Innovation Funding Incentive Reports

Scottish Hydro Electric Power Distribution

Southern Electric Power Distribution

for period 1 April 2006 to 31 March 2007

Contents

1. Executive Summary

During the year ended 31 March 2007, Scottish Hydro Electric Power Distribution plc (SHEPD) and Southern Electric Power Distribution plc (SEPD) have initiated new innovative projects and continued IFI projects started in the previous year.

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 2006 to 31 March 2007 has been £1,018,000 for Scottish and Southern Electric Power Distribution (SSEPD) which includes both SHEPD and SEPD.

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 is to encourage the distribution network operators (DNOs) to apply innovation in the way they pursue the technical development of their networks. A Good Practice Guide (Engineering Recommendation G85) has been produced by the DNOs that is available free of charge via the website of the Energy Networks Association (ENA): www.energynetworks.org.

The IFI is intended to provide funding for R&D projects focused on the technical development of distribution networks to deliver value (i.e. financial, supply quality, environmental, safety) to end consumers. IFI projects can embrace any aspect of distribution system asset management from design through to construction, commissioning, operation, maintenance and decommissioning. A DNO 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 Scottish and Southern Energy (SSE) website: www.scottish-southern.co.uk. To enhance their accessibility, they will also be available on Ofgem's website: www.ofgem.gov.uk

SSE and its energy network subsidiary 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 2006 to 31 March 2007.

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 Distributed Generation Regulatory Instructions and Guidance (RIGs) issued by Ofgem and ENA Engineering Recommendation G85.

In addition to reporting on activities in 2006/07 we have included information on current projects and intended developments.

4. Overview of IFI Activity

Our programme of projects in 2006/07 is made up of a combination of projects which have originated as a result of collaborative work with external organisations such as EA Technology Ltd (EATL) and the ENA and 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 faster sectionalising of overhead line faults by deploying portable fault passage indicators coupled with newly available Global Systems for Mobile (GSM) communications technology.

In the SHEPD area, considerable amounts of renewable generation, mainly wind farms, are in the process of being connected to our network. However, network constraints have become apparent in many geographic areas which currently limit the amount of generation we can connect until extensive transmission reinforcements are completed. We believe active network management systems and other methodologies can be developed to allow more generation to be connected. 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 in 2007/08 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 are currently investigating other engineering approaches to facilitate the connection of Distributed Generators (DG) including voltage regulation using power electronics and small scale reactive compensation.

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

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 2007/08.

Present Work and Future Developments

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 5 – Asset Management and Performance of Energy Systems. SUPERGEN is 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 and it is expected that the work packages within this collaboration will lead to demonstration projects which will meet the criteria to qualify for eligibility as IFI projects so that the research activity can be developed to deliver benefits to end users.

SSEPD has also joined SUPERGEN 1 – FlexNet. This large EPSRC supported consortium, involving seven universities, will research 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.

The name FlexNet provides linkage to the first FutureNet programme whilst recognising the distinctive aspects of the work now to be done, and the strapline 'Thinking Networks' emphasises the consortium's intention to both "think about networks" and to develop networks that can "think" for themselves. FlexNet's intention is to 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 and noted by Government and regulatory authorities.

The addition of a Transmission category to the IFI mechanism will lead to a new portfolio of projects in 2007/08 which will be taken forwards by Scottish Hydro Electric Transmission Ltd. – the transmission licensee within SSEPD.

5. Financial Summary

As R&D activities are operated from a common perspective across both 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 (CDNR). In round terms, this leads to 30% being allocated to SHEPD and 70% to SEPD.

Qualifying expenditure for the reporting period of 1 April 2006 to 31 March 2007 has been £ 302,000 for SHEPD and £ 716,000 for SEPD, of which £37,000 and £99,000 relates respectively to internal costs. The overhead costs associated with the employment of a full time R&D Manager have been apportioned across the portfolio of projects.

Financial information on the IFI projects relevant to the reporting year 1 April 2006 to 31 March 2007 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.

6. Conclusion

SSEPD recognises the key role that R&D can play in enabling our industry to meet the challenges of an ageing infrastructure, a changing generation mix and increasing customer expectations. Our intention is to focus on delivering the benefits of our current projects and to develop our portfolio of projects further to address areas that will provide further benefits.

Section 7

Scottish Hydro Electric

Power Distribution

IFI Report

for period

1 April 2006 – 31 March 2007

Scottish Hydro Electric IFI Report

Summary report of IFI project activities: April 2006 – March 2007

Number of active IFI projects.	28
NPV of costs and anticipated benefits from committed IFI projects.	NPV = £ 505,000 .
Summary of other benefits anticipated from active IFI Projects.	Various customer, safety and environmental benefits will also accrue which are as yet not fully quantified.
Total expenditure to date on IFI projects.	£ 733,000
Benefits actually achieved from IFI projects to date.	Reduction in capital cost of underground cable installation Improvement In Quality of Supply due to reduction in CIs and CMLs

Regulatory Report for DG incentive, RPZs and IFI Reporting year 2006/07 Scottish Hydro Electric Power Distribution plc	**£m**
IFI carry forward to 2007/08 (£m)	**0.376**
Eligible IFI Expenditure (£m)	**0.302**
Eligible IFI Internal Expenditure (£m)	**0.037**
Combined Distribution Network Revenue (£m)	**150.3**

Section 8

Southern Electric Power Distribution

IFI Report

for period

1 April 2006 – 31 March 2007

Southern Electric Power Distribution IFI Report

Summary report of IFI project activities:– April 2006 – March 2007

Number of active IFI projects.	28
NPV of costs and anticipated benefits from committed IFI projects.	NPV = £ 1,178,000
Summary of other benefits anticipated from active IFI Projects.	Various customer, safety and environmental benefits will also accrue which are as yet not fully quantified.
Total expenditure to date on IFI projects.	£ 1,573,000
Benefits actually achieved from IFI projects to date.	Reduction in capital cost of underground cable installation Improvement In Quality of Supply due to reduction in CIs and CMLs

Regulatory Report for DG incentive, RPZs and IFI Reporting year 2006/07 Southern Electric Power Distribution plc	**£m**
IFI carry forward to 2007/08 (£m)	**0.930**
Eligible IFI Expenditure (£m)	**0.716**
Eligible IFI Internal Expenditure (£m)	**0.099**
Combined Distribution Network Revenue (£m)	**372.0**

Section 9

Scottish Hydro Electric
Power Distribution

Southern Electric Power Distribution

Individual IFI Project Reports

for period

1 April 2006 – 31 March 2007

Overhead Network Module: April 2006 – March 2007

Description of project	Strategic Technology Programme Overhead Network Module		
Expenditure for financial year	Internal = £5,853 External = £36,972 Total = £42,825	Expenditure in previous financial years	£66,400
Technological area and / or issue addressed by project	The STP overhead network programme for budget year 2006/7 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 - Undertake long-term monitoring of conductor temperature by obtaining and analysing 12 months trial data. • S2132_2 - Validate current and proposed new ice accretion models • S2136_2 - Participation in European Project COST 727: Measuring and forecasting atmospheric icing on structures. • S2138_2 - Investigate live-line jumper-cutting limitations Stage 2 is to undertake a controlled test programme. • S2143_1 - To detect in-situ degradation of aluminium overhead line conductors • S2144_1 - Determine the residual strength of tower fittings through experimental means • S2145_1 - Explore the use of novel conductors for uprating tower line circuits.		

	• S2146_1 Undertake torsion testing to evaluate possible limits for composite tension insulators • S2147_1 Investigate the effect of multiple Spiral Vibration Dampers (SVD's) on the performance of overhead line conductors • S2149_1 – Explore high durability overhead line fittings. Initial stage to identify the range of fittings and materials.
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.

<table>
<tr><td>Expected Timescale to adoption</td><td colspan="2">Range 1-5 years - dependent on project</td><td>Duration of benefit once achieved</td><td colspan="2">Range 3-10 years - dependent on project</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">Range 1-10% - dependent on project</td></tr>
<tr><td>PV of Project Costs</td><td>£43,000
(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>£63000</td><td>NPV of Project</td><td>£20000</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.
• S2126_3 - Undertake long-term monitoring of conductor temperature by obtaining and analysing 12 months trial data. First year form initial test site data suggests that uprating may be possible in specific circumstances. A further site has been established and is being monitored.
• S2132_2 - Validate current and proposed new ice accretion models. Data has been gathered from the test site and is being analysed prior to presentation to members.
• S2136_2 - Participation in European Project COST 727: Measuring and forecasting atmospheric icing on structures. This is part of a much larger European collaborative project aiming to provide more accurate mapping of ice prone areas. Involvement is continuing with data exchange with other participants.</td></tr>
</table>

	• *S2138_2 - Investigate live-line jumper-cutting limitations Stage 2 is to undertake a controlled testing programme.* The aim is to establish practical and safe limits for operational jumper cutting. • *S2143_1 - To detect in-situ degradation of aluminium overhead line conductors.* The preliminary work to explore available techniques has been completed. • *S2144_1 - Determine the residual strength of tower fittings.* A possible technique is being investigated which has clear financial benefits compared with traditional methods. • *S2145_1- Explore the use of novel conductors for uprating tower-line circuits.* This project is determining the applicability at the distribution level of novel conductor designs used at transmission voltages to allow increased ratings using existing structures. • S2146_1 - *Undertake torsion testing to evaluate possible limits for composite tension insulators.* Laboratory testing has indicated torsion limits for a range of such insulators, which can be used to inform field staff. • *S2147_1 - Investigate the effect of multiple Spiral Vibration Dampers (SVD's) on the performance of overhead line conductors.* The application of either multiple SVD's or heavy duty SVD's could allow increased overhead line tension • *S2149_1 - Explore high durability overhead line fittings. Initial stage to identify the range of fittings and materials.* This project is at an early stage and possible materials and treatments to improve corrosion resistance have been identified.

Cable Networks Module :– April 2006 – March 2007

Description of project	Strategic Technology Programme Cable Networks Module		
Expenditure for financial year 2005/06	Internal = £5,853 External = £36,972 Total = £42,825	Expenditure in previous financial years	£66,400
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_6 - Addition of single core MV paper cable modeling functionality within CRATER cable rating software. • S3132_7 - Addition of cable crossing modelling functionality within CRATER cable rating software. • S3132_8 - Addition of load curve modelling functionality within CRATER cable rating software. • S3132_9 - Addition of fluid filled cable modelling functionality within CRATER cable rating software. • S3132_11 - Addition of EHV polymeric cable modelling functionality within CRATER cable rating software. • S3140_2 – Towards Best engineering practice for ducted cable systems. • S3145_1 – Investigate shrink back performance of PE sheath and insulation – Establish reliable test method. • S3146_1 – Testing of fire retardant coatings and tapes. • S3148_1 and S3148_2 - Requirements for earthing and bonding of single core MV power cables		

	• S3149_1 Assessment of different HV polymeric cable designs • S4158_1 – Investigate user requirements for ducts • S3159_1 - Series resonant testing of short lengths of HV cable				
Type(s) of innovation involved	Technical Substitution / Radical				
Expected Benefits of Project	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.				
Expected Timescale to adoption	Range 1-3 years - dependent on project	Duration of benefit once achieved	Range 2-7 years - dependent on project		
Estimated Success probability (at start of project)	Range 2-20% - dependent on project				
PV of Project Costs	£43,000 (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	£53,000	NPV of Project	£10,000

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. • *S3132_6 - Addition of single core MV paper cable modeling functionality within CRATER cable rating software.* The functionality to model and analyse this cable type is now available within the CRATER software tool, allowing member companies to evaluate a wider range of circuits. • *S3132_7 - Addition of cable crossing modelling functionality within CRATER cable rating software.* Comprehensive cable crossing functionality is now available in CRATER, allowing member companies to determine their own cable ratings and the interaction with NGC cables. • *S3132_8 - Addition of load curve modelling functionality within CRATER cable rating software.* The load curve modeling functionality in CRATER now allows a more accurate representation of the loads when determining ratings. • *S3132_9 - Addition of fluid filled cable modelling functionality within CRATER cable rating software.* A user-friendly spreadsheet tool for the cable engineer was created to determine sustained, cyclic and distribution current ratings for fluid filled cable ratings, using approved methods of calculation. • *S3132_11 - Addition of EHV polymeric cable modelling functionality within CRATER cable rating software.* The functionality to model and analyse this cable type is now available within the CRATER software tool, allowing member companies to evaluate a wider range of circuits. • *S3140_2 – Towards best engineering practice for ducted cable systems.* The report will form a sound basis for the creation of engineering recommendations and guidance documents for ducted cable systems.

	• *S3145_1 – Investigate shrink back performance of PE sheath and insulation – Establish reliable test method.* The project has demonstrated that shrink back can occur at lower temperatures and proposed a test to predict in service shrink back. • *S3146_1 – Testing of fire retardant coatings and tapes.* The project has, through testing, demonstrated an effective means of fire protection for triplex cables. • *S3148_1 and S3148_2 - Requirements for earthing and bonding of single core MV power cables.* Cable engineers can now determine the size of circulating currents and losses for their cable networks and use this information to determine, if appropriate, a cable size based on whole life costs. • *S3149_1 Assessment of different HV polymeric cable designs.* The initial stage of this project has not identified a suitable replacement design to lead sheaths for use as an effective moisture barrier in HV XLPE insulated cables rated at 66kV and higher. • *S4158_1 – Investigate user requirements for ducts.* This project will allow DNOs to better tender for all types of plastic cable ducts since the requirements have been agreed between all users and all the major manufacturers • *S3159_1 - Series resonant testing of short lengths of HV cable.* This project will determine whether the use of variable frequency test sets is too onerous for the commissioning of short lengths of HV cable.

Substation Module : April 2006 – March 2007

Description of project	Strategic Technology Programme Substation Module		
Expenditure for financial year 2005-06	Internal = £5,853 External = 36,972 Total = £42,825	Expenditure in previous financial years	£66,400
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 2006/07 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_3 – On load tap changer monitor – Stage 3. • S4176_2 – Comparison of available earth testing instruments • S4185_2 – AM Forum membership. • S4191_1 – Update and populate CBMVAL database. • S4193_2 – Enable effective quantification of risk and reliability. • S4194 – Regenerative transformer breathers. • S4197_1 – Concrete structure assessment.		

	• S4200_1 – Methods to assess oil bunds and intelligent pump technology • S4201_1 – Corrosive sulphur in transformers • S4202_1 – Out of phase switching • S4203_1 – Review of INSUCON • S4205_1 – Assessment of contact greases for outdoor applications. • S4206_1– Substation security • S4207_1 – ERS33 switchgear rating at reduced temperature • S4208_1– Investigate the re-assessment of switchgear ratings • S4209_1 – Post maintenance testing • S4211_1 – Management and use of actuators • S4215_1 – Internal arc considerations in substations		
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	1-3 years - dependent on project	Duration of benefit once achieved	2-7 years - dependent on project

<table>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">5-40% - dependent on project</td></tr>
<tr><td>PV of Project Costs</td><td>£43,000
(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>£59,000</td><td>NPV of Project</td><td>£16,000</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.
• S4164_3 – On load tap changer monitor – Stage 3. The results from extending the laboratory system into a live substation have been very encouraging and a subsequent stage will allow an extended trial on a wider range of tap changers.
• S4176_2 – Comparison of available earth testing instruments. The project permitted cost effective comparison of four different types of electrode system to evaluate each instrument in relation to accuracy, cost, usability and robustness.
• S4185_2 – AM Forum membership. This project allowed members to be updated on substation asset management policies and practices adopted by other European Transmission System Operators (TSOs) and Distribution Network Operators in a cost effective manner.</td></tr>
</table>

	• *S4191_1 – Update and populate CBMVAL database.* This project has delivered an up-to-date and easy-to-use software tool that enables members to make a valid assessment of the net financial benefits that might accrue from the implementation of CBM. • *S4193_2 – Enable effective quantification of risk and reliability.* The project collated and analysed the consequences of recent events (over the past 10 years) in order to establish 'benchmarks' to quantify risk. • *S4194 – Regenerative transformer breathers.* The project undertook an independent evaluation and cost benefit analysis of "maintenance-free" desiccant breathers. • *S4197_1 – Concrete structure assessment.* The project highlighted the more common types of concrete degradation and the testing that is available to assess the extent of this degradation • *S4200_1 – Methods to assess oil bunds and intelligent pump technology.* The project will enable members to compare the different policies, practices and bund pump technologies that have been adopted and to identify best practice. • *S4201_1 – Corrosive sulphur in transformers.* The project informed members regarding the issues and consequences of the failures in transformers due to corrosive sulphur. • *S4202_1 – Out of phase switching.* The project facilitated expert debate of out of phase switching issues. It was necessary for DNOs to fully understand the underlying system conditions and agree a common approach. • *S4203_1 – Review of INSUCON.* This project provided a cost effective summary commentary of INSUCON content and its relevance to members. • *S4205_1 – Assessment of contact greases for outdoor applications.* The project will recommend suitable products for the lubrication of outdoor contacts and identify best practice for their application.

	• *S4206_1– Substation security.* This project will undertake a wide review of the concept of, and approach to, the physical security of substations in order to deter theft. • S4207_1 – *ERS33 switchgear rating at reduced temperature.* The project will provide guidance that may allow utilities to run switchgear above maximum normal rated current values under specific conditions. • *S4208_1– Investigate the re-assessment of switchgear ratings.* The project will consider the provision of a methodology for understanding the risk of re-assigning switchgear fault level ratings without type testing. • *S4209_1 – Post maintenance testing.* The project will enable members to carry out the most appropriate testing regimes both from a financial and technical perspective and to establish pass/fail criteria. • *S4211_1 – Management and use of actuators.* This project should assist the members in ensuring that the risk of actuator failure is reduced, their reliability is increased and maintenance and testing is optimised. • *S4215_1 – Internal arc considerations in substations.* The project will enable members to better select HV/LV switchgear with respect to internal arc and ultimately lead to enhanced safety within the substation environment.

Distr. Energy Resources Module :– April 2006 – March 2007

Description of project	Strategic Technology Programme Networks for Distributed Energy Resources Module		
Expenditure for financial year 2006/7	Internal = £5,853 External=£36,972 Total = £42,825	Expenditure in previous financial years	£66,400
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_3 – Monitor Micro-generator Clusters • S5149_4 – Explore Active Voltage Control • S5142_2/3 – Generator Data and Structure for DG Connection Applications Stages 2 and 3 • S5152_2 – Latest developments in the connection of distributed generation • S5154 –Voltage Control Policy Assessment Tool on the IPSA Platform • S5157_1 – Evaluate the Performance of Small Scale Reactive Power Compensators Stage 1 • S5157_2 – Evaluate the Performance of Small Scale Reactive Power Compensators Stage 2 • S5160_1 – ACTIV Active Voltage Control • S5161 – Standard risk assessment approach to DNO protection • S5162 – Risk assessment analysis of voltage step changes		

	• S5164 – Managing network risks associated with the application of ER P2/6 • S5167 – Assessment of enhanced ratings for overhead lines connecting wind turbines • S5168 – Design and operation implications for Grid Code compliance • S5180 – DNMS functions to support active network management
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	1-7 years - dependent on project
Estimated Success probability (at start of project)	5-30% - dependent on project		

PV of Project Costs	£43,000 (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	£70,000	NPV of Project	£27,000

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. • *S5147_3 – Microgenerator Clusters.* Installation of monitoring points is complete at both the substation and LV network level. A twelve month monitoring programme has commenced. • *S5149_4 – Explore Active Voltage Control.* Modelling of typical radial and interconnected networks in preparation for flexing key parameters to examine limits of active voltage control. • *S5142_2/3 – Generator Data and Structure for DG Connection Applications.* A rationalised data structure has been agreed and implemented with all terms defined.

	• *S5152_2 – Latest Developments in the Connection of Distributed Generation.* Regular updates on new developments have been provided to members to help inform and influence the research programme. • *S5154_1 – Develop a voltage Control Policy Assessment Tool on the IPSA Platform.* An interface between the existing eaVCAT software and the widely used IPSA power system analysis software has been established with eaVCAT making use of an embedded IPSA analysis routine. • *S5157_1 – Performance of Small Scale Reactive Power Compensators.* Five devices were identified, detailed information gathered and comparisons made using key criteria measures from members. • *S5157_2 – Performance of Small Scale Reactive Power Compensators.* This project examined the usage of DStatcoms with large windfarms and explored the implications for DNOs. • *S5160_1 – ACTIV Active Voltage Control.* An initial scoping study was completed and further work will be undertaken outside of the STP programme. • *S5161 – Standard risk assessment approach to DNO protection.* This stage of the project identified possible standard risk assessment approaches that could be developed for the selection of protection systems at the DNO / User interface • *S5162 – Risk assessment analysis of voltage step changes.* The project investigated voltage step changes in order to define possible limits used when planning network developments and generator connections. • *S5164 – Managing network risks associated with the application of ER P2/6.* The project examined the application of P2/6 across members and developed a baseline view of the network required to deliver minimum-security standards.

	• *S5167 – Assessment of enhanced ratings for overhead lines connecting wind turbines.* The project will determine if enhanced ratings can be safely applied to lines connected to wind-farm generators without the risk of infringing statutory line-to-ground clearances, and if so to recommend appropriate correction factors. • *S5168 – Design and operation implications for Grid Code compliance.* The project explores the network design and operational implications of the Grid Code target volts and slope concept. It will develop a testing procedure for DNOs to check the necessary voltage control with recommendations for 'standard' settings. • *S5180 – DNMS functions to support active network management.* To inform members of the additional active network management functionalities available in DNMS systems that are not typically being used in the control rooms at present.

PD User Group :– April 2006 – March 2007

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 = £5,853 External = £5,954 Total = £11,807	Expenditure in previous financial years	£16,060
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	**Enhanced data manager** During FY06 the PD User Group invested in the formation of a database of results that enables significant and key information to be quickly drawn from the large population of historical results. The database can now incorporate pictures, drawings, failure records, sound files (for the analysis of heterodyned ultrasonic activity). This greatly enhances the incident reporting facilities which helps engineers to better interpret the results of partial discharge surveys and make an assessment on whether switchgear is in need of immediate attention. The database requires fine tuning and a new PD Template has been made available to all members and the input of additional data will now be the key to realising best use of the functionality. **Profile of the long term degradation of switchgear** Another 11kV switchgear panel has been installed into a test cage and long term testing has begun. Further knowledge on the relationship between surface discharge and relative humidity and profile through to failure will be gained. **Project progress to March 2007** • The panel of 11kV switchgear eventually failed due to Partial Discharge activity, a lot has been learnt regarding the relationship between surface discharge and relative humidity levels. • Outdoor switchgear trials completed as per schedule. • Several new instruments / accessories developed to be tested by members. New PD database demonstrated, some fine tuning reqd.				

Protective Coatings Forum :– April 2006 – March 2007

Description of project	Protective Coatings Forum		
Expenditure for financial year	Internal = £4,853 External = £6,000 Total = £ 10,853	Expenditure in previous financial years	£13,500
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 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 2006 – March 2007

Description of project	Four projects initiated by the ENA R&D Working Group. The Energy Networks Association (ENA) represents all UK DNOs.		
Expenditure for financial year	Internal = £5,558 External = £13,899 Total Cost =£19,457	Expenditure in previous financial years	£32,000
Technological area and / or issue addressed by project	The projects undertaken through budget year 2006/7 addressed real problems that had been identified by the ENA Working Groups as significant and which required technical investigation and development. • **ROCOF Relay functional specification** – Produce an Engineering Report into the sensitivity of loss of mains relays to genuine loss of mains by determining the number of sample cycles required and the percentage change of load compared to generator ratings (of different construction and size).The test information will be used to develop a matrix of optimum settings and test procedures for relay specification. • **SG12 Fault Level Monitor** – Develop a Fault Level Monitor (FLM) that can successfully measure fault level on a distribution network with repeatability and reliability. The FLM instrument shall use the underlying methodology proven with EA Technology's existing Extended Supply Monitor and shall measure normally occurring events (e.g. small scale disturbances resulting from tap changer operation), so no customer supply interruption will be required. • **SG14 Earthing Project** – 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. • **SG17 Lightning Protection** - Produce a new Engineering Technical Report on lightning protection to include: Background information on lightning density across the UK, annual variations and effect of topography. Catalogue and provide a view on current practices and procedures. Determine and advise on equipment protection levels and arrangements.		
Type(s) of innovation involved	Incremental and Significant innovation types are involved.		
Expected Benefits of Project	• **ROCOF Relay functional specification** – Improved understanding will allow more effective settings to be applied to these relays, which will reduce the number of spurious trips. This will improve power quality to other connected customers and the specification should reduce the cost associated with generation scheme quotes.		

<table>
<tr><td></td><td colspan="5">

- **SG12** – The FLM instrument will allow fault infeed levels to be accurately assessed. This will provide an objective measurement tool that can be used to facilitate both the initial connection of distributed generation and ongoing assessment of its effects.
- **SG14** – This project will investigate the effects of LV earth systems on HV systems. The results of this should determine the means to provide cost effective, safe earthing system without the need for expensive separations between HV and LV electrodes which in a PME system may be impractical and costly to achieve and maintain.
- **SG17** – Identification of required lightning protection application will reduce equipment failure and faults due to lightning. This will improve performance and reduce fault costs.

</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">1 – 10 years</td><td>Duration of benefit once achieved</td><td colspan="2">10 – 40 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">25-75%</td></tr>
<tr><td>PV of Project Costs</td><td>£1,143,000 (see note below)</td><td>PV of Project Benefits</td><td>£815,000</td><td>NPV of Project</td><td>£347,000</td></tr>
<tr><td colspan="6">Note – These project costs include implementation and have been calculated assuming a typical distribution license area.</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="5">

- **ROCOF Relay functional specification** – EA Technology published the Final report in March 2007.

- **SG12 Fault Level Instrument** – EA Technology and the University of Strathclyde have pursued the following activities

1. Candidate monitoring sites and Deployment of loggers– Network disturbance data has been obtained using Dranetz PX5 Power Quality instruments.

2. Algorithm Evaluation and assessment – The Fault Level Algorithm has been coded within the Matlab environment. A network model with known parameters has been created in Matlab/Simulink and the fault level estimated for a range of scenarios. Results from the applied scenarios (voltage and current waveforms) are passed into the Fault Level algorithm and results compared.

3. Dranview disturbance record analysis – Dranview data is being processed for integration into the coded Fault Level algorithm. The results from the ‘real’ data and the result from the Fault Level algorithm are to be compared to the relevant power network models supplied by the site hosts (studied in PSS/E).

</td></tr>
</table>

	4. Experimentation and Laboratory investigations **–** A fault level monitor instrument is being tested on the University of Strathclyde Micro-grid system with static and active loads. This laboratory work will enable scenario results from a very well known and modelled network to be compared against the performance of an existing Fault Level instrument. • **SG14 Earthing Techniques** – EA Technology 1. Investigation at Test Facility - Report and CIRED paper completed. Measurements carried out at the S&S Ltd test facility to enable better understanding of transfer potential. The measurement results were compared to predictions using the CDEGS software. 2. Investigation at 11kV substations - Identification of suitable test sites is underway. Site testing has commenced at two suitable sites. • **SG17 Lightning Protection** – Engineering Technical Report (ETR 134) awaiting final approval before publishing.

DG and ARM Projects :– April 2006 – March 2007

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 = £ 1,853 External=£40,175 Total = £ 42,028		Expenditure in previous financial years		£62,450
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 to be approximately 8 times the cost of successful projects. 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.				

Huddig : April 2006 – March 2007

Description of project	This project is to trial and evaluate the use of innovative overhead line construction methodologies using a multi purpose mechanical aid. Huddig is the name of a plant manufacturer based in Sweden.			
Expenditure for financial year	Internal = £1,854 External = £139,461 Total Cost =£141,315		Expenditure in previous financial years	£19,500
Technological area and / or issue addressed by project	This project addresses mechanical aids to overhead lineworks and the objectives were stated as considering practicality, reliability, support, safety, productivity and risks associated with overhead line works.			
Type(s) of innovation involved	Incremental and technological substitution			
Expected Benefits of Project	Financial project benefits are expected to be derived from reduced overhead line construction costs. It is expected to make a positive contribution to improving safety performance. Benefits will be : improved safety whilst working at height improved safety by reducing manual handling tasks reduction in overhead line construction costs			
Expected Timescale to adoption	Short - One year		Duration of benefit once achieved	7 years.
Estimated Success probability (at start of project)	Low - 25%			
PV of Project Costs	£ 83,000	PV of Project Benefits	£84,00	NPV of Project	£1,000
Commentary on project progress and potential for achieving expected benefits	Project completed. The Huddig is a flexible machine with considerable rough terrain capability. During construction of the overhead lines it was shown that the MEWP was flexible enough to remove the need for any pole climbing and manual handling tasks were reduced to dressing the poles.			

FPIs + GSM : April 2006 – March 2007

Description of project	To explore the application of Global Systems for Mobile (GSM) communications technology in conjunction with Fault Passage Indicators (FPIs)				
Expenditure for financial year	Internal = £1,854 External = £30,000 Total Cost = £31,854		Expenditure in previous financial years	£20,000	
Technological area and / or issue addressed by project	Overhead line faults and the resultant CIs and CMLs. FPIs are currently used by SSEPD, however they do not communicate their status through GSM. In the event of a fault beyond the FPI, indication of the passage of fault current is made by the flashing of a bulb. This means that an operative must physically visit the site of installation of the portable FPI to determine the status of the device. Use of a GSM enabled FPI (GSM-FPI), would allow engineers to be informed in a more efficient manner, leading to a better deployment of staff and reducing the period of time that customers are without supply. This project will trial and evaluate the use of Rightway Pathfinder Mk10 GSM Fault Passage Indicators as a means of reducing CI and CML penalties, incurred on the 11kV overhead line network				
Type(s) of innovation involved	Technological substitution				
Expected Benefits of Project	Financial project benefits are expected to be derived from reduced operational costs resulting from faster location of overhead line faults.				
Expected Timescale to adoption	Short – one to two years.		Duration of benefit once achieved	10 years	
Estimated Success probability (at start of project)	20%				
PV of Project Costs	£45,000	PV of Project Benefits	£46,000	NPV of Project	£1000
Commentary on project progress and potential for achieving expected benefits	Project currently on target. Experience to date indicates successful application on intermittent and permanent overhead line faults with faster and more accurate location of the faulty section of overhead 11kV network				

Synch PMR : April 2006 – March 2007

Description of project	This project is to develop a 11kV Pole Mounted Recloser (PMR) with synchronising equipment				
Expenditure for financial year	Internal = £ 1,853 External = £ 25,000 Total Cost = £26,853		Expenditure in previous financial years		£10,000
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 PMR has been procured and a functional specification developed for a mobile synchronizing 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				

Underground Cable Plough : April 2006 – March 2007

Description of project	Field trials with new and novel methods of laying mains cable. These include a “mole plough” device that cuts the ground and lays cable from a winch and another device that uses a “vibrating plough” to cut the ground on a moving vehicle.				
Expenditure for financial year	Internal = £ 4,854 External= £24,800 Total Cost = £29,654		Expenditure in previous financial years		£210,000
Technological area and / or issue addressed by project	Proposal addresses the cost, environmental impact and safety of installing mains cables and is expected to benefit each of these areas to a considerable degree.				
Type(s) of innovation involved	Significant and technological substitution.				
Expected Benefits of Project	Financial project benefits are estimated at 4 times the cost of the project due to reductions in cable laying costs. Environmental and safety benefits assessed on an ongoing basis.				
Expected Timescale to adoption	Short - within one year		Duration of benefit once achieved		7 Years
Estimated Success probability (at start of project)	Medium - 50%.				
PV of Project Costs	£246,000	PV of Project Benefits	£280,000	NPV of Project	£ 35,000
Commentary on project progress and potential for achieving expected benefits	Project completed. Experience gained from application of the two different designs of mole plough has been assessed across a range of differing site conditions. Also see Appendix 3 : Innovative Undergound Cable Installation Techniques				

Orkney ANM: April 2006 – March 2007

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 = £ 24,853 External = £97,868 TotalCost = £122,721	Expenditure in previous financial years	£13,775
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	Project currently on target. An online closed-loop trial has successfully been completed and full implementation is progressing during 2007/08. 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. The NNFG are approached for curtailment on a last-in first-off (LIFO) basis. Measurement of the export power flow to the Scottish mainland breaching a pre-determined threshold will result in all of the NNFG on Orkney being approached for curtailment according to LIFO. If an overload is measured between a zone and the Orkney 'Core' then the NNFG in the zone will be regulated according to LIFO. 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. Also see Appendix 2 : Active Network Management to enable additional connection of Renewable and Distributed Generation on the Orkney Isles				

Supergen 5 : April 2006 – March 2007

Description of project	This is a 4 year major (£3M) multi party collaborative project: Industrial Participants: National Grid, Scottish & Southern Energy, Iberdrola Scottish Power, United Utilities, Western Power Dsitribution, Central Networks, CE Electric UK, NIE,Advantica & EDF Energy Networks; and Universities; Manchester, Southampton, Edinburgh, Liverpool, Strathclyde,Queens (Belfast). The research programme is split into 6 work packages and 25 activities. Most of the research will be carried out by the universities				
Expenditure for financial year	Internal = £1,853 External = £50,000 Total = £51,853		Expenditure in previous financial years		£0
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 evironmental 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 expected benefits	**Progress**: As a result of a number of issues, the Consortium Agreement was not signed until November 2006. The agreement has led to the establishment of a Steering Group and an Executive Management group to provide full engagement, and effective participation, of all parties. Dependant on their internal regulations, some universities were able to start work in February 06 (when the offer letter was				

	received), and others had to wait until November 06. Unfortunately November is not a good time of year to recruit PhD students or Research Associates. The project is being brought on track, after the delayed start and is expected to meet original objectives. In particular there have been some delays in Work Package 3, as a result of delays in recruitment, and these are being managed in the context of the whole project. It is likely however that, although the majority of the project will be complete at the end of the four years, some students will still be active for a short period thereafter. Overall the management processes are strong and have been effective. Key links to industrial partners are now being formed, and in particular through Work Package 6, the first demonstrators on networks are being discussed. The first technical meeting was a major success with excellent attendance and participation. A number of papers have been written on work from within the project. **Outputs and Deliverables** The following are formal outputs from the consortium. Reports: - Report on 'Evaluation of G59 Protection relays - Discussion Document on Vision and Priorities for Industrial demonstration - Condition Monitoring Specification - Lessons learnt from writing consortium agreement - A review of voltage control - Condition monitoring -State of the art report from Activity 5.2 - Technology: - A low cost RF unit has been produced based on the chromatic methodology of deploying the RF sensors. - A fibre optic based acoustic sensor for detecting abnormal signatures from plant is near completion. - Prototype knowledge based partial discharge analysis software. This is generic and can be applied to all partial discharge phase resolved signatures. It can categorise the discharge. - Equipment to control power quality of a voltage supply is nearing completion. **The above has been extracted from the full Supergen V annual report**.

Live Line High-Res Camera : April 2006 – March 2007

Description of project	Live Line Hi-Resolution Camera				
Expenditure for financial year	Internal = £ 1,853 External = £ 15,982 Total Cost=£17,835		Expenditure in previous financial years	£0	
Technological area and / or issue addressed by project	Transmission Plant and Overhead Line faults and the resultant CIs and CMLs can be reduced by timely intervention. This project aims to improve the inspection techniques available to staff by evaluating the use of a high resolution camera incorporating wireless transmission of images to enable detailed inspection of live equipment.				
Type(s) of innovation involved	Technological substitution				
Expected Benefits of Project	Financial project benefits are expected to be derived from reduced operational costs resulting from earlier detection of transmission plant and overhead line defects before they develop to faults.				
Expected Timescale to adoption	Short – one to two years.		Duration of benefit once achieved	10 years	
Estimated Success probability (at start of project)	Success probability is assessed as 50%				
PV of Project Costs	£26,000	PV of Project Benefits	£44,000	NPV of Project	£20,000
Commentary on project progress and potential for achieving expected benefits	Project currently on target. Two inspection cameras with live working insulated rods have been procured and training arranged.				

LV Sure : April 2006 – March 2007

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-ordinated by an intelligent device the faulty section will be isolated and supply restored to healthy sections.		
Expenditure for financial year	Internal = £7,853 External=£31,000 Total = £38,853	Expenditure in previous financial years	£0
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		
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	£188,000	PV of Project Benefits	£300,000	NPV of Project	£112,000
Commentary on project progress and potential for achieving expected benefits	Tasks completed to date are : reviewed typical LV network topologies Reviewed current regulations, operational pratices 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 neworks Production of an implementation strategy, based on the preferred configuration				

Shetland RPZ : April 2006 – March 2007

Description of project	This project aims to find novel ways to facilitate the connection of further renewable generation to the Shetland network				
Expenditure for financial year	Internal = £1,854 External=£16,362 Total = £18,216		Expenditure in previous financial years		£0
Technological area and / or issue addressed by project	The electricity network in the Shetland Isles is a true electrical island, with no existing connection to the main transmission system in Great Britain. As an electrically islanded network, all variations in system demand must be met by the three generating stations; Lerwick Power Station (diesel), Sullom Voe Terminal (gas turbine) and Burradale Wind Farm. Previous studies concluded that no more firmly connected large wind generation can be accepted onto the Shetland network.				
Type(s) of innovation involved	Radical				
Expected Benefits of Project	Financial project benefits are derived from comparing the cost of the alternative solution with the cost of extensive conventional reinforcement.				
Expected Timescale to adoption	Short – 3 years				
Estimated Success probability (at start of project)	Low 25%				
PV of Project Costs	£18,000	PV of Project Benefits	£29,000	NPV of Project	£11,000
Commentary on project progress and potential for achieving expected benefits	The study addressed the technical and economical implications of incorporating an energy storage system (ESS) onto the Shetland Island network to allow the connection of further renewable generation. Three main areas were investigated to clarify whether or not an ESS could be feasible for the Shetlands: voltage support, frequency regulation and energy balancing. The studies consider various sizes and capacities of ESS and varying levels of additional DG penetration. Study works are now complete and the recommendations are being assessed. It is anticipated that the project will be concluded later in 2007.				

Distribution Network Analysis : April 2006 – March 2007

Description of project	Distribution Network Analysis		
Expenditure for financial year	Internal = £4,854 External=£30,000 Total = £34,854	Expenditure in previous financial years	£0
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, 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	Significant work has been carried out on the project scope and a grant offer for a Knowledge Transfer Partnership has been gained.				

Crow Control : April 2006 – March 2007

Description of project	Crow control				
Expenditure for financial year	Internal = £ 5,854 External = £ 560 Total Cost = £ 6,414		Expenditure in previous financial years		£0
Technological area and / or issue addressed by project	Prevention of flashovers and outages that are attributed to crows nests. 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. Experience has now been gained from a 'short term' trial. This involved the use of a tactile repellent gel. Evaluation has shown that this method was ineffective as a means of deterring the birds for a significant period. Current technologies such as anti-perch spikes are being considered for future evaluation. The 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. Additionally, investigations are being made into retro-fitting a permanent cap that will remove the potential for nesting to occur.				

GIS Tree Clearance : April 2006 – March 2007

Description of project	Geographic Information System (GIS) to support tree cutting				
Expenditure for financial year	Internal =£11,354 External=£20,000 Total Cost =£31,354		Expenditure in previous financial years	£0	
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	Project currently on target.				

HV Sure: April 2006 – March 2007

Description of project	HV Network Automation without inter-device communication		
Expenditure for financial year	Internal = £2,854 External=£40,835 Total = £43,689	Expenditure in previous financial years	£0
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.				

Network Damage Assessment : April 2006 – March 2007

Description of project	Network damage assessment				
Expenditure for financial year	Internal = £ 2,854 External=£55,800 Total Cost = £58,654		Expenditure in previous financial years		£0
Technological area and / or issue addressed by project	The project will research, specify and deliver a prototype solution to allow distribution network overhead line damage information to be captured quickly and accurately from site and transferred to a central system to facilitate a rapid assessment of the damage sustained by the network. This data will also be accessible to outlying offices and field based restoration teams to optimise the restoration process. Both the technical requirements and business process requirements will be investigated to give a sound system architecture and delivery platform. It will enable more effective identification and location of faults and more effective repair of primary assets and restoration strategies in the event of extensive network damage resulting from severe weather events.				
Type(s) of innovation involved	Significant				
Expected Benefits of Project	Financial and Quality of Supply				
Expected Timescale to adoption	2 years		Duration of benefit once achieved		10 years
Estimated Success probability (at start of project)	75%				
PV of Project Costs	£135,000	PV of Project Benefits	£145,000	NPV of Project	£10,000
Commentary on project progress and potential for achieving expected benefits	Initial work has been carried out to establish the functional specification and presentation medium. Work is ongoing to address communications and technology interface issues.				

CBRM (Transformers): April 2006 – March 2007

Description of project	Condition Based Risk Management of 50 HV Transformers		
Expenditure for financial year	Internal = £2,853 External=£39,850 Total Cost = £42,703	Expenditure in previous financial years	£0
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	Initial discussions and identification of required information complete. Information collation and risk model building and population should be complete by August 2007.				

POLESTAR FPIs : April 2006 – March 2007

Description of project	POLESTAR Fault Passage Indicators (FPIs)				
Expenditure for financial year	Internal = £ 1,852 External = £ 17,954 Total Cost = £19,804		Expenditure in previous financial years		£0
Technological area and / or issue addressed by project	Overhead line faults and the resultant CIs and CMLs. FPIs are currently used by SSEPD, however they do not communicate their status through GSM. In the event of a fault beyond the FPI, indication of the passage of fault current is made by the flashing of a bulb. This means that an operative must physically visit the site of installation of the portable FPI to determine the status of the device. Use of a GSM enabled FPI (GSM-FPI), would allow engineers to be informed in a more efficient manner, leading to a better deployment of staff and reducing the period of time that customers are without supply. This project will trial and evaluate the use of the Nortech POLESTAR Fault Passage Indicators as a means of reducing CI and CML penalties, incurred on the 11kV overhead line network				
Type(s) of innovation involved	Incremental, Technological substitution				
Expected Benefits of Project	Financial project benefits are expected to be derived from reduced operational costs resulting from faster location of overhead line faults.				
Expected Timescale to adoption	Short – one to two years.		Duration of benefit once achieved		10 years
Estimated Success probability (at start of project)	25%				
PV of Project Costs	£20,000	PV of Project Benefits	£46,000	NPV of Project	£28,000
Commentary on project progress and potential for achieving expected benefits	Project currently on target.				

Tower Loading Risk Assess. : April 2006 – March 2007

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 =£11,853 External=£28,265 Total Cost =£40,118	Expenditure in previous financial years	£0
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.				

Power Electronics Regulator: April 2006 – March 2007

Description of project	Power electronics voltage regulator				
Expenditure for financial year	Internal = £1,853 External = £4,000 Total Cost = £5,853		Expenditure in previous financial years		£0
Technological area and / or issue addressed by project	Development of a power electronics voltage regulator to be deployed on the 11kV and 33kV networks to provide a cost effective means of addressing some of the effects of an increasing number of Distributed Generation sites on weak rural networks.				
Type(s) of innovation involved	technological substitution				
Expected Benefits of Project	Financial benefits are expected from a reduction in network reinforcement works				
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 25%				
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	Despite gaining a grant offer under the DTI Technology Programme the project has stalled due to the break up of the original collaboration. A technical specification has been produced and other means of developing a prototype device are being explored.				

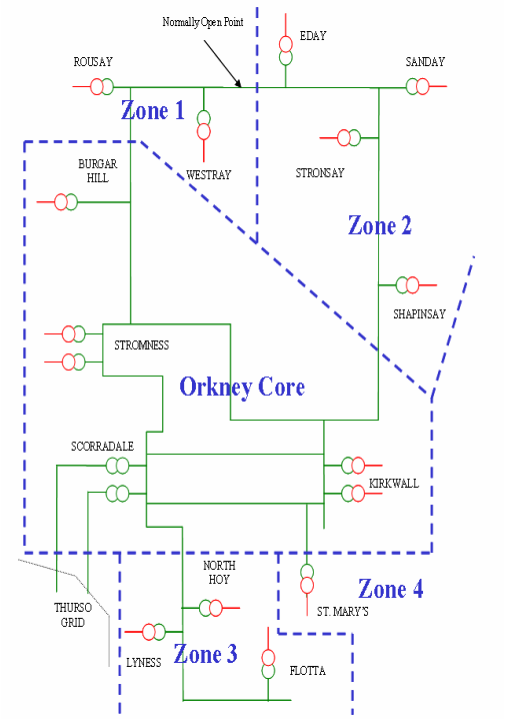
Appendix 1 : Summary Listing of IFI Project Costs

	SHEPD Int	SHEPD Total	SEPD Int	SEPD Total	SSEPD Total
Overhead Network Module	1622	12712	4231	30113	42825
Cable Networks Module	1622	12712	4231	30113	42825
Substation Module	1622	12712	4231	30113	42825
Distr. Energy Resources Module	1622	12712	4231	30113	42825
PD User Group	1622	3402	4231	8405	11807
Protective Coatings Forum	1322	3122	3531	7731	10853
ENA Projects	1265	5435	4293	14022	19457
DG and ARM Projects	422	12472	1431	29556	42028
HUDDIG	422	42262	1432	99053	141315
FPIs + GSM	422	9422	1432	22432	31854
Synch PMR	421	7921	1432	18932	26853
U/G Cable plough	1322	8762	3532	20892	29654
Orkney ANM	7322	36682	17531	86039	122721
Supergen 5	422	15422	1431	36431	51853
Live Line Hi-Res camera	422	5217	1431	12618	17835
LV Sure	2222	11522	5631	27331	38853
Shetland RPZ	422	5332	1432	12884	18216
Distribution Network Analysis	1322	10322	3532	24532	34854
Crow control	1622	1790	4232	4624	6414
GIS Tree clearance	3272	9272	8082	22082	31354
HV Sure	722	12972	2132	30717	43689
Network damage assessment	722	17462	2132	41192	58654
CBRM (Transformers)	721	12676	2132	30027	42703
POLESTAR FPIs	421	5806	1431	14000	19806
Tower loading risk assessment	3421	11901	8432	28217	40118
Power Electronics Regulator	421	1621	1432	4232	5853
TOTAL	37160	301643	99231	716401	1018044

Appendix 2
Active network management to enable additional connection of renewable and distributed generation on the Orkney Isles

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 preliminary analysis suggests 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. As a result of this work, the Orkney Isles distribution network is one of the first to have been accepted as a ‘Registered Power Zone’ by Ofgem.



The principles of operation for the APFM scheme hold for other situations where the thermal capacity of radial distribution networks is under utilised or acts as a limit to the connection of new DG units. The scheme has the potential to be applied to other parts of the UK network in the event of a successful trial and roll-out.

Collaborative project with University of Strathclyde : Robert Currie and Dr Graham Ault.

Appendix 3
Innovative underground cable installation techniques

A development of proven cable/pipe laying equipment has produced a system to install multiple power cables quickly, cheaply and with minimal disruption.

The German built Foeckersperger FSP18 cable plough machine uses a separate anchorage vehicle to pull the plough. This allows it to be used in the most difficult terrain such as encountered when installing connections to windfarms in remote locations. When used along with the tracked winch this machine is especially suited to some of the very remote, boggy and steep locations of the North and West Scotland.

SSEPD has used this system to install multiple cables up to and including 33kV in trefoil formation. To date, in excess of 100km of cable network has been installed using this system.

Advantages identified

- Cost effective when compared to traditional open trenching
- Installation timescales are significantly reduced
- Improved safety due to significant reduction in manual handling of cables and drums
- Land damage is significantly reduced
- The ability to cross rivers up to 1.5m deep provides an attractive option compared to the cost of directional drilling techniques.

The cable laying plough makes a narrow slit and at the same time several cables or pipes can be placed at the base of this slit up to a maximum depth of 2.0m. As no earth is dug out, the soil structure remains unchanged and the surface is immediately closed so that it returns to its original condition very quickly.

The lower part of the slit remains open and is gradually filled by silt so that the cable becomes encased in fine particles. Extensive soil investigations and trial hole excavations have led to confidence in the use of the system