IFI/RPZ Report

April 2007 to March 2008 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 (IFI) activity report for the regulatory year 2007/08. I am pleased to report that we have been able to show our continued commitment to the Innovation Funding Incentive to encourage increased activity in research development and demonstration by utilising our allowance completely. I believe we have spent the allowance wisely and effectively over a portfolio of projects. Section 1.6 describes the portfolio.

This year has seen EDF Energy publish its Climate and Social Commitments. These documents can be viewed on the EDF Energy website. The Climate Commitments impact all areas of our company business. Some of the technologies within our IFI portfolio will help us achieve these targets. The document specifically mentions the fluid-filled cable leak location technique which is already delivering measurable benefits (see section 4.4).

In its Social Commitments EDF Energy has made a pledge that "We will lead the industry in protecting vulnerable customers from the adverse effects of power cuts". A good example of our efforts towards this is our work with Ceres Power to develop a hybrid fuel-cell UPS device to help vulnerable customers from being affected when power failures occur, by providing an emergency light and power for essential medical equipment.

We have been instrumental in establishing a collaborative framework with the Engineering and Physical Sciences Research Council to increase the number of researchers and teachers at UK universities. The Power Networks Research Academy complements the IET Power Academy in attracting students to carry out research in power engineering.

The Energy Technology Institute (ETI) has been established to demonstrate the necessary technologies required to deliver a sustainable future. EDF Energy Networks is working with many other companies to ensure the UK remains at the forefront of research and development within the power industry.

EDF Energy Networks has continued to be involved in the European Commission Framework projects. Preparations are being finalised to engage in Project ADDRESS, to understand how distributed generation and demand side management can assist in the management of distribution networks.

After three years of building the IFI project portfolio there are several projects now being actively demonstrated, proving new technologies and realising the business benefits that we expected to see at their inception. The focus in the coming year is to increase the realisation of such benefits from these and new projects.

Barry Hatton
Director of Capital Programme
EDF Energy Networks

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 (RPZs).

1.1 Context

As part of the DPCR and TPCR, Ofgem has introduced the IFI mechanism. IFI was consulted on as an integral part of the DPCR and TPCR proposals and was widely supported by a large majority of consultees. The primary aim of the incentive is to encourage the network operators to apply innovation in the technical development of their networks. Ofgem recognises that innovation has a different risk/reward balance compared with a network operator's core business. The incentives provided by the IFI mechanism are designed to create a risk/reward balance that is consistent with research, development, demonstration and deployment.
The IFI is intended to provide funding for projects primarily focused on the technical development of the networks, to deliver value (e.g. financial, quality of supply, environmental, safety) to end consumers.
The detail of the DNO IFI mechanism is set out in the Special Licence Condition C3 and Standard Licence Condition 46. It can be summarised as follows:

- A network operator is allowed to spend up to 0.5% of its combined distribution network revenue or its combined transmission network revenue (subject to a minimum of £500,000), as the case may be on eligible IFI projects. The good practice guide provides guidance on the required characteristics of such projects;
- network operator IFI expenditure, that is internal expenditure, will be allowed as part of the total IFI expenditure accrued by the network operator;
- the network operator is allowed to recover 80% of its eligible project expenditure via the IFI mechanism within the network operator's licence;
- Ofgem will not approve IFI projects but network operators will have to openly report their IFI activities on an annual basis. These reports will be published on the Ofgem website; and
- Ofgem reserves the right to audit IFI activities if this is judged to be necessary in the interests of customers.

In Ofgem's review of IFI and subsequent open letter response of 14th February 2007, the Authority agreed:

- A commitment to extend the DPCR4 IFI scheme until the end of DPCR5 with a flat pass through rate of 80%;
- The removal of the 15% cap on internal IFI expenditure for both distribution and transmission licences when requested to do so by a licensee; and
- To work with the industry to review and revise the guidance documents by means of which IFI is controlled and managed.

1.2 IFI

Projects will be judged as eligible within the IFI provided that:

- The project satisfies the eligibility criteria described in the ENA Engineering Recommendation G85, Issue 2, Innovation Good Practice Guide for Energy Networks;
- The project has been well managed; and
- Reporting requirements have been met.

Work that has been approved within an industry recognised (or national/governmental) programme (e.g. Department for Business Enterprise and Regulatory Reform (BERR) or European Commission Funding under R, D, D&D Frameworks), whose terms of reference clearly address innovation in the networks may be considered eligible within IFI if it meets the defined criteria. Co-operation between network operators and other organisations to pursue IFI projects is encouraged. In such cases the overall project would be expected to meet the IFI eligibility criteria; it would then be acceptable for each participating network operator to use the eligibility case for the overall project. IFI projects that secure additional funding from outside agencies, such as BERR or the European Commission, will not trigger any clawback of IFI funding by Ofgem. Engagement with industry engineering committees is not considered eligible as this does not constitute a project with a specific target or deliverable.

In the event that a network operator provides resources to contribute to an eligible IFI project which is led or managed by a third party then those costs incurred by the network operator, that are not recovered from the third party will be considered to be eligible IFI expenditure. Where supporting such projects results in a net cost to the network operator, the network operator should demonstrate, at a level appropriate to the costs involved, that the expected benefits to the network operator exceed the costs involved.

IFI projects, by their nature, involve risk. It is understood, therefore, that not all IFI projects will meet their aims and objectives and deliver net benefits. However, it is expected that the benefits from those that do succeed will significantly exceed the overall costs of a network operator's IFI programme.

1.3 RPZ

An RPZ is a zone of network where innovative practices, that allow distributed generation to connect more easily, are demonstrated. RPZs are 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 (DG) and broader benefits to consumers generally. A DNO will receive additional income (over and above the main DPCR4 DG incentive) which will be recovered by the Generator Distribution Use of System (GDUoS) charge. The DNO must demonstrate that an innovative solution could offer material advantages to DG customers compared to a conventional solution.

Although an RPZ requires the connection of a new generator, RPZs are not restricted to greenfield sites. The RPZ may contain existing generators, although only new generators will attract the RPZ premium. Where an RPZ is commissioned in stages, the DNO's entitlement to the five-year period of the RPZ premium will be triggered by the commissioning date of each generating unit. The total MW of installed capacity cannot exceed the registered capacity. An individual generating unit forming part of staged development of an RPZ must be commissioned by 31 March 2012 to qualify for the RPZ premium.

Each RPZ is defined as a collection of contiguously connected distribution system assets (i.e. which provide an electrical path for the distribution of electrical energy) having one or more terminal points which together describe in full the RPZ's boundary with the total system. These terminal points will be selected such that any system components or connected customers (existing demand and generation) that may be affected by the RPZ project are included within them.

The definition of an RPZ allows flexibility and will need to be applied differently depending on the project. For example, if a number of small generators are involved, it may be useful to define the limits of the RPZ in terms of geography as well as electrically, as this will be a boundary that the stakeholders can identify. On the other hand, if an RPZ involves, for example, the innovative connection of a wind farm in a remote area, defining the boundary in terms of a circuit may be sufficient. The boundary may need to be adjusted if new DG is connected on the edge of an RPZ, provided that it is judged appropriate to include the new DG in the demonstration of innovative practices.

1.4 This Report

This report contains a summary of EDF Energy Networks' IFI activities for the period April 2007 to March 2008 inclusive. Following the publication of the ENA Engineering Recommendation G85 Innovation Good Practice Guide for Energy Networks, issue 2, December 2007 this IFI activity report uses the new individual project report template. Additional information includes the project collaborators and research providers. The guide also introduces a measure of a project's benefits rating, project's residual risk and an overall project score. These measures have been calculated using the guidance for new projects that started during this reporting period. The measures are blank for existing projects.

EDF Energy Networks withdrew one RPZ from the EPN network during the period covered by this report, namely the Martham Primary RPZ in North Norfolk.

The GenAVC voltage control system that was being trialled at Martham has been removed in preparation for the installation of an electrical energy storage device at Hemsby. As part of the Aura NMS project (section 4.5) we will install a storage device at a normal open point between Martham and Ormesby Primary substations. The power electronic interface for the storage device could conflict with the GenAVC in attempting to control the voltage profiles of the 11kV feeders supplied from Martham. Once the electrical energy storage device has been installed it is our intention to re-register Martham Primary as an RPZ.

1.5 Company Structure

EDF Energy owns and operates the licensed distribution networks serving the East of England, London and the South East of England. The licensees managed by EDF Energy Networks Ltd are:

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

These licensed areas are shown in the map overleaf.

Research, Development and Demonstration activities are conducted by EDF Energy Networks for the benefit of our customers on behalf of the three licensed network operators named above. This year (as with last year), we have continued to allocate expenditure to each licensed network in proportion to the major asset associated with each individual project. Section 2.4 provides a tabulated summary of expenditure and a graphical representation comparing expenditure with the IFI allowance.

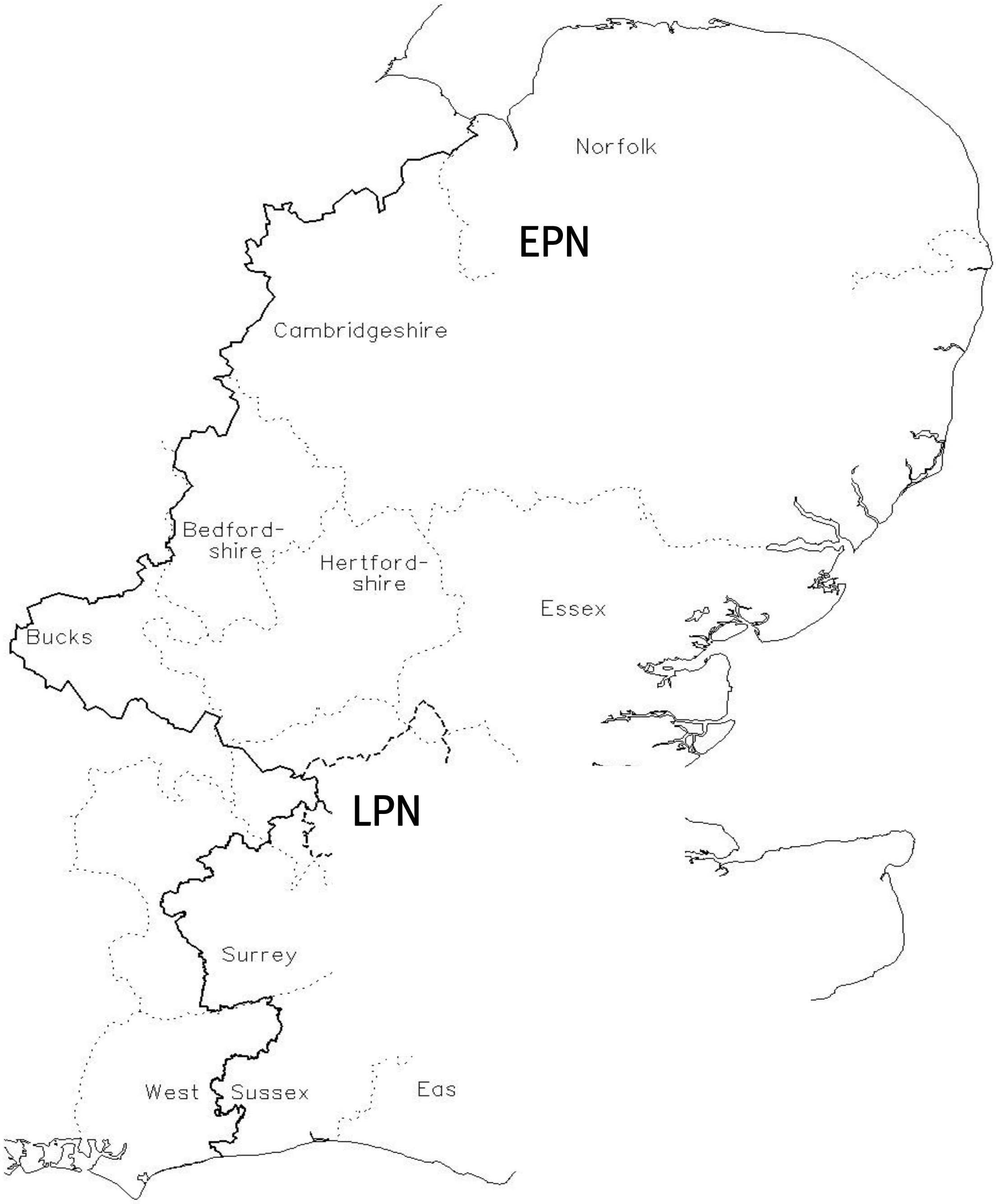


Figure 1 Licensed areas of EDF Energy Networks

1.6 Strategy and Portfolio Management

In the 2006/07 IFI activity report our strategy was described detailing the four work programmes namely, Sustainability and Environment, Network Operations, Asset Management and Future Networks. This report contains an explanation of how some of our IFI projects link together in those work programmes to deliver the strategy. This is more easily represented by the diagram below, which shows how many projects overlap between the different work programmes.

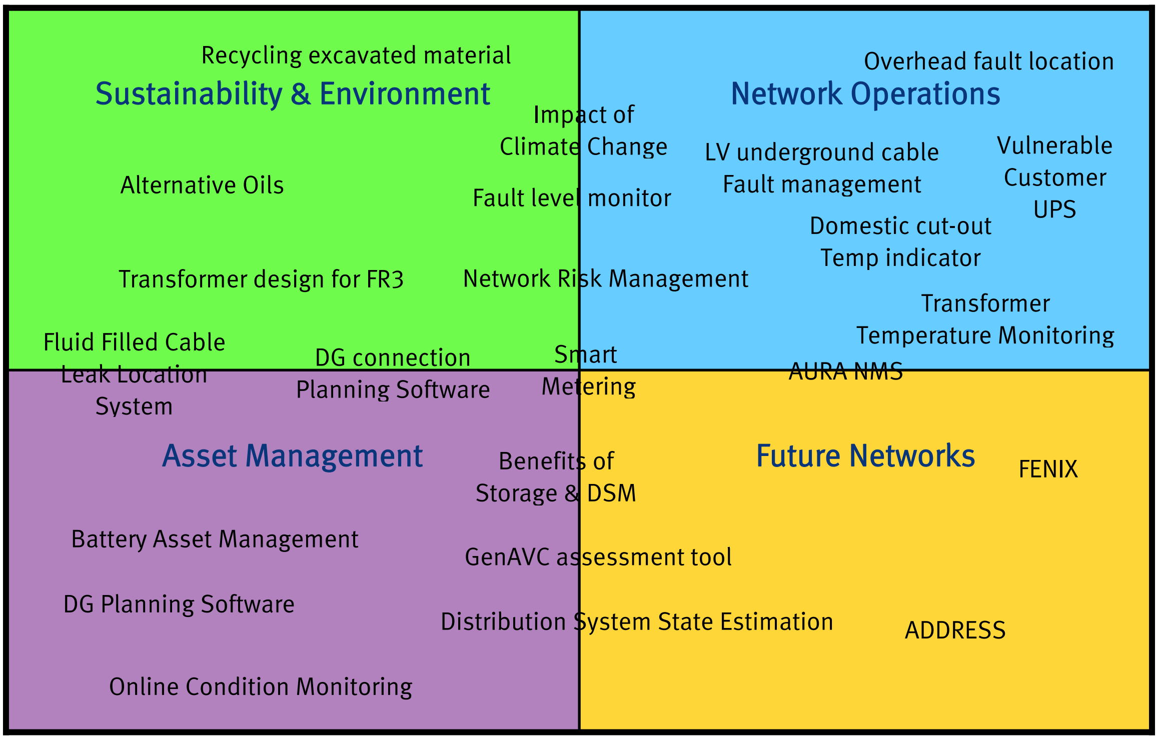


Figure 2 Diagram showing how some IFI projects map to the work programmes

"Smartgrids" is an international theme, both in Europe and the US. EDF Energy Networks has continued to participate in the work carried out in the UK, by the Electricity Networks Strategy Group (ENSG) and the Centre for Sustainable Electricity and Distributed Generation (SEDG). FENIX is a European FP6 project (section 4.11) that will allow distributed generation (DG) to be integrated into the networks of the future. AURA NMS (section 4.5) seeks to improve the security of supply of both load and generation customers. The output of the two projects will contribute to a new FP7 EU funded project called ADDRESS which seeks to integrate all customers in providing ancillary services to network operators. These projects will require smart meters with functionality to provide customers with necessary information to decide when they use their electricity. Together they form part of the Future Networks work programme.

Asset management continues to be increasingly important in attempting to extend the life of assets and in prioritising their replacement. The fluid-filled cable leak location system (section 4.4) has developed a method to find leaks in fluid-filled cables, allowing the worst leaking cables to be replaced first. Various condition monitoring projects relating to power transformers, cables and switchgear (section 4.1) are ongoing. They will help reduce the risk of managing the network and improve security of supply.

The Integration of DG is related to the Future Networks programme, but the outputs will deliver benefits in the near future. The DG connection planner application (section 4.10) will allow DG developers to use a web-based tool to consider a number of potential sites before contacting EDF Energy Networks for a formal quote. The DG planning software (section 3.1), as a proof of concept, has allowed network planners to study the impact of a DG connection proposal by more efficiently importing network data to build network models. The GenAVC assessment tool project (section 3.2) has shown it can allow additional DG to be connected without network reinforcement.
FENIX will deliver the control system applications to manage network constraints which may be due to power flow, voltage rise or fault level contribution. The 08/09 portfolio will include a project to develop DG technology for networks with little or no fault level headroom. Voltage control strategies are also being investigated and may be deployed as future RPZs. Within AURA NMS, an electrical energy storage device is being connected to the 11kV distribution network. The output of the Application of Storage and Demand Side Management (DSM) project (section 4.17) will be verified using this device. The Distribution System State Estimation project (section 4.9) will contribute to the AURA NMS decentralised control system, where each controller will have a situational awareness of the network.

The customer remains the focus of our IFI portfolio. The development of a proof of concept hybrid fuel cell UPS device (section 4.2) is receiving great interest from individuals and organisations representing vulnerable customers who are dependent on an electrical supply for their medical equipment. Other projects that will reduce the impact of supply interruptions include the on-line condition monitoring of assets and the Network Risk Management project (section 4.18). Both projects may influence the network investment required to build a sustainable future. All network operators and most supply businesses participated in the Met Office Impact of Climate Change project (section 4.13). The results will inform the way we design our future networks.
A number of projects have already delivered benefits (section 3) e.g. as part of a trial of a Climate Control Device (section 3.3), the life span of batteries in hot substation environments are being significantly extended.

With regard to future projects that meet the IFI criteria, EDF Energy Networks is drafting a number of proposals. These include an assessment of the benefits of the Common Information Model (CIM), a strategy for the reduction of losses, the benefits and risks of using superconducting cables in high load areas and the opportunities that smart metering could deliver to a network operator.

1.7 Project Partners

In this report each individual project report details the research and collaborative partners. In previous years' activity reports, EDF Energy Networks would not report the names of project partners until a report, paper or publication was in the public domain.

2. Summary of IFI Project Activities

2.1 Number of Active IFI Projects

There are a total of 35 active IFI projects. Eight new projects were started this year and seven were closed. The closed projects are reported in section 3 providing details on the next steps and the benefits being realised. The four EA Technology Ltd (EATL) Strategic Technology Programme (STP) modules are also reported.

2.2 Net Present Value (NPV) of Costs and Anticipated Benefits from Committed IFI Projects

It is estimated that the current EDF Energy Networks' IFI portfolio will deliver benefits of £26.7M. 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.

A number of overhead line performance improvement projects fall below the de-minimis level set in the Good Practice Guide. These have been grouped together to form a programme. The benefits of this programme are estimated to be in the order of £1.0M.

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 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
This regulatory year 07/08	£4,993.5k
Regulatory year 06/07	£3,575.8k
Regulatory year 05/06	£2,570.9k
Early start report 04/05	£ 275.8k
Total	**£11,416.0k**

Table 1 Total Expenditure

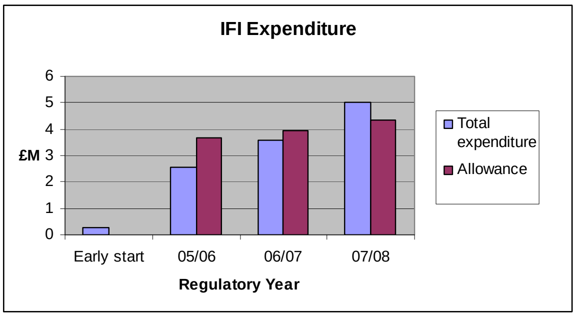


Figure 3 IFI Expenditure

2.5 Benefits Actually Achieved from IFI Projects to Date

During this regulatory year EDF Energy Networks has completed eight projects. Section 3 explains the benefits we have obtained and what still needs to be done to integrate the concepts into the business. A summary of some of the benefits being realised is detailed below.

The **DG Planning Software** project delivered a proof of concept solution. It demonstrated the potential to significantly reduce the engineering time taken to create the network analysis models, required to support the DG connection request process. The proof of concept tool has been used by planners and has reduced the preparation time to carry out studies. The total annual benefit is expected to be approximately £300k.

The **GenAVC Assessment Tool** project delivered:

- A tool that is able to assess whether voltage rise issues, associated with additional generation, can be overcome by installing GenAVC;
- A cost efficient connection for DG developer allowing additional generation to be installed; and
- Avoidance of nuisance trips at times of high volts are avoided by the generator.

EDF Energy Networks' planners now use the tool to determine whether GenAVC can resolve DG connection voltage problems rather than expensive network reinforcement.

Figure 4 GenAVC RTU installed at Horton Quarry, Steyning

The **Battery Asset Management** project developed a new range of innovative, sustainable, low power, localised air conditioning units that can be applied to sensitive pieces of equipment; in this instance, RTU batteries in distribution substations. These batteries form the power source for automatic remote control equipment in the network and are subject to thermal degradation which leads to increased CIs and CMLs. The successful implementation of the concept in RTUs has led to the introduction of the concept for other applications such as:

- Battery cabinets in substations;
- Auto reclosers (e.g. the NULEC); and
- Any other device which uses batteries and could be exposed to high temperatures.

Figure 5 The 4Energy Midi BAC (right) with a London distribution substation Remsdaq RTU

The **Domestic Cut-out Temperature Indicators** project investigated the use of low cost, thermally sensitive labels to give a meter inspector an indication of whether a domestic cut-out has been overheating.

The project showed that the most appropriate temperature sensors were the circular type (clock indicators, range 2 – RS code: 285-970). The best locations were found to be the top and bottom of the fuse carrier. A range of temperature from 60°C to 82°C appears to be most appropriate for this application.

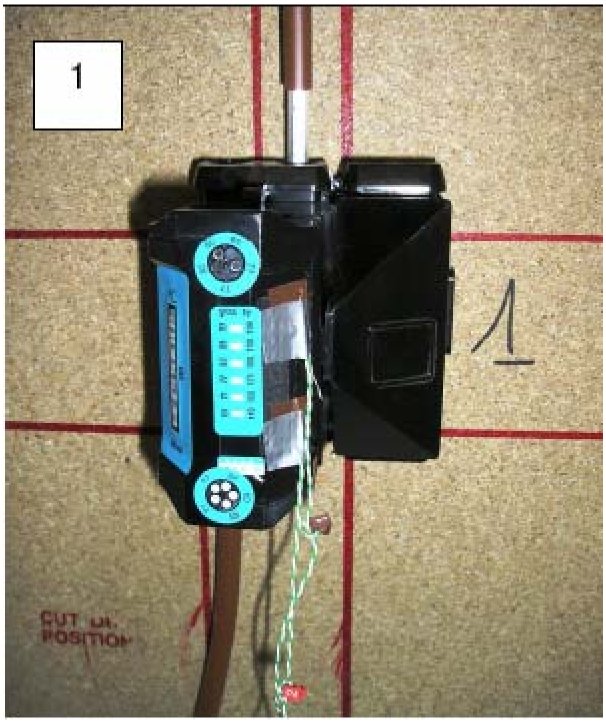


Figure 6 Domestic Cut-out showing the temperature sensitive labels under test.

The **Primary Scada Communications IP Upgrade** project allows the use of independent communications infrastructures and dual routes to the RTU. The link between the RTU and the control centre chooses the best link available e.g. satellite or GSM/GPRS. The IP protocol has allowed rapid deployment of different communications infrastructures and has facilitated the smooth introduction of ENMAC to control the SPN network. The satellite link has proven reliable even during storms.

Implementing the communications network via satellite was essential as it enabled immediate coverage across the SPN network while giving the option to extend the SCADA network to the EPN network. The technology deployed uses a TDMA (Time-Division Multiple Access) access scheme, which shares the available bandwidth across hundreds and potentially thousands of sites, thereby giving a cost-effective solution. Satellite communications are highly scalable, allowing for growth in both number of sites and bandwidth.

Figure 7 Earth Station at Fore Hamlet

Other projects that are still in the demonstration or verification stages are also starting to deliver benefits.

On-line condition monitoring: The number of feeders monitored (including cable and switchgear) has increased during the last year. Below is a summary of what has been delivered so far as part of the IFI project.

Equipment developed:

Figure 8 Fixed equipment

Figure 9 Portable Equipment

Several versions of the monitoring equipment are now available:

The fixed equipment can be used to monitor a large number of assets (cable or switchgear) whilst the portable equipment can be deployed and re-deployed at short notice to investigate problems for a limited period of time.

Sensor developed:

Figure 10 Switchgear monitoring

Figure 11 Cable monitoring

A variety of sensors can be attached to the online monitoring equipment to monitor incipient faults in cable and switchgear.

Web-based interface developed:

The web analysis interface provides an easy way to analyse the data and prioritise assets requiring further investigations.

Figure 12 The web analysis interface

The technology developed to date has enabled EDF Energy Networks to capture a number of network events (examples below).

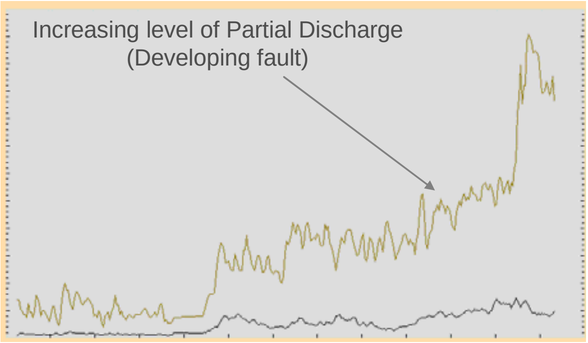


Figure 13 Increase discharge activity

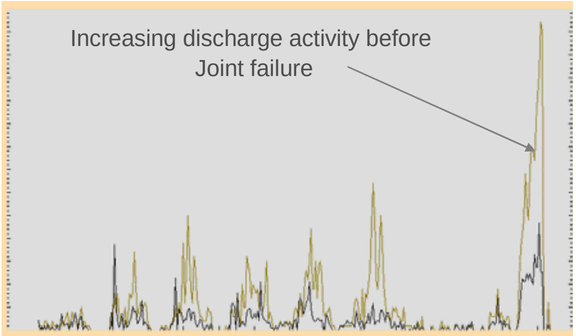


Figure 14 Joint failure

This information is helping EDF Energy Networks understand the behaviour of incipient defects, anticipate the impact of a fault, and will help reduce the number of customer interruptions.

Project benefits:

Although research work is still on-going, EDF Energy Networks is already able to:

Detect, locate and repair incipient cable faults before they occur;

- Target and prioritise cable replacements;
- Remotely monitor substations and receive automatic alarms;
- carry out remote partial discharge and safety checks before an employee enters a substation; and
- Move from reactive to proactive fault management.

Once the project is completed and the technology deployed, EDF Energy Networks expects to gain the following additional benefits:

- Improvement of quality of supply (CI, CML); and
- Reduction in Operational expenditure.

Fluid-Filled Cable Leak Location System trials have generated interest from ERDF (French DNO) and ESKOM in South Africa. Representatives from these companies attended site when the Leak Location System was being demonstrated.

During the trials, eight leaks have been found and repaired successfully, involving only nine excavations. This project also showed that the typical cost of finding a leak has reduced from approximately £40k to £5k.

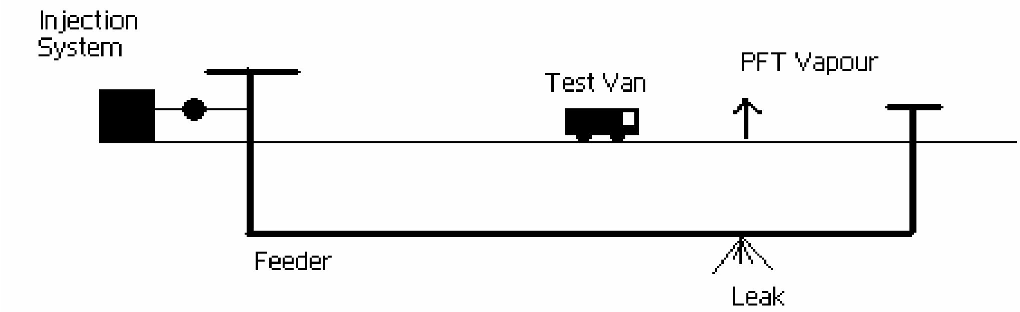


Figure 15 Schematic diagram of the leak location system

The traditional freezing technique usually requires two or more excavations in the highway and can only find one leak at a time. The circuit needs to be switched out and allowed to cool down (typically for several days) before a freeze can be applied. Freezing also has a detrimental effect on the lead cable sheath.

The new system offers several benefits:

- It allows multiple leaks to be found at the same time;
- It allows leak repairs to be prioritised;
- Customers' security of supply is only reduced for the time it takes to carry out the repair; and

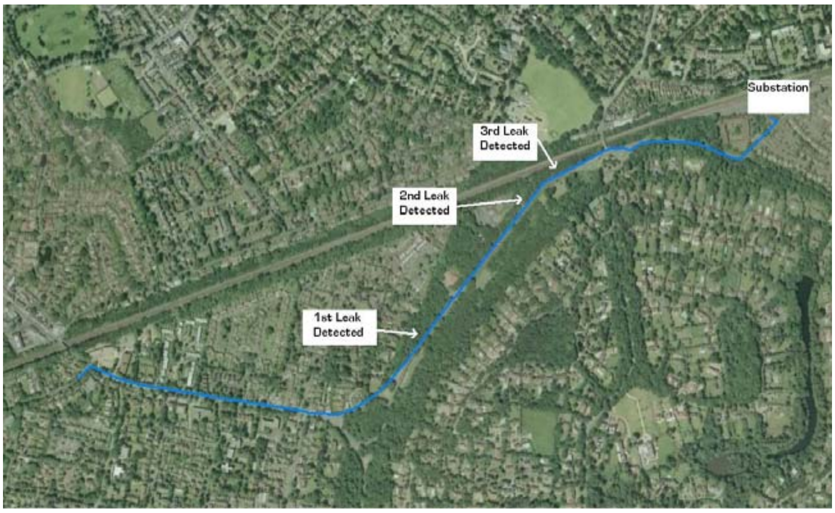


Figure 16 Aerial photograph with FFC and leak locations identified

Not only does this system allow leaks to be found more quickly while the circuit remains in service, it allows the leak location team to move on to repair other circuits. On one occasion, three leaks were found and repaired in a week, compared with an estimated three weeks using the traditional method.

2.6 Tabular Summary

	EPN	LPN	SPN	TOTAL
IFI carry forward from 06/07 (£k)	£0	£514.8k	£181.5k	£696.3k
Eligible IFI expenditure 07/08	£1,918.3k	£1,894.3k	£1,181.0k	£4,993.6k
Eligible IFI internal expenditure 07/08	£203.0k	£185.1k	£123.3k	£511.4k
Combined distribution network revenue (£m)	£384.6M	£278.8M	£201.9M	£865.3M
The IFI carry forward to 2008/09	£4.7k	£0	£0	£4.7k

2.7 Registered Power Zones

RPZ Name	Steyning Primary RPZ
RPZ DG Capacity (MW)	1.5MW
RPZ starting year	06/07

See RPZ report in Section 5.

2.8 Highlighted Project

In last year's report, we highlighted a number of projects that would be of interest to readers of the report. The following article "Cable fluid leaks located without digging" is taken from an internal company magazine.

Cable fluid leaks located without digging

EDF Energy Networks has made great progress towards the deployment of new technology to assist in the timely location of leaks on its extensive network of fluid filled cables.

Test van

R.E.A.D. sensor unit

The most important aspect of new technology is the development and field trials of a system which uses minute quantities (a few parts per million) of a Perfluorocarbon Tracer (PFT) – a chemical tag added to replacement cable fluid. When the tagged fluid reaches the site of a leak its volatile nature means that it quickly appears on the surface as minute wisps of gas.

A technology called R.E.A.D. (Random Electron Attachment Device) is used to detect the presence of PFT. This was developed in conjunction with the manufacturer, Femtotrace, Inc. and scientists at the NASA Jet Propulsion Laboratories in Pasadena, California.

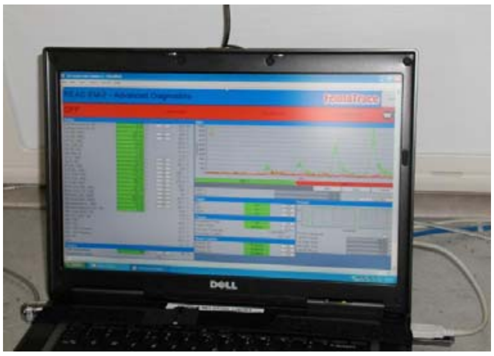
The technology is similar to that used on deep space exploration craft for analysing the atmospheres of planets and the solar system. The high sensitivity of the device means that it can be fitted into a vehicle and driven along the route of a leaking cable circuit. The site of a leak can be established without even stopping the vehicle.

The work carried out by Asset Optimisation and Technology and Customer Operations (EHV Cables Department), has led to the successful location of several cable leaks without the need for a single excavation. This provides the following advantages:

- Only one excavation is required to repair the cable, so customers suffer less disruption;
- In the long term, the amount of cable fluid leaked will be significantly reduced, which protects the environment;
- The whole process is carried out with the circuit in service which reduces the risk of supply interruptions
- Leaks can be located at significantly lower cost than existing methods; and
- Reduction in the amount of waste materials which need specialist disposal.

We plan to put this technology into full scale use in the whole of EDF Energy Networks by the end of 2007.

The versatility of the technology means that it can be used for other important analytical tasks. Work is now underway to identify and develop further uses for the device, which should greatly enhance the effective management and maintenance of EDF Energy Network's network.



Sample trace – the higher the peak, the closer the leak!

This project is part of our Transformation programme. Transformation is about making us more efficient through achieving productivity improvements and increasing income as well as making savings and improving the service we give our customers.

3. Completed IFI Projects Delivering Benefits

(Projects ordered by Expenditure)

- DG Planning Software
- GenAVC Assessment Tool
- Battery Asset Management
- Evaluation of the characteristics of Alternative Oil
- Transformer Damping
- Domestic Cut-out Temperature Indicators
- Power Factor Analysis
- Primary Scada Communications IP Upgrade

3.1 DG Planning Software

Description of Completed Project	The purpose of this project was to investigate how to model distributed generation, by using automated interfaces to pass data between the existing EDF Energy Networks' Smallworld/Netmap GIS system and a next generation network modelling/analysis tool called DigSilent PowerFactory. The project identified two candidate interface technologies – one produced by Mettenmeier, and the other produced by ITS. These enabled data transfer between Netmap and PowerFactory. A proof of concept application was developed using both candidate interfaces. The project discovered that by using this technology, the work of analysing the impact of attaching distributed generation to the network could be much quicker than the current processes used to perform the analysis. It is enabling planners to perform many more analyses and try alternative connection approaches in the same time period. The project also discovered that the Mettenmeier interface was technically superior for this application than the ITS interface. A prototype demonstrator was developed during the project which is used to demonstrate the concepts to EDF Energy Networks and external stakeholders.			
Expenditure for financial year		EPN	LPN	SPN
	External	£167,608	£66,345	£115,231
	Internal	£21,857	£8,652	£15,027
	Total	**£189,465**	**£74,997**	**£130,258**
	The costs have been allocated in proportion to the amount of connected distributed generation.			
Expenditure in previous (IFI) financial years	External	£128,658		
	Internal	£ 16,934		
	Total	**£145,592**		
Total Project Costs (Collaborative + external + EDF Energy Networks)	£ 400,000	This project is complete		
Technological area and/or issue addressed by project	To provide a mechanism to develop a DG connection strategy focussed on ease of use.			
Expected Timescale to adoption	During 2008	Duration of benefit once achieved	15 years	
Probability of Success	Proof of concept delivered.	Project NPV (Present Benefits – Present Costs) x Probability of Success	£ 360,000	
Benefits Achieved	The project delivered: A proof of concept solution demonstrating that there is the potential to significantly reduce the engineering time taken to create the network			

	analysis models that are needed to support the DG connection request process. The primary business benefits, once the final product is deployed, will include: • Improved customer service; • Increased process efficiency; and • Cost savings. Utilising Netmap as the enterprise wide data repository for connection analysis models also potentially provides the following benefits: • Common process across EDF Energy Networks' regions; • Identification of other connection requests that are in the same area and are still in the planning stage; • Provision of audit/tracking functionality and supporting evidence to defend decisions made; • Models are easily regenerated later; • The ability to more easily manage enquiries at multiple offices/locations; and • The opportunity to more easily identify deep reinforcement requirements arising from multiple connection enquiries and other planned schemes, which could also be managed through this system. A significant cost benefit is achievable from the reduction in skilled staff time and effort through the automation of study file creation. Typically, the current five or more days of skilled staff effort in modelling and analysing an HV network feeder can be reduced to one, or possibly two, days through the use of the tools developed. In some cases, studies are currently contracted out to third-party consultants. It is expected that the increase in internal productivity will mean that these external costs can be reduced. Ofgem has recently introduced a new standard licence condition (formerly known as SLC 4F but now known as SLC15) with obligations to meet target response rates and to audit and report on achievements each year. These standards/measures can be better managed via a deployment of the Netmap design/planning environment. There are further incremental benefits that arise from the provision of a study file management system in Netmap. Studies can be more easily tracked, shared and retrieved at a later date. The project has also demonstrated the potential benefits of an integrated GIS and analysis engine solution for answering DG connection requests, and its applicability to more general HV network planning and design. The way forward is based on the current availability of vectorised data in

	Netmap for SPN. This provides a suitable platform for the development and implementation of the DG connection tools at SPN, prior to roll-out in EPN and LPN which will follow the completion of network digitisation in those regions.
Project Progress March 2008	During the project. a three-stage approach was followed: • Requirements workshop; • Initial development phase followed by a workshop (Iteration 1); and • Second development phase followed by a final workshop (Iteration 2). The project team consisted of staff from EDF Energy Networks, GE Energy and Realworld who collaborated to ensure that the project included 'domain expertise' (EDF Energy Networks and GE Energy), business analyst and software programmers (Realworld) as well as project control (EDF Energy Networks, Realworld and GE Energy). The project included two iterations, enabling the EDF Energy Networks team to see an intermediate solution (Iteration 1) and reprioritise the requirements for the Iteration 2 system development. The final summary report was produced in November 2007. The recommendations are being addressed.
Collaborative Partners	
R&D Provider	GE Energy Realworld (GE Energy's software delivery partner)

3.2 GenAVC Assessment Tool

<table>
<tr><td>Description of Completed Project</td><td colspan="4">GenAVC has been developed by Econnect Ventures Ltd to manage voltage rise issues associated with the connection of distributed generation (DG) into 11kV networks. This system had achieved satisfactory operation in a trial at Martham Primary substation. The trial demonstrated that principles of voltage control could be applied in order to reduce the target busbar voltage and minimise network constraints.

At Horton Quarry, a landfill gas generator experiences nuisance trips during times of low demand. This project proposed 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, was carried out.

The tool showed that GenAVC was a solution, and a commercial grade GenAVC was installed at Steyning primary:
• To validate the management of the voltage rise issues;
• Avoid the occasional disconnections of the generator; and
• Demonstrate that GenAVC provides the least-cost connection for DG when additional generation capacity is sought.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£79,886</td><td>£0</td><td>£41,153</td></tr>
<tr><td>Internal</td><td>£15,512</td><td>£0</td><td>£ 7,991</td></tr>
<tr><td>Total</td><td>£95,398</td><td>£0</td><td>£49,144</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the amount of connected distributed generation.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£28,900</td></tr>
<tr><td>Internal</td><td colspan="3">£14,027</td></tr>
<tr><td>Total</td><td colspan="3">£42,927</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 315,000</td><td colspan="3">This project is complete.</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">A generic assessment tool to assess the benefits of the GenAVC solution.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2008</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
<tr><td>Probability of Success</td><td>Delivering benefits.</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£ 290k</td></tr>
</table>

Benefits Achieved	The project delivered: • An assessment tool that is able to assess whether voltage rise issues, associated with additional generation, can be overcome by installing GenAVC; • A cost efficient connection for Horton Quarry allowing additional generation to be installed; and • Nuisance trips at times of high voltage are avoided by the generator.
Project Progress March 2008	The GenAVC Assessment tool was developed by Econnect Ventures Ltd. Using this tool, EDF Energy Networks carried out an assessment for Horton Quarry to determine the suitability of GenAVC as a voltage control solution. The results showed that a GenAVC controller could be offered as a connection solution. A GenAVC controller was installed and commissioned to verify the results of the assessment tool. Horton Quarry has installed additional plant and is generating power onto the Steyning network without high volts causing nuisance trips. The Registered Power Zone at Steyning Primary has had additional generation connected without the need for traditional network reinforcement. See section 5.
Collaborative Partners	
R&D Provider	Econnect Ventures Ltd

3.3 Battery Asset Management

<table>
<tr><td>Description of Completed Project</td><td colspan="4">This project developed a range of innovative, sustainable, low power localised air conditioning that can be applied to sensitive pieces of equipment – in this instance, RTU batteries in distribution substations. These batteries form the power source for automatic remote control equipment in the network and are subject to thermal degradation which leads to CIs and CMLs on the network. The successful implementation of the concept in RTUs has led to the introduction of the concept for other applications such as:
• Battery cabinets in substations;
• Auto reclosers (e.g. the NULEC); and
• Any other device which uses batteries and could be exposed to high temperatures.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£47,497</td><td>£55,808</td><td>£15,436</td></tr>
<tr><td>Internal</td><td>£6,161</td><td>£7,240</td><td>£2,002</td></tr>
<tr><td>Total</td><td>£53,658</td><td>£63,048</td><td>£17,438</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of remote terminal units.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£145,543</td></tr>
<tr><td>Internal</td><td colspan="3">£ 17,547</td></tr>
<tr><td>Total</td><td colspan="3">£163,090</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 300,000</td><td colspan="3">This project is complete.</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Extending the life of batteries by creating a cool ‘thermal zone’ in hot basement substations.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Timescale to adoption</td><td>During 2008</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
<tr><td>Probability of Success</td><td>Delivering benefits</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£150k</td></tr>
</table>

Benefits Achieved	The device has been installed for the last six months in an extended 50 site trial in London, where batteries were failing frequently. This trial successfully demonstrated the effectiveness of the equipment in maintaining batteries at lower than 20°C, in ambient temperatures of up to 45°C. It also ensured that all engineering constraints have been addressed, that the equipment fits in most sites, is easy to install and interfaces seamlessly with existing RTU equipment. Cool 'thermal zones' do extend the life of batteries in hot substations and have improved the reliability of remote control switching and automatic restoration of customer supplies. A smaller RTU battery device has also been trialled in a pavement mounted cubicle where a battery is used to improve the communications of a fluid-filled cable pressure monitoring system.
Project Progress March 2008	The extended trial in the 50 London substations has met thermal specifications, has been developed to satisfy engineering requirements and is ready for deployment. The equipment has already been with no difficulty by over 10 different installers, following a 60 minute classroom training session. One of the sites chosen for the trial is Lancaster Gate Hotel, effectively creating a cool 'thermal zone' in this hot substation. In parallel, the passive cooling of "City Centre Substations" is providing thermal protection for the remaining equipment without the use of large "forced convection" or "vapour compression" air conditioning systems.
Collaborative Partners	Central Networks and ScottishPower Energy Networks
R&D Provider	4Energy

3.4 Transformer Damping

Description of project	This project sets out to determine methods to reduce noise nuisance resulting from vibrations due to 100Hz.			
Expenditure for financial year		EPN	LPN	SPN
	External	£16,403	£7,678	£10,819
	Internal	£2,415	£1,130	£1,593
	Total	**£18,818**	**£8,808**	**£12,412**
	The costs have been allocated in proportion to the number of ground mounted distribution transformers.			
Expenditure in previous (IFI) financial years	External	£8,625		
	Internal	£ 672		
	Total	**£9,297**		
Total Project Costs (Collaborative + external + EDF Energy Networks)	£ 50,000	Projected 2008/09 costs for EDF Energy Networks	External £ 0 Internal £ 0 Total **£ 0**	
Technological area and/or issue addressed by project	Methods to reduce sound radiation from an electrical transformer installation.			
Type(s) of innovation involved	Significant	Project Benefits Rating	Project Residual Risk	Overall Project Score
Expected Timescale to adoption	Year 2010	Duration of benefit once achieved	20 years	
Probability of Success	25%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£50k	
Benefits Achieved	The project is completed and a report has been issued describing methods for future noise and vibration damping systems. A future project is proposed to demonstrate these suggested systems.			
Project Progress **March 2008**	The research suggested that there could be a positive expectation that the noise level and vibration from distribution transformers could be reduced by the use of novel systems as well as by the use of appropriate anti-vibration pads installed in the correct position.			
R&D Provider	University of Southampton			

3.5 Evaluation of the Characteristics of Alternative Oils for Retro-Filling Power Transformers and for Use in New Transformers

<table>
<tr><td>Description of project</td><td colspan="4">This project assessed various alternative materials that could be used as the insulating medium of power transformers undertook electrical tests on insulation materials and attempted to verify the claimed advantages.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£2,158</td><td>£0</td><td>£0</td></tr>
<tr><td>Internal</td><td>£8,870</td><td>£0</td><td>£0</td></tr>
<tr><td>Total</td><td>£11,028</td><td>£0</td><td>£0</td></tr>
<tr><td colspan="4">The costs have been allocated to EPN as the alternative oil transformer will be trialled in the EPN licence area.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£19,041</td></tr>
<tr><td>Internal</td><td colspan="3">£ 2,797</td></tr>
<tr><td>Total</td><td colspan="3">£21,838</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 350,000</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £20,000
Internal £ 1,900
Total £21,900</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Evaluation of the characteristics of alternative oils for retro-filling power transformers and for use in new transformers.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technological substitution</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The benefits of using alternative oils in transformers are based around two main points:
Safety/environment; and
Lifetime ageing performance.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2014</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
<tr><td>Probability of Success</td><td>50%</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£ 50,000</td></tr>
<tr><td>Benefits Achieved</td><td colspan="4">The project has ended and a report has been produced. The report concluded that further work was required and a second phase is planned</td></tr>
<tr><td>Project Progress
March 2008</td><td colspan="4">The second phase has been defined, including the goals to be achieved. Areas of uncertainty uncovered during the first phase are to be re-examined and additional areas, such as the performance of the fluids with large oil gaps, are to be analysed.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">Areva T&D, M&I Materials, National Grid, Electricity North West, ScottishPower Energy Networks.</td></tr>
<tr><td>R&D Provider</td><td colspan="4">University of Manchester</td></tr>
</table>

3.6 Domestic Cut-Out Temp Indicators

<table>
<tr><td>Description of Completed Project</td><td colspan="4">This project investigated the use of low cost, thermally sensitive labels to give a meter inspector an indication whether a domestic cut-out has been overheating and further investigation is required.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£3,564</td><td>£2,268</td><td>£2,268</td></tr>
<tr><td>Internal</td><td>£1,500</td><td>£955</td><td>£955</td></tr>
<tr><td>Total</td><td>£5,064</td><td>£3,223</td><td>£3,223</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of connected customers.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£0</td></tr>
<tr><td>Internal</td><td colspan="3">£431</td></tr>
<tr><td>Total</td><td colspan="3">£431</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 10,000</td><td colspan="3">This project is complete.</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Thermal monitoring of domestic cut-outs.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Timescale to adoption</td><td>During 2008</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
<tr><td>Probability of Success</td><td>Successful</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£2.2M</td></tr>
<tr><td>Benefits Achieved</td><td colspan="4">This project has delivered:
An early warning system for detecting thermal problems in cut-outs due to customers’ load;
A method to help prevent fire damage to customers’ premises; and
Improved customer safety.
The deployment of the “clock indicator” type temperature sensors to all domestic cut-outs throughout the EDF Energy Networks will prove most challenging.</td></tr>
</table>

Project Progress March 2008	Thermal rise tests were carried out on “Single Service Supplies” and “Looped Services” configurations. One of the pinching screws was undone from the chosen cut-outs, to simulate a bad resistance contact and to cause subsequent temperature increase, (as would be seen in this type of failure mode). In both configurations, the current was increased progressively after undoing the pinching screws in order to accelerate the increase in temperature of the cut-outs. This allowed the temperature indicator’s response to be monitored. It was shown that the most appropriate temperature sensors were the circular type (clock indicators, range 2 – RS code: 285-970). The best locations were determined to be the top and bottom of the fuse carrier. A range of temperature from 60°C to 82°C appears to be most appropriate for this application.
Collaborative Partners	
R&D Provider	Tyco Electronics, Witham

3.7 Power Factor Analysis

Description of project	This project was prompted by the observation that a correlation exists between temperature and power factor. Whilst some of this may be attributable to air conditioning load in urban areas, this cannot be said of typical, rural locations. This project examined the sources of such reactive loads to better understand the reactive compensation needs of the network. This may lead to installation of power factor correction plant (or otherwise) to increase the efficiency of the distribution network.			
Expenditure for financial year		EPN	LPN	SPN
	External	£0	£0	£0
	Internal	£338	£139	£186
	Total	**£338**	**£139**	**£186**
	The costs have been allocated in proportion to the amount of connected distributed generation.			
Expenditure in previous (IFI) financial years	External	£0		
	Internal	£1,534		
	Total	**£1,534**		
Total Project Costs (Collaborative + external + EDF Energy Networks)	£ 27,500	This project is complete.		
Technological area and/or issue addressed by project	Reactive compensation needs of distribution networks			
Type(s) of innovation involved	Incremental	Project Benefits Rating	Project Residual Risk	Overall Project Score
Expected Benefits of Project	The expected benefits are: • An improvement of power factor from 0.8 to unity can provide alternative to increases in transformer size and cable capacity; and • A reduction in distribution plant losses.			
Expected Timescale to adoption	Year 2014	Duration of benefit once achieved	20 years	
Probability of Success	25%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£200k	
Benefits Achieved	The project results show that there is a need to carry out further work to identify which methods are most appropriate to improve power factor measured on a distribution network.			

Project Progress March 2008	This work looked at computer power supplies which are a major source of low power factor (In 2006, 65% of households owned a PC and this number is growing rapidly). Of the total US electricity consumption, about 1% was attributable to domestic IT equipment in 2005. Again the PC has the largest contribution to the demand total, requiring around 50% of the electricity. The most surprising discovery is that the majority of the residential PC's energy consumption (53%) occurs when it is active but not in use. These statistics are of importance because in a PC, the power factor can vary from 0.5 with no power factor correction, to between 0.9-1.0 with active power factor correction. Passive correction increases the power factor to between 0.7-0.8. Studies have shown that poor power factor affects the efficiency of the PC and perhaps more surprisingly experiments have shown that loading affects the power factor. This is of great concern considering 53% of the energy is spent whilst not in use. Such an experiment was performed and it was discovered that from about 25% load, the power factor approaches its maximum value. Between 25% and full load, the power factor seemed to vary by between 5 and 10% of its maximum value. Data analysis of recorded substation power factors was also performed as part of this work. The power factor and temperature correlation coefficients were calculated for each station and the results indicated a range of correlations from moderate to very strong. Best fit lines were calculated and it was found that second order polynomial equations best described the relationship. When the results of all the substations were combined, the correlation was much weaker because the characteristic curves of each station were different. Current and temperature correlation was investigated and found to be weaker than power factor and temperature. The relationship was best described by a second order polynomial equation. The most interesting result was that the Leicester Square substation showed a trend of increasing current with temperature. This was in contrast with the negative correlation results of all the other substations. The average weekday power factor and current profiles were plotted for all stations excluding Leicester Square. In all cases a dip in power factor was visible during working hours which coincided with an increase in current. The summer and winter profiles of Bourn substation were also examined and contrasts discussed.
Collaborative Partners	
R&D Provider	Cambridge University

3.8 Primary SCADA Communications IP Upgrade

Description of Completed Project	This project demonstrated that IP protocols can be used securely to provide the necessary primary substation SCADA communications used in distribution networks.			
Expenditure in previous (IFI) financial years	External	£202,262		
	Internal	£ 50,863		
	Total	£253,125		
Total Project Costs (Collaborative + external + EDF Energy Networks)	£ 253,125	This project is complete.		
Technological area and/or issue addressed by project	The use of IP to provide Primary SCADA communications (satellite) and to control the changeover to a back-up communications system (GPRS).			
Type(s) of innovation involved	Radical	Project Benefits Rating	Project Residual Risk	Overall Project Score
Expected Timescale to adoption	Year 2008	Duration of benefit once achieved	20 years	
Probability of Success	25%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£ 57k	
Benefits Achieved	Benefits have been realised for the SPN Primary SCADA system. The new IP communications solution went live in September 2007. Availability of the RTU is now typically 99.9%. With the capability to configure real-time use of either Main or GPRS back-up communications, service can be maintained without the requirement for immediate, on site intervention. The whole system is also mains independent and will therefore function during a Black Start. The previous system was subject to outages caused by faults in the BT network. With this new system communications can be restored remotely within minutes. The installation of this communications system facilitated the cut-over from the Schneider NMS system to the GE Energy ENMAC control system.			
Project Progress March 2008	All Primary RTUs in SPN are connected to the new ENMAC control system. 385 RTUs via satellite VSATs and 15 RTUs use terrestrial broadband due to problems obtaining satellite line of sight (LOS). These LOS issues will be pursued over the coming months and VSATs will be installed wherever possible. Both satellite and terrestrial broadband have a GPRS back up system. The satellite hub is located at the EDF Energy Networks' control centre at			

	Fore Hamlet in Ipswich. This hub has UPS and generator back-up power supplies but in the event of a hardware catastrophe or planned maintenance there is a dedicated EDF Energy Networks' disaster recovery hub at the Satlynx facility in Germany (connected via 99.999% available C&W redundant communications circuits) which can be brought into action within two hours, although in tests the operation has taken approximately 20 minutes. In addition, the GPRS back up network can still be used during outages of the UK satellite Hub.
Collaborative Partners	
R&D Provider	Satlynx

4. Individual IFI Projects

(Projects ordered by expenditure)

- Online Condition Monitoring
- Vulnerable Customer UPS
- Bankside Heat transfer
- Improved Fluid-Filled Cable Leak Location System
- AURA NMS
- Transformer Design for FR3
- Vacuum Tap Changer
- Vegetation Management
- Distribution System State Estimation
- DG Connection Planner
- Flexible Electricity Networks to Integrate the eXpected 'energy evolution' FENIX
- Optimal Transformer Utilisation Model
- Impacts of Climate Change on the UK Energy Industry
- RTU Local Display Facility
- Composite Insulators
- OHL Electrical Performance
- Transformer Damping
- Application of Storage and DSM
- Network Risk Management
- Supergen V – Amperes
- Wood pole disposal
- LV underground cable fault management
- 33kV Voltage Control
- Collaborative ENA R&D programme
- Activ Project
- Recycling Excavated Material
- Grid Transformer Monitoring
- Earthing Information system
- Electrical Energy Harvesting from Vibrations
- Transformer Temperature Fibre Optic Monitoring
- Power Networks Research Academy
- Supergen 1 – FlexNet

EATL Strategic Technology Programme

- STP Module 2 : Overhead Network
- STP Module 3 : Cable Networks
- STP Module 4 : Substations
- STP Module 5 : Networks for Distributed Energy Resources

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

4.1 On-line condition monitoring

<table>
<tr><td>Description of project</td><td colspan="4">The use of partial discharge measurement has been a well known method of checking the condition of electrical insulation. Over the past nine years, EDF Energy Networks has been actively involved in the development of online partial discharge monitoring and mapping techniques.

Opportunities to improve the existing technology have been identified. This project has taken the laboratory into the distribution network to monitor underground cables and switchgear.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£24,423</td><td>£626,863</td><td>£162,822</td></tr>
<tr><td>Internal</td><td>£2,324</td><td>£59,642</td><td>£15,492</td></tr>
<tr><td>Total</td><td>£26,747</td><td>£686,505</td><td>£178,314</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the length of installed HV cable that is directly earthed.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£892,032</td></tr>
<tr><td>Internal</td><td colspan="3">£ 85,102</td></tr>
<tr><td>Total</td><td colspan="3">£977,134</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 2M</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 500k
Internal £ 43k
Total £ 543k</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The issues being investigated by the project are:
• Online fault detection and location;
• Pre-emptive fault repairs;
• Cable replacement and maintenance strategy; and
• Quality of supply improvement.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits include:
• Ability to target the replacement of cable; and
• Ability to identify faults (cable and switchgear) before they occur, carry out a repair and reduce the number of customer interruptions.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2010</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
<tr><td>Probability of Success</td><td>75%</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£4.8M</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">Although there is still much research work to be done in terms of understanding failure modes, the programme is progressing according to plan and benefits are being delivered.</td></tr>
</table>

Project Progress March 2008	The number of feeders monitored across the EDF Energy Networks' area has increased to approximately 1000 (40 substations equipped). Sensors used to monitor both cables and switchgear include current transformers, airborne acoustics and capacitive couplers. The following stages have been completed: • Hardware development - permanent and portable versions of the Advanced Substation Monitor (ASM), Partial Discharge (PD) location/mapping equipment; • Cable analysis health index software - an analysis tool that combines cable information (length, date of installation, etc.) with condition information to inform asset management decisions; • Installation of equipment - the data collected is being used to build an extensive database of network events (partial discharges, noise, etc.) that can be exploited for research purposes; and • Development of a web-based cable sample analysis database. The technology is delivering benefits now (remote monitoring of substations, detection and location of incipient defect). Several cable faults have been identified and are awaiting cable replacements. However, much work is left to do in order to fully benefit from the on-line condition monitoring techniques. The following stages are currently in progress: • Research is currently taking place in the following areas: time to failure prediction, noise reduction, partial discharge trend analysis and recognition, defect type classification, cable degradation process analysis, failure modes and improved sensor development; • Complete solution validation: desk study, spot testing, monitoring, mapping and repairs; • Integration with network control system (demonstration); • Integration of network information to manage risks (cable type, number of customers, automation, etc.); and • Development of ring main unit mini PD monitor to extend the detection range of the system. Selected list of publications: • Transmission and Distribution World article (Oct 2007): "EDF Energy identifies high-risk cable sections", Matthieu Michel; and • Journal publication: "Second Generation Wavelet Transform in PD Measurement and De-noising". IEEE Transactions on Dielectrics and Electrical Insulation. December 2007, Vol. 14, No.6.
Collaborative Partners	
R&D Providers	IPEC Ltd, ERA Technology, EDF R&D (France), PPA Energy, IPEC HV and Glasgow Caledonian University.

4.2 Vulnerable Customers UPS

Description of project	This project aims to develop solutions that provide continuity of electrical power to vulnerable customers - those who are classified as needing a combination of lights, appliances, electronics and medical equipment to remain operational in the event of a power failure. Ceres Power has developed the capabilities and specialist expertise to deliver a fuel cell solution.			
Expenditure for financial year		EPN	LPN	SPN
	External	£197,892	£125,931	£125,931
	Internal	£19,044	£12,119	£12,119
	Total	**£216,936**	**£138,050**	**£138,050**
	The costs have been allocated in proportion to the number of customers in each licence area.			
Expenditure in previous (IFI) financial years	External	£0		
	Internal	£5,390		
	Total	**£5,390**		
Total Project Costs (Collaborative + external + EDF Energy Networks)	**£ 1.2M**	Projected 2008/09 costs for EDF Energy Networks	External £ 179,000 Internal £ 5,000 Total **£ 184,000**	
Technological area and/or issue addressed by project	Hybrid fuel cell – battery for customers medically dependent on electricity.			
Type(s) of innovation involved	Radical	Project Benefits Rating	Project Residual Risk	Overall Project Score
Expected Benefits of Project	The expected benefits include a means of reassuring vulnerable customers that the effects of a power cut are reduced.			
Expected Timescale to adoption	Year 2012	Duration of benefit once achieved	20 years	
Probability of Success	25%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£ 200,000	

Potential for achieving expected benefits	At the end of the project, in December 2008, we expect a prototype to be delivered. The prototype/engineering demonstrator which will be delivered at the end of the project comprises two parts: • The internal battery component that provides the continuous supply of energy following an interruption for a period of approximately two hours, dependent on energy usage; and • The external fuel cell module that provides the extended supply of energy dependent on the size of the gas bottle. During the development, calculations showed that the fuel cell module could not be stored indoors as oxygen in a room used by the module is depleted in a number of hours.
Project Progress March 2008	The following phases have been completed: • Phase 1 feasibility study; and • Phase 2 battery UPS. The current phase 3 fuel cell UPS is on target with the following tasks completed: • Design of fuel cell UPS; • Test of key fuel cell module components; and • Build of core fuel cell module. In addition, concept designs have been generated to show what a final customer product would look like.
Collaborative Partners	
R&D Provider	CeresPower

4.3 Bankside Heat Transfer

Description of project	Substation transformers produce waste heat which is usually lost to the environment. The re-planted substation at Bankside, adjacent to the Tate Modern, will use transformers with water cooled heat exchangers. It is proposed that the waste heat from the transformers will be used by the Tate Modern to assist with its building heating process. This will benefit EDF Energy Networks, as less energy will need to be expended within cooler fans at the substation, and lower maintenance and replacement of cooler fans will be incurred.			
Expenditure for financial year		EPN	LPN	SPN
	External	£0	£397,192	£0
	Internal	£0	£44,201	£0
	Total	**£0**	**£441,393**	**£0**
	The costs have been allocated to LPN as the trial is being carried out at Bankside substation in London.			
Expenditure in previous (IFI) financial years	External	£46,477		
	Internal	£ 8,743		
	Total	**£55,220**		
Total Project Costs (Collaborative + external + EDF Energy Networks)	**£700,500**	Projected 2008/09 costs for EDF Energy Networks	External £250,000 Internal £ 4,500 Total **£254,500**	
Technological area and/or issue addressed by project	Environmentally friendly cooling of transformers			
Type(s) of innovation involved	Significant	Project Benefits Rating	Project Residual Risk	Overall Project Score
Expected Benefits of Project	The expected benefits include: • Waste heat will be used by a third party; • Fewer maintenance interventions for cooling; • Less auxiliary electricity consumption; and • Lower noise level from coolers.			
Expected Timescale to adoption	Year 2010	Duration of benefit once achieved	20 years	
Probability of Success	75%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£200k	

Potential for achieving expected benefits	The analysis of the system and discussions with the Tate suggest that a quantity of heat will be taken by the existing Tate Modern - the engineering for the project does not give any cause for concern that the system will provide heat. The next phase of the Tate Modern project will be designed to extract additional heat from the system.
Project Progress March 2008	The mechanical hardware has been installed, including four transformers, pipework, fans and pumps. The secondary heat exchanger system is in the process of final design and will be installed in July 2008. The control systems have been designed and are in the process of manufacture.
Collaborative Partners	
R&D Provider	Wilson Transformers

4.4 Improved Fluid-Filled Cable Leak Location System

<table>
<tr><td>Description of project</td><td colspan="4">This project is to evaluate the suitability of using PFT tracer technology to determine fluid-filled cable leak locations and reduce the number of excavations required. The technology was originally developed by NASA.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£126,348</td><td>£126,348</td><td>£108,299</td></tr>
<tr><td>Internal</td><td>£13,834</td><td>£13,834</td><td>£11,858</td></tr>
<tr><td>Total</td><td>£140,182</td><td>£140,182</td><td>£120,157</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the existing lengths of fluid-filled cables.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£480,306</td></tr>
<tr><td>Internal</td><td colspan="3">£ 84,111</td></tr>
<tr><td>Total</td><td colspan="3">£564,417</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 1.1M</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £90,000
Internal £15,000
Total £105,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">PFT tracer technology to determine cable leak location and reduce the number of excavations required.

Develop and field trial methods of mixing PFT compounds into cable fluid.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits include:
Faster and more accurate oil leak locations;
Operational cost savings with fewer and smaller excavations;
Positive impact on environment;
Improved relationship with Environmental Agency through demonstration of a pro-active and world's best practice leak location techniques;
Reduction in Network Risk because the process can be used without switching out the leaking circuit; and
Better Asset Management of fluid-filled cable condition monitoring associated with the leak location process.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2010</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
<tr><td>Probability of Success</td><td>75%</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£5M</td></tr>
</table>

Potential for achieving expected benefits	Assuming the system can be successfully introduced into Customer Operations, there is a very high probability of achieving the expected benefits, especially when the cost of carrying out the work is under continuous inflationary pressure.
Project Progress March 2008	Improvements have been made to the sensitivity of the detection equipment supplied by Femtotrace. Further work is still required to achieve the sensitivity required for carrying out true "drive by" detection of leaking fluid-filled cables. Progress has also been made on the methods of introducing PFT tagged fluid into leaking fluid-filled cable circuits, with the design and procurement of bespoke mixing and tagging equipment from two external suppliers.
Collaborative Partners	Con Edison
R&D Provider	Femtotrace Inc. Prochem H&R Chempharm Ltd

4.5 AURA NMS – Autonomous Regional Active Network Management System

<table>
<tr><td>Description of project</td><td colspan="4">The objective of this project is to develop a distributed control system to deliver:
• Realtime 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; and
• Network optimisation, taking into account DG and electrical energy storage.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£158,448</td><td>£62,719</td><td>£108,933</td></tr>
<tr><td>Internal</td><td>£15,523</td><td>£6,145</td><td>£10,672</td></tr>
<tr><td>Total</td><td>£173,971</td><td>£68,864</td><td>£119,605</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the amount of distributed generation connected.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£1,265,520</td></tr>
<tr><td>Internal</td><td colspan="3">£ 111,371</td></tr>
<tr><td>Total</td><td colspan="3">£1,376,891</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 5,760,000</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 800,000
Internal £ 200,000
Total £1,000,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The scoping and development of three major areas:
• DG and demand side management to facilitate the connection of DG to the network;
• Develop a controller that will monitor electricity networks, isolate faults quickly and allow DG to remain connected and operating; and
• Optimise the network with respect to losses.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits include:
• Maximisation of the contribution of DG to the electricity network;
• Reduction in carbon emissions and help towards the UK government's 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.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2015</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
</table>

Probability of Success	25%	Project NPV (Present Benefits – Present Costs) x Probability of Success	This project is expected to deliver benefits in the order of millions of pounds. As part of the project the real value will be calculated.
Potential for achieving expected benefits	The software development has, from the start, targeted a realistic substation hardware platform. It has been written using high level tools with a view to easy integration with other elements of substation automation, and an extensive and progressive system of testing has been specified. Various control functions have been written as modules that can stand alone when required. Assessment of communication opportunities and limitations has run in parallel with control development. There will be meaningful tests, completed by the end of the research phase, which will enable a full appraisal to be made and a decision to be taken on what pilot deployment could be undertaken. There is strong reason to believe that a substantial fraction of the technology will go on to have a meaningful deployment.		
Project Progress March 2008	During the last 12 months, the requirements specification has been refined, two case study network areas identified and described in terms of the network, load, generation, instrumentation and communication features. Work package 0 has developed a basic real-time (quasi-steady state) simulation of the network and the first steps taken to integrate this with the controller hardware. The simulator is able to subject the controller to load and generation profiles and outages on various feeders that exercise the control functions. This test facility is to be supplemented by a communications emulator and the preparatory studies to design this have been undertaken. The electrical and communication networks have been cross-referenced in readiness for integrating these two emulations. Work package 1 has finalised a functional specification of the control functions to be developed and commenced development of core functions within voltage control, thermal constraint satisfaction and supply restoration. The first trials of algorithms on the target hardware have been conducted. The software to manage the data models and the communications with network equipment has been designed. The system of arbitration between functions has been considered and basic inter-function communication established. Work package 2 has identified current provision of communication equipment and networking within the SCADA system, as well as obtaining information on communication patterns experienced during system operation. Constraints on communications have been identified, and modelling of the systems has been carried out. The modelling is in the form of a specific network simulation, and a generic simulation. The specific network simulation has been used to verify the approach against the existing communications network, and is to be used to supply parameters to the generic simulation. Communication technologies with the potential of adding new functionality to the network have been explored. Work package 3 studied how far an improved automation restoration scheme could go in reducing customer interruptions. Software to illustrate this, with case studies, is in development and further analysis of customer minutes lost is under way. Analysis of the general case of how active network management can increase		

	capacity for distributed generation has been revisited and applied to one of the case study areas for a detailed assessment of additional capacity realised. Work is in progress to build a cost benefit assessment.
Collaborative Partners	This is a Strategic Partnership between the EPSRC, ABB, EDF Energy Networks and ScottishPower Energy Networks.
R&D Providers	Aura NMS is led by Imperial College London and supported by the Universities of Bath, Cardiff, Durham, Edinburgh, Loughborough, Manchester and Strathclyde.

4.6 Transformer Design for FR3

<table>
<tr><td>Description of project</td><td colspan="4">This project will design and build a transformer that will be filled with FR3 vegetable oil manufactured by Coopers Power Systems. This requires considerable design work and evaluation of the various components used in the manufacture of the transformer. Techniques to manage a clean up, should a spill of FR3 occur, will also be developed.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£194,210</td><td>£0</td><td>£0</td></tr>
<tr><td>Internal</td><td>£18,697</td><td>£0</td><td>£0</td></tr>
<tr><td>Total</td><td>£212,907</td><td>£0</td><td>£0</td></tr>
<tr><td colspan="4">The costs have been allocated to EPN as this transformer will be installed in the EPN licence area.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£882,300</td></tr>
<tr><td>Internal</td><td colspan="3">£ 77,324</td></tr>
<tr><td>Total</td><td colspan="3">£959,624</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 1.2M</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 0
Internal £0
Total £0</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The demonstration will:
• 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.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technological substitution</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits include:
• Longer life of the transformer;
• Lower disposal costs for the fluid;
• Higher rating from the same transformer; and
• The fluid is highly biodegradable.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2009</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
<tr><td>Probability of Success</td><td>75%</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£ 1.5M</td></tr>
</table>

Potential for achieving expected benefits	The materials tests and research on the characteristic of the fluid suggest that the transformers will operate satisfactorily.
Project Progress March 2008	A 33/11kV transformer has been in service for several months in Guildford and is giving satisfactory service. The fluid characteristics will be monitored as well as the winding temperatures. A 132/33kV transformer has been installed in Luton and is being commissioned. It is expected to go live by the end of August 2008.
Collaborative Partners	
R&D Provider	Areva T&D University of Manchester Coopers Power Systems

4.7 Vacuum Tap Changer

<table>
<tr><td>Description of project</td><td colspan="4">The project will develop a vacuum bolt-on type tap changer based on the design of the ATL - AT type. A conceptual design is already in place. It will include the design, manufacture, KEMA type testing and fitting of a prototype on a new transformer for field service. The tap changer will be based on the AT type design; a proven reliable product with many advantages over the in-tank type. In essence, the existing DNO transformer design should remain unchanged. It is also envisaged the tap changer could be retro-fitted to old transformers.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£93,840</td><td>£38,640</td><td>£51,520</td></tr>
<tr><td>Internal</td><td>£9,710</td><td>£3,998</td><td>£5,331</td></tr>
<tr><td>Total</td><td>£103,550</td><td>£42,638</td><td>£56,851</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of primary transformers supplying the distribution network.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">This project was not reported in the 06/07 activity report.</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£870,000</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 150,000
Internal £ 15,000
Total £ 165,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Bolt-on type vacuum insulated on-load tap changer for a power transformer.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technological substitution</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits include the following:
• It is maintenance free; and
• Provides an alternative to in-tank type tap changers.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2014</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
<tr><td>Probability of Success</td><td>25%</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£100k</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">The work so far using modelling techniques and part prototypes suggests that it will be possible to design and manufacture a “bolt-on” vacuum tap changer.</td></tr>
</table>

Project Progress March 2008	Modelling is ongoing and some part prototypes have been built to examine the action of the mechanism. A number of changes have been made in the light of these tests. It is predicted that a working prototype will be available for testing in the early part of 2009.
Collaborative Partners	
R&D Provider	Brush Transformers

4.8 Vegetation Management

<table>
<tr><td>Description of project</td><td colspan="4">This project proposes to:
Monitor vegetation growth at 1,650 sites across the UK network; and
Develop a software model which will take account of factors such as tree species, bioclimatic area and the effect of climate change, in order to estimate the speed of vegetation growth at different sites.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£123,840</td><td>£0</td><td>£48,160</td></tr>
<tr><td>Internal</td><td>£13,360</td><td>£0</td><td>£5,195</td></tr>
<tr><td>Total</td><td>**£137,200**</td><td>**£0**</td><td>**£53,355**</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the length of 11kV overhead line.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">This project was not reported in the 06/07 activity report.</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>**£ 1.74M**</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 0
Internal £ 3,000
Total **£ 3,000**</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Rate of vegetation growth</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits include a software tool, that will enable EDF Energy Networks and other DNOs to predict whether areas are high or low growth, and hence allow two-fold savings:
In high growth areas, proactive cutting can be carried out, thus reducing the number of outages (by cutting before the vegetation enters the live zone) and cost to DNOs; and
Simultaneously, cutting cycles in low growth areas will be extended, resulting in fewer spans being cut each year.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2011</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
<tr><td>Probability of Success</td><td>50%</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£400k</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">The project is progressing in accordance with the project plan and is expected to deliver the initial results in December 2008.</td></tr>
</table>

Project Progress March 2008	The project is being delivered in line with the project plan. Sample sites have been set up for EDF Energy Networks, National Grid, ScottishPower Energy Networks and Central Networks. Consents to use the sites for research for the next four years have been obtained and the initial measurements have been made.
Collaborative Partners	Electricity North West, ScottishPower Energy Networks, Central Networks and National Grid.
R&D Provider	ADAS

4.9 Distribution System State Estimation

Description of project	To develop prototype algorithms for distribution system state estimation (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		EPN	LPN	SPN
	External	£69,360	£28,560	£38,080
	Internal	£6,599	£2,717	£3,623
	Total	**£75,959**	**£31,277**	**£41,703**
	The costs have been allocated in proportion to the number of primary transformers supplying the distribution network.			
Expenditure in previous (IFI) financial years	External	£184,000		
	Internal	£ 14,147		
	Total	**£198,147**		
Total Project Costs (Collaborative + external + EDF Energy Networks)	**£ 396,000**	Projected 2008/09 costs for EDF Energy Networks	External £ 136,000 Internal £ 10,000 Total **£ 146,000**	
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	Project Benefits Rating	Project Residual Risk	Overall Project Score
Expected Benefits of Project	The expected benefits 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. • 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	Year 2009	Duration of benefit once achieved	20 years	

Probability of Success	25%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£800,000
Potential for achieving expected benefits	It is hoped that the results of this project will be used in the AURA NMS controller. There are also plans to use the outputs in a proposed project to consider network losses. AURA NMS controller will act upon receiving information about the state estimates from the estimator that is being developed in this project. The state estimator will provide information about limit violation and extent of loss across the network, which will enable the AURA decision making engine to reconfigure the network, and control voltage to minimise loss and maximise DG injection without violating limits.		
Project Progress March 2008	The benefit, in terms of having increased DG MW connected from the knowledge of improved state estimate has been demonstrated. There is an established correlation between state estimation accuracy, the number of real-time measurements and the size of generation that can be accommodated. Optimisation-based modelling of pseudo measurements (Loads) is carried out to demonstrate the quality, consistency and performance of the state estimator algorithm. Placement of meters, based on estimation error minimisation through a stochastic optimisation approach, is demonstrated in UKGDS network model. The current work involves developing an algorithm for choosing the most effective measurements and locations in EDF Energy Networks' Hartley and Ninfield 33kV grid substations.		
Collaborative Partners	-		
R&D Provider	Imperial College London		

4.10 DG Connection Planner

<table>
<tr><td>Description of project</td><td colspan="6">This project is to build on the work reported in "Internet Services for Planning Distributed Generation Connections" funded by BERR, to provide DG developers with access to suitable connection locations and estimated connection costs. The system uses an OS map background to allow users to position a proposed generator connection, DNO Long Term Development Statement (LTDS) data to derive suitable connection scenarios and costing information for the provision of budget estimates.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td colspan="2">LPN</td><td colspan="2">SPN</td></tr>
<tr><td>External</td><td>£58,032</td><td colspan="2">£22,971</td><td colspan="2">£39,897</td></tr>
<tr><td>Internal</td><td>£5,521</td><td colspan="2">£2,186</td><td colspan="2">£3,796</td></tr>
<tr><td>Total</td><td>£63,553</td><td colspan="2">£25,157</td><td colspan="2">£43,693</td></tr>
<tr><td colspan="6">The costs have been allocated in proportion to the amount of connected distributed generation.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="5">£25,908</td></tr>
<tr><td>Internal</td><td colspan="5">£ 2,968</td></tr>
<tr><td>Total</td><td colspan="5">£28,876</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td colspan="2">£ 277,700</td><td colspan="2">Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 26,000
Internal £ 3,000
Total £ 29,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="6">Areas where cost-efficient DG connections can be realised; visualisation of connection costs and network capacity; and visualisation of DG activity.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td colspan="2">Project Benefits Rating</td><td colspan="2">Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="6">Areas where the network is likely to be sufficiently robust to support generation connections can be identified by developers prior to making formal contact with the DNO.

The DG developer may be prepared to accept a lower accuracy on costs and be more interested in assessing the engineering feasibility. This is likely to be particularly true if the applicant has a number of sites under consideration and wants to eliminate those that are in locations which are going to be difficult to connect.

This could reduce the need for significant reinforcement in support of generation connections, by providing visibility of the more suitable locations.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">Year 2011</td><td colspan="2">Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
</table>

Probability of Success	25%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£ 167,000
Potential for achieving expected benefits	There is excellent potential for achieving the expected benefits. Cost and capacity maps, that provide an overview of connection opportunities, have been developed for the web portal, demonstrating the feasibility of providing this information through a web-browser. Comments may also be added to the maps for specific areas where there may be connection opportunities or problems. An activity map that provides the DNO with feedback regarding connection activity also shows good potential.		
Project Progress March 2008	Cost and capacity maps have been developed and demonstrated. Activity maps have been demonstrated, although there is still work outstanding to complete the development. The ability to add comments to the map has been demonstrated. An overview map has been developed for primary circuits and substations within the EPN area.		
Collaborative Partners			
R&D Provider	IMASS Ltd and Econnect Ventures Ltd		

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

<table>
<tr><td>Description of project</td><td colspan="4">The objective of FENIX is to boost Distributed Energy Resources (DER) by maximising their contribution to the electric power system, through aggregation into Large Scale Virtual Power Plants (LSVPP) and decentralised management.

The project is organised in three phases:
• Analysis of the DER contribution to the electrical system, assessed in two future scenarios (Northern and Southern) with realistic DER penetration;
• Development of a layered communication and control solution validated for a comprehensive set of network use cases, including normal and abnormal operation, as well as recommendations to adapt international power standards; and
• Validation through two large field deployments, one focused on domestic CHP aggregation, and the second aggregating large DER in LSVPPs (wind farms, industrial cogeneration), integrated with global network management and markets.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£38,370</td><td>£15,188</td><td>£26,380</td></tr>
<tr><td>Internal</td><td>£12,250</td><td>£4,849</td><td>£8,422</td></tr>
<tr><td>Total</td><td>£50,620</td><td>£20,037</td><td>£34,802</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the amount of connected distributed generation.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£ 980</td></tr>
<tr><td>Internal</td><td colspan="3">£16,360</td></tr>
<tr><td>Total</td><td colspan="3">£17,340</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>14.7M€</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">Internal £ 25,000
External £ 100,000
Total £ 125,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">To conceptualise, design and demonstrate a technical architecture and commercial framework that would enable DER based systems to become the solution for a future, cost efficient, secure and sustainable EU electricity supply system.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits include:
• Maximising the contribution of DG to the electricity network;
• Reducing carbon emissions and help towards the UK Government's climate change targets; and
• Reducing network losses through having the source of generation close to the load.</td></tr>
</table>

Expected Timescale to adoption	Year 2015	Duration of benefit once achieved	20 years
Probability of Success	25%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£2M. The estimate will be refined in the WP3 to assess the economic impact of this architecture.
Potential for achieving expected benefits	The two scenarios demonstrating the FENIX benefits, are proceeding well. Various stakeholders have been contacted and will be invited to the CIRED Smart Grids' workshop in Frankfurt. ADDRESS, a FP7 funded project, will build on the developments of FENIX.		
Project Progress March 2008	During the second year of the project, WP1, "System Solutions for DER Integration and Demand Response through LSVPP", has focused on the development of the VPP concept, characterisation of the VPP, and development of the various software tools and market interfaces to allow interaction of the VPP (and DER) with the wider system. In response to the first year review of the FENIX project, this WP has also focused on identification of a common glossary of FENIX terms and definitions and agreement on core FENIX terms and interactions (in partnership with WP2, and in discussion with the wider consortium). The key deliverables have been two reports: One report details the role of the demand side in the FENIX concept, and develops novel algorithms for the participation of the demand side in VPP portfolios, and in the provision of system ancillary and support services. The other report details the characterisation of the VPP, looking at both the steady state and dynamic characterisation of the VPP portfolio, identifying the functions and services that can be provided by the VPP, and the implications for system management, and commercial market operation that originate from VPP activity. This deliverable goes on to identify the existing tools available for aggregation and optimisation of DER and the market interfaces currently used to provide access to the wholesale energy and ancillary services markets and mechanisms. A gap analysis is undertaken to identify the areas where adaptation and evolution is required to incorporate the requirements and specific characteristics of the VPP. WP2, "Electrical and information system architecture adapted to the presence of LSVPP", has focused on the new functions that would be needed in order to adapt the distribution grid tools, delivering: A general architecture that: • Can embrace peculiarities of each European country such as: - In the UK, the market mechanism, with the presence of a Balancing Market company; - In Spain, the control of wind production by the REE control centre (CECRE); and		

	- In Spain, the installation of a Node Management Mechanism operated by the distribution system operator (DSO). • Optimises the changes in the business of the energy supplier and DSO by introducing the new functionalities of the Technical VPP (TVPP). The objectives were to: - Optimise the impact on the existing information systems; and - Optimise the number of interactions between the different actors. An orchestration of actions that enable DER units to offer services to energy markets and to the DSO. These actions were described: • One day ahead to validate the generation schedules; and • In realtime in order to adjust the DER outputs. WP3, "Commercial framework for operation and control of power systems with LSVPPs", has accomplished, during the second year, four different tasks: • Description of the Northern and Southern Scenarios aimed at illustrating the progress to date of the local scenario definitions for field demonstrations of the FENIX concept; • Definition of alternative business models of VPP concepts from the perspectives of a typical distribution system operator, incumbent electricity supplier and independent DER aggregator respectively; • Assessment and description of the aspects of the regulatory framework that are considered critical to the development of flexible networks, with significant contribution from distributed energy resources; and • Description of contract models that will need to be developed between the various parties in a LSVPP framework. In WP4, "Demonstration of LSVPP concept feasibility" real networks have been selected for the demonstrations. The main lines of the specifications of the physical demonstrations are well defined and equipment has been acquired. The main characteristics anticipated for field and lab demonstrators are being drafted in an internal working paper. It also identifies all the necessary tasks to perform the demonstrations and proposes a roadmap for this. In WP5, "Stakeholders Advisory Group, Dissemination and Training", a series of newsletters has been conceived, and the first of these released, as the FENIX bulletin. Upcoming newsletters are scheduled for issue roughly every three months in parallel with emerging project results and completion of deliverables.

	The consortium has delivered a large number of presentations on FENIX results at International Conferences (CIRED, IEEE Powertech, etc.). The role of the Strategic Advisory Group in the project has also been readapted and rescheduled. A new meetings timetable has been proposed for forthcoming years, as well as a tentative schedule for national seminars. A seminar will be held in the UK.
Collaborative Partners	FENIX is an Integrated Project and is supported by the European Commission under the sixth framework programme. www.fenix-project.org
R&D Providers	Iberdrola SA, Electricité de France, EDF Energy Networks, Red Eléctrica de España SA, National Grid Transco, SIEMENS Aktien-gesellschaft Österreich PSE, Korona Inzeniring DD, Areva T&D Energy Management Europe, ZIV PmasC SL, ScalAgent Distributed Technologies, ECRO SRL, Pöyry Energy Consulting, Fundación LABEIN, Energy Research Centre of the Netherlands, Groupment pour inventer la distribution électrique de l'avenir, Institut für solare energieversorgungstechnik verein an der universität Kassel E.V. (ISET), The University of Manchester, Vrije Universiteit Amsterdam, Imperial Collage London and Gamesa Innovation and Technology.

4.12 Optimal Transformer Utilisation Model

<table>
<tr><td>Description of project</td><td colspan="4">EDF Energy Networks currently models emergency/cyclic ratings of power transformers by using a method based on formulae described in CP1010 / BS7735 (a loading guide for oil immersed transformers). This model allows the load-related risk on a substation to be quantified in order to prioritise network reinforcement expenditure. The model predicts the temperature rise within the transformer, in order to determine a maximum rating on a daily basis which each transformer can sustain.

It has become apparent by comparing the output of the EDF Energy Networks' model with the temperatures observed in practice, that there are some differences. The main causes for differences in modelled and observed temperature are over-simplifications in the model, and the absence of effective data for transformer and heat exchanger parameters.

The Cambridge University Engineering Department, in particular the EPEC group, has particular expertise in computer modelling and will be able to significantly improve the EDF Energy Networks' model; this will take the form of a new model for the transformer and a comparison of output with that observed in practice. By using numerical methods, unknown transformer parameters (which cannot easily be measured in practice on an operational transformer) will be determined to produce a model which accurately reflects transformer behaviour. The parameters will be used in the EDF Energy Networks' model, or the Cambridge Model will be used in its entirety to produce accurate results.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£43,845</td><td>£18,054</td><td>£24,072</td></tr>
<tr><td>Internal</td><td>£4,342</td><td>£1,788</td><td>£2,384</td></tr>
<tr><td>Total</td><td>**£48,187**</td><td>**£19,842**</td><td>**£26,456**</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of installed primary transformers.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">This project was not reported in the 06/07 activity report.</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>**£ 150,000**</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 21,500
Internal £ 3,000
Total **£ 24,500**</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Emergency/cyclic ratings of power transformers</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>11.2</td><td>-1</td><td>12.2</td></tr>
</table>

Expected Benefits of Project	The expected benefits include: • Accurate assessment of load-related risk on a substation will allow EDF Energy Networks to confidently predict whether there is an unacceptable risk to supplies; and • Optimum timing of reinforcement work programmes (ability to defer spending where appropriate).		
Expected Timescale to adoption	Year 2014	Duration of benefit once achieved	20 years
Probability of Success	50%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£ 660k
Potential for achieving expected benefits	The model developed is expected to give the improved representation of hot spot temperatures.		
Project Progress March 2008	The work so far has included the measurement of dimensions of the transformer. Drawings of the outside of the transformer have been obtained, but sourcing detailed drawings of the windings is proving difficult. The next stage (currently in progress) is to validate the thermal characteristic parameters for exponential equations. An initial simulation has been completed but more accurate dimensions of the windings are required. A two-dimensional model has been chosen. Temperature measurements of a real transformer have been taken using thermal pictures of the outside of a transformer. These thermal pictures have been compared with the loading profile for that day, but ambient temperature data is being sought to improve the tool. A demonstration of the “At Risk Evaluation” tool, to calculate the hot spot temperature profile, has been carried out so comparisons can be made.		
Collaborative Partners			
R&D Provider	Cambridge University Engineering Department		

4.13 Impact of Climate Change on the UK Energy Industry

<table>
<tr><td>Description of project</td><td colspan="4">In 2006 the Met Office carried out a scoping study on the impacts of climate change on the UK energy industry. The report was the result of collaboration between E.ON UK, EDF Energy Networks, National Grid and the Met Office Hadley Centre to scope the impacts of climate change on the UK energy industry.

This Phase 2 project was industry-funded; it involved 11 UK energy companies and was undertaken by the Met Office. It focused on the priorities identified by the previous study. During the project, new tools and methods, required to understand the impact of climate change on the energy industry will be developed, and new data resources will be designed to address gaps in underpinning information.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£23,277</td><td>£14,813</td><td>£14,813</td></tr>
<tr><td>Internal</td><td>£2,215</td><td>£1,409</td><td>£1,409</td></tr>
<tr><td>Total</td><td>£25,492</td><td>£16,222</td><td>£16,222</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of connected customers.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">This project was not reported in previous IFI activity reports.</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 554,000</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 0,0
Internal £ 0,0
Total £ 0,0</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The project has been run as a series of work packages (WP). Those WPs, relevant to distribution and transmission, are described below:
WP1 – Modelling Energy Impacts. Models created to assess impacts of climate change on electricity demand, conductor performance, transformer performance, cables, overhead network, and wind power;
WP2 – Guidance for the Energy Industry on the use of the United Kingdom Impacts Programme new scenarios of climate change (UKCIP08). UKCIP08 is planned for release in November 2008;
WP3 – Climate Models and Wind Projections. Investigating methods of including estimates of future wind resource in wind farm viability;
WP4 – Climate Change and Underground Cable Performance. Modelling future soil conditions to increase understanding of the impacts of climate change on cables;
WP6 – Climate change and the Urban Heat Island Effect. Producing information on the urban heat island for use when panning infrastructure in cities;
WP7 – Final reporting and presentation of the results to each company; and
WP8 – Predicted climatologies for the UK: 2008 – 2018.</td></tr>
</table>

<table>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technological substitution</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>13.6</td><td>-2.0</td><td>15.6</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits include:
• For the elements assessed, an understanding of the sensitivity to climate change and key meteorological drivers of the impacts. This will highlight priorities for adaptation;
• New models for projecting impacts suitable for inclusion in climate models or for application to climate model output;
• Guidance on the application of climate models to energy industry applications, which should result in appropriate use of climate information by Networks; and
• New information on urban heat islands and climatologies for the next 10 years to assist infrastructure design and planning.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2011</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
<tr><td>Probability of Success</td><td>50%</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£ 100,000</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">There is a good chance of achieving the expected benefits. This was a year long project that finished at the end of May 2008 on time and to budget and specification. Project outputs and reports are now available via the project website.
The project has highlighted some areas of Networks where no change to existing practice is required because of climate change and other areas where adaptation may be beneficial. The new models that have been developed and used in this project will be a useful legacy. The new information produced, specifically for the energy industry, has been demonstrated to have significant benefits over what was previously available.</td></tr>
<tr><td>Project Progress
March 2008</td><td colspan="4">In March 2008 the status of the project work packages was as follows.
WP1 - complete
WP2 – 50% complete
WP3 - complete
WP4 – 90% complete
WP6 – 90% complete
WP7 – 50% complete
WP8 – 80% complete

Overall the project was 75% complete.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">All the network operators and most energy supply businesses.</td></tr>
<tr><td>R&D Provider</td><td colspan="4">Met Office</td></tr>
</table>

4.14 RTU Local Display Facility

<table>
<tr><td>Description of project</td><td colspan="4">This project will enhance a Remote Terminal Unit (RTU) to allow local touch screen facilities to be installed in the door of each RTU cubicle.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£0</td><td>£39,170</td><td>£0</td></tr>
<tr><td>Internal</td><td>£0</td><td>£6,465</td><td>£0</td></tr>
<tr><td>Total</td><td>£0</td><td>£45,635</td><td>£0</td></tr>
<tr><td colspan="4">The costs have been allocated to LPN where the RTU is being modified.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">This project was not reported in the 06/07 activity report.</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 60,000</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 10,000
Internal £ 5,000
Total £ 15,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Local display facility for primary RTUs.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits include:
Allowing the local on-site engineer to operate controls more safely;
Obtaining more detailed information about the plant in the substation; and
Having a view of what can be seen at the control centre to assist with fault finding.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2009</td><td>Duration of benefit once achieved</td><td colspan="2">20 Years</td></tr>
<tr><td>Probability of Success</td><td>50%</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£50k</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">This project has delivered a graphical interface for the RTUs in London. Fine tuning during the testing phase has improved the final product adding clarity of the display.</td></tr>
<tr><td>Project Progress
March 2008</td><td colspan="4">A T5500 Configuration Tool has been developed to construct mimic screens via a graphical interface. This is an improvement compared to the existing technique that involves editing a text file .</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4"></td></tr>
<tr><td>R&D Provider</td><td colspan="4">Converteam</td></tr>
</table>

4.15 Condition Monitoring of Composite Insulators

<table>
<tr><td>Description of project</td><td colspan="4">Composite insulators are now deployed throughout the world and are steadily replacing traditional ceramic and glass insulators. Low weight and physical robustness are two properties which have led to an increasing market share for composite insulators over the last 20 years. However, there is concern over the long-term ageing of these insulators.

This work will characterise the millimetre-scale arcing activity between water droplets, and develop an experimental knowledge and theoretical understanding of how this leads to macroscopic behaviour. In particular, it will identify the local service conditions on the millimetre scale which cause the ageing of hydrophobic material surfaces.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£27,072</td><td>£0</td><td>£10,528</td></tr>
<tr><td>Internal</td><td>£2,576</td><td>£0</td><td>£1,002</td></tr>
<tr><td>Total</td><td>£29,648</td><td>£0</td><td>£11,530</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the length of 11kV overhead line.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">This project was not reported in the 06/07 activity report.</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 120,000</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 37,000
Internal £ 3,000
Total £ 40,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Develop reliability models for hydrophobic insulators, recommend test schedules for type approval and product development, and identify condition monitoring techniques for existing installations.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits include:
• An improved understanding of insulation ageing;
• A better understanding of risk associated with ageing of insulation;
• Reduced operational costs through extended times between insulator replacement;
• Reduced outages as a result of reduced, unforeseen insulation failure;
• Improved methods for testing of new products; and
• Stronger management of suppliers.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2011</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
</table>

Probability of Success	25%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£ 100k
Potential for achieving expected benefits	The project is proceeding well. The probability of success is somewhat higher than when the project started.		
Project Progress March 2008	The project has made good progress characterising a number of insulators taken from service. The insulator retrieval and characterisation to date has been focused on insulators in more exposed areas (i.e. coastal). The characterisation has so far been electrical, and is now moving into chemical characterisation. Leakage current versus frequency tests have been carried out and the results have been compared to a new sample of the same base material. Similarly, flashover electrical tests, in both dry and wet conditions, have been completed and compared to a new sample. Some ageing has been identified and the implications of this are being assessed. Composite insulators from a suitable inland location have been identified and will be recovered in 2008. A comparison between the ageing of coastal and inland insulators will then be completed. The format of an appropriate asset management policy has been drawn up to ensure that, at the project end, technology transfer is efficient. This policy is designed to maintain safety, to ensure an acceptable level of reliability, to optimise insulator maintenance, inspection, replacement and provide information to improve purchasing and design decisions. The policy will include geographic dependency, maintenance and fault inspection regimes, asset tracking, data management and diagnosis techniques.		
Collaborative Partners			
R&D Provider	University of Manchester		

4.16 Improvements in Overhead Line Performance

<table>
<tr><td>Description of project</td><td colspan="6">This report covers a number of smaller projects each less than the de minimis level. Each project investigates different aspects that impact the performance of overhead lines.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td colspan="2">EPN</td><td colspan="2">LPN</td><td>SPN</td></tr>
<tr><td>External</td><td colspan="2">£38,778</td><td colspan="2">£0</td><td>£15,080</td></tr>
<tr><td>Internal</td><td colspan="2">£6,213</td><td colspan="2">£0</td><td>£2,416</td></tr>
<tr><td>Total</td><td colspan="2">£44,991</td><td colspan="2">£0</td><td>£17,496</td></tr>
<tr><td colspan="6">The costs have been allocated in proportion to the length of 11kV overhead line.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="5">£103,766</td></tr>
<tr><td>Internal</td><td colspan="5">£ 18,837</td></tr>
<tr><td>Total</td><td colspan="5">£122,603</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td colspan="2">£ 200,000</td><td colspan="2">Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 0
Internal £ 0
Total £ 0</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="6">Improving ratings of lines, assessing the physical condition of support structures, electrical condition monitoring and wildlife deterrents.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td colspan="2">Project Benefits Rating</td><td colspan="2">Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="6">The expected benefits include:
Understanding the benefits of aluminium conductor composite core (ACCC) compared with other technologies like AAAC and ACSR conductors;
Understanding of basic phenomena governing insulator and surge arresters failures;
Visual inspection of support structure, using unmanned helicopter, removes the need to climb the pole or tower; and
Effective methods to prevent roosting on lines that oversail customers' premises.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">Year 2010</td><td colspan="2">Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
<tr><td>Probability of Success</td><td colspan="2">Varies between 25% and 75%</td><td colspan="2">Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£ 1.0M</td></tr>
</table>

Potential for achieving expected benefits	The ACCC conductor may be used for a wind farm connection where high loads are expected. Some audible bird deterrent systems only showed short term benefit. The unmanned helicopter concept will not proceed.
Project Progress March 2008	The project to increase our understanding of the basic phenomena governing insulator and surge arresters failures is now reported as a separate report titled "Condition monitoring of composite insulators." See Section 4.15. A drum of ACCC conductor and fittings was purchased to build a span at the EDF Energy Networks' training establishment to assess construction techniques. A number of bird deterrent systems have been assessed. The unmanned helicopter trial did not proceed as the helicopter could only be flown in good weather conditions.
Collaborative Partners	
R&D Provider	Composite Technology Corporation Runfold Plastics Ltd Scaringbirds.com Ltd Highspy

4.17 Application of Storage and Demand Side Management

<table>
<tr><td>Description of project</td><td colspan="4">The project will 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.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£14,400</td><td>£5,700</td><td>£9,900</td></tr>
<tr><td>Internal</td><td>£1,370</td><td>£542</td><td>£942</td></tr>
<tr><td>Total</td><td>£15,770</td><td>£6,242</td><td>£10,842</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the amount of connected distributed generation.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£169,000</td></tr>
<tr><td>Internal</td><td colspan="3">£ 14,420</td></tr>
<tr><td>Total</td><td colspan="3">£183,420</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 460,000</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 35,000
Internal £ 5,000
Total £ 40,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">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 realtime control of storage and load control devices, to manage network voltage and flow profiles in realtime; and
• Quantification and optimisation of the multiple value streams of various storage applications and load control management.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits include:
• Quantification of 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.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year - 2015</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
</table>

Probability of Success	75%	Project NPV (Present Benefits – Present Costs) x Probability of Success	Only when the methodology proposed in this project is developed, will it be possible to evaluate financial benefits of storage and DSM across various future development scenarios.
Potential for achieving expected benefits	Significant progress has been made in the development of the tools to quantify the value of DSM and storage in applications for active distribution network management strategies. Initial findings indicate that application of DSM and storage techniques for active management of distribution networks have most value: • In congested urban areas with restrictions on the physical expansion of the system; and • When increased amounts of DG need to be integrated in the existing networks. On the basis of the sample networks studied, DSM provides the most cost effective application to these network problems.		
Project Progress March 2008	Project progress against milestones: • Models of responsive demand and storage have been developed and implemented in the United Kingdom Generic Distribution System (UKGDS) network and representative EDF Energy Networks' distribution networks to solve specific problems; • Detailed models of heat demand in commercial buildings for use in network management applications have been devised and tested; • Techniques and prototype algorithms for congestion management in distribution networks have been developed and tested in the case study network areas; and • Identification of the regulatory and commercial barriers for application of storage and DSM in network management strategies.		
Collaborative Partners	Scottish and Southern Energy		
R&D Provider	Imperial College		

4.18 Network Risk Management

<table>
<tr><td>Description of project</td><td colspan="4">The aim of this project is to develop algorithms for calculating the risk, which the continued use of the components of a distribution system pose, to ongoing satisfactory system operation. It will take into account the significant levels of uncertainty that characterise both the condition of the individual assets and the overall operation of the network.
The measurement of risk will characterise network performance in the near future, ensuring that it will reflect the anticipated variability in operation of future distribution networks.

The outcome of the project will be new methodologies, enabling a formal understanding of the criticality of different operational conditions and the accuracy with which network parameters must be specified. In addition, it will illustrate the value of an explicitly predictive indicator of the suitability of proposed changes in system operation.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£12,650</td><td>£8,050</td><td>£8,050</td></tr>
<tr><td>Internal</td><td>£ 1,204</td><td>£ 766</td><td>£ 766</td></tr>
<tr><td>Total</td><td>£13,854</td><td>£8,816</td><td>£8,816</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of connected customers.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£148,300</td></tr>
<tr><td>Internal</td><td colspan="3">£ 12,814</td></tr>
<tr><td>Total</td><td colspan="3">£161,114</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 454,000</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">Internal £ 5,000
External £ 100,000
Total £ 105,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">This project will address:
• The formulation and implementation of algorithms to provide, in near-realtime, an assessment of the risk or vulnerability of a section of EDF Energy Networks’ distribution system in the near future;
• What parameters have most influence on the calculated measure of network risk; and
• Provide a comprehensive demonstration of the value of a measure of risk for guiding network operation.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Benefits are expected to include:
• Development tools that will allow the DNO to take into account the explicit uncertainty involved in the distribution system operation; and
• Methodologies and tools that can be applied in active distribution networks to optimise the utilisation of the existing</td></tr>
</table>

	network capacity, through the introduction of new devices and/or the modification of network operation strategies in a more informed manner.		
Expected Timescale to adoption	Year 2010	Duration of benefit once achieved	20 years
Probability of Success	75%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£ 200,000
Potential for achieving expected benefits	To date, 20% of the work has been completed. At this comparatively early stage, reasonable progress has been made, as reflected by the detailed examination of the progress towards deliverables detailed below. Nonetheless, careful monitoring will be required in the following year to ensure continued satisfactory progress.		
Project Progress March 2008	The team's progress towards the nominated deliverables is: WP 1 - risk assessment algorithm. The theoretical distinction between risk and reliability has been defined, ensuring that any developed algorithms will generate unique information. Techniques have been developed for identifying network conditions when an operational measure of network vulnerability provides distinct information. Work on the precise risk assessment algorithm is still ongoing. WP 2 - algorithm for formalised, continuous refinement of operational parameters. Work has confirmed the need for such a process and has shown that suitable resources exist within EDF Energy Networks' data collections. These are complemented by the results of a scoping study which has identified realistic bounds for parameters such as asset failure likelihoods, stochastic models used to describe restoration and repair processes and the effectiveness of network operational processes. WP 3 - suite of system/feeder risk representations. Progress has been confined to consideration of the techniques needed to communicate a measure of network risk. WP 4 - medium-term projection of risk evolution. The techniques developed as part of WP1 provide indications of the network conditions in which a longer term measure of risk will contain unique information. Future work can be focused on the relevant network conditions where a medium to long-term risk projection will have the most value. WP 5 - approximate analytical models for risk assessment. The completion of a data survey providing bounds on: the range of asset failure likelihoods; the effectiveness of operational processes and the nature of repair and restoration processes, will help to ensure that numerical studies consider only appropriate degrees of variability. In		

	addition, sensitivity studies have been completed to show how variability in operational parameters will affect different measures of risk. WP 6 - identification of high risk assets. Only limited progress has been made towards this deliverable.
Collaborative Partners	
R&D Provider	Imperial College London

4.19 Supergen V - AMPerES

(Asset Management and Performance of Energy Systems)

<table>
<tr><td>Description of project</td><td colspan="6">This is a four year, major, multi-party collaborative project. The research programme is split into six work packages and 25 activities. Most of the research will be carried out by universities. An EDF Energy Networks representative has been identified for each work package so that research can be steered towards delivering benefits to the DNOs.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td colspan="2">EPN</td><td colspan="2">LPN</td><td>SPN</td></tr>
<tr><td>External</td><td colspan="2">£ 11,000</td><td colspan="2">£ 7,000</td><td>£ 7,000</td></tr>
<tr><td>Internal</td><td colspan="2">£ 1,047</td><td colspan="2">£ 666</td><td>£ 666</td></tr>
<tr><td>Total</td><td colspan="2">£ 12,047</td><td colspan="2">£ 7,666</td><td>£ 7,666</td></tr>
<tr><td colspan="6">The costs have been allocated in proportion to the number of connected customers.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="5">£ 50,000</td></tr>
<tr><td>Internal</td><td colspan="5">£ 4,172</td></tr>
<tr><td>Total</td><td colspan="5">£ 54,172</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td colspan="2">£ 2,800,000</td><td colspan="2">Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 25,000
Internal £ 5,000
Total £ 30,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="6">The research programme is split into six work packages namely:
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.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Radical</td><td colspan="2">Project Benefits Rating</td><td colspan="2">Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="6">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.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">Year 2013</td><td colspan="2">Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
</table>

Probability of Success	25%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£150k
Potential for achieving expected benefits	Asset management is core to the business. The appropriate use of the emerging opportunities for condition monitoring is key to optimising performance, both financially and in terms of quality of supply. A number of technologies are being developed as part of this programme; however, it also gives a broader window to the global research community. Through demonstration, the true value of condition monitoring will be identified, enabling appropriate business decisions on adoption of technologies.		
Project Progress March 2008	The project is now fully resourced in all the universities (PhD and RAs). A number of demonstrators have been identified and are being implemented ahead of schedule. The high-level work to develop optimal asset replacement and network expansion methodologies is progressing well, and it has been agreed that this project should become a demonstrator; the form of which is being agreed by the Steering Group. More physical demonstrators are being built at both distribution and transmission substations. The initial evaluation of techniques is complete and machine learning techniques have been selected for implementation. The more fundamental work on ageing of plant, which is necessary to underpin the more applied activities, is also progressing according to plan, with development of methods to characterise ageing plants being developed. To date, 14 reports and 38 publications have arisen from this work. Technical documents produced: • Loss of Mains Detection and Amelioration on Networks; • Loss-of-Mains detection by differential ROCOF Protection using internet protocol; • Interim report on protection and control of distribution networks with synchronous islands; • Reducing the Environmental Impact of Electrical Plant - Annual Report; • First report on use of high temperature conductors on distribution networks; • Final report on high temperature low sag conductors; • Report on ICSD 2007; • Report on literature on non-power frequency ageing in dielectrics; and • Condition monitoring - state of the art report version 2. 27 technical publications have been submitted or published in the last 12 months.		

	Technology and trials The following demonstrator projects are presently being implemented in both transmission (due to finish mid-June) and distribution substations: • Monitoring of two 275/132kV National Grid transformers; • Monitoring of six Scottish Power substations; and • Processing of partial discharge data from EDF Energy Networks' substations. These will be used to prove data acquisition technology and develop interpretation tools.
Collaborative Partners	National Grid ScottishPower Energy Networks Scottish and Southern Electric Electricity North West Western Power Distribution Central Networks CE Electric UK Northern Ireland Electricity and Advantica
R&D Provider	Universities of Edinburgh Liverpool Manchester Queens (Belfast) Southampton and Strathclyde

4.20 Wood pole disposal

Description of project	The majority of poles are currently sent to landfill with the rest being used for barter with landowners. Waste disposal is becoming an increasing issue for EDF Energy Networks and the Environmental Agency. As with the recycling of excavated material, the cost of landfill is increasing and the number of poles being replaced is also rising. There is, therefore, a need to find a sustainable alternative to landfill. The disposal of wood pole is an aspect of the distribution system asset management (decommissioning). This project is done in collaboration with the Forestry Commission 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 involves the burning of contaminated wood at temperatures to drive off and collect volatile gases to be used for generation of electricity, and to recover the charred wood as a charcoal product. The project will also develop tests to characterise the poles in respect of age, to determine the amount of potential pollutants left in the wood.			
Expenditure for financial year		EPN	LPN	SPN
	External	£14,400	£0	£5,600
	Internal	£1,370	£0	£533
	Total	**£15,770**	**£0**	**£6,133**
	The costs have been allocated proportion to the length of 11kV overhead line.			
Expenditure in previous (IFI) financial years	External	£1,000		
	Internal	£2,494		
	Total	**£3,494**		
Total Project Costs (Collaborative + external + EDF Energy Networks)	**£75,000**	Projected 2008/09 costs for EDF Energy Networks	External £ 20,000 Internal £ 2,000 Total **£ 22,000**	
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. The collection of the volatile gases to be used for generation of electricity and production of charcoal is an innovative method for the disposal of wood poles.			
Type(s) of innovation involved	Significant	Project Benefits Rating	Project Residual Risk	Overall Project Score

Expected Benefits of Project	The diversion of the poles from landfill has a financial benefit and helps the Company meet its objective of achieving the 60% recycling target. The project will support EDF Energy Networks' environmental aspirations.		
Expected Timescale to adoption	Year 2014	Duration of benefit once achieved	20 years
Probability of Success	75%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£ 250k
Potential for achieving expected benefits	The process to recover the volatile gases has proved difficult. A new method of charcoaling the recovered wood pole is creating interest.		
Project Progress March 2008	The discovery of a patent on a similar technique to recover the distillate has slowed progress. The increased level of biomass generation has changed the direction of the project to convert the recovered wood poles into a suitable fuel.		
Collaborative Partners			
R&D Provider	Forestry Commission		

4.21 LV Underground Cable Fault Management

<table>
<tr><td>Description of project</td><td colspan="4">EDF Energy Networks has identified opportunities from intermittent fault detection and location on LV underground cables.
This project combines the use of an intermittent cable fault location device (T-P22) with an improved re-energisation device (REZAP Fault Master) so that LV intermittent faults can be better managed and customer interruptions reduced.
The project is also supporting the development of a “modular REZAP”.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£7,667</td><td>£4,000</td><td>£5,000</td></tr>
<tr><td>Internal</td><td>£729</td><td>£381</td><td>£476</td></tr>
<tr><td>Total</td><td>£8,396</td><td>£4,381</td><td>£5,476</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the length of installed LV cable.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£290,085</td></tr>
<tr><td>Internal</td><td colspan="3">£ 27,709</td></tr>
<tr><td>Total</td><td colspan="3">£317,794</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 450,000</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £45,000
Internal £ 5,000
Total £50,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The project is developing the following techniques:
• Time reflection to determine fault location;
• Transient impedance fault location;
• Travelling wave fault location; and
• An auto-reclosing device.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">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 customer minutes lost; and
• Reduction in worst served customers.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2008</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
<tr><td>Probability of Success</td><td>75%</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£ 1.2M</td></tr>
</table>

Potential for achieving expected benefits	Work is currently on-going to modify EDF Energy Networks' LV fault management strategy to formally approve the use of the equipment developed as part of this project.
Project Progress March 2008	T-P22 (Intermittent fault location equipment) Following successful trials of the device, EDF Energy Networks has purchased a number of T-P22 equipment and is currently finalising details for a company wide deployment. The following developments were carried out: • Migration to GPRS communication has been completed successfully and is ready to be rolled out to other T-P22 units; and; • Auto download of data has been completed and can be accessed via the iHost webserver. REZAP Fault Master (LV auto-reclosing equipment) The trial of the REZAP Fault Master devices has been delayed due to operational restrictions on the EDF Energy Networks' LV network. The following developments are progressing according to plan: • Single-ended fault distance estimation; and • Modular REZAP (redesigned REZAP to fit into Low Voltage pillars and link boxes).
Collaborative Partners	Electricity North West and ScottishPower Energy Networks
R&D Provider	Kehui Ltd, Kelman Ltd and Nortech Management Ltd

4.22 33kV Voltage Control

<table>
<tr><td>Description of project</td><td colspan="4">This project proposes a study to evaluate active voltage control and reactive power flow management of interconnected 33kV systems (via SCADA), to minimise losses whilst accommodating embedded generation.
With the provision of real and reactive power measurements, generator outputs and tap changer positions, the project will develop voltage control strategies taking into the account DG contributions and co-ordination with various EDF Energy Networks and National Grid strategies .</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£10,594</td><td>£0</td><td>£5,458</td></tr>
<tr><td>Internal</td><td>£1,008</td><td>£0</td><td>£519</td></tr>
<tr><td>Total</td><td>£11,602</td><td>£0</td><td>£5,977</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of primary transformers where co-ordinated 33kV voltage control could be beneficial.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">External £ 6000
Internal £ 1007
Total £ 7007</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 118,000</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 6000
Internal £ 1007
Total £ 7007</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Co-ordinated 33kV voltage control strategies taking into account DG contributions.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits are:
• Enhanced software tools and techniques for mathematical modelling and analysis of AVC schemes in distribution networks;
• Increased headroom to allow more DG to connect to lower voltage networks; and
• Reduced network losses caused by reactive power flow.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2013</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
<tr><td>Probability of Success</td><td>25%</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£ 100,000</td></tr>
</table>

Potential for achieving expected benefits	Based upon the progress to March 2008 there is considerable potential for achieving expected benefits. The major benefits close to realisation are: • Increased headroom to allow more DG to connect to lower voltage networks; and • Software assessment tool for SuperTAPP n+ relay operation and settings.
Project Progress March 2008	Progress to date includes: • Rigorous investigation, implementation, testing and comparison of existing modelling and analysis tools for AVC schemes in distribution networks; • Theoretical demonstration of benefits of SuperTAPP AVC scheme in distribution networks using enhanced software tools and techniques; • Practical demonstration of potential benefits of SuperTAPP AVC scheme using EDF Energy Networks' network case study and data; and • The acceptance of three technical papers at international conferences: UPEC 2007, PSCC 2008 and UPEC 2008.
Collaborative Partners	Fundamentals Ltd
R&D Provider	Brunel University

4.23 Collaborative ENA R&D Programme

<table>
<tr><td>Description of project</td><td colspan="4">The Energy Networks Association (ENA) represents all UK DNOs. These projects listed below have been initiated by the ENA R&D Working Group and have been funded through the IFI.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£7,268</td><td>£2,993</td><td>£3,990</td></tr>
<tr><td>Internal</td><td>£691</td><td>£285</td><td>£380</td></tr>
<tr><td>Total</td><td>£7,959</td><td>£3,278</td><td>£4,370</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of primary transformers.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£17,875</td></tr>
<tr><td>Internal</td><td colspan="3">£ 1,393</td></tr>
<tr><td>Total</td><td colspan="3">£19,268</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 215,000</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 5,000
Internal £ 1,000
Total £ 6,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The projects listed below address real problems which have been identified by the ENA Working Groups as significant and which require technical investigation and development.

• SG12 Fault Level Monitor – The device will connect to the network, and establish the network source impedance from small-scale disturbances/perturbations resulting from transformer tap changer operation, etc. This impedance can be accurately correlated to a true network fault level for that location, providing near-realtime information to network control and planning engineers alike.
• SG14 Earthing Project – Develop new techniques to assess the impact of lower voltage earth electrodes on higher voltage 'hot zones' and to measure the resistance of distribution substation earth systems.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental and Significant innovation types are involved.</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The developed unit will allow the DNOs to accurately assess fault "infeed" levels and design distribution networks appropriately. The particular benefits of Fault Level Monitor project are seen to be:
• Providing a realtime and consistent estimation of fault level;
• Accurately taking into account all connected network elements (e.g. Motors);
• Facilitating the connection of distributed generation by providing a standardised methodology for the assessment of network fault levels;
• Enabling an ongoing assessment of the effects of connected</td></tr>
</table>

	distributed generation to be made; and • Providing reassurance to generator developers that decisions to upgrade networks are not subjective but based on objective measurement. The **Earthing project** will: • Deliver a clear rationale describing the correct location of LV earth electrodes with respect to HV earth electrodes. This will have potential benefits in improving understanding of the safety of the earth installations. ESQC Regulation 8(2) (b) requires that HV electrodes are installed and used in such a manner so as to prevent danger in the LV network due to a fault in the HV network; • Consider the effects of touch and step potentials under fault conditions in all designs for earthing systems. However, the quantity of concern is actually the current flowing through a human body when in contact with metalwork subject to this potential and the time the current flows for. An electrode simply sited in soil, which has a surface potential, cannot be regarded as presenting the same hazard as metalwork with a direct metallic connection to the earth fault current return path; and • Determine these effects and provide a means to obtain cost effective safe earthing systems without the need for extensive separations between HV and LV electrodes which, in a PME system, may be impractical to achieve and maintain.		
Expected Timescale to adoption	Year 2008 - 2015	Duration of benefit once achieved	10 – 20 years
Probability of Success	25 - 75%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£ 500,000
Potential for achieving expected benefits	To progress to stage 2 of **Fault Level Monitor project** as originally defined, the results obtained from stage 1 had to support a statement that it was technically feasible to develop a Fault Level Measuring Instrument capable of deriving answers within ±5% of the actual Source and Motor Infeed values. The Algorithm validation work has cast some doubt over the achievability of that goal. The verification of results between the existing Fault Level Monitor with expected values does, however, offer some signs that the results obtained in the algorithm validation phase are not clear. The proposed testing of the existing Fault Level Monitor, within a defined third party test network, has not been pursued at this time. Although this might provide further data supporting the instrument's capabilities, it would not answer the question as to why the differences exist between		

	the apparent capability of the existing instrument and the performance of the algorithms implemented in Matlab. As the results of Stage 1 do not support an unambiguous statement that it is technically feasible to develop a Fault Level Monitor with the required degree of accuracy, this project will conclude at Stage 1. Proposals are being prepared for consideration to carry out further work to resolve questions about the apparent differences in performance of the existing Fault Level Monitor and the Fault Level Monitor algorithms implemented in Matlab. The **Earthing Project** results from tests and simulations can be used to propose a recommended procedure for measuring transfer potential between HV and LV systems.
Project Progress March 2008	A number of activities have been pursued by both EA Technology and the University of Strathclyde in the progression of **Fault Level Monitor project**. These are summarised as: • **Experiment and Laboratory Investigation** – the performance of the previous Fault Level Monitor was tested against the known parameters of the University of Strathclyde's microgrid. In general a reasonable level of agreement was achieved. • **Algorithm Validation** – the algorithms from the Fault Level Monitor, coded within Matlab, were tested using a network model in Matlab/Simulink to provide the sampled data to the algorithm. The results were compared to values of source infeed and motor infeed calculated directly from the parameters of the disturbances used. This resulted in an assessment of the potential accuracy of the instrument under a variety of load and disturbance conditions. At the power factor and load disturbance conditions, which were most likely to be experienced in a real power system, the results were not within the required accuracy band. • **Comparison of Real Site** – in contrast to the results obtained under the algorithm validation section, comparison of measurements made on a real network with the Fault Level Monitor exhibited a much closer agreement with the expected results. **The Earthing project** is complete. It has revealed the previously unknown effect that the LV electrode system can have on the shape of the HV voltage contours in the soil, that results in a lower than predicted average transfer potential on the LV neutral/earth. This has important consequences for distribution system design and could result in a reduction in the required HV:LV separation distances. For example, it means that new installations could be situated closer to an HV site than previously thought. It also goes some way towards explaining why there are far fewer reports of damage on LV networks co-incident with an HV

	fault, when their earthing systems are separate, but not by the 3m to 9m distance required in DNO policies.
Collaborative Partners	National Grid ScottishPower Energy Networks Scottish and Southern Electricity North West Western Power Distribution Central Networks and CE Electric UK
R&D Providers	EA Technology Ltd Strategy and Solutions Ltd University of Strathclyde

4.24 Activ Project

<table>
<tr><td>Description of project</td><td colspan="4">This project will investigate active voltage control in order to increase the efficiency of the network and facilitate the connection of distributed generation. More specifically, it will undertake field trials of the “Fundamentals” SuperTAPP n+ automatic voltage control (AVC) relay and develop associated modelling criteria for network planners.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£3,315</td><td>£1,312</td><td>£2,279</td></tr>
<tr><td>Internal</td><td>£410</td><td>£162</td><td>£282</td></tr>
<tr><td>Total</td><td>£3,725</td><td>£1,474</td><td>£2,561</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the amount of connected distributed generation.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">This project was started in this reporting year.</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£254,206</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 47,000
Internal £ 10,000
Total £ 57,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">To investigate the performance of the Fundamentals SuperTAPP n+ AVC relay to regulate voltage on 33kV and 11kV network feeders with load and generation present.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits of the project are:
Enabling the connection of distributed generation using a simple solution which requires minimal network modification;
Improving the voltage profile of supply;
Reducing the requirement for network extensions or reinforcement and increasing the capacity for the connection of distributed generation; and
Reducing the risk of voltage being outside statutory limits and thus damaging equipment and injuring personnel.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2010</td><td>Duration of benefit once achieved</td><td colspan="2">10 years</td></tr>
<tr><td>Probability of Success</td><td>75%</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£ 223k</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">With one trial site installed (with promising initial results) and a further two identified, there is a high probability that the expected benefits will be achieved.</td></tr>
</table>

Project Progress March 2008	The relay and monitoring equipment were installed at the first site in Elland (part of CE Electric UK's network) between the 17 and 19 March. The site has two transformers, presently using a master/follower system, and a landfill generator is connected on one feeder that is also supplying load. The relay has been installed open loop initially. The following values have been recorded: • Real and reactive current and voltage from the generator; • Real and reactive current and voltage through one transformer; • Real and reactive current on the feeder; • Real and reactive generator current estimated by the relay; • Tap change events; • Tap change signals from the relay; and • Voltage at the remote end of the feeder with the greatest voltage drop. The project was started in December 2007 and is currently on schedule. Initial results show that the estimation follows the generator output closely (for a landfill gas generator with a steady output).
Collaborative Partners	CE Electric UK Central Networks ScottishPower Energy Networks and Electricity North West
R&D Provider	EA Technology Ltd Fundamentals Ltd

4.25 Recycling Excavated Material

<table>
<tr><td>Description of project</td><td colspan="4">This project will identify ways in which excavated ground works material, which occurs as part of EDF Energy Networks' jointing, maintenance and project work, can be recycled and how the change to the use of recycled materials can be managed both internally and with local authorities. The installation of underground cables is an aspect of the distribution system asset management (construction) that meets the definition of an eligible IFI project.

Currently, over 500,000 tonnes/annum of excavated material are sent to landfill. Disposal costs are rising and are in the order of £20/tonne. Equal amounts of aggregate (approximately £16/tonne) are excavated to produce virgin type one material required by the Highways Authorities to backfill utility excavations.

The impact of sending excavated material to landfill sites is not sustainable and demonstrates that EDF Energy Networks takes the challenge of corporate responsibility seriously.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£765</td><td>£425</td><td>£510</td></tr>
<tr><td>Internal</td><td>£1,720</td><td>£956</td><td>£1,147</td></tr>
<tr><td>Total</td><td>£2,485</td><td>£1,381</td><td>£1,657</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the length of installed underground cable.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£24,681</td></tr>
<tr><td>Internal</td><td colspan="3">£ 6,463</td></tr>
<tr><td>Total</td><td colspan="3">£31,144</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 80,000</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 24,681
Internal £ 8,000
Total £ 32,681</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The innovative part of this project is to show that the recycled material can meet the requirements of the Highway Authorities and can be approved as an alternative to virgin type one material.
It will also contribute to achieving the "45% of material recycled" government target. This will be carried out alongside a full product and process life cycle analysis.

Any recommendations will be backed up by scientific evidence (comparison between recycled material properties and reinstatement specification) and a cost benefit analysis. All findings will be shared across all utility industries.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

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 136,000 tonnes; • Less vehicle movement to landfill sites and gravel yards; and • Less pollution on roads caused by vehicle movement.		
Expected Timescale to adoption	Year 2014	Duration of benefit once achieved	20 years
Probability of Success	75%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£1.9M
Potential for achieving expected benefits	There is a high probability that the objectives will be met as a number of authorities are already allowing use of recycled materials.		
Project Progress March 2008	Although there was an initial reluctance to use the suggested recycled material, local authorities are now much more receptive and many trials have taken place. A sustainability group has been set up between a number of local authorities, other utility companies and their contractors in order to share experiences. Work supported by the University of Sussex has commenced on a sustainability life cycle model. Lastly, members of the project team have been asked to speak at national and local events on sustainability relating to street works.		
Collaborative Partners			
R&D Provider	University of Surrey		

4.26 Grid Transformer Monitoring

Description of project	This project will evaluate the benefits of deploying the Intellix MO150 transformer monitoring system. Devices will be installed on four typical grid transformers at two sites. Full installation involves the integration of alarms/monitoring data with existing EDF Energy Networks' SCADA (ENMAC and possibly one CORGIS site) and historic data acquisition into LIMES data historian for strategic analysis.			
Expenditure for financial year		EPN	LPN	SPN
	External	£2,346	£966	£1,288
	Internal	£223	£92	£123
	Total	**£2,569**	**£1,058**	**£1,411**
	The costs have been allocated in proportion to the number of primary transformers supplying the distribution network.			
Expenditure in previous (IFI) financial years	External	£ 94,000		
	Internal	£ 7,327		
	Total	**£101,327**		
Total Project Costs (Collaborative + external + EDF Energy Networks)	**£ 170,000**	Projected 2008/09 costs for EDF Energy Networks	External £61,000 Internal £ 2,400 Total **£63,400**	
Technological area and/or issue addressed by project	Grid transformer monitoring			
Type(s) of innovation involved	Incremental	Project Benefits Rating	Project Residual Risk	Overall Project Score
Expected Benefits of Project	The expected benefits include the following: • Optimisation of the lifespan of power transformers; • Monitoring and performing realtime, online transformer diagnostics can help reduce the risk of unexpected and sometimes catastrophic failures, thus avoiding expensive replacement, clean-up costs and unplanned downtime; and • Permit short time overloading with online realtime monitoring.			
Expected Timescale to adoption	Year 2009	Duration of benefit once achieved	20 years	
Probability of Success	50%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£200k	
Potential for achieving expected benefits	The system has been installed at one site and the local monitoring is operating satisfactorily.			

Project Progress March 2008	The monitoring systems have been installed on two transformers. These are operating satisfactorily on a local basis. The communication channels have been installed to this site and are currently undergoing test (This will enable remote communication with the equipment).
Collaborative Partners	
R&D Provider	GE Energy and MW Test Equipment Ltd

4.27 Earthing Information System

<table>
<tr><td>Description of project</td><td colspan="4">The project will develop a GIS Information System to assist the installation of rural ground earthing systems, by providing a graphical presentation of ground conditions and the likelihood of a suitable earthing resistance being met.

Earthing rural substations can be very labour intensive, as there is sometimes a need to drive earthing rods into the ground to a depth of 12 metres (in order to achieve the necessary 10 ohm resistance). Usually rods are driven by pneumatic tools or by hand. Where hard ground restricts the depth of installation, an array of rods are installed at shallower depths, or an earthing system is installed some distance from the substation to achieve the required resistance.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£0</td><td>£0</td><td>£0</td></tr>
<tr><td>Internal</td><td>£1,173</td><td>£483</td><td>£644</td></tr>
<tr><td>Total</td><td>£1,173</td><td>£483</td><td>£644</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of distribution substations.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">This project was not reported in the 06/07 activity report.</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£450,000</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 225,000
Internal £ 10,000
Total £ 235,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">A network-wide information system that will help improve planning and costing of new and replacement earthing installations.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits are:
Accurate estimation of the cost of installation of rural ground earthing systems;
Advice on the number and technique of installation; and
Employee safety.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2012</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
<tr><td>Probability of Success</td><td>50%</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£ 110k</td></tr>
</table>

Potential for achieving expected benefits	This collaboration with Central Networks is proceeding well. Regular meetings have ensured issues are resolved with the minimum of delay.
Project Progress March 2008	Ease of Installation The British Geological Survey has collated all available engineering properties for the two test areas to allocate strength values to DIGMAP, and a first-pass working layer of engineering properties has been established. Cranfield University has mapped the areas with rock close to the surface, as well as soil with either impermeable horizon, excess of gravel in the profile or soils which have been established over gravel indicating areas in which installation will require heavier equipment. Electrical Resistivity BGS has collated all available data for the test areas from resistivity sounding databases and Cranfield University has collated all relevant soil properties and developed a model to generate worst case scenarios for both soil moisture and soil temperature related changes in soil resistivity. Next steps The integration of the relevant datasets for both the Ease of Installation and the Electrical Resistivity assessment.
Collaborative Partners	Central Networks
R&D Provider	British Geological Survey and Cranfield University

4.28 Electrical Energy Harvesting from Vibrations

<table>
<tr><td>Description of project</td><td colspan="4">In 2005 The Facility Architects Ltd won an international design competition which sought creative architectural ideas for restoring the 1,000 railway arches in London. Included in The Facility’s proposal was the intention to use ‘power harvesting’ generators to capture some of the ambient energy in the arch (e.g. vibrational energy transferred through the arch by trains passing overhead, kinetic energy lost into the ground by pedestrians as they walk through the arch) and convert it into electrical energy that could be used to power electrical devices such as low power LED lights.
The project has been restructured into four phases:
• Technical feasibility and system integration;
• Economic feasibility;
• Pilot project; and
• Business Development.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£0</td><td>£0</td><td>£0</td></tr>
<tr><td>Internal</td><td>£0</td><td>£0</td><td>£0</td></tr>
<tr><td>Total</td><td>£0</td><td>£0</td><td>£0</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of connected customers.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£10,000</td></tr>
<tr><td>Internal</td><td colspan="3">£ 779</td></tr>
<tr><td>Total</td><td colspan="3">£10,779</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 200,000</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 10,000
Internal £ 1,000
Total £ 11,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Electrical Energy Harvesting from vibrations and footsteps.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Benefits are expected to include:
• Being able to provide lighting in areas where cable installation is problematic or exposed to vandalism;
• An energy harvesting floor system;
• The resulting device could power remote sensors on primary equipment to provide condition monitoring facilities; and
• The technology may be capable of transfer to other network assets that vibrate as a form of noise reduction.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2014</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
</table>

Probability of Success	25%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£20k
Potential for achieving expected benefits	This project is at a very early stage of development. The PACEsetter project has aroused the interest of several private and public organisations.		
Project Progress March 2008	A new project manager has been appointed full time and the work schedule has been updated to accommodate a number of feasibility studies (technical and economic). Contractual issues on the use of IP needed to be resolved. *Energy Harvesting using Vibrations:* Permissions have been granted by Network Rail for 15 accelerometer positions to be tested ranging from the rails through to the structure of the viaduct itself. There were delays in gaining vibration data from railway arches, but railway sleepers may provide greater interest. *Energy Harvesting from footsteps:* Calculations of the potential energy from footsteps available for capture, and the potential energy available for conversion from gym equipment have been carried out. A visit to TechnoGym Italy who is interested in sharing knowledge on footstep outputs from walking and running.		
Collaborative Partners	Phillips Lighting and Scott Wilson Engineering		
R&D Provider	Facility Innovate Hull University and Perpetuum based at the University of Southampton		

4.29 Transformer Temperature Fibre Optic Monitoring

<table>
<tr><td>Description of project</td><td colspan="4">It is proposed that fibre optic temperature monitoring will be fitted to one of the new 30MVA transformers to be installed at Barnes substation. The monitoring will be installed in addition to the conventional electro-mechanical winding temperature instruments so that the performance of the two instruments can be compared.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£ 0</td><td>£ 0</td><td>£ 0</td></tr>
<tr><td>Internal</td><td>£ 0</td><td>£ 0</td><td>£ 0</td></tr>
<tr><td>Total</td><td>£ 0</td><td>£ 0</td><td>£ 0</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of installed primary transformers.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£47,250</td></tr>
<tr><td>Internal</td><td colspan="3">£ 4,491</td></tr>
<tr><td>Total</td><td colspan="3">£51,741</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 52,000</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £10,000
Internal £ 2,000
Total £ 12,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Temperature Monitoring using Fibre Optics</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits include:
• A validation of the traditional referred temperature;
• Assessment of seasonal ratings; and
• Enhanced ratings of power transformers.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2010</td><td>Duration of benefit once achieved</td><td colspan="2">20 years</td></tr>
<tr><td>Probability of Success</td><td>75%</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£50k</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">Final completion is dependent on Siemens providing the appropriate software to enable the data to be downloaded and analysed.</td></tr>
<tr><td>Project Progress
March 2008</td><td colspan="4">The equipment is fitted and in operation. Some of the data can be viewed from a website.</td></tr>
<tr><td>R&D Provider</td><td colspan="4">Siemens/EBG</td></tr>
</table>

4.30 Power Networks Research Academy

<table>
<tr><td>Description of project</td><td colspan="4">Power Networks Research Academy has been established through a strategic partnership agreement between the Engineering and Physical Sciences Research Council (EPSRC), Network operators and electricity supply industry related manufacturers and consultants. They will fund PhD researchers in power industry-related projects, help maintain, as well as improve, the research and teaching capacity in power engineering subjects.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£ 0</td><td>£0</td><td>£0</td></tr>
<tr><td>Internal</td><td>£0</td><td>£0</td><td>£0</td></tr>
<tr><td>Total</td><td>£0</td><td>£0</td><td>£0</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of customers in each licensed network.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">The Academy has not been reported in previous years.</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td colspan="2">£ 1.49M</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td>External £ 57,000
Internal £ 3,000
Total £ 60,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The projects for the first cohort of Academy scholars are:
• Overhead Lines Measurement System;
• System Impacts and Opportunities of HVDC Upgrades;
• Application of Artificial Immune System Algorithm to Distribution Networks; and
• Circuit Breaker Condition Monitoring.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant, Technological substitution and Radical innovations</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>9.4</td><td>0.0</td><td>9.4</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">It is expected that the Academy will:
• Promote a stronger, more active and robust R&D environment in power networks disciplines at UK universities;
• Provide capacity and capability to undertake the specialist research needed by industry and wider stakeholders;
• Strengthen the teaching capability at those institutions;
• Focus on building the health of discipline across a number of power research universities;
• Facilitate a resource of trained engineering staff with academic capability, who will be capable of tackling electrical power engineering challenges; and
• Deliver research output that is industrially relevant.</td></tr>
</table>

Expected Timescale to adoption	Year 2012 onwards	Duration of benefit once achieved	20 years
Probability of Success	25%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£200,000
Potential for achieving expected benefits	The scholars will start their research topics in September 2008. It is therefore too early to predict the potential for achieving expected benefits. However each project has been allocated an industrial champion who will support and ensure that the project maintains its industrial relevance.		
Project Progress March 2008	The scholars start their research topics in September 2008.		
Collaborative Partners	EPSRC National Grid Scottish and Southern Central Networks		
R&D Providers	Universities of Cardiff Manchester Queens (Belfast) Southampton Strathclyde Imperial College London		

4.31 Supergen I – FlexNet

<table>
<tr><td>Description of project</td><td colspan="4">FlexNet will put in place a substantial body of work that will build on the achievements of FutureNet and lay out the major steps, technical, economic, market design, public acceptance and others, that will lead to flexible networks, including starting to showcase these so that they can be taken up by the commercial sector, government and regulators for practical implementation.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£ 0</td><td>£0</td><td>£0</td></tr>
<tr><td>Internal</td><td>£0</td><td>£0</td><td>£0</td></tr>
<tr><td>Total</td><td>£0</td><td>£0</td><td>£0</td></tr>
<tr><td colspan="4">The costs will be allocated in proportion to the number of customers in each licensed network.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">The programme started in this regulatory year.</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 7.6M</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 20,000
Internal £ 3,000
Total £ 23,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Some key questions to be addressed are:
How can we judge the degree of flexibility needed?
How can flexibility be achieved?
How much flexibility should come from primary plant giving margin and how much from secondary plant giving enhanced controllability? and
What constrains or encourages flexibility, what technologies are acceptable and what economic frameworks and public policies provide flexibility at the least, overall, long term cost?</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant, Technological substitution and Radical innovations</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>7.2</td><td>-2</td><td>9.2</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Each work stream is expected to deliver benefits.
<u>Shape and Size of Future Electricity Networks</u> will continue to build on the FutureNet scenarios.
<u>Markets and Investments</u> will investigate some of the economic issues of the electricity market.
<u>Power System Electronics</u> will investigate why capital cost, cost of power losses and concerns over local network integration result in power electronic systems currently being restricted to voltage control.
<u>Smart, Flexible Controls</u> will help network operators to understand the benefits of changing the network operation philosophy and the requirements for its implementation.</td></tr>
</table>

	• Customers, Citizens and Loads will analyse potential contributions that customers and responsive demand can make towards enabling a more flexible energy system, to identify barriers to this participation and their possible remedies, and to analyse the place-related factors shaping public acceptance of a more flexible network infrastructure. • Validation and Showcase will provide the basis for testing the research outcomes in a representative environment and demonstrating their effectiveness in addressing problems central to the realisation of flexible power networks. • Future Energy Mix will consider possible changes in (UK) energy systems to 2050 and examine the impact of these changes on energy transportation networks. • Future LV Networks will investigate losses through auditing and analysing the relative impact of load profile, sharing, imbalance and sag on losses. • Education, Deliberative Engagement and Public Acceptance of Future Networks will inform many of the social issues and engagement.		
Expected Timescale to adoption	Year 2012 onwards	Duration of benefit once achieved	20 years
Probability of Success	25%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£2M
Potential for achieving expected benefits	Some of the consortium members who produced the results of Supergen I - FutureNet are continuing to participate in FlexNet. It is expected that the quality of work will continue. The input of the industrial partners will be able to enrich the research with their own experiences.		
Project Progress March 2008	The project started on 1 October 2007. Since then the academic partners have recruited PhD students and research assistants to undertake the research. The project management and steering groups have been established to manage and govern the progress of the project. Some of the work-streams are already producing some useful results.		
Collaborative Partners	EPSRC, National Grid, Scottish and Southern Energy, Central Networks, ScottishPower Energy Networks, CE Electric UK, Electricity North West and Rolls-Royce plc.		
R&D Provider	Universities of Bath, Birmingham, Cambridge, Cardiff, Edinburgh, Manchester, Strathclyde and Imperial College London.		

4.32 Strategic Technology Programme Overhead Network Module

<table>
<tr><td>Description of project</td><td colspan="4">The STP overhead network programme for the 2007/8 regulatory year aimed to reduce costs and improve performance of overhead networks by increasing understanding of issues that have a negative impact on costs and performance.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£36,327</td><td>£0</td><td>£10,851</td></tr>
<tr><td>Internal</td><td>£ 3,928</td><td>£0</td><td>£ 1,173</td></tr>
<tr><td>Total</td><td>£40,255</td><td>£0</td><td>£12,024</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the length of installed overhead line.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£ 94,272</td></tr>
<tr><td>Internal</td><td colspan="3">£ 10,617</td></tr>
<tr><td>Total</td><td colspan="3">£104,889</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 344,079 annually</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 50,000
Internal £ 4,000
Total £ 54,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The programme is also expected to have a positive impact on safety and environmental performance. The projects all address real problems that have been identified by the module steering group members as significant and which require technical investigation and development.

The projects within the programme aimed to:
• S2126_3 – Complete long-term monitoring of conductor temperature by obtaining and analysing 12 months' trial data;
• S2126_4 – Monitoring overhead line conductor temperature at two trial sites at constant current;
• S2136_3 – Continue participation in European Project COST 727: Measuring and forecasting atmospheric icing on structures;
• S2140_2 – Carry out field trials of techniques for checking the foundations of newly installed poles;
• S2143_2 – Conduct a feasibility study to detect in-situ degradation of aluminium overhead line conductors;
• S2146_2 Undertake torsion testing to evaluate possible limits for composite tension insulators;
• S2148_1 – Re-appraise ACE104 methodology;
• S2150_1 Evaluate TDR for assessment of tower foundations using actual field data;
• S2151_1 – Investigate alternatives to wood poles;
• S2152_1 – Evaluate performance of ice recording solution at severe weather test site;
• S2154_1 – Investigate ice loading of novel conductors; and
• S2155_1 – Examine comparative performance of available pole-top shrouds.</td></tr>
</table>

<table>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technological substitution, Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">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:
• Avoiding 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;
• Reducing levels of premature failure of assets;
• Providing more cost effective and early identification of damaged insulators and discharging components, which if not addressed would result in faults;
• Confidently extending the service life of towers and reducing potential levels of tower failures;
• Reducing lifetime costs by the appropriate use of alternative materials.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Range 1-5 years – dependent on project</td><td colspan="2">Duration of benefit once achieved</td><td>Range 3-7 years – dependent on project</td></tr>
<tr><td>Probability of Success</td><td>Range 2-50% – dependent on project</td><td colspan="2">Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td>£ 85,917</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure which, if successfully addressed, would enable the expected benefits to be achieved.</td></tr>
<tr><td>Project Progress
March 2008</td><td colspan="4">The second phase of monitoring overhead conductor temperatures at steady rated current was carried out during the year. The data has yet to be analysed. In contrast to the first phase, when four different types of conductor, all with similar ratings, were monitored at a single location, phase two monitored two different-sized conductors of the same type (so different design temperatures for the same current) simultaneously at two very different locations; one near sea level and one high up in the Scottish Highlands. Phase 1 found that day time ratings could probably be increased. Hopefully analysis of the Phase 2 data will provide confirmation of this and possibly find other location-dependent benefits.

An experimental investigation of live-line jumper cutting was carried out</td></tr>
</table>

	to determine whether or not it was acceptable to cut 11kV jumpers carrying load. Members found the results very interesting (spectacular in some cases!) and the work is likely to lead to changes in working practices resulting in substantial time and cost savings for DNOs. Three projects were carried out at our severe weather site on Deadwater Fell, all concerned with icing of conductors. Two “novel” conductors with higher ratings than conventional conductors (one with a gap between core and conducting strands, the other with a carbon-fibre based composite core) have been monitored for ice loading alongside a conventional aluminium alloy conductor. Preliminary analysis indicates little difference in ice loads but big differences in creep between the three conductors. At the same time, two ice meters have been tested, one as a stand-alone STP2 project and the other as part of a European project on conductor icing. The former performed very well and could provide DNOs with realtime information on ice build-up on exposed conductors. A non-destructive device, for detecting defects in concrete, has been assessed for its applicability to HV tower foundations. Subsequent excavations of the tested foundations indicated that the device is a useful and sufficiently accurate tool for assessing foundation integrity. Its use could result in significant time and cost savings for DNOs. A study of alternatives to wood poles for HV OH lines, looking at the advantages and disadvantages, and the practical applicability within UK DNOs, indicated there were significant benefits to be gained from using concrete poles in certain situations. A test rig has been designed to investigate the practical problems of erecting and working on lines mounted on concrete poles.
Collaborative Partners	CE Electric Scottish and Southern Energy Central Networks ScottishPower Energy Networks Electricity North West Northern Ireland Electricity and Western Power Distribution
R&D Provider	EA Technology Ltd

4.33 Strategic Technology Programme Cable Networks Module

<table>
<tr><td>Description of project</td><td colspan="4">The STP cable networks programme for the 2007/8 regulatory year 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, falls within the remit of Module 3. Where appropriate, Module 3 worked with other modules to achieve common goals.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£21,702</td><td>£11,323</td><td>£14,154</td></tr>
<tr><td>Internal</td><td>£ 2,347</td><td>£ 1,224</td><td>£ 1,531</td></tr>
<tr><td>Total</td><td>£24,049</td><td>£12,547</td><td>£15,685</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the length of installed underground cable.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£105,172</td></tr>
<tr><td>Internal</td><td colspan="3">£ 10,253</td></tr>
<tr><td>Total</td><td colspan="3">£115,425</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 364,820 annually</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 50,000
Internal £ 4,000
Total £ 54,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">The projects undertaken within the programme during 2006-07 aimed to:
• S3132_10 – Further develop cable ratings to address gas compression cables;
• S3132_12 – Further develop cable ratings;
• S3140_3 – Develop best practice for the installation of Ducted Cable systems;
• S3144_2 and 3 – Compare processes for the treatment of redundant fluid-filled cables;
• S3151_1, 2 and 3 – Aid understanding and control of thermo-mechanical forces in cable systems;
• S4152 – Examine separable connectors and cable compartments in 11kV switchgear;
• S3159_1 – Investigate current ratings of triplexed cable in plastic ducts; and
• S3157_1 – Carry out PD testing of MV cable systems to provide asset risk management data.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technological substitution, Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">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:
• Offsetting future increases in CAPEX and OPEX;
• Achieving CI/CML savings per connected customer; and
• Increasing the safety of staff and the public by reducing the number of accidents/incidents.</td></tr>
</table>

Expected Timescale to adoption	Range 1-3 years – dependent on project	Duration of benefit once achieved	Range 3-5 years – dependent on project
Probability of Success	Range 2-50% – dependent on project	Project NPV (Present Benefits – Present Costs) x Probability of Success	£ 82,068
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.		
Project Progress March 2008	In 2007/08 projects were completed to allow the calculation of current ratings of crossing cables (S3132_7), gas compression cables (S3132_10) and dynamic ratings (S3132_12). This almost finishes the creation of a comprehensive suite of cable rating tools for network designers and cable engineers. The outputs are of particular benefit in solving difficult multi-circuit problems. Without them there are risks of overloading the circuits. The cable rating work is being extended to the accurate modelling and calculation of technical losses in cable networks. The S3148 project has delivered a tool for comparing the merits of cross-bonding and solid bonding of MV polymeric cable systems, including outputs of annualised energy losses, as well as current ratings, circulating currents and elementary section length. Further work on the economic and environmental impacts of losses is continuing in the 2008/09 STP programme. Work is ongoing to assess the mechanical and thermal integrity of plastic ducts (S3155). This builds on previous experimental work carried out within the STP to underpin conduit specification, vital to ensure that the Electricity Industry is not faced with a serious problem of duct collapse in the future. Trials have been arranged to compare the effectiveness of three different processes for the treatment of oil filled cables at end-of-life. This work (S3144) on oil removal has been held up by difficulties in obtaining suitable sites and persuading all parties to take part, but the problems have now been resolved. The outputs of the project should allow DNOs to select the best and most cost effective process, ensuring that long term impact on the environment of redundant oil filled cables is minimised. Significant progress is being made in determining the most effective system (on-line and off-line) for Partial Discharge (PD) testing of MV cable systems (S3157). When complete it should give the DNOs useful asset risk management data.		

Collaborative Partners	CE Electric Scottish and Southern Energy Central Networks Scottish Power Energy Networks Electricity North West ESB Networks and Western Power Distribution
R&D Provider	EA Technology Ltd

4.34 Strategic Technology Programme Substation Module

<table>
<tr><td>Description of project</td><td colspan="4">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 1950s to 1970s. 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 undertaken in 2007/08 encompasses the development of 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.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£21,702</td><td>£11,323</td><td>£14,154</td></tr>
<tr><td>Internal</td><td>£ 2,347</td><td>£ 1,224</td><td>£ 1,531</td></tr>
<tr><td>Total</td><td>£24,049</td><td>£12,547</td><td>£15,685</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of primary substations.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£ 94,272</td></tr>
<tr><td>Internal</td><td colspan="3">£ 8,386</td></tr>
<tr><td>Total</td><td colspan="3">£102,658</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 304,648 annually</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 50,000
Internal £ 4,000
Total £ 54,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Eighteen new projects were approved during the year. They are:
• S4164_4 – On load tap changer monitor – develop and install trial systems;
• S4176_3 – Assessment and inspection of substation earthing systems
• S4181_2 – Transformer Post Mortems
• S4185_2 – AM Forum membership;
• S4212_1 – Dissemination Seminar to ensure wider appreciation of STP module outputs;
• S4219_1 – Management of substation batteries;
• S4220_1 – Management of 145kV Disconnectors;
• S4221_1 – Investigate Out of Phase Switching;
• S4222_1 – Explore Alternatives to ENATS 35-1 Transformers;
• S4223_1 – Review of Underground Substation design;
• S4225_1 – Assessment of BS148 and IEC60296 Insulating</td></tr>
</table>

	Oils; • S4228_1 – Investigate Alternative Measuring Techniques for Insulation Materials; and • S4234_1 –Exploration of Ferroresonance Issues.			
Type(s) of innovation involved	Incremental, Significant, Technological substitution, Radical	Project Benefits Rating	Project Residual Risk	Overall Project Score
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: • Offsetting future increases in CAPEX and OPEX; • Increasing the safety of staff and the 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, to alleviate environmental impact.			
Expected Timescale to adoption	Range 1-2 years – dependent on project	Duration of benefit once achieved	Range 1-10 years – dependent on project	
Probability of Success	Range 5-50% – dependent on project	Project NPV (Present Benefits – Present Costs) x Probability of Success	£ 63,649	
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.			

Project Progress March 2008	The wide ranging projects intended to provide numerous benefits, both in terms of safety, knowledge sharing, network performance, mitigation of risks to plant and minimising effects to the environment. The majority of projects have not only resulted in essential knowledge transfer, they have enabled skills to be developed between STP 4 Members and also European partners. Key examples of this were the participation in the AM Forum, (S4185_3), the sponsoring of the Ferro-Resonance Seminar, (S4234_1), the Out Of Phase Workshop, (S4221_1) and the Substation Maintenance Seminar, (S4212_1). Each of these has contributed significantly to developing better understanding of electrical plant, its application, utilisation, performance and life cycle. These projects have resulted in the creation of further supplementary projects for 2008/2009. Additional key development and technical projects have also been undertaken. The On–Load Tap Changer Monitor, (S4164_4) and the Programme of Transformer Post Mortems, (S4181_2), for instance, could each lead to a reduction in potential multiple transformer failures, together providing mitigation of multiple potential incidents. Condition based monitoring and the prediction of end of life of plant, will lead to an improvement in network performance, providing a clearer understanding of degradation and the failure processes, which will provide the ability to identify and predict end of life, providing many years benefit. This will enable assets to be replaced in a controlled manner, within agreed timescales, minimise disruptive failures and the implications associated with them, in terms of safety, cost, CI's and CML's.
Collaborative Partners	CE Electric Scottish and Southern Energy Central Networks ScottishPower Energy Networks Electricity North West ESB Networks and Western Power Distribution
R&D Provider	EA Technology Ltd

4.35 Strategic Technology Programme Networks for Distributed Energy Resources Module

<table>
<tr><td>Description of project</td><td colspan="4">The projects undertaken during the 2007/8 regulatory year 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 were identified as being significant by the module steering group members. This resulted in technical investigation and development.</td></tr>
<tr><td rowspan="5">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External</td><td>£22,646</td><td>£8,964</td><td>£15,569</td></tr>
<tr><td>Internal</td><td>£2,449</td><td>£969</td><td>£1,684</td></tr>
<tr><td>Total</td><td>£25,095</td><td>£9,933</td><td>£17,253</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the amount of installed distributed generation.</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£ 94,272</td></tr>
<tr><td>Internal</td><td colspan="3">£ 8,270</td></tr>
<tr><td>Total</td><td colspan="3">£102,542</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy Networks)</td><td>£ 371,475 annually</td><td>Projected 2008/09 costs for EDF Energy Networks</td><td colspan="2">External £ 50,000
Internal £ 4,000
Total £ 54,000</td></tr>
<tr><td>Technological area and/or issue addressed by project</td><td colspan="4">Nineteen new project stages were approved during the year.
These projects aimed to:
S5147_4 – Monitor Microgenerator Clusters;
S5147_5 – Analyse Microgenerator Cluster monitoring results;
S5147_7 – Reporti Microgenerator Monitoring;
S5149_5 – Explore Active Voltage Control;
S5142_4 – Examine Generator Data and Structure for DG Connection Applications;
S5151_4 – Examine Network Risk Modelling;
S5152_3/4 – Discover latest developments in the connection of distributed generation;
S5157_3 – Evaluate the Performance of Small Scale Reactive Power Compensators;
S5161_2 – Look at a standard risk assessment approach to DNO protection;
S5167_1 – Assess enhanced ratings for overhead lines connecting windfarms;
S5170_1 – Explore low cost design options for connecting DG to overhead line networks;
S5171_1 - Investigate the use of inverter connected DG to alleviate fault level contribution;
S5172_1 – Examine optimum power factor to support a low carbon economy;
S5173_1 – Look at alternative techniques for temperature</td></tr>
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<table>
<tr><td></td><td colspan="4">connected demands;
S5174_1 – Assess the potential for DSM from small customers;
S5176_1 – Assess the impact of high penetrations of micro-generation on cable networks;
S5182_1 – Examine treatment of distribution network losses;
S5185_1 – Assess the potential for DSM from larger customers; and
S5186_1/2 – Investigate effects on network of proposed ban on incandescent light bulbs</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental, Significant, Technological substitution</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">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, 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;
Improving quality of supply and reducing the 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 using 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.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Range 1-5 years – dependent on project</td><td>Duration of benefit once achieved</td><td colspan="2">Range 1-10 years – dependent on project</td></tr>
<tr><td>Probability of Success</td><td>Range 10-30% – dependent on project</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£ 80,744</td></tr>
</table>

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.
Project Progress March 2008	During 2007/08, Northern Ireland Electricity joined the Module, bringing the number of full members to eight. A total of thirteen reports and briefing papers were delivered during the year, including a review of CIRED 2007 for all Modules; this was an efficient and cost-effective means of disseminating information and trends from the event, enabling STP members to identify areas of future research and development relevant to the UK context. The year also saw the completion of twelve months' monitoring of the microgenerator cluster in Manchester, a network with a high penetration of microgeneration where the houses are new build (i.e. well insulated with a relatively low heating requirement). Laboratory tests on compact fluorescent light bulbs were undertaken to examine the network effects of the proposed ban on incandescent bulbs and a follow-on stage was approved to monitor whole house performance under typical mixed loads with measurements concentrating on the harmonic effects.
Collaborative Partners	CE Electric Scottish and Southern Energy Central Networks ScottishPower Energy Networks Electricity North West ESB Networks Manx Electricity Authority and Northern Ireland Electricity
R&D Provider	EA Technology Ltd

5. Steyning Primary RPZ

Description of project and technical details	Following the successful trial of GenAVC at Martham Primary in North Norfolk (the EDF Energy Networks (EPN) plc RPZ), Econnect Ventures Limited was asked to develop an assessment tool to determine whether GenAVC would be an appropriate solution to voltage rise problems in the early stages of DG connection process. A landfill gas generation site suffers nuisance tripping due to high volts during periods of light load throughout the summer months. The generator operator also has a greater supply of landfill gas than it can utilise to generate energy. Excess gas cannot be stored and needs to be flared into the environment. The generator operator wishes to install an additional 1.5MW unit at his site. To validate the assessment tool, EDF Energy Networks installed GenAVC at Steyning Primary. The results of the system are being monitored.
Expenditure for financial year	Expenditure is detailed in the GenAVC Assessment tool IFI project report contained in section 3.2 of this report.
Type(s) of innovation involved	The assessment tool did show that GenAVC is an appropriate solution to a voltage rise problem. GenAVC takes into account the voltage contribution from DG connected to the network and biases the target voltage of the primary substation tap changers to allow additional generation to be connected and the output of the generators to be maximised.
Status (planned, under construction, operational) and operational starting year	Operational
Connection cost	Connection costs using GenAVC were reduced when compared to the traditional network reinforcement methods which would have involved the installation of 4.5km of underground cable.
Benefit to customers compared to those envisage when project was registered	This RPZ was registered to allow the generator operator to be able to utilise its additional gas supply to generate energy, as opposed to flaring the excess gas into the environment. It already operates two 1MW of landfill gas generators connected to distribution network supplied from Steyning Primary substation. The assessment tool estimated that approximately 1.5MW of additional generation could be connected without infringing statutory voltage or power flow limits. All connected customers benefit from improved voltage control especially during periods of light load when higher volts were experienced.