IFI/RPZ Report

April 2005 to March 2006 Inclusive

for the licensed companies:

EDF Energy Networks (EPN) plc
EDF Energy Networks (LPN) plc
EDF Energy Networks (SPN) plc

Foreword

Welcome to EDF Energy Networks' Innovation Funding Incentive report for the regulatory year 2005/06.

At EDF Energy we believe that research and development is a key part of a successful and dynamic energy industry. The relatively straightforward ways of improving efficiency and the quality of our services are behind us. The innovative use of technology is central to taking our industry forward and improving the customer experience. This principle of innovation is shared and shaped by being part of EDF Group, one of the world's largest utility companies.

One year into this regulatory review period, I am pleased that this IFI activity report demonstrates our support of Ofgem and the regulatory framework that promotes collaborative Research and Development. We have built a portfolio of high quality innovative projects. I believe we have spent our allowance wisely and have started delivering benefits to our customers.

I am also pleased we are able to show our support for the Registered Power Zone incentive having obtained a RPZ in Martham in Norfolk. Such innovation provides network access solutions that would not be possible with traditional passive network solutions.

I wish to thank all our staff who have represented EDF Energy Networks on national committees such as the Electricity Networks Strategy Group and its Distribution Working Group work programmes, and who have contributed to international projects such as the Smartgrids' Technology Platform. In establishing our portfolio of collaborative projects with industry's leading suppliers, universities, R&D providers and other DNOs we have taken the opportunity to address some of the major economic, technological and societal challenges that will face our industry going forward. As a long term player in the UK Energy Industry, we are looking forward to working with all our key partners in the years to come.

Paul Cuttill OBE
Chief Operating Officer, Networks
EDF Energy

1. Introduction

During the development of the Distribution Price Control Review (DPCR) that took effect on 1 April 2005, Ofgem proposed two new incentives: the Innovation Funding Incentive (IFI) and Registered Power Zones (RPZ).

1.1 Context

As part of the DPCR, Ofgem has introduced the IFI and RPZ incentive mechanisms. These incentives were subject to consultion as an integral part of the DPCR proposals and were widely supported by a large majority of consultees. As part of this development process Ofgem published a Regulatory Impact Assessment 22 setting out the case for the introduction of the IFI and RPZs.

The primary aim of these two new incentives is to encourage the DNOs to apply innovation in the way they pursue the technical development of their networks. Ofgem recognised that innovation has a different risk/reward balance compared with a DNO's core business. The incentives provided by the IFI and RPZ mechanisms are designed to create a risk/reward balance that is consistent with research, development and innovation.

The two main business drivers for providing these incentives at this time are the growing need to efficiently manage the renewal of network assets and to provide connections for an increasing capacity of distributed generation at all distribution voltage levels. These are significant challenges that will both benefit from innovation.

1.2 IFI

The IFI is intended to provide funding for projects focused on the technical development of distribution networks, up to and including 132kV, to deliver value (i.e. financial, supply quality, environmental, safety) to end consumers. IFI projects can embrace any aspect of the distribution system asset management from design through to construction, commissioning, operation, maintenance and decommissioning. The detail of the IFI mechanism is set out in Special Licence Condition C3, Standard Licence Condition 51 and the Distributed Generation Regulatory Instructions and Guidance (DG-RIGs). The workings of the mechanism can be summarised as follows:

A Distribution Network Operator (DNO) is allowed to spend up to 0.5% of its Combined Distribution Network Revenue on eligible IFI projects. The DNO is allowed to recover from customers a significant proportion of its IFI expenditure. This proportion is set at 90% in 2005/6 reducing in equal steps to 70% in 2009/10.

Ofgem do not approve IFI projects but DNOs have to openly report their IFI activities on an annual basis. Ofgem reserves the right to audit IFI activities if this is judged to be necessary in the interests of customers.

1.3 RPZ

In contrast to the IFI, RPZs are focused specifically on the connection of generation to distribution systems. The estimates made by DNOs as part of the DPCR process indicated that some 10GW of generation could be connected in the period 2005 – 2010. This generation could involve connections at every distribution voltage level bringing new system design and operating challenges.

RPZs are therefore intended to encourage DNOs to develop and demonstrate new, more cost effective ways of connecting and operating generation that will deliver specific benefits to new distributed generators and broader benefits to consumers generally. The detail of the RPZ mechanism is set out in the Special Licence Condition D2, Standard Licence Condition 51 and the DG RIGs.

The RPZ mechanism is financially capped in two ways. For the first two years DNOs can only apply for two RPZ registrations per year; this will be reviewed in 2007. Also, in any year, a DNO's additional revenue from RPZ schemes cannot exceed £0.5M.

1.4 This Report

This report contains a summary of EDF Energy Networks' IFI activities for the period April 2005 to March 2006 inclusive. Where this report refers to the "Early Start" report it means the IFI activity reported between October 2004 and March 2005.

EDF Energy Networks registered one RPZ for the EPN network during the period covered by this report, namely the Martham Primary RPZ in Norfolk. Details of the Martham Primary RPZ are contained in this report.

EDF Energy Networks does have a number of innovative distributed generator connections but, because the generators were commissioned before 1 April 2005, they do not meet the RPZ requirements. One example of an innovative approach is that applied to Scroby Sands windfarm connection. The windfarm's connection utilises an intelligent control system to determine the additional capacity during intact network conditions, while sending "down turn" or constraint signals to the wind farm during fault conditions when there is insufficient circuit capacity. This approach resulted in considerable cost savings over a more typical network reinforcement solution.

Another example of innovation is that applied to a landfill gas generating station connection at Brockhurst Wood near Horsham., As an alternative to replacing many kilometres of overhead line to remove a voltage constraint, the system measures the voltage at the point of connection and sends the generator a signal to reduce its output if the upper statutory voltage limit is reached. Failure to respond to a signal within an agreed time period results in the generator disconnecting itself. The scheme was developed in conjunction with Econnect Ventures Ltd.

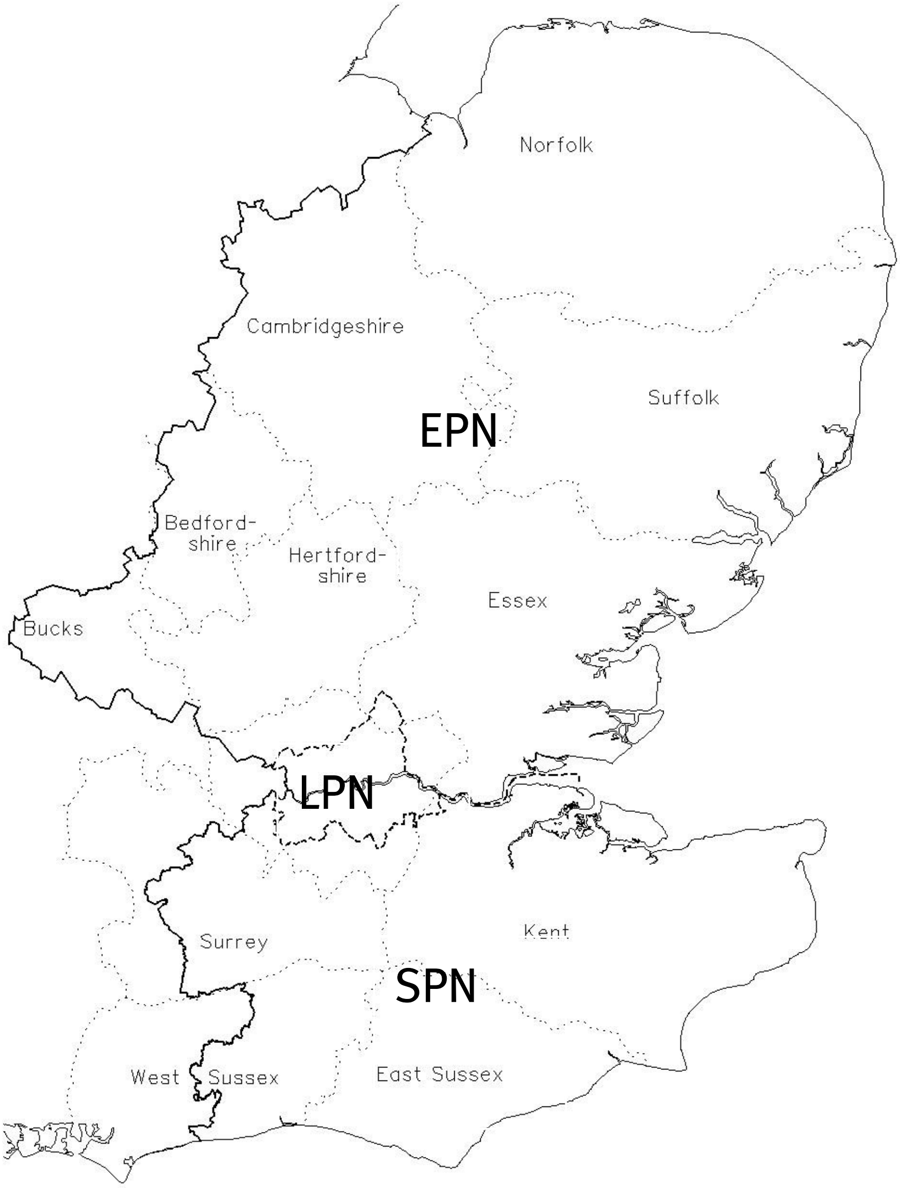
The main challenge in developing the RPZ incentive is to find DG developers who wish to consider an innovative connection with different benefits and risks to those of a traditional design solution.

1.5 EDF Energy Structure

EDF Energy Networks owns and operates the distribution networks serving the East of England, London and the South East of England through the following licensed companies:

- EDF Energy Networks (EPN) plc for East of England, referred to as EPN in the rest of this report
- EDF Energy Networks (LPN) plc for London, referred to as LPN in the rest of this report
- EDF Energy Networks (SPN) plc for the South East of England, referred to as SPN in the rest of this report.

These license areas are shown in the map overleaf.


Norfolk
Cambridgeshire
Suffolk
EPN
Bedford-
shire
Hertford-
shire
Essex
Bucks
LPN
Surrey
Kent
SPN
West
Sussex
East Sussex

Research and Development activities are conducted by EDF Energy Networks for the benefit of our customers on behalf of the three licensed network operators named above. The total expenditure of £2.85M has been split between the three licensed networks in proportion to their combined network revenue. Section 2.6 provides a tabulated summary. As a consequence we are submitting one combined report for the three licensees with benefits assigned to the licence area(s) to which they apply.

EDF Energy Networks has, prior to the start of the IFI, been involved with research and development projects with many universities and industry specialists. Stages of some existing projects and programmes are delivering benefits. Subsequent stages of these programmes have now been entered into our IFI framework. It is our strategic intent to establish a balanced portfolio of projects which concentrates on three main topics of:

- Improving the customer experience;
- Integrating Distributed Generation; and
- Delivering network improvements.

1.6 Project Partners

EA Technology Ltd is our R&D provider for the Strategic Technology Programme (STP) modules.

The whole power industry is facing a shortage of skilled power engineers and other key workers. To replace these we need to attract talented young people into our industry and reverse the decline in university courses in power engineering. Innovation can be key to this, not only through the direct sponsorship of post graduate students, but in creating a dynamic industry that young people are excited about and attracted to. EDF Energy Networks have established projects with many universities. As an active partner of the Institution of Engineering and Technology's Power Academy we have also have established projects with the university partners and many employer partners. This may increase students' awareness of career opportunities in the electricity sectors.

Partners for other projects have not been disclosed because EDF Energy Networks is bound by mutual confidentiality agreements. Once papers have been published in the public domain they will be reported in future IFI/RPZ reports.

2. Summary of IFI Project Activities

2.1 Number of active IFI projects

There are 22 EDF Energy Networks led IFI projects in addition to those linked with the four EA Technology Ltd (EATL) STP modules.

2.2 NPV of costs and anticipated benefits from committed IFI projects

The IFI portfolio NPV of committed EDF Energy Networks led projects is estimated to be £24.8M. The Project NPV benefit of each project in the IFI Programme is calculated by taking the present value of the estimated benefits and applying a probability of success. Estimated costs are netted off the anticipated year of occurrence. A discount rate of 6.9% has been used.

Each project undertaken in a STP module falls below the de-minimis level set in the Good Practice Guide. It is recognised that as each project has variable benefits and different start / completion timeframes it is not possible to give a specific figure for the benefits achieved against a given financial year. The benefits will be across a range of areas including construction, maintenance, refurbishment and operation.

2.3 Summary of other benefits anticipated from active IFI projects

Other benefits which are anticipated from active IFI projects include:

- An improvement in the security of supply and quality of service received by our customers;
- A reduction in the cost of DG connections; and
- Environmental and safety benefits.

2.4 Total expenditure to date on IFI projects

Regulatory year	Total expenditure
Early start report 04/05*	£ 275.8k
This regulatory year 05/06	£2570.9k
Total	£2846.7k

* Early Start Report – £309k less £33.2k disallowed by Ofgem

2.5 Benefits actually achieved from IFI projects to date

Some of our projects have reached the demonstration or validation stage and are starting to deliver benefits.

For example, the HV on-line condition monitoring programme currently monitors the level of partial discharge of over 600 feeders and some critical switchgear. There have been three occurrences where the insulation was deteriorating and a decision was made to switch out a cable section to carry out a repair. Once the circuits were re-energised, the level of discharge was greatly reduced and the risk of an interruption was removed.

To date, this technology has enabled 200 metres of underground cable to be strategically replaced. In one instance in Chatham, Kent 100m of cable were replaced. A cable fault on this feeder supplying 5479 customers would have resulted result in 0.13 CML and 0.21 CI. A key benefit is that it is possible to more precisely target the replacement sections of a cable.

The system also assisted the detection and location of discharge in a critical switchgear equipment supplying electricity to Stansted Airport.

Our LV intermittent cable fault programme has also delivered benefits. Customers who are subjected to intermittent faults often have to wait until the fault becomes permanent and suffer many interruptions before the fault location is successfully carried out. Field staff are now installing intermittent fault location equipment following repetitive faults. There have been five instances where intermittent faults were successfully located. Customers have benefited from not being subjected to prolonged repetitive interruptions.

The Protection schemes demonstrator tool has been used extensively in training over 100 operational staff with further training planned. EDF Energy Networks intends that all operational staff will undertake this training to update their knowledge of Protection. Being highly portable, the units can be taken to any suitable training location where a number of operators can be trained together.

2.6 Tabular Summary

	EPN	LPN	SPN	TOTAL
IFI carry forward (£k)	£0k	£0k	£0k	£0k
Eligible IFI expenditure 05/06	£1105.5k	£848.4k	£617.0k	£2,570.9k
Eligible IFI internal expenditure 05/06	£116.8k	£89.7k	£65.2k	£271.7k
Combined distribution network revenue (£m)	£316.31M	£241.82M	£174.80M	£732.93M

The IFI carry forward to 2006/07 is £817.9k.

2.7 Registered Power Zones

RPZ Name	Martham Primary RPZ
RPZ DG Capacity (MW)	Awaiting new DG to connect to the RPZ
RPZ starting year	05/06

See RPZ report in Section 4.

3. Individual IFI Projects

EDF Energy Networks led projects

- HV on-line condition monitoring programme;
- LV intermittent cable fault programme;
- AURA NMS;
- Application of Storage and DSM;
- The use of Perfluorocarbon Tracers (PFT) leak location techniques;
- Distribution State Estimation;
- Transformer design for FR3;
- Development of overhead line condition monitoring techniques;
- Risk Assessment;
- Energy efficiency in substations;
- FENIX;
- GenAVC assessment tool;
- LV automation;
- Evaluation of the characteristics of alternative oils for retro-filling power transformers and for use in new transformers;
- National committee activities;
- Network resilience;
- Protection schemes demonstrator tool;
- Recycling excavated materials;
- Relay tester;
- Supergen V;
- Transformer temperature monitoring with fibre optic; and
- Wood pole disposal.

EATL Strategic Technology Programme

- STP: Overhead Network Module 2;
- STP: Cable Network Module 3;
- STP: Substations Module 4; and
- STP: Distributed Generation Module 5.

As most DNOs subscribe to all four Strategic Technology Modules, these four reports have been written by EA Technology Ltd to provide consistent reporting.

3.1 HV on-line condition monitoring programme

Description of Project	The use of partial discharge has been a well known method of checking the condition of electrical insulation. Over the past 7 years, EDF Energy Networks have been leading the development of "on-line" partial discharge monitoring and mapping techniques. Initial results show that there is a potential for achieving benefits in pre-empting faults before they manifest themselves in the form of customer interruptions. Further opportunities to improve the existing generation of equipment have been identified. This project has taken the laboratory into the distribution network to monitor underground cables and switchgear.
Expenditure for financial year	External costs £254.9k Internal costs £35.3k Total EDF Energy Networks costs Total costs £290.2k
Expenditure in previous (IFI) financial years	£103.2k Reported in the "Early Start" report
Technological area and / or issue addressed by project	The issues being investigated by the project are: • On-line fault detection and location; • Pre-emptive fault repairs; • Cable replacement & maintenance strategy; • Quality of supply improvement.
Type(s) of innovation involved	Radical Innovation
Expected Benefits of Project	Benefits are expected to include: • Ability to target the replacement of cables or cable sections; • Ability to identify faults (cable & switchgear) before they occur, carry out a repair and reduce the number of customer interruptions; and • Reduction of the risk of subsequent fault occurring due to age and deterioration.
Expected Timescale to adoption	3 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	75%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£4.8M

Commentary on project progress and potential for achieving expected benefits	Project Progress: Approximately 600 feeders and switchgear are currently monitored in the EDF Energy Networks' area. The newly developed experimental software and hardware has enabled EDF Energy Networks to identify circuits with increased risk of failure and take action before failure: • Circuits with increasing partial discharge activity are identified by the monitoring equipment; • Fault location (On-line mapping) is carried out by a trained field operative without disconnection of the electricity supply (or reconfiguration of the network); • The information is passed to the distribution planners and the decision is taken whether to carry out a targeted repair or a cable replacement; and • The success of the intervention is evaluated by witnessing a reduced level the discharge activity after the repair and/or analyzing the sample of cable replaced. Stages completed: • Development of experimental web analysis interface; and • Development & installation of five "Advanced Substation Monitoring" (ASM) equipment units for use in primary and smaller substations. Stages in progress: • Improvement, consolidation & automation of software (automatic location of fault, discrimination of substation signals, SMS/email alarms, noise reduction, etc.); • Development/improvement of knowledge rules; • Evaluation of system performance (testing of new monitoring equipment, detection range); • Trial implementation into control system; • Trial cable replacements to further validate the technology & fully assess limitations; and • Research on the prediction of cable remaining life & behaviour of faults before failure. Benefits delivered: To date, there have been four successful preventive repairs carried out before failure occurred: • Chatham West, Kent: 5,479 customers connected, a fault on this feeder would have resulted in 0.13 CML and 0.21 CI. (100 m of cable were replaced); • Carnaby Street, London: 364 customers connected, a cable termination was repaired; • Moreton Street, London: 100 m of cable were replaced; and • Stansted Airport, Essex, discharging switchgear identified and repaired Several cable faults were also detected by the monitoring equipment but failed before they could be isolated. Research papers were presented at the CIRED 2005 & INSUCON 2006 conferences.

3.2 LV Intermittent cable fault programme

Description of Project	Re-energisation devices have been used for many years to maintain customers' LV supplies. EDF Energy Networks have identified opportunities to improve the detection & location of intermittent faults on LV underground cables. This project combines the use of an intermittent cable fault location device with an improved re-energisation device and look at further developments such that LV intermittent faults can be better managed and customer interruption reduced.
Expenditure for financial year	External costs £194.3k Internal costs £ 7.4k Total EDF Energy Networks costs Total costs £201.7k
Expenditure in previous (IFI) financial years	£56.5k Reported in the "Early Start" report
Technological area and / or issue addressed by project	The project is developing the following techniques: • Remote fault location; • Time reflection to determine fault location; • Transient impedance fault location; • Travelling wave fault location; and • Auto reclosing device.
Type(s) of innovation involved	Radical Innovation
Expected Benefits of Project	Benefits are expected to include: • Reduction in number of site visits to replace fuses. • Reduction in repeated customer interruptions due to intermittent faults being re-energised. • Reduction in customers minutes lost; and • Reduction in worst served customers.
Expected Timescale to adoption	3 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	75%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£1.2M
Commentary on project progress and potential for achieving expected benefits	Project progress: EDF Energy Networks have identified two devices, the T-P22 & REZAP Fault Master, which we have contributed to the development over the past few years. Initial trials (8 x T-P22 and 20 x REZAP Fault Master) have already enabled us to successfully locate and repair intermittent LV faults. Further improvements need to be carried out before we can fully benefit from these technologies, they include: • Automatic downloading and analysis of data; • Automatic alarms sent directly to field engineer; and • Development of smaller auto-reclosing device to fit into LV pillars and link boxes.

	Stages completed: • Theory development; • Identification of potential improvement for auto-reclosing device (REZAP Fault Master); and • Identification of potential improvement for LV intermittent fault location equipment (T-P22). Stages in progress: • Field trialing of “auto-reclosing device” & “Intermittent fault location” equipment in all EDF Energy Networks’ areas; • Full assessment of potential benefits; • Research and development: improvements for auto-reclosing device (This work will be jointly funded between EDF Energy Networks & United Utilities); and • Research and development: improvements for LV intermittent fault location device (This work will be jointly funded between EDF Energy Networks, United Utilities & SP PowerSystems). Benefits delivered: • 5 intermittent faults were located; • Some faults were located after 2 fuse operations rather than 8 or 10 in some extreme cases; • Successful trials already prompted request for adoption in one of the EDF Energy Networks’ areas; and • This new proactive attitude to dealing with intermittent faults has generated some positive feedback from customers affected by multiple interruptions. The project also looked at installing temperature strips on LV fuses as well as using the “TOPAS 1000” to analyze and locate fault signals. A research paper “Low Voltage Fault Detection and Localisation using the TOPAS 1000 Disturbance Recorder” was presented at CIRED 2005.

3.3 AURA NMS – Automated Regional Active Network Management System

Description of Project	This is a Strategic Partnership between EDF Energy Networks, ABB, EPSRC, and SP Power Systems. The aim of the project is to develop a distributed control system to deliver the following: • Real-time automated reconfiguration initially to a regional network of up to four primary substations; • Economically, efficiently and effectively integrate large amounts of small scale distributed generation taking into account legacy infrastructure and renewal programmes. • Network optimisation taking into account DG; and electrical energy storage.
Expenditure for financial year	External costs £260.1k Internal costs £31.7k Total EDF Energy Networks costs Total costs £291.8k
Expenditure in previous (IFI) financial years	£0 Not reported in the "Early Start" report
Technological area and / or issue addressed by project	The scoping and development of two major areas: • Distributed Generation and demand side management to facilitate the connection of DG to the network; and • Develop a controller that will monitor electricity networks, isolate faults quickly and allow distributed generation to remain connected and operating.
Type(s) of innovation involved	Radical innovation
Expected Benefits of Project	Benefits are expected to include: • Maximisation of the contribution of DG to the electricity network; • Reduction in carbon emissions and help towards the UK governments climate change targets; • Reduction in network losses by having the source of generation close to the load; • Improvement in quality and security of supply; • Improvement in network resilience; and • Reducing the current market failures to increase network capacity for DG.
Expected Timescale to adoption	7 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	25%
Project NPV (Present Benefits x Probability of Success) – Present Costs	This project is expected to deliver benefits in the order of several millions of pounds. As part of the project the real value will be calculated.

Commentary on project progress and potential for achieving expected benefits	Project Progress The electrical energy storage device and its ancillary equipment is being designed and developed by ABB Sweden. The battery storage units have been purchased. The trial location for installation has been decided. The location was based on providing the maximum number of operational configurations to validate the proposed business case scenarios. It avoids being close to a primary substation and has been selected to be close to a wind farm where the charge cycle will take place when electricity is being generated and discharged at times of high electricity prices. The academics have been successful in their peer review to obtain funding from the EPSRC.

3.4 Application of storage and demand side management

Description of Project	To investigate and quantify the benefits of integration of electricity storage and Demand Side Management (DSM) technologies in the operation and development of active distribution networks.
Expenditure for financial year	External costs £ 100.0k Internal costs £ 7.6k Total EDF Energy Networks costs Total costs £ 107.6k
Expenditure in previous (IFI) financial years	£0 Not reported in the "Early Start" report
Technological area and / or issue addressed by project	The main areas addressed are: • Feasibility assessment of alternative applications of DSM and storage to solve network problems; • Development of techniques for optimisation of the operation of active distribution network including real time control of storage and load control devices to manage network voltage and flow profiles in real time; and • Quantification and optimisation of the multiple value streams of various storage applications and load control management.
Type(s) of innovation involved	Radical innovation
Expected Benefits of Project	Benefits are expected to include: • Quantifying the value of specific storage and DSM technologies; and • A business case showing whether storage and DSM can deliver value in the performance of the network will be validated from the data collected from the AURA NMS project.
Expected Timescale to adoption	7 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	75%
Project NPV (Present Benefits x Probability of Success) – Present Costs	Only when the methodology proposed in this project is developed, it will be possible to evaluate financial benefits of storage and DSM across various future development scenarios.
Commentary on project progress and potential for achieving expected benefits	Work has been carried out on modelling of storage and demand response to include effects of both demand reduction (discharging for storage) and demand recovery (charging for storage) of various magnitudes and durations, taking into account losses in efficiency. The developed demand response and storage models are incorporated in a simplified network model to examine their application in managing network thermal constraints.

3.5 The use of Perfluorocarbon Tracers (PFT) leak location techniques

Description of Project	This is an assessment of the suitability of using PFT tracer technology to determine cable leak locations and reduce the number of excavations required. The technology was developed by NASA and this is in collaboration with Con Edison.
Expenditure for financial year	External costs £ 147.5k Internal costs £ 19.0k Total EDF Energy Networks costs Total costs £ 166.5k
Expenditure in previous (IFI) financial years	£16.0k was reported in the early start report
Technological area and / or issue addressed by project	The use of PFT tracer technology to determine cable leak location and reduce the number of excavations required.
Type(s) of innovation involved	Radical
Expected Benefits of Project	Benefits are expected to include: • Faster and more accurate oil leak locations; • Operational cost savings due to fewer and smaller excavations; • Positive impact on environment; and • Improved relationship with Environmental Agency through demonstration of a pro-active and world's best practice leak location techniques.
Expected Timescale to adoption	3 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	50%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£5M
Commentary on project progress and potential for achieving expected benefits	Stages completed Femtotrace has completed the final prototype testing of the unit that will detect the traces of the PFT blended oil. Stages in progress EA Technology Ltd has been conducting PFT compatibility tests with the various cable components. Alternative methods for doping the oil are being investigated. Blending trials have been completed with our cable fluid suppliers. Results indicate that blending perfluoromethylcyclohexane into the oil during the manufacturing process will be a good solution. A vehicle has been commissioned to house the unit and this is expected the end of April 2006. A visit to the US is being planned to witness the Beta unit.

3.6 Distribution System State Estimation (DSSE)

Description of Project	To develop prototype algorithms for DSSE, taking into account the greater use of active components in future distribution networks. The effectiveness of the new algorithms will be evaluated using a suitable section of EDF Energy Networks' network model, providing a useful demonstration of the algorithms' ability to facilitate new approaches for the operation and control strategies of future active distribution networks.
Expenditure for financial year	External costs £100.0k Internal costs £ 7.6k Total EDF Energy Networks costs Total costs £107.6k
Expenditure in previous (IFI) financial years	£0 Not reported in the "Early Start" report
Technological area and / or issue addressed by project	The overall research objective will be achieved through two parallel work streams, to be completed in a coordinated manner. One work stream will focus on DSSE methodologies and the other on implementation issues.
Type(s) of innovation involved	Radical innovation
Expected Benefits of Project	Benefits are expected to include: • Establishing the difference between the investment reinforcement costs associated with traditional, passive network operation based solutions and the costs of the system within the context of an active distribution network operation that uses DSSE; and • It can be expected that a DSSE will play a similar role to the state estimators used in transmission systems, enabling the release of untapped network capacity and the provision of network services such as fast flow control and voltage support.
Expected Timescale to adoption	7 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	25%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£800k
Commentary on project progress and potential for achieving expected benefits	This is a three year project to deliver a state estimator that is capable of providing a real time representation of our distribution networks. The data collected will need to be fed into the state estimator to validate results, detect wrong or false measurements, and calculate estimates for missing data. Additional transducers may need to be introduced in to the network to provide new data-points.

3.7 Transformer design for FR3

Description of Project	This project is to design and build a transformer that will be to be filled with FR3 vegetable oil manufactured by Coopers Power System. This requires considerable design work and evaluation of the various components used in the manufacture of the transformer.
Expenditure for financial year	External costs £871.0k Internal costs £ 73.0k Total EDF Energy Networks costs Total costs £944.0k
Expenditure in previous (IFI) financial years	£0k Not reported in the "Early Start" report
Technological area and / or issue addressed by project	The trial will be to: • Evaluate the possibility of the use of FR3 as the initial fluid to be used in a transformer with 132kV as the primary voltage; • Assess the reaction of the components used in the manufacture of a transformer with the fluid; and • In particular, assess the fluid use in the tap-changer and other components The transformer will be equipped with a comprehensive monitoring system to enable data to be obtained regarding the performance of the transformer and compare with another similar transformer filled with mineral oil.
Type(s) of innovation involved	Technological Substitution
Expected Benefits of Project	Benefits are expected to include: • Longer life of the transformer; • Lower disposal costs for the fluid; • Higher rating from the same transformer; and • The fluid is highly biodegradable.
Expected Timescale to adoption	3 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	75%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£1.5M

Commentary on project progress and potential for achieving expected benefits	Initial design work has been completed to build a 132/33kV 90MVA transformer using FR3 (Coopers) as the insulating fluid. The University of Manchester has assisted with assessing the reaction of FR3 with insulation materials and the impregnation of various insulation boards within the transformer. Reinhausen Tapchangers have also assessed the use of alternative fluids in their tapchangers and, although have not accepted FR3 as a suitable alternative fluid because they have not completed testing, they have approved another older version of a Cooper's fluid. The transformer has now been successfully built and impregnated with fluid. Type and routine tests have been completed which are all satisfactory, apart from the noise level test which has given results above the guarantee. This is not caused by the alternative fluid but by unsuitable fans – this will be resolved in the near future. The transformer is ready for installation when the site is completed.

3.8 Development of overhead line condition monitoring techniques

Description of Project	This study will investigate the fundamental principles and phenomena related to faults due to insulator or surge arrester failures and will attempt to establish the feasibility of a remote system that will allow better monitoring and location of such failures.
Expenditure for financial year	External costs £48.0k Internal costs £ 4.8k Total EDF Energy Networks costs Total costs £52.8k
Expenditure in previous (IFI) financial years	£1.2k Reported in the "Early Start" report
Technological area and / or issue addressed by project	A feasibility study to devise a more convenient monitoring system that will allow detection and location of faulty insulators and surge arresters and tree flashovers, and help avoid faults on the system.
Type(s) of innovation involved	Radical innovation
Expected Benefits of Project	Benefits are expected to include: • A better understanding of basic phenomena governing insulator and surge arresters failures as well as tree flashover; and • The feasibility of a new approach to location and/or remote monitoring of overhead line condition failures as well as tree proximity.
Expected Timescale to adoption	7 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	25%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£1M
Commentary on project progress and potential for achieving expected benefits	An initial assessment to determine whether monitoring of overhead lines can be developed using similar techniques to that of underground cable partial discharge monitoring. The next stage will involve the development of experimental equipment to monitor the characteristics of failing insulators and surge arresters.

3.9 Risk assessment

Description of Project	To establish the feasibility of completing a risk based assessment of the operational performance of a section of EDF Energy Networks' network, based on current data resources available to describe network configuration and performance.
Expenditure for financial year	External costs £48.3k Internal costs £ 3.7k Total EDF Energy Networks costs Total costs £52.0k
Expenditure in previous (IFI) financial years	£0k Not reported in the "Early Start" report
Technological area and / or issue addressed by project	This process will consider: • The quality of the network state estimation (in terms of load levels, voltage profile, line flows, and network continuity/configuration); • The availability of condition assessment data characterising network assets; and • The thoroughness with which current restoration procedures, both automatic and manual, used to reconnect supply following an outage, are documented.
Type(s) of innovation involved	Significant innovation
Expected Benefits of Project	Benefits are expected to include: • Potential savings if existing monitoring procedures can be consolidated. Standard modes of communication could reduce expensive standalone monitoring systems; • Identification of areas in network where quality of supply, at present, cannot be known accurately would be beneficial; and • Identification of gaps in asset monitoring will reduce the likelihood of unexpected catastrophic equipment failure.
Expected Timescale to adoption	3 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	75%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£200k

Commentary on project progress and potential for achieving expected benefits	A gap analysis of the information available and what could be collected is being completed. The significance of available data resources are being assessed by applying them in a risk assessment package, developed to complement the project. The report shows that there is a significant amount of information already collected and measures of risk exposure at the network and/or load point level can be calculated. The measures of risk obtained provide significant information about the nature and degree of network vulnerability and how the behaviour of the individual assets is governing risk at different levels of the network. Additionally, the component focused measure of risk provides indications of the mitigation strategies appropriate for the different levels of the network. Nonetheless, the measures of risk are still reliant on available data resources and enhancement of the quality of the information used in the risk assessment is likely to bring substantial further benefits. Progress towards expected benefits of project: Potential savings if existing monitoring procedures can be consolidated. Standard modes of communication could reduce expensive standalone monitoring systems. • To date, the potential for consolidation of monitoring procedures has not been explored fully. Ongoing work is aimed at determining the precision with which component condition must be specified in order to obtain a useful measure of risk. The outcome of this work will clarify the information requirements of the risk assessment process, allowing a clearer picture of the scope for consolidation of network monitoring. Identification of gaps in asset monitoring will reduce the likelihood of unexpected catastrophic equipment failure. • This represents a significant opportunity for continued work as it is apparent that the condition of the majority of the network assets is not monitored. The component focused risk assessment method developed represents a means to determine on which components accurate monitoring is likely to be most useful.

3.10 Energy efficiency in substations

Description of Project	This project is to investigate energy efficiency measures that could be introduced into substations.
Expenditure for financial year	External costs £ 8.0k Internal costs £ 1.0k Total EDF Energy Networks costs Total costs £ 9.0k
Expenditure in previous (IFI) financial years	£0k Not reported in the "Early Start" report
Technological area and / or issue addressed by project	Energy efficiency
Type(s) of innovation involved	Incremental innovation
Expected Benefits of Project	• Understand what can be done to use less energy in our substations; and • Consideration of the use of renewable technology.
Expected Timescale to adoption	3 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	50%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£50k
Commentary on project progress and potential for achieving expected benefits	Initial Report produced by EATL has been accepted by EDF Energy Networks. This highlighted the need to identify the specific areas where power is used within substations and actions required to enhance the thermal capacity of the substation structures. It is proposed to monitor a range of substation designs to understand the power usage/loss to allow future power savings.

3.11 FENIX Flexible Electricity Networks to Integrate the eXpected 'energy evolution'

Description of Project	This is an EU framework 6 project. www.fenix-project.org The objective of FENIX is to boost DER (Distributed Energy Resources) by maximizing their contribution to the electric power system, through aggregation into Large Scale Virtual Power Plants (LSVPP) and decentralized management. Distributed Generation (DG) can be considered a subset of DER. DER includes storage and DSM.
Expenditure for financial year	External costs £0.5k Internal costs £10.0k Total EDF Energy Networks costs Total costs £10.5k
Expenditure in previous (IFI) financial years	£0 Not reported in the "Early Start" report
Technological area and / or issue addressed by project	To conceptualise, design and demonstrate a technical architecture and commercial framework that would enable DER based systems to become the solution for the future cost efficient, secure and sustainable EU electricity supply system.
Type(s) of innovation involved	Radical innovation
Expected Benefits of Project	Benefits are expected to include: • Maximise the contribution of DER to the electricity network; • Reduce carbon emissions and help towards the UK governments climate change targets; and • Reduce network losses by having the source of generation close to the load.
Expected Timescale to adoption	7 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	25%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£2M. The estimate will be refined in a work package to assess the economic impact of this architecture and allowing small generator operators access to the Balancing Mechanism and Ancillary Services.
Commentary on project progress and potential for achieving expected benefits	EDF Energy Networks have contributed to various work packages in defining what role DER could play in a FENIX future. Work package 1 required the definition and characterisation of local functions and control capabilities of DER in order to design and prototype a local intelligent FENIX unit and the FENIX LSVPP controller based on Distribution Energy Management System technology. EDF Energy Networks' major contribution will be in the practical demonstration of the FENIX box allowing small and domestic sized DG units to participate in energy and ancillary markets.

3.12 GenAVC assessment tool

Description of Project	This project proposes to produce a generic tool to assess the benefits of GenAVC (a voltage rise management solution) developed by Econnect Ventures Ltd. A comparison of the output of this assessment tool with traditional methods of solving voltage rise issues will be carried out. If the tool shows that GenAVC is a solution then a commercial grade GenAVC shall be installed at a second primary substation to validate the management of voltage rise issues and avoid the occasional disconnections of the generator.
Expenditure for financial year	External costs £ 0.0k Internal costs £ 6.4k Total EDF Energy Networks costs Total costs £ 6.4k
Expenditure in previous (IFI) financial years	£0 Not reported in the "Early Start" report
Technological area and / or issue addressed by project	A comparison of the output of this assessment tool with traditional methods of solving voltage rise issues will be carried out.
Type(s) of innovation involved	Incremental innovation
Expected Benefits of Project	Benefits are expected to include: • A least-cost connection compared to the traditional circuit reinforcement connection back to the primary substation for a DG developer; • The assessment tool will provide the developer with an indication of additional generator headroom at the planning stage; and • The tool will show when traditional solutions can be avoided. This will result in reduced cable installation that disrupts highways and causes general inconvenience to the public.
Expected Timescale to adoption	3 years
Duration of benefit once achieved	10 years
Estimated Success probability (at start of project)	75%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£290k.
Commentary on project progress and potential for achieving expected benefits	GenAVC has been developed by Econnect Ventures Ltd to manage voltage rise issues associated with the connection of DG into 11kV networks. This system has achieved satisfactory operation in a trial at Martham Primary substation. The trial has successfully shown the principles of voltage control can be applied to reduce the target busbar voltage and minimise network constraints. There is a landfill gas generator who experiences nuisance trips during times of low demand. This project proposes to produce a generic tool to assess the benefits of the GenAVC solution. A comparison of the output of this assessment tool with traditional methods of solving voltage rise issues will be carried out.

3.13 Evaluation of the characteristics of alternative oils

Description of Project	To assess various alternative materials that could be used as the insulating medium of power transformers and to undertake electrical tests on insulation materials to validate the claimed advantages.
Expenditure for financial year	External costs £8.9k Internal costs £1.1k Total EDF Energy Networks costs Total costs £10.0k
Expenditure in previous (IFI) financial years	£10.5k Reported in the "Early Start" report
Technological area and / or issue addressed by project	Evaluation of the characteristics of alternative oils for retro-filling power transformers and for use in new transformers
Type(s) of innovation involved	Technological substitution
Expected Benefits of Project	The benefits of using alternative oils in transformers are based around two main points: • Safety/environment; and • Lifetime ageing performance.
Expected Timescale to adoption	7 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	50%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£50k
Commentary on project progress and potential for achieving expected benefits	A range of alternative oils and a mineral oil have been tested to compare electrical characteristics for new and aged oils with cellulose materials found in transformers. Finite element analysis models are being developed to represent the internal structure of power transformers. The reaction of the fluids under dielectric testing is ongoing and various test chambers have been evaluated to ensure that the most appropriate tests are conducted. Thermal aging tests and partial discharge at a range of temperatures of the fluids are also in progress, together with sparking and arcing tests. Results so far indicate that all the fluids have properties that can be used in power transformers, but the extent and duty is yet to be determined.

3.14 LV automation

Description of Project	This project explores whether a novel protection and automation system for low voltage circuits technology can be transferred to the low voltage distribution network. This project is split into five phases: • Phase 1 Cost benefit and initial safety case ; • Phase 2 Low voltage system modelling and protection discrimination, combined with detailed safety and operational review; • Phase 3 Produce a prototype system; • Phase 4 Test the prototype system on agreed low voltage circuits of the EDF Energy Networks' LV network; and • Phase 5 Produce an commercial version of the system
Expenditure for financial year	External costs £39.0k Internal costs £ 3.8k Total EDF Energy Networks costs Total costs £42.8k
Expenditure in previous (IFI) financial years	£0k Not reported in the "Early Start" report
Technological area and / or issue addressed by project	This project proposes to: • Explore the issues which would arise in applying the system to the radial underground low voltage distribution network; • Analyse the safety and operational implications arising from use on low voltage distribution networks; • Produce a prototype system suitable for deployment on radial underground low voltage distribution networks; and • Install and test the system on agreed radial underground low voltage circuits of the EDF Energy Networks' LV network.
Type(s) of innovation involved	Technical Substitution
Expected Benefits of Project	This technology when implemented on the network, could deliver improvements in quality of supply. In particular: • Automatic sectionalising and automatic isolation of faulted sections of LV circuit; • Automatic restoration of supplies to healthy sections of LV network; and • Use of semi-conductor technology not previously adopted.
Expected Timescale to adoption	7 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	25%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£1.56M

Commentary on project progress and potential for achieving expected benefits	Stages completed: Phase 1 consisted of the following tasks: • "Typical" radial LV network topologies were examined; • Determine the types of LV faults encountered; • Analysis of low voltage fault incidence; • Review current operational practice related to low voltage faults; • Estimation of the benefits of various LVSure deployment options and production of a benefit matrix; and • The final report for Phase 1 has been received and the initial review confirms that there are opportunities in urban areas to make savings on CML and CI counts. Stages in progress: Phase 2 consists of the following: • A report documenting the results of detailed power system analysis and protection co-ordination carried out on a representative distribution network model, with both the current arrangements and deployment of the recommended automation solution; • A system specification, drawing on the findings of the previous stages; • A requirement specification based on the previous work in this phase and incorporating the safety and operational investigations; and • A detailed report assessing the safety and operational implications of deploying a LVSure based low voltage network automation system.

3.15 National committee activity

Description of Project	EDF Energy Networks is represented in many National Committees, which include the Distribution Working Group work programmes of the Electricity Networks Strategy Group, the committees and work groups of the Energy Networks Association and Electricity Supply Research Network.
Expenditure for financial year	External costs £0.0k Internal costs £21.7k Total EDF Energy Networks costs Total costs £21.7k
Expenditure in previous (IFI) financial years	£0k Reported in the "Early Start" report
Technological area and / or issue addressed by project	The following websites provide details of the work carried out by each national committee the ENSG - www.ensg.org.uk the ENA – www.energynetworks.org the ESR Network – www.nottingham.ac.uk/esrnetwork/home.htm
Type(s) of innovation involved	All innovative types involved (incremental, significant, technical substitution, radical)
Expected Benefits of Project	Benefits are expected to include: • Make recommendations to address longer term technical and related commercial issues affecting distribution networks in transition to a low-carbon energy market; • Co-ordinated approach to various research and development projects; and • Synergy creation among UK research councils and industrialists and to ensure core competencies are maintained.
Expected Timescale to adoption	7 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	25%
Project NPV ((Present Benefits x Probability of Success) – Present Costs)	All the work carried out by these various national bodies could have a dramatic effect on the way we manage our energy networks. If the work of the four DWG work programmes in partnership with the DNOs is able to deliver demonstrations of the various innovative connections, then the present benefits could be millions of pounds.
Commentary on project progress and potential for achieving expected benefits	The DWG work programmes are well supported by EDF Energy Networks' staff. Paul Cuttill is a member of the ENSG. David Openshaw (Head of Asset Management) is the programme director for the Network Design for a Low Carbon Economy. Many staff represent EDF Energy Networks on the DWG work programmes of the ENSG, the committees and work groups of the ENA and ESR Network.

3.16 Network resilience

Description of Project	Several recent studies have revealed that many High Voltage paper insulated power cables have already or will soon reach the end of their design life. The ageing process is not fully understood and will depend on external influences such as the type of soil it is buried in and how heavily the cable has been loaded. The cost of replacing all of the cables is prohibitive in the short term, EDF Energy Networks is therefore seeking lower cost replacement strategies that will provide an efficient use of the remaining cable lifetime. This aim of this project is to develop an innovative investment appraisal tool to prioritise network developments.
Expenditure for financial year	External costs £15.9k Internal costs £ 1.2k Total EDF Energy Networks costs Total costs £17.1k
Expenditure in previous (IFI) financial years	£0.0k Not reported in the "Early Start" report
Technological area and / or issue addressed by project	The issues being investigated by the project are: • Cable replacement & maintenance strategy; and • Ageing underground cable networks.
Type(s) of innovation involved	Radical innovation
Expected Benefits of Project	Benefits are expected to include: • Development of a cable replacement strategy incorporating newly developed technologies such as "on-line" monitoring and mapping techniques; • Optimisation of the maintenance & investments costs; and • Optimisation of the operating costs.
Expected Timescale to adoption	3 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	75%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£200k. An accurate assessment of the financial benefits will be determined during the project.
Commentary on project progress and potential for achieving expected benefits	Stages completed: • Benchmarking of diagnosis methods available for predicting cables replacement. Stages in progress: • Development of a draft process for cable replacement; • Experimentation of process: Two EDF Energy Networks' primary substations with ageing underground cable networks have been selected; and • Improvement of the process following the trials.

3.17 Protection schemes demonstration tool

Description of Project	To develop several relay training demonstrators for use in a series of training courses. These demonstrators are a fairly complete protection scheme (such as distance protection) in a robust transit case which just plugs into a 13A socket.
Expenditure for financial year	External costs £0k Internal costs £15.5k Total EDF Energy Networks costs Total costs £15.5k
Expenditure in previous (IFI) financial years	£0k Not reported in the "Early Start" report
Technological area and / or issue addressed by project	Protection scheme demonstration teaching tool for various protection configurations.
Type(s) of innovation involved	Radical innovation
Expected Benefits of Project	Benefits are expected to include: • Protection training in a safe environment away from an energised substation. These relay training demonstrators do not require complete circuit breaker panels with the various combinations of relays. Being highly portable, the units can be taken to any suitable training location where a number of operators can be trained together; and • Simulating faults close to a live network can be hazardous and often the only opportunity is during the commissioning stage of a project when timescales can be short. Using these units, training can be carried out in the safety of a classroom at a time to suit those requiring the training.
Expected Timescale to adoption	3 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	100%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£500k
Commentary on project progress and potential for achieving expected benefits	The "Relays In A Box" demonstrator has been used extensively in training over 100 operational staff to date, with more training planned through out this year and beyond. EDF Energy Networks intends that all operational staff will undertake this training to update their knowledge of protection.

3.18 Recycling excavated material

Description of Project	This project will identify the ways in which excavated ground works material which occurs as part of EDF Energy Networks jointing, maintenance and project work can be recycled. This will reduce the amount of material sent to land landfill, importing of virgin type one material, traffic volume on the highway and pollution.
Expenditure for financial year	External costs £0.8k Internal costs £3.3k Total EDF Energy Networks costs Total costs £4.1k
Expenditure in previous (IFI) financial years	£0k Not reported in the "Early Start" report
Technological area and / or issue addressed by project	This project addresses the government targets of 45% of material is recycled is achieved and approved by Highway Authorities.
Type(s) of innovation involved	Radical innovation
Expected Benefits of Project	Benefits are expected to include: • Reduction in the amount of material sent to landfill by 136,000 tonnes/year; • Reduction in excavated virgin material from around the world by a similar amount; • Less vehicle movement to landfill sites and gravel yards; and • Less pollution on roads caused by vehicle movement.
Expected Timescale to adoption	7 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	75%
Project NPV (Present Benefits x Probability of Success) – Present Costs)	£1.9M
Commentary on project progress and potential for achieving expected benefits	During this year expenditure has concentrated on understanding the Street Works related processes and training. Our academic partners have attended recycling/sustainability conferences, such as the Soil stabilisation conference run by the Concrete Centre. A literature search relating to material specifications road constructions and soil stabilisation complemented the training activities.

3.19 Relay tester

Description of Project	There is a requirement to perform annual trip testing of all circuit breakers. Current practice for schemes involving IDMT protection involves initiating the trip by manual movement of the relay disc (for older electromechanical relays) and by various other means for electronic relays. Neither of these approaches proves the integrity of the protection and in the case of the first method is actually undesirable due to physical intervention of the relay. It is possible to perform this test by secondary injection of the relay, but existing equipment can only produce the desired trip, but gives no condition information about the relay timing. Following discussions with Relay Engineering Services, they have suggested that it is possible to perform an annual test that tests the relay and its setting.
Expenditure for financial year	External costs £0k Internal costs £5.2k Total EDF Energy Networks costs Total costs £5.2k
Expenditure in previous (IFI) financial years	£0k Not reported in the "Early Start" report
Technological area and / or issue addressed by project	To perform this annual test by secondary injection of the relay and to accurately measure the current seen by the relay and time the overall trip operation thereby enabling an accurate operating time of the relay to be established.
Type(s) of innovation involved	Incremental innovation
Expected Benefits of Project	Benefits are expected to include: • This tester / timer allows IDMT relay performance (at one setting multiple) to be quickly established on the majority of circuit breakers on an annual basis, and not at 10-year intervals as currently undertaken. Such a test would give simple and frequent 'condition assessment', highlighting relays which may be under performing.
Expected Timescale to adoption	3 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	75%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£90k

Commentary on project progress and potential for achieving expected benefits	Successful field trials were undertaken during January and February 2006. Some design changes were discussed with the company building the prototype and these are being incorporated into the new version. Further field testing is expected to take place in June/July 2006 with production versions being available by late summer. This test equipment is unique and the manufacturer is already anticipating world-wide sales based upon interest shown so far. To network operators, adoption of this method of testing will greatly enhance their protection asset condition knowledge.

3.20 Supergen V - AMPerES (Asset Management and Performance of Energy Systems)

Description	This is a 4 year major (£3M) multi party collaborative project: • Industrial Participants: National Grid, Scottish and Southern, SP Power Systems, United Utilities, Western Power Distribution, 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 & 25 activities. Most of the research will be carried out by the universities.
Expenditure for financial year	External costs £25.0k Internal costs £1.9k Total EDF Energy Networks costs Total costs £26.9k
Expenditure in previous (IFI) financial years	£0k Not reported in the "Early Start" report
Technological area and / or issue addressed by project	• WP 1: Programme delivery, outreach and implementation; • WP 2: Enhanced network performance and planning; • WP 3: New protection and control techniques that adapt to changing networks; • WP 4: Infrastructure for reducing environmental impact; • WP 5: Ageing mechanisms; and • WP 6: Condition monitoring techniques.
Type(s) of innovation involved	Radical innovation
Expected Benefits of Project	The expected aims of the project are: • To deliver a suite of intelligent diagnostic tools for plant; • To provide platform technologies for integrated network planning and asset management; • To progress plans to develop and implement improved and reduced environmental impact networks; and • To develop models and recommendations for network operation and management.
Expected Timescale to adoption	7 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	25%
Project NPV Present Benefits x Probability of Success) – Present Costs	£150k. It has been agreed that the research programme needs to produce tangible benefits for the DNO's. (Implementations and trials on the network rather than reports).

Commentary on project progress and potential for achieving expected benefits	The first steering group committee meeting took place in Hoylake in February 2006. The overall programme was presented to the project participants. Stages completed: • Content of work packages has been finalised; • EDF Energy Networks have nominated contacts for each work package and identified activities we are likely to be an active participant; and • The management structure has been finalised. Stages in progress: • The collaboration agreement is still under negotiation, an updated draft was circulated following comments from DNO's; and • Universities are currently recruiting research associates & PhD students so that research work can begin. Benefits delivered: • Opportunity to discuss common problems & collaborate with other DNO's.

3.21 Transformer temperature fibre optic monitoring

Description of Project	It is proposed that fibre optic temperature monitoring will be fitted to one of the new 30MVA transformers to be installed at Barnes substation in London. The monitoring will be installed in addition to the conventional electro-mechanical winding temperature instruments. This will give a comparison between the two instruments.
Expenditure for financial year	External costs £22.1k Internal costs £ 2.1k Total EDF Energy Networks costs Total costs £24.2k
Expenditure in previous (IFI) financial years	£0k Not reported in the "Early Start" report
Technological area and / or issue addressed by project	Temperature Fibre Optic Monitoring
Type(s) of innovation involved	Incremental innovation
Expected Benefits of Project	• A validation of the traditional referred temperature; • Assessment of seasonal ratings; and • Enhanced ratings of power transformers.
Expected Timescale to adoption	3 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	75%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£50k
Commentary on project progress and potential for achieving expected benefits	The transformer has been built and installed. All factory and site tests have been completed. The fibre temperature indicators have been tested at the factory and gave consistent results and basic on site tests have been completed. The transformer is not yet commissioned and so the performance of the winding temperature instruments cannot yet be assessed. A remote monitoring system via GSM modems is in the process of final commissioning.

3.22 Wood pole disposal

Description of Project	This project is to carry out a small scale trial of burning redundant poles to produce charcoal and to provide feedstock for electricity generation. The theory has been proved in a laboratory experiment and now needs to be scaled up to evaluate the potential for commercial charcoal production and electricity generation by building and running a small pilot plant. The work involved is to burn the contaminated wood at temperatures to drive off the volatile gases to be used for generation of electricity and to recover the charred wood as a charcoal product. The project will also involve tests to characterise the poles in respect to age to determine the amount of potential pollutants left in the wood.
Expenditure for financial year	External costs £0.0k Internal costs £2.2k Total EDF Energy Networks costs Total costs £2.2k
Expenditure in previous (IFI) financial years	£0 Not reported in the “Early Start” report
Technological area and / or issue addressed by project	The technical issue being addressed by this project is to develop an environmental process for the disposal of wood poles.
Type(s) of innovation involved	Significant innovation
Expected Benefits of Project	The diversion of the poles from landfill has both the financial benefit but also will help to meet the Company objective of achieving the 60% recycling target for 2006 and beyond. The use of the proposal will aid the good environmental image that the Company aspires to and provide a good trail for a waste product.
Expected Timescale to adoption	7 years
Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	75%
Project NPV (Present Benefits x Probability of Success) – Present Costs	£250k
Commentary on project progress and potential for achieving expected benefits	The theory has been proved in a laboratory experiment and now needs to be scaled up to evaluate the potential for commercial charcoal production and electricity generation by building and running a small pilot plant.

3.23 STP: Module 2 - Overhead Networks

Description of project	Strategic Technology Programme Overhead Network Module
Expenditure for financial year	External costs £36.0k Internal costs £ 2.9k Total EDF Energy Networks costs Total costs £38.9k
Expenditure in previous (IFI) financial years	£22.4k Reported in the "Early Start" report
Technological area and / or issue addressed by project	The STP overhead network programme for budget year 2005/6 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: • S2120_2 - Improve detection of defective surge arresters in-situ with selection and evaluation of the most promising solutions; • S2126_2 - Undertake long-term monitoring of conductor temperature by obtaining and analysing 12 months trial data; • S2132 - Validate current and proposed new ice accretion models; • S2133 - Investigate the use of sacrificial anodes for protecting tower foundations to defer or remove the need for full foundation refurbishment; • S2134_1 - Determine the susceptibility of currently used surge arresters to the principal modes of failure; • S2135 - Evaluate the life expectancy of copper conductors; • S2136 - Participate in European Project COST 727: Measuring and forecasting atmospheric icing on structures; • S2138_1 - Investigate live-line jumper-cutting limitations Stage 2 is to define a realistic experimental programme; • S2139 - Begin to evaluate a new corona discharge camera system; and • S2140 - Explore possible means of checking the foundations of newly installed poles.
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; and • Reduce lifetime costs by the appropriate use of alternative materials.		
Expected Timescale to adoption	Range 1-7 years - dependent on project	Duration of benefit once achieved	Range 2-10 years - dependent on project
Estimated Success probability (at start of project)	Range 5-20% - dependent on project		
PV of Project Costs	£36.0k (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	£54.6k
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: • S2120_2 - Improve detection of defective surge arresters with selection and evaluation of the most promising solutions. Laboratory tests have determined the most effective techniques and these have been presented to members with recommendations for further action; • S2126_2 - Undertake long-term monitoring of conductor temperature by obtaining and analysing 12 months trial data. The trial is continuing with the expectation that the results will indicate it should be possible to re-rate (up-rate) some overhead line circuits in certain circumstances; • S2132 - Validate current ice accretion models. The data currently being collected will be used to revise national overhead line design standards; • S2133 - Investigate the use of sacrificial anodes for protecting tower foundations to defer or remove the need for full foundation refurbishment. A practical reference document has been produced to assist in the application and specification of such devices; • S2134_1 - Determine the susceptibility of currently used surge arresters to the principal modes of failure. The findings provide a review of the capabilities of a range of surge arresters, allowing informed and more cost effective specification of these devices; • S2135 - Life expectancy of copper conductors. The results of initial laboratory testing of samples of varying age provided from UK distribution networks will be available shortly. They should allow an initial assessment of the overall condition of copper based conductors to be made; • S2136 - 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. This in turn will allow the most appropriate structure to be constructed; • S2138_1 - Investigate live-line jumper-cutting limitations. Controlled testing regime has been specified and this should lead to improved working practices being adopted; • S2139 - Begin to evaluate a new corona discharge camera system. This project is at a very early stage; and • S2140 - Explore possible means of checking the foundations of newly installed poles. An initial review of worldwide practice and commercially available techniques has begun.

3.24 STP: Module 3 - Cable Network

Description of project	Strategic Technology Programme Cable Networks Module
Expenditure for financial year 2005/06	External costs £46.9k Internal costs £ 2.3k Total EDF Energy Networks costs Total costs £ 49.2k
Expenditure in previous (IFI) financial years	£22.1k Reported in the "Early Start" report
Technological area and / or issue addressed by project	The STP cable network programme for budget year 2005/6 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. Eight new projects were approved during the year (shown in bold below). The projects undertaken within the programme during 2005-06 (include some approved in previous years) aimed to: • S3100_2 – Define better functional requirements for link boxes; • S3108_2 – Produce software for assessing earthing practice on PME systems; • S3115 – Determine the corrosion resistance of aluminium foil cables; • S3120 – Assess novel flame retardant coatings for cables in basements; • S3121 - Produce a cable fluid sniffer Stage 1(b) Feasibility study; • S3123 – Produce a guide and specify functional requirements for the selection of cable ducts; • **S3125 - Assess new degreasing products form MV and LV cables;** • **S3126 - Explore issues associated with the use of polyurethane and development of alternative jointing resins;** • S3131 – Produce a summary of CIGRE issues relating to HV cables; • S3113_2 - Addition of duct bank modelling functionality within CRATER cable rating software; • S3113_3 - Addition of paper cable modelling within CRATER cable rating product; • S3132_1 - Addition of HV polymeric cable modelling functionality within CRATER cable rating software; • S3132_2 - Addition of LV cable modelling functionality within CRATER cable rating software; • S3132_3 - Addition of cyclic and emergency rating modelling functionality within CRATER cable rating software; • **S3132_4 - Addition of limited time rating of mixed circuit modelling functionality within CRATER cable rating software;** • **S3132_5 - CRATER cable rating software, overview report;** • **S3132_6 - Addition of single core MV paper cable modelling functionality within CRATER cable rating software;** • **S3132_7 - Addition of cable crossing modelling functionality within CRATER cable rating software;** • **S3140_1 – produce a spreadsheet tool for pulling-in of cables into ducts;** • **S3144_1 – Evaluate the Hydragel process for the treatment of redundant fluid filled cables.**

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; • Savings of the order of 0.25 CML per connected customer; and • Increased safety of staff and public by reducing the number of accidents / incidents.		
Expected Timescale to adoption	Range 1-5 years - dependent on project	Duration of benefit once achieved	Range 2-10 years - dependent on project
Estimated Success probability (at start of project)	Range 2-30% - dependent on project		
PV of Project Costs	£36.0k (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	£59.5k
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: • *S3100_2 – Define better functional requirements for link boxes.* A document that defines functional requirements for LV link boxes has been produced for member companies. Previously such a document did not exist; • *S3108_2 – Software for earthing practice on PME systems.* An assessment tool has been produced for earthing practice on PME systems which evaluates the compliance with regulations and practices, carries out a check of LV cable circuit design; • *S3115 – Corrosion resistance of aluminium foil cables.* Tests have shown that corrosion of the laminated aluminium foil sheath is likely if the outer sheath of the cable is damaged leading to moisture penetration to the cable core; • *S3120 – Flame retardant coatings for cables in basements.* Findings recommended the use of a system consisting of a water-based intumescent coating and an associated water resistant topcoat. This should give valuable long-term fire protection to PE cables in basements and substations; • *S3121 - Cable fluid sniffer Stage 1(b) Feasibility study.* Laboratory familiarisation has been carried out and field trials are being undertaken; • *S3123 – Guide and functional requirements for the selection of cable ducts.* A report giving some advice on the use of plastic ducts in heavily loaded circuits has been produced; • *S3125 - Degreasing products for MV and LV cables.* The project defined a suitable wet-wipe that will ensure satisfactory cleaning		

	of LV, MV and HV cables without adversely affecting their performance; • *S3126 - Explore issues associated with the use of polyurethane and development of alternative jointing resins.* The project concluded that under current legislation, and provided employers comply with the requirements of the COSHH Regulations, the continued use of polyurethane resin systems is acceptable. Alternative systems are available, but currently more expensive than polyurethane resins; • *S3131 – Summary of CIGRE issues relating to HV cables.* An extensive report (140 pages) provides a comprehensive picture of work carried out by Cigré over the past 5 years, as well that currently underway and some that is planned. This places the work of the module in an international context; • *S3113_2 - Addition of duct bank modelling functionality within CRATER cable rating software.* The spreadsheet produced is a valuable tool for cable engineers. It ensures correct rating of cables installed in non-standard ducts and conditions; • *S3113_3 - Addition of paper 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 MV paper cable ratings, using approved methods of calculation; • *S3132_1 - Addition of HV polymeric 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 HV polymeric cable ratings, using approved methods of calculation; • *S3132_2 - Addition of LV 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 LV cable ratings, using approved methods of calculation; • *S3132_3 - Addition of cyclic and emergency rating modelling functionality within CRATER cable rating software.* A user-friendly spreadsheet tool for the cable engineer was created to determine cyclic and emergency current ratings for most practical mixed circuit problems; • *S3132_4 – Addition of limited time rating of mixed circuit modelling functionality within CRATER cable rating software.* The basic functionality is now incorporated into CRATER and operation with grouped circuits is being developed; • *S3132_5 - CRATER cable rating software, overview report.* The report, which is in preparation, will cover a range of practical applications for CRATER. The intention is that the report will form a handy reference to be used in conjunction with the basic operating manuals; • *S3132_6 - Addition of single core MV paper cable modelling functionality within CRATER cable rating software.* Preliminary scoping work has been carried out and a questionnaire sent out to ascertain user requirements; • *S3132_7 - Addition of cable crossing modelling functionality within CRATER cable rating software.* The method for calculating ratings of cable crossings has been established and development work is on-going; • *S3140_1 – produce a spreadsheet tool for pulling-in of cables*

	into ducts. Proprietary software is being evaluated for this project, which is at an early stage; and • *S3144_1 – Evaluate the Hydragel process for the treatment of redundant fluid filled cables.* Information has been collected on the two available processes and further information is being gathered from members.

3.25 STP: Module 4 - Substations

Description of project	Strategic Technology Programme Substation Module
Expenditure for financial year	External costs £36.0k Internal costs £ 0.5k Total EDF Energy Networks costs Total costs £36.5k
Expenditure in previous (IFI) financial years	£22.0k Reported in the "Early Start" report
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 2005/06 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 (shown in bold below). The projects undertaken within the programme during 2005-06 (include some approved in previous years) aimed to: In progress Projects • S0499 - Extend the TASA tap-changer diagnostic trial; • S4107_2 – Field test on a sample of switchgear. The headspace gas testing technique to indicate the condition of oil filled switchgear ; • **S4180 – Develop an indicator to detect discharge activity in substations;** • **S4172 – Follow-up of S0455 paint preparation for tanks to determine the longer term performance of the technique;** • **S4173 – Enhance the Transformer thermal rating assessment system;** • **S4178 – Testing and management of substation standby batteries;** • **S4181 – Ongoing programme of transformer post mortems to provide better correlation between condition assessment tests, true condition and remaining life;** • **S4182 – Develop a better understanding of frequency response analysis of transformers;** • **S4186 – Study of PM cast resin VTs;** • **S4188_1 – Assess replacement insulator grease;** • **S4189_1 – Examine substation noise;** • **S4190_1 - Review of pad mounted substations; and** • **S4193_1 - Develop a common approach to risk and reliability.**

	Completed Projects • S0497 – Transformer post mortems to assist estimation of remaining life from non-invasive tests; • S4130_4 – Assess wipes for HV oil filled equipment; • S4149 - Assess the quality, performance and longevity of recent substation equipment; • S4155 - Investigate ester based insulating oils; • S4162 – Extend the range of non-intrusive PD for › 90kV switchgear; • S4164 – Feasibility study into on-line tapchanger monitoring; • S4167 – Improve CBRM by use of better understanding of degradation processes; • S4172 – Scoping studies on transformer refurbishment, fault passage indicators, out of phase switching and fire legislation for substations; • S4174 - Compare a range of power system protection software; • S4175 – Assess circuit breaker cleaning techniques and materials; • S4176 – Compare available earth testing instruments; • S4179 - Explore in-situ testing of vacuum interrupters; and • S4187_1 – Hold a risk modelling workshop.		
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; and • 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	1-5 years - dependent on project	Duration of benefit once achieved	2-7 years - dependent on project
Estimated Success probability (at start of project)	1-20% - dependent on project		
PV of Project Costs	£36.0k (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	£64.2k

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. In progress Projects: • *S0499 - Extend the TASA tap-changer diagnostic trial.* The original trial had a low sample population and this work aims to increase the sample size. If earlier results are confirmed then the technique offers the potential for non-invasive condition assessment of tapchangers, with consequent improvements in network performance due to avoided failures and reduced OPEX from better targeted maintenance; • *S4107_2 - Headspace gas testing of oil filled switchgear.* Working closely with members, the project aims to collect headspace gas samples from units within the field and resolve any GCMS issues. If correlation is successful then the project offers the prospect of targeted maintenance and reduction of invasive inspections; • *S4180 – Develop an indicator to detect discharge activity in substations.* Results suggest the device in its present form cannot reliable detect/indicator discharge activity in many substation environments. This development will not be pursued within STP, but related trials of an electronic NO_x detector are being undertaken by the Discharge User Group; • *S4172 – Follow-up of S0455 Surface preparation of tanks.* The performance of the paint systems are being reviewed as a follow-up to earlier work; • *S4173 – Transformer thermal rating system.* This project is to re-develop the current Transformer Thermal Rating software to enable members to assess BSP Transformer safe loading limits; • *S4178 – Testing and management of substation standby batteries.* The project aims to assess the effectiveness of Battery Impedance testing methods to replace traditional discharge testing; • *S4181 – On-going programme of transformer post mortems.* Further work in this area to build on the good results obtained in an earlier project, where a good correlation between non-invasive tests and internal examinations had been shown; • *S4182 – Understanding frequency response analysis.* Frequency Response Analysis is a potentially useful condition assessment technique that can be significant in identifying and defining end of life for grid and primary transformers. Initial tests have produced some good results; • *S4186 – Study of PM cast resin VTs.* Members are completing an issues questionnaire and testing regimes are being developed; • *S4188_1 – Assess replacement insulator grease.* The project is to compare the performance of Insojell Grease with its proposed replacement, Dow Corning 3099 HVIC by performing a number of pre-specified accelerated aging tests; • *S4189_1 – Examine substation noise.* The project is investigating and clarifying the issues surrounding substation noise and develop a common, agreed framework to enable members to assess noise issues and take appropriate actions; • *S4190_1 - Review of pad mounted substations.* The project will provide an overview of members experience and identify any issues that may be arising through changing legislation; and

	• *S4193_1 - Develop a common approach to risk and reliability.* The objective of this initial stage of work is to quantify the information requirements and determine its availability. An outline of the approach to be adopted has been produced and is currently being refined. Completed Projects • *S0497 – Transformer post mortems to assist estimation of remaining life from non-invasive tests.* A good correlation between non-invasive tests and internal examinations has been shown. This will assist in interpreting on-going non-invasive testing of other transformers; • *S4130_4 – Assess wipes for HV oil filled equipment.* Final development and testing of a new 3rd party high performance wipe, which was specially developed to the specification, which was developed in early stages of the project, was undertaken. This is now a product available for members; • *S4149 - Assess the quality, performance and longevity of recent substation equipment.* An analysis of failure rates and reliability of modern substation equipment was undertaken and has highlighted a number of issues which warrant further investigation; • *S4155 - Investigate ester based insulating oils.* The project concluded that both natural and synthetic ester oils offer advantages over mineral oil in terms of biodegradability and electrical performance although oxidation stability and viscosity are poor; • *S4162 – Extend the range of non-intrusive PD for use on > 90kV switchgear.* The work identified the population of equipment suitable for PD testing, concluding that some types would benefit from such testing; • *S4164 – Feasibility study into on-line tap-changer monitoring.* The project concluded that it is possible to consistently characterise the operation of such devices using acoustic emissions techniques; • *S4167 – Improve CBRM by use of better understanding of degradation processes.* Mathematical models of asset ageing have been refined and calibrated in order to improve the accuracy of CBRM results; • *S4172 – Scoping studies on transformer refurbishment, fault passage indicators, out of phase switching and fire legislation for substations.* A series of short projects that allowed specific issues to be examined before deciding if a larger project in that area is appropriate; • *S4174 - Compare a range of power system protection software.* The available power system protection software was ranked in terms of its functionality, cost and ease of use. This will be used to assist members in making informed decisions; • *S4175 – Assess circuit breaker cleaning techniques and materials.* This project assessed different techniques and materials for cleaning circuit breaker contacts. A number of materials have been recommended together with a working practice; • *S4176 – Compare available earth testing instruments.* The project examined the operation of a number of simple clamp-on instruments and compared their effectiveness. The results showed that several instruments were quite inaccurate and could

	give misleading results; • *S4179 - Explore testing of vacuum interrupters.* The project investigated current and alternative methods of testing vacuum interrupters. It concluded that routine loss of vacuum testing would provide little benefit. It would be more appropriate to determine "at risk" interrupters and inspect these more frequently; and • *S4187_1 – Hold a risk modelling workshop.* A workshop for members and experts to discuss risk quantification was held.

3.26 STP: Module 5 - Distributed Generation

Description of project	Strategic Technology Programme Distributed Generation Module
Expenditure for financial year 2005/6	External costs £36.0k Internal costs £ 0.5k Total EDF Energy Networks costs Total costs £36.5k
Expenditure in previous (IFI) financial years	£21.9k Reported in the "Early Start" report
Technological area and / or issue addressed by project	The projects undertaken through budget year 2005/6 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. Fourteen new project stages were approved during the year (shown in bold below). The projects undertaken within the programme during 2005-06 (include some approved in previous years) aimed to: Projects in Progress • S5138 – Review of industry codes; • **S5147_3 – Monitor microgenerator clusters;** • **S5149_4 – Explore active voltage control;** • **S5150_2 – Review G59/1 and G75 protection and identify improvements;** • **S5151_3 – Model network risk;** • **S5142 – Define generator data and structure for DG connection applications;** • **S5154_1 – Develop a voltage control policy assessment tool on the IPSA platform;** • **S5155_1 – Explore lower cost connection solutions for distributed generation; and** • **S5157_1 – Evaluate the performance of small scale reactive Power compensators.** Completed Project Stages • S5144 – Workshop on regulatory and economic issues; • S5145 – Dynamic circuit ratings; • S5147_1 - Microgeneration clusters; • S5149_1 - Active voltage control; • S5150 Stage 1 – G59 and G75 protection; • S5151_1– Network risk modelling; • **S5133 – Tapchangers reverse power capabilities;** • **S5143 – Produce a draft code of practice on stability;** • **S5149 Stages 2 & 3 - Active voltage control;** • **S5151 Stage 2 – Network risk modelling; and** • **S5152_1 – Examine the latest developments in the connection of distributed generation.**
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); and • 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 active management of networks.		
Expected Timescale to adoption	1-5 years - dependent on project	Duration of benefit once achieved	1-5 years - dependent on project
Estimated Success probability (at start of project)	5-25% - dependent on project		
PV of Project Costs	£36.0k (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	£57.1k
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. Projects in Progress • *S5147_3 – Microgenerator clusters.* Installation of monitoring points is currently underway and a new substation is being commissioned. Monitoring will commence upon completion of installation and commissioning; • *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;		

	• *S5150_2 – G59/1 and G75 protection.* An initial review is complete and further work is pending results from allied university project; • *S5151_3 – Model network risk.* Following establishment of user requirements and review of available risk models and approaches is being undertaken; • *S5142 – Define generator data and structure for DG connection applications.* The generator data has been identified and a data structure agreed. Rationalisation of this data should now be considered; • *S5154_1 – Develop a voltage control policy assessment tool on the IPSA platform.* The interface between the existing eaVCAT software and the widely used IPSA power system analysis software has been developed and is currently being tested; • *S5155_1 – Explore lower cost connection solutions for distributed generation.* This project is at the information gathering stage, but intends to identify lower cost solutions; and • *S5157_1 – Performance of small scale reactive power Compensators.* Four devices have been identified and detailed information is being collated. User requirements are being sought from members. Completed Project Stages • *S5144 – Workshop on regulatory and economic issues.* A workshop to ensure the regulatory and economic environment is fully understood to assist selection of most appropriate technical developments; • *S5145 – Dynamic circuit ratings.* A report has been produced which summarises international work to date, evaluates available technologies and examines how these could be applied to UK distribution networks; • *S5147_1 – Monitor microgeneration clusters.* The project initiation document has been prepared and approved; • *S5149_1 – Explore active voltage control.* The project initiation document has been prepared and approved; • *S5150 Stage 1 – G59 and G75 protection.* The project initiation document has been prepared and approved; • *S5151_1– Model network risk.* The project initiation document has been prepared and approved; • *S5133 – Tapchangers reverse power capabilities.* It was concluded that under certain conditions there is an increased probability of internal flashover for single compartment tap-changers with single transition resistors. Steps should be taken to increase the maintenance frequency or de-rate the tap-changer to negate these affects; • *S5143 – Draft code of practice on stability.* The draft code of practice can be used to develop policy within each member company. It will facilitate the connection of distributed generation by providing a guideline on stability issues; • *S5149 Stages 2 & 3 - Active voltage control.* An overview of current control practices and how distributed generation impacts on them has been produced and a workshop held to explore the specific issues. This provides a firm basis for in depth studies of how active voltage control can be implemented and its advantages and disadvantages in different situations; • *S5151 Stage 2 – Model network risk.* The user requirements of a

	network risk model have been defined, documented and agreed and will be used to direct subsequent stages of the project; and • *S5152 – 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.

4. Martham Primary RPZ

Description of project and technical details	North Norfolk has a number of small wind-farms connected to the EDF Energy Networks' 11kV rural network. The circuits are mostly overhead feeders of various lengths. Voltage rise is a clearly documented problem that needs to be solved to allow increased penetration of DG to be connected to these networks without the costs of traditional reinforcement methods. GenAVC has been developed in conjunction with EDF Energy Networks and United Utilities as a solution to this problem. GenAVC has been installed at Martham Primary, North Norfolk.
Expenditure for financial year	None
Type(s) of innovation involved	GenAVC is installed at the primary substation. Measured parameters from the generator and primary substation are fed into a state estimator. The output of the system biases the target voltage of the traditional substation Automatic Voltage Controller (AVC).
Status (planned, under construction, operational) and operational starting year	Status Operational. GenAVC started operating in closed loop mode during 05/06.
Connection cost	Network supplied from Martham has been conditioned to accept new generation. We are waiting for DG developers to make enquiries to connect to this network.
Benefit to customers compared to those envisage when project was registered	There is already 3.8MW of wind generation connected to Martham Primary substation. It is estimated that the same amount again could be integrated into this network by the use of GenAVC. Connection costs will be reduced with the use of GenAVC and generator trips due to high volts will be reduced.