are co-coordinated by an intelligent device the faulty section will be isolated and supply restored to healthy sections.		
Expenditure for financial year	Internal = £4,900 External=£71,144 Total = £76,044	Expenditure in previous financial years	£38,853
Technological area and / or issue addressed by project	It is recognised that a cost effective means to better isolate faults occurring on the low voltage electricity distribution network will yield significant performance benefits. Current practice is reliant upon fuses, typically located at substation sites and arranged so as to protect individual phases of a low voltage feeder. Whilst providing a reliable and simple means of fault isolation the resultant scale of loss of supply may be large and may require the passage of high fault current to achieve fast operation. By embedding a number of autonomous points of isolation at strategic points within the low voltage network and having their operation co-ordinated with an “intelligent” device rather than a fuse at the substation, the loss of supply resulting from a fault can be reduced. Appropriate discrimination with downstream protective devices, such as service fuses, should allow a fault to be detected and isolated with smaller fault current passage, thereby reducing the stress on network components. EA Technology and Equipmake have developed a Patented automation system for Power Circuits called “SignalSure”. In the event of a fault on the circuit SignalSure isolates faulted sections of the circuits. Isolation of the faulted section and restoration of supply to unfaulted sections of the circuit is completely automatic and does not require communication between the devices which comprise the SignalSure system. Currently SignalSure is installed and operational on the rail network and is used to reconfigure signalling power circuits in the event of a fault. However, with minor modifications it can be adapted to provide an automatic network re-configuration function for low voltage electricity distribution networks, delivering an enhanced level of performance for customers.		
Type(s) of innovation involved	Significant innovation		
Expected Benefits of Project	Improvement in Quality of Supply is expected due to a reduction in CIs and CMLs. Financial benefits will be derived from a reduction in operating costs associated with LV underground cable faults		

<table>
<tr><td>Expected Timescale to adoption</td><td colspan="2">Short – 3 years</td><td colspan="2">Duration of benefit once achieved</td><td>10 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">Medium 50%</td></tr>
<tr><td>PV of Project Costs</td><td>£188,000</td><td>PV of Project Benefits</td><td>£300,000</td><td>NPV of Project</td><td>£112,000</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="5">Tasks completed to date are :
Review of typical LV network topologies.
Reviewed current regulations, operational practices and processes
Analysed low voltage fault incidence using data provided by Scottish & Southern Energy
Identified possible applications and deployment options
Estimate the benefits for a number of agreed alternate SignalSure deployment strategies and produce a benefit matrix
Identified the technical constraints and financial implications of adapting existing SignalSure components for use of LV networks
Production of an implementation strategy, based on the preferred configuration.
Phase 2 of the project will see an engineering review of the work completed to date in order to determine the physical, electrical and functional characteristics that would be feasible for a prototype system based on the existing “SignalSure” concept;
Production of an outline system specification for the prototype system based on the above and the knowledge gained from the work carried out in Phase 1;
Production of a prototype system suitable for deployment on a low voltage underground test circuit.
Install and test the prototype system on the test circuit to evaluate its performance and prove whether the concept would be suitable for productisation and installation on the low voltage distribution network;
Conduct network field trials of the approved system on a number of circuits to demonstrate the performance of the system under real network conditions.</td></tr>
</table>

HV Sure: April 2007 – March 2008

Description of project	HV Network Automation without inter-device communication				
Expenditure for financial year	Internal = £3,900 External=£0 Total = £3,900	Expenditure in previous financial years	£43,689		
Technological area and / or issue addressed by project	This project is designed to develop a new design of HV 'switch' that has the capability to test whether or not a fault exists in the adjacent network section. These devices can work autonomously to decide whether or not to supply to restore supply to that section following loss of supply resulting from a fault. Technology already exists for LV applications and the project seeks to transfer the concept to the HV distribution network in a series of stages: 1. Establish the technical feasibility and explore the issues which would arise in applying the system to the HV distribution network. 2. Analyse the safety and operational implications arising from use of the system. 3. Produce a prototype system suitable for deployment on open ring HV distribution network circuits. 4. Install and test the system on agreed HV circuits of the SSEPD network.				
Type(s) of innovation involved	Significant, Technological Substitution, Radical				
Expected Benefits of Project	By embedding the new 'switch' devices at strategic points within the HV network, an automation scheme can be applied to the HV network that will operate autonomously without the need for inter-device communication or human intervention. The particular benefits of this project are seen to be: • An alternative to existing HV Automation systems exist that rely on costly and sometimes unreliable communication circuits being available to transfer status or timing information. • Extend the opportunities for automaton schemes to circuits without communications with the resultant improvement in CIs, CMLs and restoration times for those circuits. • By avoiding closing onto a fault, the network is not exposed to multiple fault current pulses, thereby reducing the stress on network components.				
Expected Timescale to adoption	Medium – 7 years	Duration of benefit once achieved	20 years		
Estimated Success probability (at start of project)	Low 25%				
PV of Project Costs	£170,000	PV of Project Benefits	£272,000	NPV of Project	£102,000

Commentary on project progress and potential for achieving expected benefits	Project currently on target.

CBRM (Transformers): April 2007 – March 2008

Description of project	Condition Based Risk Management of 50 HV Transformers		
Expenditure for financial year	Internal = £5,900 External=£18,000 Total Cost = £23,900	Expenditure in previous financial years	£42,703
Technological area and / or issue addressed by project	The process known generically as 'CBRM' has been developed as a result of EA Technology working with distribution and transmission companies. CBRM relies on the application of some basic principles and building, in each application, a systematic process to combine engineering knowledge, asset information and practical experience to define current and future condition, performance and risk. The ultimate aim is the provision of information to assist companies target investment to maintain a defined level of network performance at minimum cost without compromising on safety or environmental impact. **Technical development** CBRM relies upon utilising the best available technical knowledge of assets, degradation processes, failure modes, condition assessment techniques and practical engineering experience; it is clearly 'technical'. Successful application enhances a Network Operator's ability to target investment (for asset replacement, refurbishment) and operational spending to achieve a defined level of performance. Thus impacting on the future performance and development of networks. This project will apply the methodology to a statistical sample of 50 132kV and 66kV transformers.		
Type(s) of innovation involved	Incremental		
Expected Benefits of Project	Financial and Quality of Supply The whole purpose of CBRM is to assist companies target future investment in order to deliver the required level of performance at minimum cost, i.e. it is specifically designed to deliver customer value. The process delivers a measure of risk (for different investment scenarios) that can be broken down into financial, supply quality, safety and environmental.		

	Improved targeting of investment specifically to optimise risk will result in a reduction of risk for the same level of investment. As risk is quantified in monetary terms (in the CBRM process) it is possible to estimate the value of risk reduction. From previous experience we estimate that applying CBRM to a typical population of 50 transformers will reduce risk by approximately £10,000 per annum over the next 10 years.				
Expected Timescale to adoption	1 year		Duration of benefit once achieved		20 years
Estimated Success probability (at start of project)	75%				
PV of Project Costs	£49,000	PV of Project Benefits	£72,000	NPV of Project	£24,000
Commentary on project progress and potential for achieving expected benefits	A report has been produced for consideration by SSE following results of the works done on a trail sample of units which were identified as being representative of those contained within SSE. Evaluation of the report will recommend whether the use of CBRM is too adopted as the standard tool for asset management within SSE.				

CRATER for Submarine Cables: April 2007 – March 2008

Description of project	This project is to create an MS Excel© based software application (to be entitled CRATER for Submarine Cables) to determine the current ratings of SSEPD's submarine cables under a wide range of conditions, including steady, cyclic and emergency loading. Other planned features are calculations of grouped circuit rating (on-shore), circuit loss, capacitance, charging current and useful power carrying capacity.				
Expenditure for financial year	Internal =£4,900 External=£35,827 Total Cost =£40,727		Expenditure in previous financial years	£0	
Technological area and / or issue addressed by project	To create a software application to determine the current ratings of submarine cables under a wide range of conditions; including steady, cyclic and emergency loading. Other planned features are calculations of grouped circuit rating (on shore), circuit loss, capacitance, charging current and useful power carrying capacity The objectives of the project are ; To create a user friendly spreadsheet to provide realistic ratings for the SHEPD submarine cables presently installed To provide a comprehensive supporting manual including, where necessary, illustrative examples.				
Type(s) of innovation involved	Technological, Innovative and Financial				
Expected Benefits of Project	Quality of Supply and Financial				
Expected Timescale to adoption	Short - within three years.		Duration of benefit once achieved	10 years	
Estimated Success probability (at start of project)	20%				
PV of Project Costs	£41,053	PV of Project Benefits	£132,041	NPV of Project	£97,238
Commentary on project progress and potential for achieving expected benefits	Software has successfully been written with the package complete ready for adoption. Training will be required for operatives with this to be arranged as soon as possible to enable full implementation.				

Ultra TEV Alarm: April 2007 – March 2008

Description of project	The UltraTEV Alarm system is a cost effective way to provide permanent condition monitoring of switchgear, enhancing operator safety and providing confidence in the continuing reliability and safety of plant.				
Expenditure for financial year	Internal =£4,900 External=£22,690 Total Cost =£27,590		Expenditure in previous financial years	£0	
Technological area and / or issue addressed by project	The UltraTEV Alarm can be used for a variety of applications: • Low cost permanent monitoring of critical assets • Workforce confidence following a switchgear incident • Enhancing substation staff confidence and safety • To automatically restrict substation access • Extending life of assets scheduled for replacement • Indicating problems with newly commissioned switchgear				
Type(s) of innovation involved	Technological, Innovative and Financial				
Expected Benefits of Project	Quality of Supply, Financial and Safety				
Expected Timescale to adoption	Short - within three years.		Duration of benefit once achieved	10 years	
Estimated Success probability (at start of project)	20%				
PV of Project Costs	£28,434	PV of Project Benefits	£33,394	NPV of Project	£5,943
Commentary on project progress and potential for achieving expected benefits	Project currently on target with two trial installations being monitored by EA Technology with visibility to SSE via a web based interface.				

Synch PMR: April 2007 – March 2008

Description of project	This project is to develop an 11kV mobile synchronising switch to enable the reconnection of sections of 11kV overhead line which have been disconnected from the system for planned works with supplies maintained to customers via mobile generation.				
Expenditure for financial year	Internal = £3,900 External = £29,000 Total Cost = £32,900		Expenditure in previous financial years	£26,853	
Technological area and / or issue addressed by project	Increasing use of mobile diesel generation (MDG) has, wherever practical, reduced loss of supply to customers during planned works on the distribution networks. Where supply is being maintained by MDG it is currently not possible to synchronise the islanded network back to the Grid. This project aims to provide continuity of supply to consumers supplied by MDG.				
Type(s) of innovation involved	incremental				
Expected Benefits of Project	Financial project benefits resulting from reduction in labour costs. Quality of supply improvements derived from a reduction in CIs and CMLs.				
Expected Timescale to adoption	Short - three years.		Duration of benefit once achieved	20 years	
Estimated Success probability (at start of project)	Success probability is assessed as 20%				
PV of Project Costs	£ 26,000	PV of Project Benefits	£31,000	NPV of Project	£5,000
Commentary on project progress and potential for achieving expected benefits	Project currently on target. A suitable synchronising switch has been procured and a functional specification developed for a mobile synchronising unit which can be temporarily connected across the network switching point. This would allow the islanded network to be re-connected to the grid source without interrupting supply.				

Tower Loading Risk Assess. : April 2007 – March 2008

Description of project	Non intrusive techniques to ascertain the strength and integrity of underground steel and concrete components of overhead tower foundations.		
Expenditure for financial year	Internal =£13,900 External=£230,000 Total Cost =£243,900	Expenditure in previous financial years	£40,118
Technological area and / or issue addressed by project	Corrosion of steelwork in tower foundations has been a concern for some time as many steel overhead towers are more than fifty years old. The project will investigate the use of non-intrusive techniques to ascertain the strength and integrity of both underground steel and concrete components of the tower foundations of a representative sample of the Scottish and Southern overhead power distribution network. The investigation will be undertaken on the foundations of approximately 120 overhead towers to assess the feasibility of two complimentary techniques: 1. Polarisation Resistance Measurements to obtain an instantaneous value of the steel foundation corrosion rate that is based on the consideration of the electromechanical mechanisms involved in corrosion. These measurements will provide information on the state of the tower foundations and should identify foundations that are most likely to have suffered significant corrosion damage. 2. Transient Dynamic Response to assess the integrity of both pre-cast and cast in situ concrete piles. The method is based on measuring the frequency and amplitude response of a concrete foundation based on an impulse wave being passed through the foundation. The response contains information which is related to the integrity of the concrete foundation and to analyse the influences of the native soil surrounding the foundation. These techniques are not used by UK DNO companies to assess tower foundations, but other types of business have found them to be useful for assessing concrete and steel structures. The project objectives are: To undertake an initial investigation of 120 overhead tower lines using both techniques. To assess the feasibility and benefits of using this approach to assess all overhead tower assets. To analyse the data gained from the site surveys to provide a subset of towers where further investigation is recommended. To undertake witnessing of tower foundation excavation works where further investigation is recommended. To provide an assessment of the viability and effectiveness of the use of non-invasive assessments of tower foundations using Polarisation Resistance and TDR via a report on the findings from the techniques, the severity of any corrosion and/or concrete damage.		

Type(s) of innovation involved	Technological substitution				
Expected Benefits of Project	Financial benefits are expected to be derived from a reduction in unnecessary works on tower foundations.				
Expected Timescale to adoption	Short - three years.		Duration of benefit once achieved		25 years
Estimated Success probability (at start of project)	Success probability is assessed as 50%				
PV of Project Costs	£100,000	PV of Project Benefits	£160,000	NPV of Project	£60,000
Commentary on project progress and potential for achieving expected benefits	Project currently on target.				

RMU Substation Mini Monitor: April 2007 – March 2008

Description of project	The project outcome will result in the development of a low cost mini monitor with remote access to measure partial discharge activity in ring main units and associated connected cables. The monitor will be capable of being installed in one of two situations. · As a permanent installation into either the Remote Terminal Unit (RTU) of Ring Main Unit's (RMU's) to provide continuous, on-line partial discharge monitoring, · As a portable, stand-alone unit for temporary, continuous monitoring.				
Expenditure for financial year	Internal = £3,900 External = £31,250 Total Cost = £35,150		Expenditure in previous financial years	£0	
Technological area and / or issue addressed by project	By monitoring the condition of the insulation in HV plant it is possible to provide reliable life extension of these assets identifying and locating insulation defects before they lead to insulation failure. By integrating the PD test and monitoring technology within a condition-based asset management approach, electricity utilities can make huge savings to their OPEX and CAPEX expenditure.				
Type(s) of innovation involved	Technological and Innovative with financial benefits.				
Expected Benefits of Project	· Improving network reliability and availability and reducing customer minutes lost (CML) and customers interruptions (CI's) · By replacing only the cable accessories or small sections of cables where the insulation is defective, instead of the wholesale replacement of the entire cable (at huge expense) · By deferring asset replacement to beyond the 'design life' of the cable/switchgear whilst still maintaining good network reliability and availability figures.				
Expected Timescale to adoption	Short - three years.		Duration of benefit once achieved	20 years	
Estimated Success probability (at start of project)	Success probability is assessed as 30%				
PV of Project Costs	£68,103	PV of Project Benefits	£101,888	NPV of Project	£36,166
Commentary on project progress and potential for achieving expected benefits	Development of the Mini Monitor is currently on target with the Beta prototype in the final stages of development. Specification detail has been agreed between the collaboration partners. It is anticipated that pre production units will be available for field evaluation in the very near future. The project remains to on target for completion including analysis of field trial data during late 2008				

Application of Storage & DSM: April 2007 – March 2008

Description of project	To investigate and quantify the benefits of integration of electricity storage and Demand Side Management (DSM) technologies in the operation and development of active distribution networks.				
Expenditure for financial year	Internal = £3,900 External = £168,000 Total Cost = £171,900		Expenditure in previous financial years	£0	
Technological area and / or issue addressed by project	The main areas addressed are : • Feasibility assessment of alternative applications of DSM and storage to solve network problems; • Development of techniques for optimisation of the operation of active distribution network including real time control of storage and load control devices to manage network voltage and flow profiles in real time and • Quantification and optimisation of the multiple value streams of various storage applications and load control management				
Type(s) of innovation involved	Radical innovation				
Expected Benefits of Project	Benefits are expected to include • Quantification of the value of specific storage and DSM technologies • A business case showing whether storage and DSM can deliver value in the performance of the network				
Expected Timescale to adoption	7 years.		Duration of benefit once achieved	20 years	
Estimated Success probability (at start of project)	Success probability is assessed as 75%				
PV of Project Costs	£ 460,000	PV of Project Benefits	£tba	NPV of Project	£tba
Commentary on project progress and potential for achieving expected benefits	Significant progress has been made in the development of tools to quantify the value of Demand Side Management and storage in applications for active distribution network management strategies. Initial findings indicate that application of Demand Side Management and storage techniques for active management of distribution networks have most value in congested urban areas with restrictions on the physical expansion of the system or when increased amounts of distributed generation need to be integrated in the existing networks. On the basis of the sample networks studied, demand side management provides the most cost effective application to these network problems.				

	Project progress against the main areas up to March 2008: • Models of responsive demand and storage have been developed and implemented in the UKGDS generic network and case study EDF Energy Networks' 11kV network areas to solve specific network problems; • Detailed models of heat demand in commercial buildings for use in network management applications have been devised and tested; • Techniques and prototype algorithms for congestion management in distribution networks have been developed and tested in the case study network areas; and • Identification of the regulatory and commercial barriers for application of storage and DSM in network management strategies.

IntelliTeam Network Automation: April 2007 – March 2008

Description of project	A pilot scheme to evaluate the performance of next generation network automation to automatically reconfigure the network into isolatable sections.			
Expenditure for financial year	Internal = £5,900 External = £98,500 Total Cost = £104,400		Expenditure in previous financial years	£0
Technological area and / or issue addressed by project	It is proposed to establish a pilot scheme to evaluate both the overhead and underground plant functionality and how they can interact on mixed networks. The pilot will be split into three phases – phase 1 is to understand the costing and technical requirements for interfacing onto our network and the design of an underground circuit breaker – phase 2 is to install the equipment on a section of overhead network with phase 3 on a section of underground network			
Type(s) of innovation involved	Incremental Innovation, Technological Substitution, Significant Innovation.			
Expected Benefits of Project	Large improvements in CI/CMLs can be achieved using true automation - exploiting modern technology, and where the manual element is removed as much as possible. Using 'intelligent' auto-reclosers there is no restriction imposed by protection discrimination – this being achieved using a high speed radio link with banks of auto-reclosers having the same protection settings. These auto-reclosers will detect the faulted section, reclose for transient faults, isolate permanent faults and reconfigure the network. The control engineer would only see permanent faults. Real time load management and network constraints will allow the load management to be automated. This scheme can equally well be applied to the underground network using bespoke circuit breakers.			
Expected Timescale to adoption	Short - three years.		Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	Success probability is assessed as 50%			
PV of Project Costs	£ 188,325	PV of Project Benefits	£ 277,860	NPV of Project	£ 95,713
Commentary on project progress and potential for achieving expected benefits	Circuit locations have been identified along with plant requirements. Communication surveys are in progress with communications equipment testing to follow. Production of overhead plant is on schedule with deployment of first overhead equipment during summer of 2008 Factory acceptance testing of the system with radios developed for UK use has been carried out. The project is on target.			

Trenchless Wash Over System: April 2007 – March 2008

Description of project	To develop and trial a system to allow in situ replacement of existing underground cables with new cables				
Expenditure for financial year	Internal = £30,000 External = £0 Total Cost = £30,000		Expenditure in previous financial years	£0	
Technological area and / or issue addressed by project	The replacement of underground cables is usually carried out by open excavation which creates significant disruption, incurs significant cost and has a significant impact on the environment. The general public and business community are increasingly less tolerant of road closures and delays due to infrastructure works.				
Type(s) of innovation involved	Incremental				
Expected Benefits of Project	Benefits are expected to be • Reduction in material sent to landfill • Reduction in costs • Less disruption				
Expected Timescale to adoption	Short - three years.		Duration of benefit once achieved	5 years	
Estimated Success probability (at start of project)	Success probability is assessed as 50%				
PV of Project Costs	£ 60,441	PV of Project Benefits	£ 642,551	NPV of Project	£ 582,110
Commentary on project progress and potential for achieving expected benefits	Project is on track Initial development works have been carried out to develop the traditional directional drilling system to an innovative “overwash” system. Delivery has been taken of a new improved overwash head based on the results of field trials.				

Appendix 1: Summary Listing of IFI Project Costs

	SHEPD Int Cost	SHEPD Total Cost	SEPD Int	SEPD Total Cost	SSEPD Total Cost
Overhead Network Module	1965	16287	3935	32623	48910
Cable Networks Module	1965	19320	3935	38697	58017
Substation Module	1965	14646	3935	29335	43981
Distr. Energy Resources Module	1965	19027	3935	38111	57138
PD User Group	1299	3281	2601	6573	9854
Protective Coatings Forum	1632	3630	3268	7270	10900
ENA Projects	1299	3154	2601	6316	9740
DG and ARM Projects	1299	14851	2601	29748	44599
Supergen 5	1299	9624	2601	19276	28900
Orkney ANM	1965	26274	3935	52626	78900
Self Tuning Petersen	1632	11108	3268	22248	33356
Distribution Network Analysis	1965	13882	3935	27806	41688
Integrated Veg Management	1798	19114	3602	38286	57400
Live Line Tree Felling	1798	2714	3602	5436	8150
Power Electronics Regulator	1299	26568	2601	53217	79785
Crow control	4962	6627	9938	13273	19900
GIS Tree clearance	4962	17949	9938	35951	53900
LV Sure	1632	25323	3268	50721	76044
HV Sure	1299	1289	2601	2601	3900
CBRM (Transformers)	1965	7959	3935	15941	23900
Crater for Submarine Cables	1632	13562	3268	27165	40727
Ultra TEV Alarm	1632	9187	3268	18403	27590
Synch PMR PH2	1299	10956	2601	21944	32900
Tower loading risk assessment	4629	81219	9271	162681	243900
RMU S/S Mini Monitor	1299	11705	2601	23445	35150
Application of Storage & DSM	1299	57243	2601	114657	171900
IntelliTeam DA	1965	34765	3935	69635	104400
Trenchless Wash Over System	9990	9990	20010	20010	30000
Total	**63703**	**491261**	**127597**	**983998**	**1475259**

Appendix 2 - RMU Substation Mini Monitor

Background to the Project

In February 2007 IPEC HV completed a 10-month DTI R&D sponsored development project on the PD Surveyor TM hand held Partial Discharge (PD) test unit. This handheld technology has been developed to be used for initial PD 'screening' of indoor MV plant and has the dual benefit of being used as both a personal safety and security device *and* as a first-line PD detection and 'screening' unit, suitable for use by all operational staff in indoor MV substations.

Further to discussions and demonstrations of the PD Surveyor TM unit which have been held with UK DNO's over the past 6 months it has been proposed that the new design of a remote-access mini-monitor should be developed, based on the hand-held PD Surveyor TM technology. The simple, low-cost monitor will be designed for the dual application, as follows:

- As a permanent installation into either the Remote Terminal Unit (RTU) of Ring MainUnit's (RMU's) to provide continuous, on-line partial discharge monitoring,
- As a portable, stand-alone unit for temporary, continuous monitoring.

The technology will be called the SSM-Mini™ PD Monitor and it will be designed to measure and store PD levels in the cables and switchgear to which it is attached. The monitoring data will be stored locally in 'flash' memory and will also be automatically downloaded every 20-30 minutes and transmitted over the SCADA system via the RTU and/or other communications systems.

Permanent Unit for installation into the Remote Terminal Units of Ring Main Unit's (RMU's)

It is envisaged, in the long-term, that the main application of the SSM-Mini™ PD Monitor will be for it to be installed permanently in the Remote Terminal Unit *(*RTU*)* of Ring Main Units (RMU's) or other secondary switchgear to monitor PD activity in the both cables and the RMU/Switchgear itself. This system will provide an 'early-warning' (via the remote-access comms system) against incipient insulation faults on the network by sending out an alarm if PD activity increases beyond pre-set thresholds. A measurement of the cumulative PD activity (i.e. PD magnitude x number of pulses) in the cables and switchgear will be made which will be called the PD 'Criticality'. IPEC HV have recently developed a Concept Design (Alpha Prototype) for the Permanent, RTU mounted SSM-Mini™ PD Monitor unit which is shown below in Figure 1. This will be developed to final production design through 2x design iterations during the project.

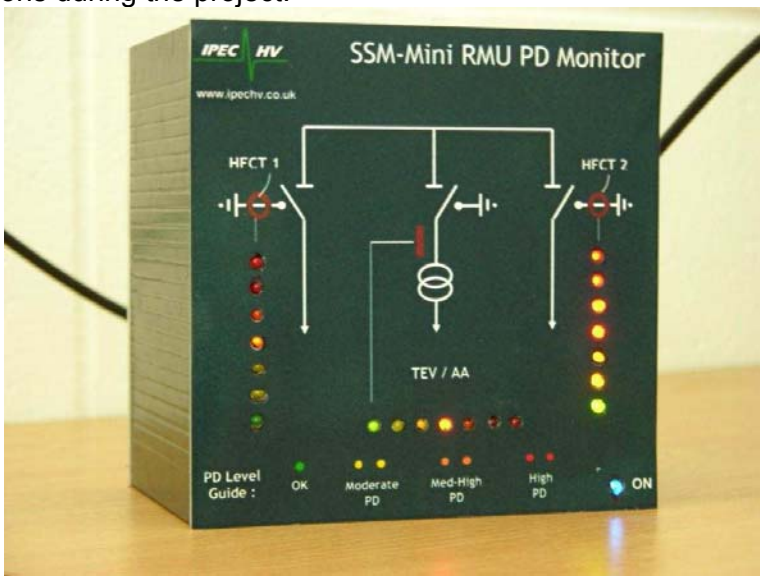


Figure 1: Concept Design (Alpha Prototype) of Permanent SSM-Mini™ RMU PD Monitor

Portable Unit for moving between Substations and RMU's

The secondary application for the SSM-Mini Technology will be as a stand-alone, portable PD Monitor which can be left in the substation or extended periods of time of between 1 day up to 6 months to log and trend PD data. As per the permanent version shown in Figure 1 on the previous page, data will be downloadable either manually (from the built-in flash memory) or remotely via the SCADA/comms system. It is intended that the communications system will very flexible in order to interface with most modern comms systems; direct serial link, LAN, Bluetooth via a central 'Bluetooth hub' and/or other comms platform requested by the DNO partners.
In order to test and evaluate the technology during the development project in as wide a number of substations as possible during the project it is proposed that a total of 10x Portable SSM-Mini Monitors are supplied to the DNO partners for trialling on their networks in months 9 to 11 of the project.

SSM-Mini™ RMU PD Monitor - Features

- Low-Cost 24/7 PD Monitoring Technology for primary switchgear & cables, ring main units (RMU's) and other secondary MV switchgear and cables
- Permanent Unit will incorporate 3x permanent PD sensors - 2x HFCT for cable PD detection and 'precedence' timing & 1x TEV for 'local'/switchgear pd detection
- Portable Unit will incorporate 4x portable PD sensors - 2x HFCT for cable PD detection and 'precedence' timing 2x TEV for 'local'/switchgear pd detection and 'precedence' timing
- Measures and Logs Cable PD and 'Local' PD in the Switchgear (Magnitude & Count)
- Stores up to 6 months of data on local 'flash' memory
- Generates a PD 'Criticality' Measurement (0-100) with 7x colour-coded PD levels
- Downloads PD data every 20-30 mins via RTU SCADA and/or other comms systems
- Compact, panel mount enclosure for easy integration in RTU (permanent installation)
- Compact, lightweight unit for portable installations.
- 'Precedence Detector' functionality for cable & TEV PD signals to show 'which pulse came first' to provide directional data on the source of PD's detected
- Allows for further extension of PD monitoring into the network, beyond the 'reach' of PD monitors installed at Primary Substations.

Appendix 3 - Bowden Rightway MK10 GSM

INTRODUCTION

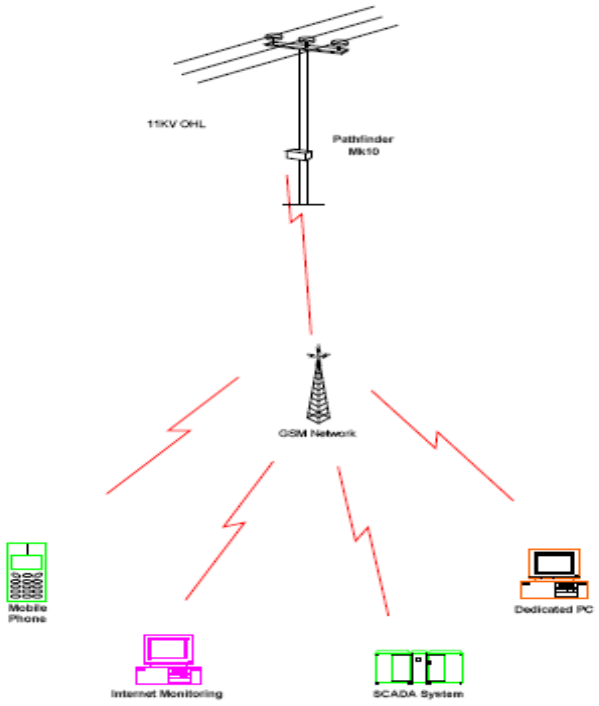
The Rightway Pathfinder Mk10 is an instrument for indicating the passage of fault current in overhead 11KV and 33KV power lines and then transmitting an SMS text message to a remote mobile phone, PC, SCADA system or internet website.
It has been developed from our earlier popular range of overhead line fault passage indicators and has the same reliability of earlier models, but now incorporates additional features, which provide additional benefits to the power system engineer.

DESCRIPTION

The Pathfinder Mk10 outer enclosure is in a polycarbonate UV resistant material with an IP Rating of IP65. Electronics are conformal coated as a precaution against condensation. The Antenna mounting is inside the enclosure for added security.
The micro-chip controlled electronics is powered by a Lithium Thionyl Chloride Battery with a service free life of up to10 years, dependant on usage.
A bright RED flip flop Flag Indicator behind the clear lens gives a positive visual indication of the passage of fault current in the overhead line conductors.
Two weatherproof external switches on the front of the instrument provide an ON/OFF battery test control and a dual sensitivity option.

COMMUNICATIONS

This Pathfinder Mk10 incorporates the Bowden Powerwatch System which is a new generation remote monitoring system that uses a Dual Band GSM network as the communications medium.
The Pathfinder Mk10 outstation communicates with a base station via a GSM network SMS messaging system to report that there has been a passage of fault current on the overhead line conductors at that location on the distribution network.
The Mk10 reports to a base station that can take several forms and includes mobile telephone free standing PC, internet based site and SCADA integrated display.



Communications Architecture