IFI/RPZ Report

April 2006 to March 2007 Inclusive

for the licensed companies:

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

Foreword

Welcome to the EDF Energy Networks' Innovation Funding Incentive activity report for the regulatory year 2006/07. The year has seen a number of important and fundamental developments which will have a major impact on our industry - issues concerning climate change and our need for secure, sustainable and affordable energy supplies. These have been highlighted in a number of recommendations and obligations; for example the requirement for EU member states to achieve a mandatory target of 20% for renewable energy's share of energy consumption in the EU by 2020; the Stern Review recommendation that the power sector globally should be at least 60% decarbonised by 2050; and by no means least, the Government's Energy White Paper.

The drive for secure, sustainable, and affordable sources of energy has direct implications for electricity distribution networks. In particular, it will lead to much higher volumes of renewable energy sources and CHP in the form of distributed generation which in turn will require a far more 'active' approach to network management. Moreover, Network Operators may in future need to play a more interactive role in terms of their interface with connected customers and with the national transmission network; for example in providing a system balancing role and other ancillary services.

It is therefore not surprising that these issues have weighed heavily in the overall make-up of our portfolio of IFI funded projects. Section 1.6 describes our IFI Strategy and shows that some 36% of our current project expenditure is related directly towards environmental sustainability and the development of future network technologies. One particularly innovative project is our Substation Heat Transfer project that uses waste heat from the cooling systems of the transformers at Bankside substation in London to provide space heating for the Tate Modern Gallery (see Section 3.13).

However, whilst supporting a low carbon economy and developing future network architectures are vitally important areas; these must not be at the expense of customer service, safety or efficient network operation. Again, referring to Section 1.6 of this report, it will be seen that 38% of our project expenditure is targeted towards developments to improve quality of supply, reliability, network utilisation and our management of electrical losses; whilst 26% is allocated to the development of innovative operational techniques to improve safety and customer satisfaction.

We have recognised that a successful R&D strategy depends on effective collaboration, and have therefore continued to build our links with other organisations to foster a sustainable future for the Electricity Supply Industry. Many universities funded by the Engineering and Physical Sciences Research Council are in turn benefiting from their engagement with Network Operators; not least in providing context through greater visibility of the real issues facing Distribution Network Operators.

Finally, I am pleased to be able to demonstrate our continued support for the Registered Power Zone incentive having now registered a second RPZ in Steyning, West Sussex. A novel voltage control assessment technique will permit the connection of an additional generator at an existing landfill gas generation site and hence obviate the need for flaring of the excess landfill gas (see Section 4).

Paul Cuttill OBE
Chief Operating Officer, Networks
EDF Energy

1. Introduction

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

1.1 Context

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

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

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

1.2 IFI

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

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

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

1.3 RPZ

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

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

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

1.4 This Report

This report contains a summary of EDF Energy Networks' IFI activities for the period April 2006 to March 2007 inclusive.

EDF Energy Networks registered one RPZ for the SPN network during the period covered by this report, namely the Steyning Primary RPZ in West Sussex. Details of the Steyning Primary RPZ are contained in section 4 of this report.

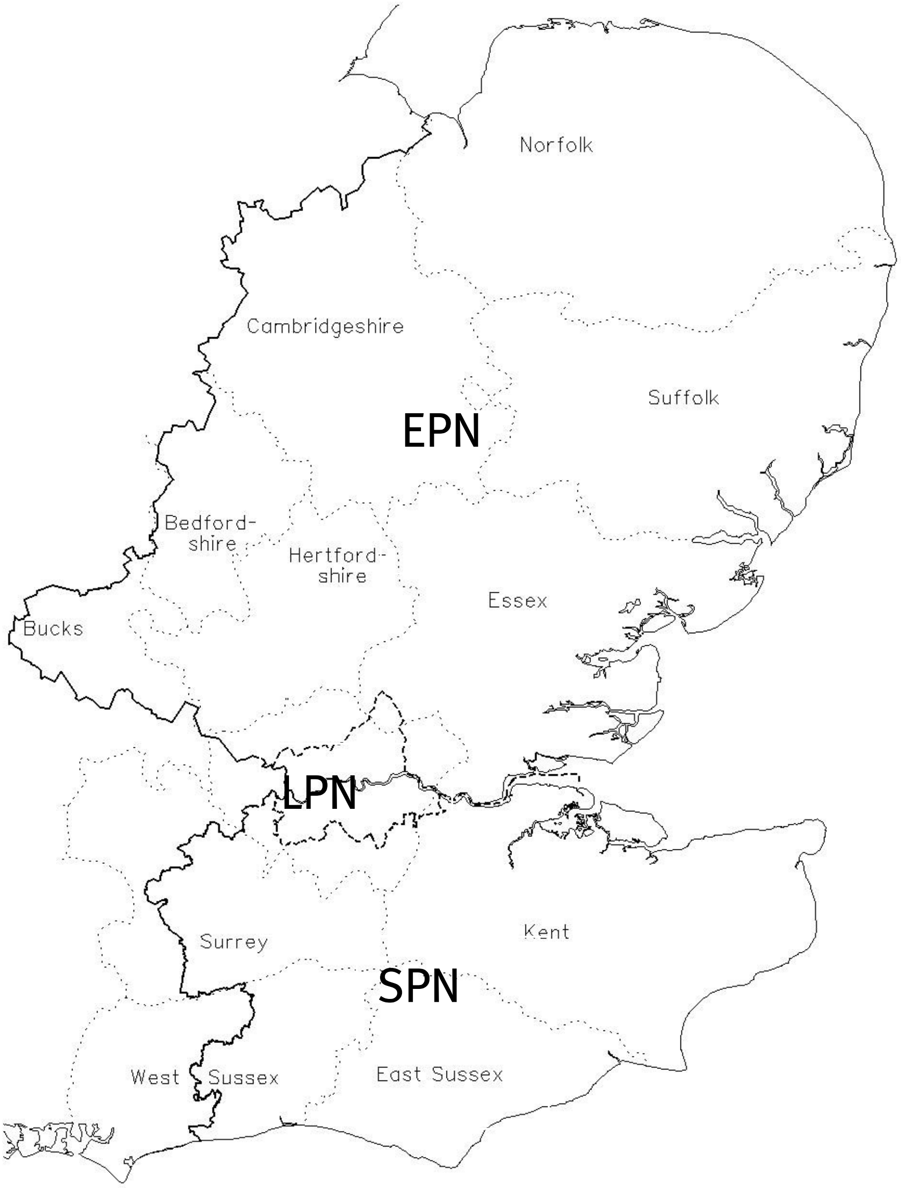
Attracting new DG developers to the Martham Primary RPZ reported in our last report continues to be a challenge. In the Steyning Primary RPZ we have been fortunate to have a landfill gas DG operator who wishes to make use of excess landfill gas greater than the original estimates made when the first DG was installed in 1997. Landfill gas cannot be stored and needs to be flared if it is not be used to generate electrical energy. Another benefit of this RPZ is the negative environmental impacts of flaring can be avoided.

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 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 license areas are shown in the map overleaf.


Norfolk
Cambridgeshire
Suffolk
EPN
Bedfordshire
Hertfordshire
Essex
Bucks
LPN
Surrey
Kent
SPN
West Sussex
East Sussex

Research and Development activities are conducted by EDF Energy Networks for the benefit of our customers on behalf of the three licensed network operators named above. In our last report, the total IFI expenditure was split in proportion to the three licensed networks' combined network revenue. This year we have allocated the expenditure to each licensed network in proportion to the major asset associated with each individual project. Section 2.6 provides a tabulated summary of this regulatory year's expenditure.

1.6 Strategy & portfolio management

EDF Energy Networks' main objectives within the IFI framework are to:

- Improve the customer experience;
- Develop a diversified portfolio of projects (short/medium/long term, high/low risk);
- Ensure projects align both with internal and external stakeholders expectations; and
- Ensure projects deliver tangible benefits (network improvement, etc.).

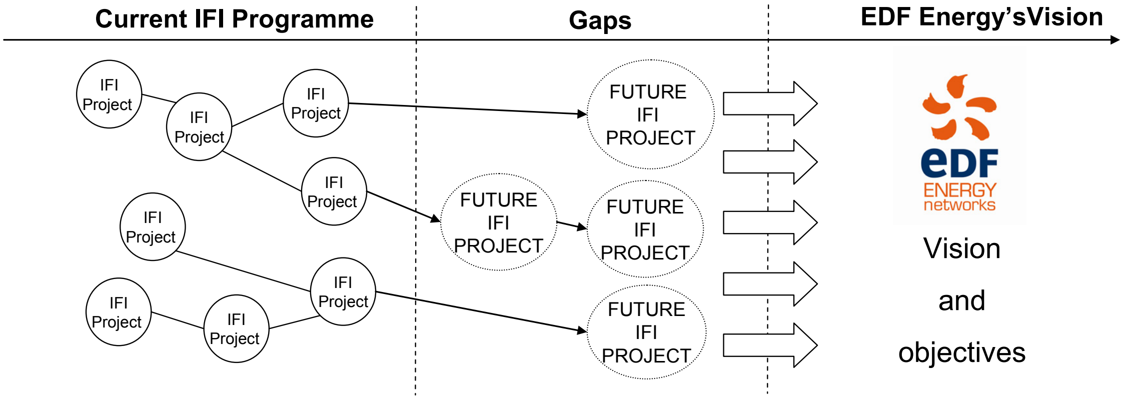
EDF Energy Networks has developed an Innovation Funding Incentive strategy to ensure a rigorous selection and review process for our projects. We also want to ensure the diversity of our portfolio by addressing a wide range of current and forthcoming issues. The EDF Energy Networks' research programme is divided into 4 work programmes:

WORK PROGRAMME	Sustainability & Environment	Network Operations	Asset Management	Future Networks
MAIN SUBJECTS	Low Carbon Economy Sustainable Energy / Distributed Generation / Energy Efficiency	Short term needs / Novel working techniques / Improved Safety / Customers satisfaction	Security-Quality of Supply / Risk management/ Asset Management / Investments / Network design Condition monitoring / Losses	Smart - Future Networks / Major technical innovations / IT Systems evolution
CURRENT IFI ALLOWANCE SPEND	18%	26%	38%	18%

Work packages (Individual project contribution to work programmes is highlighted in this report)

EDF Energy Networks has also developed an "IFI portfolio management tool" that enables progress to be carefully monitored, project to be classified and the overall status of the portfolio to be monitored.

Finally, following Ofgem's intention to extend the IFI scheme to the next price control review, EDF Energy Networks has started work on a long term R&D road map. This will help us identify gaps between the current portfolio of projects and our long term vision and objectives.



R&D roadmap process

1.7 Project Partners

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

At this year's CIRED conference papers were presented by a number of staff describing benefits realised by projects in the demonstration phase. One paper described our continued work with IPEC Ltd to improve the monitoring of cable and switchgear insulation deterioration. IPEC's "Advanced substation monitoring" system is now commercially available.

Econnect Ventures Ltd is developing an assessment tool to help network planners determine whether GenAVC is an appropriate solution for a distributed generation connection where voltage limits are identified as an issue.

4Energy Ltd has been collaborating with a number of DNOs to develop a range of climate control devices to extend the life of batteries when exposed to high temperature environments.

CeresPower Ltd a fuel cell manufacturer is developing a UPS device for our vulnerable customers who a medically dependent on electricity as part of our Discretionary Reward Scheme submission for 2008.

Our university partners have published papers at a number of conferences in the UK, Europe and the United States.

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

2. Summary of IFI Project Activities

2.1 Number of active IFI projects

There are 29 EDF Energy Networks led IFI projects in addition to those linked with the four EA Technology Ltd (EATL) STP modules.

2.2 NPV of costs and anticipated benefits from committed IFI projects

The IFI portfolio NPV of committed EDF Energy Networks led projects is estimated to be £21.7M. 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 of the order £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 which are anticipated from active IFI projects include:

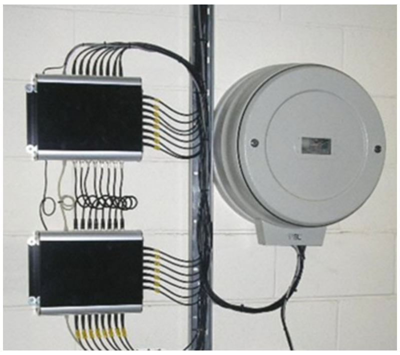
- An improvement in the security of supply and quality of service received by our customers;
- A reduction in the cost of DG connections; and
- Environmental and safety benefits.

2.4 Total expenditure to date on IFI projects

Regulatory year	Total expenditure
Early start report 04/05	£ 275.8k
Regulatory year 05/06	£2570.9k
This regulatory year 06/07	£3,575.8k
Total	£6,422.5k

2.5 Benefits actually achieved from IFI projects to date

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



The HV on-line condition monitoring programme continues to deliver benefits. The number of feeders monitored (including cable and switchgear) remains approximately 600 across the EDF Energy Networks' area. The newly developed "Advanced substation monitoring" system is now commercially available from IPEC.

In the LPN license area, three preventive cable replacements were carried out following the detection of increasingly high partial discharge activity:
- Two instances fed from Bulwer Street primary substation on feeders 2 & 5, 600m of paper insulated cables was replaced.

- At Verney Road primary substation 100m of cable was replaced on feeder 12.

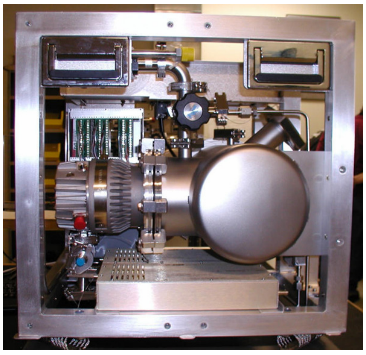
Approximately 50 other feeders are currently being considered for preventive cable replacement. For all replacements carried out, the success of the intervention was verified by a reduction in the partial discharge activity following repairs and re-energisation.

The SCADA comms IP Protocol upgrade project has allowed independent comms infrastructures and dual routes to the RTU to be used. 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 comms infrastructures and will facilitate a smoother ENMAC cut-over process to the SPN network.

Last year we reported on our 'On-Load' Relay & Circuit Breaker Timing Tester project in collaboration with Relay Engineering Services Ltd. Following additional field tests that incorporated some design changes this test equipment is now being used by some our field staff in wider scale user trials. Several useful modifications have come from this and the unit will benefit from these upgrades in future. The unit not only validates the protection relay operating time by measuring the operating time for a given point on the protection curve, it is also measures the Circuit Breaker operating time which together enhances our asset condition knowledge. Protection schemes have been identified that would not have behaved as designed. These were resolved with on-site adjustments or with a referral to a protection engineer. Others have lead to new schemes being installed. The timing tester has increased the number of circuits that can be tested annually and probably prevented an event that could have resulted in unnecessary customer interruptions. A brochure for the PCA2 relay tester is now available on the RES website, www.relayeng.com

The following equipment has been developed (some partly) as part of the Innovation funding incentive scheme:

RTU Battery Climate Control Device for hot distribution substations developed by 4Energy Ltd



Oil leak location unit developed by Femtotrace, Inc.

LV fault location developed by Kehui Ltd

2.6 Tabular Summary

	EPN	LPN	SPN	TOTAL
IFI carry forward (£k)	£357.4k	£269.7k	£190.8k	£817.9k
Eligible IFI expenditure 05/06	£2,020.0k	£808.4k	£751.9k	3,575.8k
Eligible IFI internal expenditure 05/06	£202.3k	£83.1k	£104.9k	390.3k
Combined distribution network revenue (£m)	£336.32M	£264.65M	£186.68M	£787.65M
The IFI carry forward to 2007/08	£0	£514.8k	£181.5k	£696.3k

2.7 Registered Power Zones

RPZ Name	Steyning Primary RPZ
RPZ DG Capacity (MW)	Additional generation will be connected shortly.
RPZ starting year	06/07

See RPZ report in Section 4.

2.8 ENA Brochure articles

During 2007 the Energy Networks Association R&D working group planned to publish a brochure to demonstrate the range of projects being funded by each DNO's IFI allowance. The working group asked each DNO to submit two one-page magazine-style project articles. The two articles submitted by EDF Energy Networks described our online condition monitoring project and our collaboration with Econnect Ventures Ltd on the GenAVC project.

It was agreed by the ENA R&D working group that each DNO should include their articles in their IFI activity reports. These are included in the following two pages.

HV ON-LINE CONDITION MONITORING

THE CHALLENGE

Currently, very little substantive information is known about the condition of the underground HV network and the average age of the network is increasing. Until now, techniques used to identify degrading sections of cable or joints have been invasive and of limited viable application.
With increasing pressure to improve network performance, operate the network smarter and reduce operational cost; Procedures need to be developed and proven in order to minimize the effects of network ageing and efficiently manage the maintenance and replacement in advance of this valuable asset.

According to various studies, a significant proportion of cables are reaching the end of their normal predicted life, and the fault rate can be expected to increase over the coming years. Not doing anything can be expected to result in an increasing fault rate as the cables get older with more customers being interrupted. An increase in operational expenditures (OPEX) is also likely to occur due to the increasing number of repairs required.

SOLUTION

EDF Energy Networks and a consortium of selected partners have been developing “on-line condition monitoring” techniques based on the detection of partial discharge (PD).

The project has now entered a new phase with the introduction of an improved monitoring equipment ASM (Advanced Substation Monitor, shown on fig 1), as well as the development of a robust web based infrastructure in order to efficiently manage and interpret the substantial amount of data being collected (Fig 2).

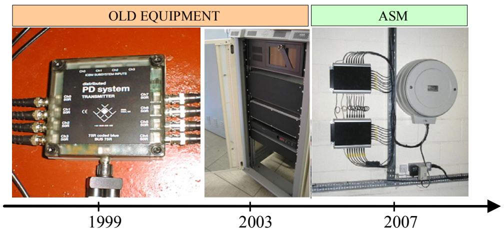


Fig 1 - On-line condition monitoring equipment evolution

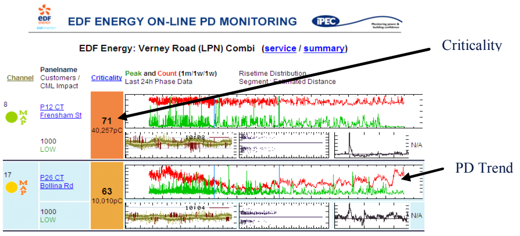


Fig 2 - Web based Analysis interface

BENEFITS

- Reduction in OPEX due to cost savings of repairing faults as part of planned cable replacement.
- Deferment of capital expenditure by avoiding premature replacement of underground HV cables.
- Improvement of the quality of supply (CI & CML) by avoiding HV faults.
- Reduction in multiple interruptions by providing a better and more accurate “first diagnostic”.
- Organised cable replacement programme rather than emergency opening notices will reduce potential disruption to the public.
- The technology can be used to monitor other assets (i.e.: switchgear).

ON-LINE CONDITION MONITORING TRIAL

The value and the potential of the technology have already been established as a number of incipient faults on the EDF Energy network have been detected in advance and cable replacements successfully carried out before a failure occurred (Fig 3).

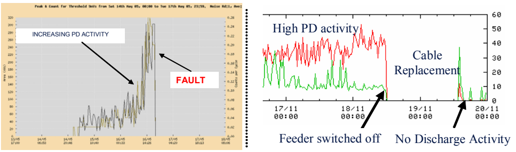


Fig 3 - Fault detection & Preventive cable replacement

EDF Energy Networks is currently carrying out an extended trial, part of which will include integration into the control system. The objectives are to fully validate the technology and prepare the integration of this innovation into asset management processes.

GenAVC™

Intelligent Active Network Management

THE CHALLENGE

Distribution networks have traditionally been operated as passive networks with uni-directional power flows. With the connection of increasing amounts of distributed generation (DG), networks are becoming more active with power flowing in both directions. The intrinsic variability of wind power, and indeed other forms of DG, combined with the normal background changes in load demand, leads to a varying voltage profile along the circuits containing DG. The algorithms used in conventional Automatic Voltage Control (AVC) relays controlling the 33/11kV transformers were designed for passive networks. These conventional AVC algorithms frequently limit the amount of DG that can be connected. The challenge to Distribution Network Operators (DNOs) is to accommodate the current desired increase in levels of distributed generation (DG) at an economic cost, whilst maintaining the voltage of all the customer connections on the network within statutory limits.

A SOLUTION

GenAVC™ developed by Econnect Ventures Limited, provides a cost-effective voltage control solution by applying proven state estimation techniques to regularly calculate voltages throughout the local 11kV network. Feedback from a small number of real-time measurements at key locations is applied to a network model to estimate the range of voltages.

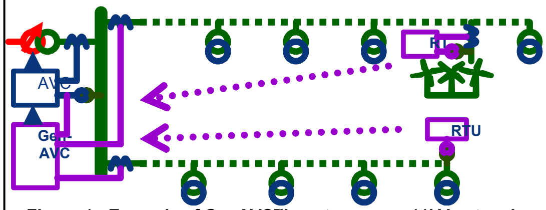


Figure 1 - Example of GenAVC™ system on an 11kV network

Should the estimated voltage at any point on the network approach the statutory limits, GenAVC™ sends a control signal to the transformer Automatic Voltage Control (AVC) relay to adjust the voltage set point appropriately. The consequent tap change operation on the primary transformer then restores the network voltages within statutory limits.

The state estimation is constantly updated to ensure that all tap change operations are appropriate responses to the real-time voltages of the network as a whole. Thus, the ever-changing levels of a wind farm's power output or local demand can be accommodated on the network without exceeding statutory voltage regulations.

Figure 2 – Great Orton wind farm, GenAVC™ trial site

GenAVC™ functionality is described as a voltage rise mitigation solution in ENA Engineering Technical Recommendation 126 - "Active Voltage Control with Remote Sensing".

BENEFITS

- Can allow double the capacity of DG to be connected into an 11kV distribution network by eliminating voltage problems.
- Increased power export and revenue for developers. Existing sites can be replanted with larger capacity.
- Increased network utilisation.
- Lower cost than "conventional" network reinforcements. Some projects, which were not economically feasible, may now possible with GenAVC™.

GenAVC™ FIELD TRIALS

GenAVC™ has been trialled at two locations in the UK on networks owned by United Utilities and EDF Energy Networks. GenAVC™ has been actively controlling the voltage for over 3000 customers on EDF Energy Network's Martham 11kV network since autumn 2005. Close monitoring of active operations has shown that GenAVC™ has successfully performed as predicted in earlier studies. The Martham 11kV network has been registered as the first EPN RPZ.

Based on the Econnect Ventures GenAVC brochure November 2006

3. Individual IFI Projects

(Projects ordered by Expenditure)

- AURA NMS – Autonomous Regional Active Network Management System
- HV on-line condition monitoring project
- The use of Perfluorocarbon Tracers (PFT) leak location techniques
- Primary SCADA Comms IP upgrade
- Battery Asset Management
- Network Risk Management
- Grid Transformer Monitoring
- Distribution System State Estimation
- Improvements in Overhead Line Performance
- Application of Storage and Demand Side Management
- Underground LV Cable Fault Management
- Bankside Heat Transfer
- GenAVC Assessment Tool
- DG Connection Planner
- Transformer Temperature Fibre Optic Monitoring
- Supergen V - AMPerES
- Recycling Excavated Material
- Collaborative ENA R&D Programme
- Vibration Harvesting
- Transformer Damping
- 33kV Voltage Control
- FENIX
- Vulnerable Customer UPS
- Transformer design for FR3
- Power Factor Analysis
- Evaluation of the characteristics of alternative oils
- Wood pole disposal
- Domestic Cut-out Temp Indicators

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 Modules, these four reports have been written by EA Technology Ltd to provide consistent reporting.

3.1 AURA NMS – Autonomous Regional Active Network Management System

<table>
<tr><td>Description of Project
Strategy Contribution
SUSTAINABILITY & ENVIRONMENT
NETWORK OPERATIONS
FUTURE NETWORKS</td><td>This is a Strategic Partnership with EPSRC, ABB, SP Power Systems Ltd. The project is to develop a distributed control system to deliver the following:
• Real-time automated reconfiguration initially to a regional network of up to four primary substations;
• Economically, efficiently and effectively integrate large amounts of small scale distributed generation taking into account legacy infrastructure and renewal programmes; and
• Network optimisation taking into account DG and electrical energy storage.</td></tr>
<tr><td>Expenditure for financial year</td><td><table>
<tr><th></th><th>EPN</th><th>LPN</th><th>SPN</th></tr>
<tr><td>External costs</td><td>£1,005,420</td><td>£0</td><td>£0</td></tr>
<tr><td>Internal costs</td><td>£79,671</td><td>£0</td><td>£0</td></tr>
<tr><td>Total costs</td><td>£1,085,091</td><td>£0</td><td>£0</td></tr>
</table>The costs have been allocated solely to the EPN Licence area as the costs are associated with the electrical energy storage device planned to be connected to the Martham Primary Network.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td>£ 291.8k was reported in the 05/06 activity report.
This project was not reported in the Early Start report.</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td>The scoping and development of three major areas.
• Distributed Generation 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 distributed generation to remain connected and operating; and
• Co-operation with the traditional control centre network management systems when considering actions which might affect other parts of the network.</td></tr>
<tr><td>Type(s) of innovation involved</td><td>Radical innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td>Benefits are expected to include:
• Maximisation of the contribution of DG to the electricity network;
• Reduction in carbon emissions and help towards the UK governments climate change targets;
• Reduction in network losses by having the source of generation close to the load;
• Improvement in quality and security of supply;
• Improvement in network resilience; and
• Reducing the current market failures to increase network capacity for DG.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>7 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td>20 years</td></tr>
</table>

Estimated Success probability (at start of project)	25%
Project NPV (Present Benefits x Probability of Success) – Present Costs	This project is expected to deliver benefits in the order of millions of pounds. As part of the project the real value will be calculated.
Commentary on project progress and potential for achieving expected benefits	Most of the work this year has been taken up with the academic research assistants understanding the problems of network operation and determining the existing communication limitations and considering what can be performed differently. Demonstration networks have been selected and information to describe the networks has been gathered. Information gaps are being identified by the academics. The functional and specification requirements are being assessed. Presentations were given at the IET describing the benefits of the AURA NMS distributed control concept. Developments of the ABB Energy storage device controller continue to be improved. It is expected that the energy storage device will be connected in the EPN network during 2008.

3.2 HV on-line condition monitoring project

<table>
<tr><td>Description of Project
Strategy Contribution
NETWORK OPERATIONS
ASSET MANAGEMENT</td><td colspan="4">The use of partial discharge has been a well known method of checking the condition of electrical insulation. Over the past 8 years, EDF Energy Networks has been actively involved in the development of “on-line” partial discharge monitoring and mapping techniques.
Further opportunities to improve the existing generation of equipment have been identified.
This project has taken equipment from the laboratory into the distribution network to monitor underground cables and switchgear.
This project now incorporates the Network Resilience project reported separately in the last activity report.</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 costs</td><td>£108,226</td><td>£324,679</td><td>£108,226</td></tr>
<tr><td>Internal costs</td><td>£8,500</td><td>£25,501</td><td>£8,500</td></tr>
<tr><td>Total costs</td><td>£116,727</td><td>£350,180</td><td>£116,727</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>Expenditure in previous (IFI) financial years</td><td colspan="4">£291.2k was reported in the 05/06 activity report.
£103.2k was reported in the Early Start report.</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The issues being investigated by the project are:
• On-line fault detection and location;
• Pre-emptive fault repairs;
• Cable replacement & maintenance strategy; and
• Quality of supply improvement.</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="4">Radical Innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Benefits are expected to include:
• Ability to target the replacement of cable; and
• Ability to identify faults (cable & 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 colspan="4">3 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">75%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£4.8M</td></tr>
</table>

Commentary on project progress and potential for achieving expected benefits	The number of feeders monitored (including cable and switchgear) remains approximately 600 across the EDF Energy Networks' area. The newly developed "Advanced Substation Monitoring" (ASM) system is now commercially available (to other DNOs), the main features of the equipment include: • Fully automated on-line monitoring of up to 128 channels; • Portable: Can be deployed both in primary and secondary substations; • Multiple asset monitoring: Cables, switchgear, transformers; • Advanced software analysis of discharge wave shape to distinguish partial discharge from noise; • Partial discharge criticality based on knowledge rules; • Automated alarms by email, text and SCADA; and • Web based interface to analyse data and assist asset management decisions. This equipment is part of a suite of on-line Partial Discharge spot testing, monitoring & mapping tools developed by EDF Energy Networks. The following stages are currently in progress: • Experimentation of two "PD surveyor" spot testing equipments; • Development of a web based cable analysis database (in cooperation with ERA Technology) to assist the understanding of failure modes and the associated Partial discharge signatures; • Validation of an experimental "cable replacement procedure"; • Further ASM's installations are being carried out in order to increase the amount of data available for research purpose and be able to fully evaluate the impact of deploying the technology; and • Research on the prediction of cable remaining life & behaviour of faults before failure. (This is being carried out in cooperation with a number of partners, including ERA Technology and EDF R&D in France). Benefits delivered: Three preventive cable replacement were carried out following the detection of high partial discharge activity: • Bulwer Street primary substation: feeders 2 & 5, 600m of paper insulated cables was replaced and • Verney Road primary substation: feeder 12, 100m of cable was replaced. Approximately 50 other feeders are currently being considered for preventive cable replacement. For all replacements carried out, the success of the intervention was verified by a drop of the partial discharge activity following repairs and re-energisation. A conference paper was presented at the CIRED 2007 conference.

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

<table>
<tr><td>Description of Project
Strategy Contribution
NETWORK OPERATIONS
ASSET MANAGEMENT</td><td colspan="4">This project is to evaluate the suitability of using PFT tracer technology to determine cable leak location and reduce the number of excavations required. The technology was developed by NASA. This is in collaboration with Con Edison.</td></tr>
<tr><td rowspan="4">Expenditure for financial year</td><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External costs</td><td>£116,482</td><td>£116,482</td><td>£99,842</td></tr>
<tr><td>Internal costs</td><td>£17,014</td><td>£17,014</td><td>£14,583</td></tr>
<tr><td>Total costs</td><td>£133,496</td><td>£133,496</td><td>£114,425</td></tr>
<tr><td></td><td colspan="4">The costs have been allocated in proportion to the existing lengths of fluid filled cables.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">£163.1k was reported in the 05/06 activity report.
£16.0k was reported in the Early Start report and
£220k was paid up front in March 2004 for the costs of developing the detector unit.</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.</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="4">Radical</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Benefits are expected to include:
• Faster and more accurate oil leak locations;
• Operational cost savings with fewer and smaller excavations;
• Positive impact on environment ; and
• Improved relationship with Environmental Agency through demonstration of a pro-active and world’s best practice leak location techniques.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="4">3 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">50%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£5M</td></tr>
</table>

Commentary on project progress and potential for achieving expected benefits	Since the last report EA Technology has conducted a 1 year, PFT compatibility trial with the various cable components. A successful method of tagging cable fluid with PFT has been identified and tested on a small scale. The READ Beta unit was been delivered and installed in a purpose built vehicle. Reliability of what is a development instrument is steadily improving. To date three circuits have been tagged with PFT tracer and two of the leaks have been located in a single excavation, with an associated estimated cost saving of £25k. Additional circuits are now being selected to extend the trial and develop a more in depth knowledge of the device and the technology. A further project to enhance the performance of the device is now being started with an anticipated improvement of 50% over the existing results so far.

3.4 Primary SCADA communications, Internet Protocol (IP) upgrade

<table>
<tr><td>Description of Project
Strategy Contribution
NETWORK OPERATIONS
ASSET MANAGEMENT</td><td colspan="4">This project is to demonstrate that IP protocols can be used securely to provide the necessary primary substation SCADA comms used in the EPN and SPN 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 costs</td><td>£50,565</td><td>£0</td><td>£151,696</td></tr>
<tr><td>Internal costs</td><td>£12,716</td><td>£0</td><td>£38,147</td></tr>
<tr><td>Total costs</td><td>£63,281</td><td>£0</td><td>£189,843</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of substations connected to the Primary SCADA system in EPN and SPN. LPN continues to use Corgis and its proprietary protocols.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">This project was not reported in the 05/06 activity report.</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The use of IP to provide Primary SCADA comms (satellite) and to control the changeover to a back-up comms system (GPRS).</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="4">Radical innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Benefits are expected to include:
• Improved SCADA network efficiency;
• Improved SCADA network availability;
• Reduced costs when integrating additional comms systems;
• Ability to use a wide range of different comms systems;
• Ability to use fibre comms in the future;
• Ability to make use of IT industry comms equipment; and
• Remove the manufacture ‘tie in’ imposed by using proprietary serial protocols.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="4">3 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">25%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£57k</td></tr>
</table>

Commentary on project progress and potential for achieving expected benefits	Following the success of the trial conducted on the SPN, the system is currently in the process of being rolled out to facilitate a smoother ENMAC cut-over process to the SPN network. A trial system of 12 sites is currently running in EPN to help identify and rectify any remaining minor issues and problems. The project has allowed independent comms infrastructures and dual routes to SCADA RTUs to be used. 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 comms infrastructures.

3.5 Battery Asset Management

<table>
<tr><td>Description of Project
Strategy Contribution
NETWORK OPERATIONS
ASSET MANAGEMENT</td><td colspan="4">The aim of the project is to extend battery life in Remote Terminal Units (RTUs) in distribution substations and to consider other applications where the concept can be used on the distribution network. A successful implementation of the concept in RTUs could lead to the introduction of the concept for other applications such as in:
• 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 costs</td><td>£58,217</td><td>£68,405</td><td>£18,921</td></tr>
<tr><td>Internal costs</td><td>£7,019</td><td>£8,247</td><td>£2,281</td></tr>
<tr><td>Total costs</td><td>£65,236</td><td>£76,652</td><td>£21,202</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of RTUs.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">This project was not reported in the 05/06 activity report.</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">Extending the life of batteries</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="4">Significant innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected project benefits are:
• Extended life of batteries;
• Dependable energy from batteries; and
Increased reliability of remote control switching and automatic restoration of customer supplies.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="4">2 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">10 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">75%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£150k</td></tr>
</table>

Commentary on project progress and potential for achieving expected benefits	The development of prototype battery air conditioners for basement substations including sample monitoring was successfully carried out. A successful two-week trial was carried out and a further year-long trial is planned. There is a large population of RTUs, which utilise batteries for remote control and automation purposes, on the network. Successful implementation of Battery Air Conditioning systems (BACs) in these units will increase reliability and therefore reduce the number of "battery-fail" alarms received by Control. Investigation and report on back-up batteries supporting different voltage level distribution networks. A number of batteries in hot environments show healthy battery volts, but when tested resulted in not being able to carry out automated switching. The report will review the technology, operational factors, maintenance and efficacy testing with respect to battery life. The development of prototype passive BACs for a Talus T200 pole mounted equipment and NULEC pole mounted reclosers was carried out. A successful four-week trial was also completed. During the trial, the temperature on the interior of the BAC was monitored and logged. The BACs was able to regulate the temperature to about 20°C (the ideal ambient battery temperature) for the duration of the trial. The development of a BAC system for battery cabinets in primary substations is underway. Batteries in primary substations have a number of uses including protection and emergency lighting. Successful completion of the project and implementation will ensure that the batteries will perform the above functions in optimum conditions. Batteries installed in BACs would last a lot longer than we have experienced in the past few years. Successful implementation of this project would also help increase the reliability of our automation systems in the respective units. This in turn would improve quality of supply to customers. In addition it would help us reduce the rate of disposal of these batteries thereby meeting environmental targets.

3.6 DG Planning Strategy

<table>
<tr><td>Description of Project

Strategy Contribution

SUSTAINABILITY & ENVIRONMENT
FUTURE NETWORKS</td><td>This project will develop a proof-of-concept generator connection planning system which will provide network planning staff with a single tool comprising a geographic information system (Smallworld Network Resource Manager with Design Manager) to identify topographic details and an embedded network analysis engine (DigSilent PowerFactory).

The project commences with a review of commercially available software interfaces between EDF Energy Network's GIS (Smallworld NETMAP) and DigSilent PowerFactory. The three most likely interfaces will be installed and tested to verify the business case.</td></tr>
<tr><td>Expenditure for financial year</td><td><table>
<tr><th></th><th>EPN</th><th>LPN</th><th>SPN</th></tr>
<tr><td>External costs</td><td>£61,756</td><td>£24,445</td><td>£42,457</td></tr>
<tr><td>Internal costs</td><td>£8,129</td><td>£3,218</td><td>£5,588</td></tr>
<tr><td>Total costs</td><td>£69,884</td><td>£27,663</td><td>£48,046</td></tr>
</table>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>This project was not reported in the 05/06 activity report.</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td>To provide a mechanism to develop a DG interconnection strategy focussed on ease of use.</td></tr>
<tr><td>Type(s) of innovation involved</td><td>Radical innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td>The expected project benefits are:
An appreciation of the time saving in transferring network data from one system to another;
An understanding of the issues that need to be addressed; and
The knowledge to proceed with a fully scoped project to implement the concept.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>3 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td>15 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td>75%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td>£360k</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td>The project started in February and the system requirements for the various interfaces between the various systems have been defined and user requirements to calculate the cost of a DG connection application.

The project is on target to deliver the necessary proof-of-concept project information and knowledge to fully scope an implementation project.</td></tr>
</table>

3.7 Network Risk Management

<table>
<tr><td>Description of Project

Strategy Contribution
NETWORK OPERATIONS
ASSET MANAGEMENT
FUTURE NETWORKS</td><td>The aim of this project is to develop algorithms for calculating the risk which the continued use of the elements of a distribution system pose to ongoing satisfactory system operation, taking into account the significant levels of uncertainty that characterise both the condition of the individual assets and the overall operation of the network.

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 also illustrate the value of an explicitly predictive indicator of the suitability of proposed changes in system operation.</td></tr>
<tr><td>Expenditure for financial year</td><td><table>
<tr><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External costs</td><td>£44,000</td><td>£28,000</td><td>£28,000</td></tr>
<tr><td>Internal costs</td><td>£4,010</td><td>£2,552</td><td>£2,552</td></tr>
<tr><td>Total costs</td><td>£48,010</td><td>£30,552</td><td>£30,552</td></tr>
</table>
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>£ 52.0k was reported in the 05/06 activity report.
This project was not reported in the Early Start report</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td>This project will address:
The formulation and implementation of algorithms to provide, in near real-time, an assessment of the risk or vulnerability of a section of EDF Energy Networks' distribution system;
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>Type(s) of innovation involved</td><td>Significant innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td>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
Develop methodologies and tools for running active distribution networks to optimise the utilisation of the existing network through allowing the introduction of new devices or the modification of network operation strategies in a more informed manner.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>3 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td>20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td>75%</td></tr>
</table>

Project NPV (Present Benefits x Probability of Success) – Present Costs	£200k.
Commentary on project progress and potential for achieving expected benefits	Progress to date has focused on the development and testing of the risk assessment algorithms. Building on the risk assessment processes used in the preceding scoping study, algorithms have been developed and are being tested on both a simple test network and also in more realistic representative network fragments. The algorithms developed can take into account of: • Different probabilistic models for failure repair and network restoration; • Operational failures in fuse/circuit breaker and disconnects; and • Variability in asset condition. The developed algorithms have been used to obtain comparative measures of system vulnerability under normal operating conditions and when the system is already affected by an existing failure or maintenance activity. Some of the results obtained will be presented at the upcoming IEEE Power Engineering Society General Meeting and Conference, reflecting the significance of these outcomes. The other aspect of work was addressed was the significance of an accurate specification of asset condition. While some work has been conducted into summarising the variability in asset condition in the EDF Energy Networks' network, other aspects of the work are examining the potential influence that the additional information could have on operational risk. These two aspects of work are well aligned with required studies identified in the project proposal, suggesting that work is progress satisfactorily. It is recognized, however, that challenges still remain to extend the developed algorithms for application across a realistic network.

3.8 Grid Transformer Monitoring

<table>
<tr><td>Description of Project

Strategy Contribution

SUSTAINABILITY & ENVIRONMENT
NETWORK OPERATIONS
ASSET MANAGEMENT</td><td>This project will investigate the ease with which the Intellix MO150 devices can be installed on six typical grid transformers at three sites. Full installation involves integration of alarms/monitoring data with existing EDF Energy Networks’ SCADA and historic data acquisition into LIMES data historian for strategic analysis.</td></tr>
<tr><td>Expenditure for financial year</td><td><table>
<tr><th></th><th>EPN</th><th>LPN</th><th>SPN</th></tr>
<tr><td>External costs</td><td>£47,940</td><td>£19,740</td><td>£26,320</td></tr>
<tr><td>Internal costs</td><td>£3,737</td><td>£1,539</td><td>£2,052</td></tr>
<tr><td>Total costs</td><td>£51,677</td><td>£21,279</td><td>£28,372</td></tr>
</table>
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>This project was not reported in the 05/06 activity report.</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td>Grid transformer monitoring</td></tr>
<tr><td>Type(s) of innovation involved</td><td>Incremental innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td>The expected project benefits are:
• Optimise The Lifespan of power transformers; and
• Monitoring and performing real-time, on-line transformer diagnostics can help reduce the risk of unexpected and sometimes catastrophic failures, thus avoiding expensive replacement, clean-up costs and unplanned downtime.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>7 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td>20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td>50%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td>£200k</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td>Three sites have been selected with the intention of connecting two transformers on each site to the Intellix monitor.

These six transformers have been selected to provide information on the condition of the transformers remaining in service during long 132kV construction outages.

Meetings have been held on site to assess the site and physical installation of the on-line monitoring units.

A meeting has also been held with GE Energy to consider the communication systems, remote access and integration of alarms with ENMAC.</td></tr>
</table>

3.9 Distribution System State Estimation

<table>
<tr><td>Description of Project
Strategy Contribution
SUSTAINABILITY & ENVIRONMENT
ASSET MANAGEMENT
FUTURE NETWORKS</td><td colspan="4">The aim is 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 an useful demonstration of the algorithms’ ability to facilitate new approaches for the operation and control strategies of future 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 costs</td><td>£42,840</td><td>£17,640</td><td>£23,520</td></tr>
<tr><td>Internal costs</td><td>£3,339</td><td>£1,375</td><td>£1,833</td></tr>
<tr><td>Total costs</td><td>£46,179</td><td>£19,015</td><td>£25,353</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">£ 107,616 was reported in the 05/06 activity report.
This project was not reported in the Early Start report.</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">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.</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="4">Radical innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Benefits are expected to include:
• Establishing the difference between the investment reinforcement costs associated with traditional, passive network operation based solutions and the costs of the system within the context of an active distribution network operation that uses DSSE; and
• It can be expected that a DSSE will play a similar role to the state estimators used in transmission systems, enabling the release of untapped network capacity and the provision of network services such as fast flow control and voltage support.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="4">7 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">25%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£800k.</td></tr>
</table>

Commentary on project progress and potential for achieving expected benefits	The project has been progressing well as observed through regular project review meetings. The research in the methodology development work stream has produced results that have informed in the direction of other work stream research and milestones. Three test cases around Nutfield primary substation have been developed and used to validate effectiveness of state estimation algorithm. The next task will focus on inclusion of active components in the network nodes and their impact on the quality and consistency of the developed state estimator model. The work stream on implementation has taken off with the joining of a research assistant recently as this is how the research under two work streams was initially planned. It is now clear that with the addition of few key measurements the network can be monitored for effective control and capacity utilisation. The costing model for assessing the business case is being developed.

3.10 Improvements in Overhead Line Performance

<table>
<tr><td>Description of Project
Strategy Contribution
NETWORK OPERATIONS</td><td colspan="4">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>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External costs</td><td>£40,152</td><td>£0</td><td>£15,614</td></tr>
<tr><td>Internal costs</td><td>£9,242</td><td>£0</td><td>£3,594</td></tr>
<tr><td>Total costs</td><td>£49,394</td><td>£0</td><td>£19,209</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">£52.8k was reported in the 05/06 activity report.
£1.2k was reported in the Early Start report.</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">Improving ratings of lines, assessing the physical condition of support structures, electrical condition monitoring and wildlife deterrents.</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="4">Incremental innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Benefits are expected to include:
• Understanding the benefits of aluminium conductor composite core ACCC compared with other technologies like AAAC and ACSR;
• 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="4">Various 3 to 7 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">Various 25% to 75%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£1M</td></tr>
</table>

Commentary on project progress and potential for achieving expected benefits	Trials to install ACCC are being conducted to assess the tooling and accessories required to install the conductor. The feasibility study to assess of the electrical performance of Overhead lines has continued. An investigation is being carried out on the potential of using a Remote Control helicopter to assess the condition of overhead line towers Different techniques to humanely prevent birds from roosting on Overhead lines were successfully tested.

3.11 Application of Storage and Demand Side Management

<table>
<tr><td>Description of Project
Strategy Contribution
SUSTAINABILITY & ENVIRONMENT
ASSET MANAGEMENT
FUTURE NETWORKS</td><td colspan="4">To investigate and quantify the benefits of integration of electricity storage and Demand Side Management (DSM) technologies in the operation and development of active distribution networks.</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 costs</td><td>£33,120</td><td>£13,110</td><td>£22,770</td></tr>
<tr><td>Internal costs</td><td>£3,274</td><td>£1,296</td><td>£2,251</td></tr>
<tr><td>Total costs</td><td>£36,394</td><td>£14,406</td><td>£25,021</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">£ 107,616 was reported in the 05/06 activity report.
This project was not reported in the Early Start report</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 real time control of storage and load control devices to manage network voltage and flow profiles in real time; and
• Quantification and optimisation of the multiple value streams of various storage applications and load control management.</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="4">Radical innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Benefits are expected to include:
• Quantifying the value of specific storage and DSM technologies; and
• A business case showing whether storage and DSM can deliver value in the performance of the network.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="4">7 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">75%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">Only when the methodology proposed in this project is developed, it will be possible to evaluate financial benefits of storage and DSM across various future development scenarios.</td></tr>
</table>

Commentary on project progress and potential for achieving expected benefits	This project is progressing well in spite of the delays in appointing a researcher. The main deliverables to date are: • The identification of the potential application of storage and DSM was performed. Significant progress to an answer to the question on the benefits of storage and DSM was obtained; • A generic linear model for storage was developed. This model considers all the relevant parameters as storage/energy ratings, storage efficiency and constrains of minimum energy available in storage at the end of each period. This model was tested and validated through extensive testing and a good balance between complexity of the model and representation of key features was obtained; • Storage models were thoroughly tested using this tool in order to tune the constraints and decide how many and which are the decision variable relevant to network control application; • A complete formulation of the DC optimal power flow model including storage, DSM flexible enough to consider different generation profiles and network structures was completed, implemented and tested; and • A methodology for the quantification of the benefits of storage and DSM was developed and tested using a two bus bar system. The key challenges on the development of this methodology were the problem of the explosion of data results obtained when multi-period studies are conducted and the definition and testing of the most suitable metrics to quantify the benefits of storage and DSM.

3.12 Underground LV Cable Fault Management

<table>
<tr><td>Description of Project
Strategy Contribution
NETWORK OPERATIONS
ASSET MANAGEMENT</td><td>EDF Energy Networks has identified opportunities from intermittent fault detection & location on LV underground cables. Re-energisation devices have been used for many years to maintain customers' LV supplies. This project combines the use of an intermittent cable fault location device with an improved re-energisation device and look at further developments so that LV intermittent faults can be better managed and customer interruption reduced.</td></tr>
<tr><td>Expenditure for financial year</td><td><table>
<tr><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External costs</td><td>£23,959</td><td>£12,500</td><td>£15,626</td></tr>
<tr><td>Internal costs</td><td>£3,454</td><td>£1,802</td><td>£2,253</td></tr>
<tr><td>Total costs</td><td>£27,414</td><td>£14,303</td><td>£17,878</td></tr>
</table>The costs have been allocated in proportion to the length of installed LV cable.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td>£201.7k was reported in the 05/06 activity report.
£56.5k was reported in the Early start report.</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td>The project is developing the following techniques:
• Time reflection to determine fault location;
• Transient impedance Fault location; and
• Travelling wave fault location.
• Auto reclosing device</td></tr>
<tr><td>Type(s) of innovation involved</td><td>Radical</td></tr>
<tr><td>Expected Benefits of Project</td><td>Benefits are expected to include:
• Reduction in number of site visits to replace fuses;
• Reduction in repeated customer interruptions due to intermittent faults being re-energised;
• Reduction in customers minutes lost; and
• Reduction in worst served customers.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>2 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td>20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td>75%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td>£1.2M</td></tr>
</table>

Commentary on project progress and potential for achieving expected benefits	T-P22: Trial of the T-P22 intermittent fault location equipment has been completed and the technology is being adopted by EDF Energy Networks (40 units have been purchased and are currently being deployed). Development of software to enable the T-P22 units to be automatically interrogated and data to be remotely downloaded is currently in progress. This development is being carried out in cooperation with United Utilities and SP Power Systems Ltd. REZAP Fault Master: Trial of the REZAP Fault master has been delayed due to a design fault identified by the manufacturer. The fault has now been rectified and the units are being deployed. The following new feature will be evaluated during the trial: - Mobile phone controller (remote operation using mobile phone). - Trips to lockout and Auto reset capability. - Load profiler. The following stages are currently in progress: - Development of Single ended fault distance estimation. - Developments of modular REZAP (redesigned version of the REZAP to fit into Low Voltage pillars and link boxes).

3.13 Substation Heat Transfer

<table>
<tr><td>Description of Project

Strategy Contribution
SUSTAINABILITY & ENVIRONMENT
NETWORK OPERATIONS
ASSET MANAGEMENT</td><td colspan="4">Substation transformers produce waste heat which is usually lost to the environment. The re-planted substation at Bankside, adjacent 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 their 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.

This project has been nominated for a sustainability award.</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 costs</td><td>£0</td><td>£46,477</td><td>£0</td></tr>
<tr><td>Internal costs</td><td>£0</td><td>£8,743</td><td>£0</td></tr>
<tr><td>Total costs</td><td>£0</td><td>£55,220</td><td>£0</td></tr>
<tr><td colspan="4">The costs have been allocated to LPN as the trial is being carried out at Bankside substation in London.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">This project was not reported in the 05/06 activity report.</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">Environmentally friendly cooling of transformers</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="4">Significant innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Benefits are expected to 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.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="4">3 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">75%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£200k</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="4">Final designs have been completed for the operational philosophy of the system.

The layout and design for the mechanical pipework and valve system has been completed.

Initial design parameters for the control system have been produced with the intention of going to tender for the build of the control system.</td></tr>
</table>

3.14 GenAVC Assessment Tool

<table>
<tr><td>Description of Project
Strategy Contribution
SUSTAINABILITY & ENVIRONMENT
ASSET MANAGEMENT
FUTURE NETWORKS</td><td colspan="4">GenAVC has been developed by Econnect to manage voltage rise issues associated with the connection of Distributed Generation (DG) into 11kV networks. This system has achieved satisfactory operation in a trial at Martham Primary substation. The trial has successfully shown the principles of voltage control can be applied to reduce the target busbar voltage and minimise network constraints.
At Horton Quarry, a landfill gas generator experiences nuisance trips during times of low demand. This project proposes to produce a generic tool to assess the benefits of the GenAVC solution. A comparison of the output of this assessment tool with traditional methods of solving voltage rise issues will be carried out.
If the tool shows that GenAVC is a solution then a commercial grade GenAVC shall be installed at Steyning primary to validate the management the voltage rise issues and 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 costs</td><td>£19,074</td><td>£0</td><td>£9,826</td></tr>
<tr><td>Internal costs</td><td>£5,034</td><td>£0</td><td>£2,593</td></tr>
<tr><td>Total costs</td><td>£24,108</td><td>£0</td><td>£12,419</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the amount of connected distributed generation. No costs have been allocated to LPN as voltage rise is unlikely to be an issue.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">This project was not reported in the 05/06 activity report.</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>Type(s) of innovation involved</td><td colspan="4">Incremental innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Benefits are expected to include:
• An assessment tool that is able to compare connections using traditional methods of solving voltage rise issues with those of installing GenAVC;
• Cost efficient connections with the right decision being made; and
• Nuisance trips at times of low load and high volts will be avoided by the generator.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="4">3 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">50%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£290k</td></tr>
</table>

Commentary on project progress and potential for achieving expected benefits	Network data has been supplied to Econnect to assess the ability of the assessment tool to indicate whether GenAVC is an appropriate solution for a generation connection. Initial indications are that for the selected scheme GenAVC will generate additional voltage headroom throughout the whole 11kV network connected to Steyning primary substation. To validate these indications it has been decided to install a GenAVC at Steyning. Monitoring of the network before and after the installation will demonstrate whether the assessment tool can provide planning information that can be relied on. Installation is expected by the end of July 2007, with final commissioning by the beginning of September 2007.

3.15 DG Connection Planner

<table>
<tr><td>Description of Project
Strategy Contribution
SUSTAINABILITY & ENVIRONMENT
FUTURE NETWORKS</td><td>This project is to build on the work reported in “Internet Services for Planning Distributed Generation connections” funded by the DTI to provide DG developers 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 LTDS data to derive suitable connection scenarios and costing information for the provision of budget estimates.</td></tr>
<tr><td>Expenditure for financial year</td><td><table>
<tr><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External costs</td><td>£12,436</td><td>£4,923</td><td>£8,550</td></tr>
<tr><td>Internal costs</td><td>£1,425</td><td>£564</td><td>£979</td></tr>
<tr><td>Total costs</td><td>£13,860</td><td>£5,486</td><td>£9,529</td></tr>
</table>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>This project was not reported in the 05/06 activity report.</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td>Areas where cost-efficient DG connections can be realised;
visualisation of connection costs and network capacity;
visualisation of DG activity.</td></tr>
<tr><td>Type(s) of innovation involved</td><td>Incremental innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td>Benefits are expected to include:
• 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 that are going to be difficult to connect; and
• 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>3 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td>20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td>25%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td>£167k</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td>Requirements analysis is on schedule.
Design and construction activities have started, with a mid-point review for the development phase.</td></tr>
</table>

3.16 Transformer Temperature Fibre Optic Monitoring

<table>
<tr><td>Description of Project
Strategy Contribution
ASSET MANAGEMENT</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. This will give a comparison between the two instruments.</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 costs</td><td>£12,827</td><td>£5,282</td><td>£7,042</td></tr>
<tr><td>Internal costs</td><td>£1,220</td><td>£502</td><td>£670</td></tr>
<tr><td>Total costs</td><td>£14,046</td><td>£5,784</td><td>£7,712</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of primary transformers.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">£ 24.2k was reported in the 05/06 activity report.
This project was not reported in the Early Start report</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>Type(s) of innovation involved</td><td colspan="4">Incremental innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Benefits are expected to 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 colspan="4">3 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">75%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£50k</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="4">The transformer has been built and installed. All factory and site tests have been completed.
The fibre temperature indicators have been tested at the factory and gave consistent results and basic on site tests have been completed. The transformer is not yet commissioned and so the performance of the winding temperature instruments cannot yet be assessed. A remote monitoring system via GSM modems is in the process of final commissioning.

The on site work has now been completed and monitoring via the internet is now possible. Some small adjustments need to be made to the software and an additional data downloading system is still awaited.</td></tr>
</table>

3.17 Supergen V – AMPerES

(Asset Management and Performance of Energy Systems)

<table>
<tr><td>Description

Strategy Contribution

SUSTAINABILITY & ENVIRONMENT
NETWORK OPERATIONS
ASSET MANAGEMENT
FUTURE NETWORKS</td><td>This is a 4 year major (£3M) multi party collaborative project:
• Universities: Manchester, Southampton, Edinburgh, Liverpool, Strathclyde, Queens (Belfast);
• Industrial Parties: National Grid, SP Power Systems Ltd., Scottish and Southern, United Utilities, Western Power Distribution, Central Networks, CE Electric, NIE, Advantica & EDF Energy Networks.

The research programme is split into 6 work packages & 25 activities. Most of the research will be carried out by the universities. An EDF Energy Networks’ representative has been identified for each work package so that research can be stirred toward delivering benefits to the DNOs.</td></tr>
<tr><td>Expenditure for financial year</td><td><table>
<tr><th></th><th>EPN</th><th>LPN</th><th>SPN</th></tr>
<tr><td>External costs</td><td>£11,000</td><td>£7,000</td><td>£7,000</td></tr>
<tr><td>Internal costs</td><td>£1,000</td><td>£636</td><td>£636</td></tr>
<tr><td>Total costs</td><td>£12,000</td><td>£7,636</td><td>£7,636</td></tr>
</table>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>£ 26.9k was reported in the 05/06 activity report.
This project was not reported in the Early Start report</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td>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
WP 6: Condition monitoring techniques</td></tr>
<tr><td>Type(s) of innovation involved</td><td>Radical innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td>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>7 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td>20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td>25%</td></tr>
</table>

Project NPV (Present Benefits x Probability of Success) – Present Costs	£150K
Commentary on project progress and potential for achieving expected benefits	Progress: As a result of a number of issues, the Consortium Agreement was not signed until November 2006. The agreement has led to the establishment of a Steering Group and an Executive Management group to provide full engagement, and effective participation, of all parties. Dependant on their internal regulations, some universities were able to start work in February 06 (when the offer letter was received), and others had to wait until November 06. Unfortunately November is not a good time of year to recruit PhD students or Research Associates. The project is being brought on track, after the delayed start and is expected to meet original objectives. In particular there have been some delays in Work Package 3, as a result of delays in recruitment, and these are being managed in the context of the whole project. It is likely however that, although the majority of the project will be complete at the end of the four years, some students will still be active for a short period thereafter. Overall the management processes are strong and have been effective. Key links to industrial partners are now being formed, and in particular through Work Package 6, the first demonstrators on networks are being discussed. The first technical meeting was a major success with excellent attendance and participation. A number of papers have been written on work from within the project. Outputs and Deliverables The following are formal outputs from the consortium. Reports: • Report on 'Evaluation of G59 Protection relays; • Discussion Document on Vision and Priorities for Industrial demonstration; • Condition Monitoring Specification; • Lessons learnt from writing consortium agreement; • A review of voltage control; and • Condition monitoring –State of the art report from Activity 5.2. Technology: • A low cost RF unit has been produced based on the chromatic methodology of deploying the RF sensors; • A fibre optic based acoustic sensor for detecting abnormal signatures from plant is near completion; • Prototype knowledge based partial discharge analysis software. This is generic and can be applied to all partial discharge phase resolved signatures. It can categorise the discharge; and • Equipment to control power quality of a voltage supply is nearing completion. The above has been extracted from the full Supergen V annual report.

3.18 Recycling Excavated Material

<table>
<tr><td>Description of Project

Strategy Contribution

SUSTAINABILITY & ENVIRONMENT
NETWORK OPERATIONS</td><td colspan="4">This project will identify the ways in which excavated ground works material which occurs as part of EDF Energy Networks' jointing, maintenance and project work can be recycled. 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 136,000 tonnes/annum of excavated material is sent to landfill. Disposal costs are rising and are in the order of £20/ton. Equal amounts of aggregate (approx. £16/ton) are excavated to produce virgin type one material required by the Highways Authorities to backfill utility excavations. This project is identifying ways in which excavated material which occurs as part of our jointing, maintenance and project work can be recycled.

The impact of sending excavated material to landfill sites is not sustainable and demonstrates 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 costs</td><td>£10,985</td><td>£5,731</td><td>£7,164</td></tr>
<tr><td>Internal costs</td><td>£1,455</td><td>£759</td><td>£949</td></tr>
<tr><td>Total costs</td><td>£12,440</td><td>£6,491</td><td>£8,113</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the length of installed underground cable.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">£ 4.1k was reported in the 05/06 activity report.
This project was not reported in the Early Start report</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 exacting requirements of the Highway Authorities and can be approved as an alternative to virgin type one material and the government targets of 45% of material is recycled is achieved. 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>Type(s) of innovation involved</td><td colspan="4">Radical innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Benefits are expected to include:
• Reduction in the amount of material sent to landfill by 136,000 tonnes/annum;
• Reduction in excavated virgin material from around the world by 136,000 tonnes/annum;
• Less vehicle movement to landfill sites and gravel yards; and
• Less pollution on roads caused by vehicle movement.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="4">7 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
</table>

Estimated Success probability (at start of project)	75%
Project NPV (Present Benefits x Probability of Success) – Present Costs)	£1.9M
Commentary on project progress and potential for achieving expected benefits	During this year, expenditure has concentrated on understanding the Street Works related processes and training. Our academic partners have attended recycling/sustainability conferences, such as the National Street Works conference, Surveyor conference on recycled materials, WRAP and NISP conferences. A literature search relating to material specifications road constructions and soil stabilisation complemented the training activities. Work has also started with one of our alliance contractors on developing a recycling process suitable for the electricity industry. This project was entered and selected to represent EDF Energy Networks in the Sustainable Future Trophies competition (a competition promotes environmental, economic and social sustainability) at the EDF Group level final.

3.19 Collaborative ENA R&D Programme

<table>
<tr><td>Description of project
Strategy Contribution
SUSTAINABILITY & ENVIRONMENT
NETWORK OPERATIONS
ASSET MANAGEMENT</td><td colspan="4">The Energy Networks Association (ENA) represents all UK DNOs. The four projects 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 costs</td><td>£9,116</td><td>£3,754</td><td>£5,005</td></tr>
<tr><td>Internal costs</td><td>£711</td><td>£292</td><td>£390</td></tr>
<tr><td>Total costs</td><td>£9,827</td><td>£4,046</td><td>£5,395</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">Some of these projects were included in the National Committee Activity reported in the 05/06 activity report.</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The projects listed below address real problems that had been identified by the ENA Working Groups as significant and required technical investigation and development.

ROCOF Relay functional specification – Produce an Engineering Report into the sensitivity of loss of mains relays to genuine loss of mains by determining the number of sample cycles required and the percentage change of load compared to generator ratings (of different construction and size).The test information will be used to develop a matrix of optimum settings and test procedures for relay specification.
SG12 Fault Level Monitor – Develop a Fault Level Monitor (FLM) that can successfully measure fault level on a distribution network with repeatability and reliability. The FLM instrument shall use the underlying methodology proven with EA Technology’s existing Extended Supply Monitor and shall measure normally occurring events (e.g. small scale disturbances resulting from tap changer operation), so no customer supply interruption will be required.
SG14 Earthing Project – Develop new techniques to assess the impact of lower voltage earth electrodes on higher voltage ‘hot zones’ and to measure the resistance of distribution substation earth systems.
SG17 Lightning Protection - Produce a new Engineering Technical Report on lightning protection to include:
Background information on lightning density across the UK, annual variations and effect of topography.
Catalogue and provide a view on current practices and procedures.
Determine and advise on equipment protection levels and arrangements.</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="4">Incremental and Significant innovation types are involved.</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">**ROCOF Relay functional specification** – Improved understanding will allow more effective settings to be applied to these relays, which will reduce the number of spurious trips. This will improve power quality to other connected customers and the specification should reduce the cost associated with generation scheme quotes.
SG12 – The FLM instrument will allow fault infeed levels to be accurately assessed.</td></tr>
</table>

	This will provide an objective measurement tool that can be used to facilitate both the initial connection of distributed generation and ongoing assessment of its effects. **SG14** – This project will investigate the effects of LV earth systems on HV systems. The results of this should determine the means to provide cost effective, safe earthing system without the need for expensive separations between HV and LV electrodes which in a PME system may be impractical and costly to achieve and maintain. **SG17** – Identification of required lightning protection application will reduce equipment failure and faults due to lightning. This will improve performance and reduce fault costs.				
Expected Timescale to adoption	1 - 10 years	Duration of benefit once achieved	10 - 40years		
Estimated Success probability (at start of project)	25 - 75%				
PV of Project Costs	£1,143,489 (see note below)	PV of Project Benefits	£815,569	NPV of Project Costs	£347,921
Note – These project costs include implementation and have been calculated assuming a typical distribution license area.					
Commentary on project progress and potential for achieving expected benefits	**ROCOF Relay functional specification** – EA Technology published the Final report in March 2007. **SG12 Fault Level Instrument** – EA Technology and the University of Strathclyde have pursued the following activities Candidate monitoring sites and Deployment of loggers– Network disturbance data has been obtained using Dranetz PX5 Power Quality instruments. Algorithm Evaluation and assessment – The Fault Level Algorithm has been coded within the Matlab environment. A network model with known parameters has been created in Matlab/Simulink and the fault level estimated for a range of scenarios. Results from the applied scenarios (voltage and current waveforms) are passed into the Fault Level algorithm and results compared. Dranview disturbance record analysis – Dranview data is being processed for integration into the coded Fault Level algorithm. The results from the 'real' data and the result from the Fault Level algorithm are to be compared to the relevant power network models supplied by the site hosts (studied in PSS/E). Experimentation and Laboratory investigations – A fault level monitor instrument is being tested on the University of Strathclyde Micro-grid system with static and active loads. This laboratory work will enable scenario results from a very well known and modelled network to be compared against the performance of an existing Fault Level instrument. **SG14 Earthing Techniques** – EA Technology Investigation at Test Facility - Report and CIRED paper completed. Measurements carried out at the S&S Ltd test facility to enable better understanding of transfer potential. The measurement results were compared to predictions using the CDEGS software. Investigation at 11kV substations - Identification of suitable test sites is underway. Site testing has commenced at two suitable sites. **SG17 Lightning Protection** – Engineering Technical Report (ETR 134) awaiting final approval before publishing.				

3.20 Electrical Energy Harvesting from Vibrations

Description of Project Strategy Contribution SUSTAINABILITY & ENVIRONMENT	The Facility Architects Ltd recently won an international design competition which sought creative architectural ideas for restoring the 1000 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-wattage LED lights. The project is split into three phases: • The Design and Fabrication of Prototype Power Harvesters; • Integration of Power Harvesters into a Lighting System; and • Technology Demonstrator and Final Project Report.			
Expenditure for financial year		EPN	LPN	SPN
	External costs	£5,100	£2,100	£2,800
	Internal costs	£398	£164	£218
	Total costs	£5,498	£2,264	£3,018
	The costs have been allocated in proportion to the number of connected customers.			
Expenditure in previous (IFI) financial years	This project was not reported in the 05/06 activity report.			
Technological area and / or issue addressed by project	Electrical Energy Harvesting from vibrations and footsteps			
Type(s) of innovation involved	Radical innovation			
Expected Benefits of Project	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; and • The technology may be able to be transferred to other network assets that vibrate as a form of noise reduction.			
Expected Timescale to adoption	7 years			
Duration of benefit once achieved	20 years			
Estimated Success probability (at start of project)	25%			
Project NPV (Present Benefits x Probability of Success) – Present Costs	£20k			

Commentary on project progress and potential for achieving expected benefits	*Energy Harvesting using Vibrations:* Facility Innovate commissioned Scott Wilson, the 9th largest environmental services company in the UK, to carry out vibration spectrum analysis on a railway viaduct in Thame, Oxfordshire. Scott Wilson, Facility Innovate and the University of Southampton and their commercial partners Perpetuum have held meetings at Southampton University to confirm the scope of works which Scott Wilson is to carry out on this project. 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. This work is ongoing and a vibrational analysis report is being prepared. Facility Innovate & Southampton University met with Philips Lighting earlier this year. Philips Lighting as the world leaders in LED technology are supporting this project and have supplied Southampton with their latest LED lighting components. Vibrational analysis from Metronet and Scott Wilson, show that at some frequencies an output of 1 watt is being generated and this would be adequate to power 6 LED light fittings within a single fitting. *Energy Harvesting from footsteps:* This part of the project with Hull University is still in its early stage of development. A reconnaissance tour to TechnoGym, Italy who are interested in sharing knowledge on footstep outputs from walking and running.

3.21 Transformer Damping

<table>
<tr><td>Description of Project
Strategy Contribution
NETWORK OPERATIONS</td><td colspan="4">This project sets out to determine methods to reduce noise nuisance resulting from vibrations due to 100Hz.</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 costs</td><td>£4,054</td><td>£1,898</td><td>£2,674</td></tr>
<tr><td>Internal costs</td><td>£316</td><td>£148</td><td>£208</td></tr>
<tr><td>Total costs</td><td>£4,370</td><td>£2,045</td><td>£2,882</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of ground mounted distribution transformers.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">This project was not reported in the 05/06 activity report.</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">Reduction of noise and vibration produced by ground mounted distribution transformers.</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="4">Incremental innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Benefits are expected to include:
• New and retrofit techniques to reduce noise caused by vibration; and
• Reduction of noise complaints.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="4">3 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">25%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£200k</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="4">A draft report has been produced and a meeting held with University of Southampton to discuss the report and further work that may be necessary.

A summary of the findings is that the noise and vibration can be reduced by the use of suitable anti vibration pads and further reduced by filling the space under the transformer with sound absorbing material.

Further reductions in sound level can be made by installing sound absorbers on the tank walls, although this requires further development.</td></tr>
</table>

3.22 33kV Voltage Control

<table>
<tr><td>Description of Project
Strategy Contribution
SUSTAINABILITY & ENVIRONMENT
ASSET MANAGEMENT
FUTURE NETWORKS</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 while accommodating embedded generation. With the provision of real & reactive power measurements, generator outputs and tap-changer positions, the project would develop voltage control strategies taking into the account DG contributions and co-ordination with various internal strategies and those of National Grid.</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 costs</td><td>£3,960</td><td>£0</td><td>£2,040</td></tr>
<tr><td>Internal costs</td><td>£664</td><td>£0</td><td>£342</td></tr>
<tr><td>Total costs</td><td>£4,624</td><td>£0</td><td>£2,382</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">This project was not reported in the 05/06 activity report.</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">Co-ordinated 33kV voltage control</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="4">Significant innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Benefits are expected to include:
• 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 colspan="4">7 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">25%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£100k</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="4">EDF Energy Networks is sponsoring a PhD student to research novel 33kV voltage control techniques.
Initial investigations to understand present day techniques and what new techniques are being developed by industry have been completed.
The Enhanced Transformer Automatic Paralleling Package (TAPP) voltage control scheme has been implemented into OCEPS Ltd. load flow software to investigate its functionality. Initial results has been obtained and presented.
The student has prepared a paper to be presented at this year's Universities Power Engineering Conference</td></tr>
</table>

3.23 FENIX

*Flexible **E**lectricity **N**etworks to **I**ntegrate the e**X**pected 'energy evolution'*

<table>
<tr><td>Description of Project
Strategy Contribution
SUSTAINABILITY & ENVIRONMENT
FUTURE NETWORKS</td><td>The objective of FENIX is to boost Distributed Energy Resources (DER) by maximizing their contribution to the electric power system, through aggregation into Large Scale Virtual Power Plants (LSVPP) and decentralized management.
The project is organized 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;
• Validation through 2 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>Expenditure for financial year</td><td><table>
<tr><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External costs</td><td>£230</td><td>£91</td><td>£158</td></tr>
<tr><td>Internal costs</td><td>£3,053</td><td>£1,208</td><td>£2,099</td></tr>
<tr><td>Total costs</td><td>£3,283</td><td>£1,300</td><td>£2,257</td></tr>
</table>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>£ 10.5k was reported in the 05/06 activity report.
This project was not reported in the Early Start report</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td>To conceptualise, design and demonstrate a technical architecture and commercial framework that would enable DER based systems to become the solution for the future cost efficient, secure and sustainable EU electricity supply system.</td></tr>
<tr><td>Type(s) of innovation involved</td><td>Radical innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td>Benefits are expected to include:
• Maximise the contribution of DG to the electricity network;
• Reduce carbon emissions and help towards the UK governments climate change targets; and
• Reduce network losses by having the source of generation close to the load.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>7 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td>20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td>25%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td>£2M. The estimate will be refined in the work package to assess the economic impact of this architecture.</td></tr>
</table>

Commentary on project progress and potential for achieving expected benefits	The research done in **WP1 "System Solutions for DER Integration and Demand Response through LSVPP"** during the first year of the FENIX project has focused on defining the fundamental FENIX principles, identifying the system support requirements that DER can contribute to and evaluating the control characteristics of DER technology to provide this system support. All of which provide a strong research framework for the development of FENIX LSVPP characterisation and the progress of the laboratory and field demonstrations. In brief, it can be concluded that there is significant scope in the various DER technologies (e.g. distributed generation, load and storage) to offer network services. The grid aggregation approach proposed under the LSVPP is well suited to offering transmission system services such as frequency control, active power reserve and network restoration. In **WP2 "Electrical and information system architecture adapted to the presence of LSVPP"**, the establishment of a common format for the description of all use case scenarios, and detailed selection made, associated with a partial description, of the use case scenarios related to the Northern and Southern demonstrators have been done. In **WP3 "Commercial framework for operation and control of power systems with LSVPPs"**, the development of the Northern scenario and the development of the Southern Scenario are ongoing. All preliminary work and preparations for generation of the scenarios have been completed. In **WP4 "Northern and Southern demonstrations"** work has progressed to determine where the demonstrations will take place. The necessary communications between the participating partners e.g. DG operator, Distribution System operator, transmission system operator and Energy supplier have been discussed. Some of the demonstrations will take place by monitoring actual distributed generation; other parts will be through laboratory experiment and simulation.

3.24 Vulnerable Customer UPS

<table>
<tr><td>Description of Project
Strategy Contribution
NETWORK OPERATIONS</td><td colspan="4">As part of the work for our Discretionary Reward Scheme submission focussing on Priority customers, this project aims to develop solutions that provide continuity of electrical power to vulnerable customers, 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.</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 costs</td><td>£0</td><td>£0</td><td>£0</td></tr>
<tr><td>Internal costs</td><td>£2,371</td><td>£1,509</td><td>£1,509</td></tr>
<tr><td>Total costs</td><td>£2,371</td><td>£1,509</td><td>£1,509</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of customers in each licence area.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">This project was not reported in the 05/06 activity report.</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">Hybrid fuel cell – battery for customers medically dependent on electricity.</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="4">Radical innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">This project will provide EDF Energy Networks with a means of reassuring vulnerable customers. The UPS device will be provided to those electrically dependent customers on our worst served feeders until the feeder performance improves.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="4">7 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">25%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">-£600k</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="4">Milestone 1 – Feasibility study due 8th June 2007. All activities are on target for completion on this date.
Feasibility report will include details of product specification derived from analysis of product functions and features.</td></tr>
</table>

3.25 Transformer design for FR3

<table>
<tr><td>Description of Project

Strategy Contribution

SUSTAINABILITY & ENVIRONMENT
NETWORK OPERATIONS
ASSET MANAGEMENT</td><td>This project is to design and build a transformer that will be filled with FR3 vegetable oil manufactured by Coopers Power system. This requires considerable design work and evaluation of the various components used in the manufacture of the transformer. Techniques to manage a clean up should a spillage of FR3 occur has also been developed.</td></tr>
<tr><td>Expenditure for financial year</td><td><table>
<tr><th></th><th>EPN</th><th>LPN</th><th>SPN</th></tr>
<tr><td>External costs</td><td>£11,300</td><td>£0</td><td>£0</td></tr>
<tr><td>Internal costs</td><td>£4,324</td><td>£0</td><td>£0</td></tr>
<tr><td>Total costs</td><td>£15,624</td><td>£0</td><td>£0</td></tr>
</table>
The costs have been allocated to EPN as this transformer will be installed in the EPN licence area.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td>£ 944.0k was reported in the 05/06 activity report.
This project was not reported in the Early Start report</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td>The trial will be to:
• Evaluate the possibility of the use of FR3 as the initial fluid to be used in a transformer with 132kV as the primary voltage;
• Assess the reaction of the components used in the manufacture of a transformer with the fluid; and
• In particular, assess the fluid use in the tap-changer and other components.
The transformer will be equipped with a comprehensive monitoring system to enable data to be obtained regarding the performance of the transformer and compare with another similar transformer filled with mineral oil.</td></tr>
<tr><td>Type(s) of innovation involved</td><td>Technological Substitution</td></tr>
<tr><td>Expected Benefits of Project</td><td>Benefits are expected to include:
• Longer life of the transformer;
• Lower disposal costs for the fluid;
• Higher rating from the same transformer; and
• The fluid is highly biodegradable.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>3 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td>20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td>75%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td>£1.5M</td></tr>
</table>

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

3.26 Power Factor Analysis

<table>
<tr><td>Description of Project
Strategy Contribution
ASSET MANAGEMENT</td><td colspan="4">A trend has been observed on rural and urban distribution networks where the power factor can be seen to reduce in summer. Whilst some of this may be attributable to air conditioning load in urban areas, this cannot be said of typical rural locations. This project examines the sources of such reactive loads to better understand the reactive compensation needs of the network.</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 costs</td><td>£0</td><td>£0</td><td>£0</td></tr>
<tr><td>Internal costs</td><td>£782</td><td>£322</td><td>£430</td></tr>
<tr><td>Total costs</td><td>£782</td><td>£322</td><td>£430</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of primary transformers.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">This project was not reported in the 05/06 activity report.</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">Reactive compensation needs of distribution networks</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="4">Incremental innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Benefits are expected to include:
• Improvements of power factor from 0.8 to unity can yield over 18MW of useable power from a grid transformer – a viable alternative to increases in transformer size and cable capacity; and
• Losses in distribution plant are reduced.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="4">7 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">25%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£200k</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="4">50% of the work has been completed with reasonable progress and some areas identified for future work.
Output of studies will provide an indication of whether reactive compensation is required. It will also serve to inform DNOs on whether investment in this area is worthwhile.</td></tr>
</table>

3.27 Evaluation of the characteristics of alternative oils for retro-filling power transformers and for use in new transformers

<table>
<tr><td>Description of Project
Strategy Contribution
SUSTAINABILITY & ENVIRONMENT
NETWORK OPERATIONS
ASSET MANAGEMENT</td><td colspan="4">To assess various alternative materials that could be used as the insulating medium of power transformers and to undertake electrical tests on insulation materials to validate the claimed advantages.</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 costs</td><td>£1,241</td><td>£0</td><td>£0</td></tr>
<tr><td>Internal costs</td><td>£97</td><td>£0</td><td>£0</td></tr>
<tr><td>Total costs</td><td>£1,338</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 installed in the EPN licence area.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">£10.3k was reported in the 05/06 activity report.
£10.5k was reported in the Early start report</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>Type(s) of innovation involved</td><td colspan="4">Technological substitution</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 colspan="4">7 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">50%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£50k</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="4">A range of alternative oils and a mineral oil have been tested to compare electrical characteristics for new and aged oils with cellulose materials found in transformers.
Finite element analysis models are being developed to represent the internal structure of power transformers.
The reaction of the fluids under dielectric testing is ongoing and various test chambers have been evaluated to ensure that the most appropriate tests are conducted.
Thermal aging tests and partial discharge at a range of temperatures of the fluids are also in progress, together with sparking and arcing tests.
Results so far indicate that all the fluids have properties that can be used in power transformers, but the extent and duty is yet to be determined.</td></tr>
</table>

3.28 Wood pole disposal

<table>
<tr><td>Description of Project

Strategy Contribution

SUSTAINABILITY
& ENVIRONMENT</td><td>The majority of poles are currently sent to landfill with the rest being used for barter with landowners. The issue of waste disposal is high on the Environmental Agency agenda. 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 the volatile gases to be collected and 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 to age, to determine the amount of potential pollutants left in the wood.</td></tr>
<tr><td>Expenditure for financial year</td><td><table>
<tr><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External costs</td><td>£720</td><td>£0</td><td>£280</td></tr>
<tr><td>Internal costs</td><td>£211</td><td>£0</td><td>£82</td></tr>
<tr><td>Total costs</td><td>£931</td><td>£0</td><td>£362</td></tr>
</table>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>£ 2.2k was reported in the 05/06 activity report.
This project was not reported in the Early Start report</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td>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.</td></tr>
<tr><td>Type(s) of innovation involved</td><td>Significant innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td>The diversion of the poles from landfill has both the financial benefit but also will help to meet the Company objective of achieving the 60% recycling target for 2006 and beyond.

The use of the proposal will aid the good environmental image that the Company aspires to and provide a good trail for a waste product.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>7 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td>20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td>75%</td></tr>
</table>

Project NPV (Present Benefits x Probability of Success) – Present Costs	£250k
Commentary on project progress and potential for achieving expected benefits	The theory has been proved in a laboratory experiment and now needs to be scaled up to evaluate the potential for commercial charcoal production and electricity generation by building and running a small pilot plant.

3.29 Domestic Cut-out Temp Indicators

<table>
<tr><td>Description of Project
Strategy Contribution
NETWORK OPERATIONS
ASSET MANAGEMENT</td><td colspan="4">This project is investigating the use of cheap thermally sensitive labels to give the meter inspector an indication that the cut-out has been running hot and needs to be investigated.</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 costs</td><td>£0</td><td>£0</td><td>£0</td></tr>
<tr><td>Internal costs</td><td>£190</td><td>£121</td><td>£121</td></tr>
<tr><td>Total costs</td><td>£190</td><td>£121</td><td>£121</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 the 05/06 activity report.</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>Type(s) of innovation involved</td><td colspan="4">Incremental innovation</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">• Early warning of cut-outs that have been getting hot due to load; and
• Prevention of fires due to cut-outs</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="4">3 years</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">50%</td></tr>
<tr><td>Project NPV
(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£2.2M</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="4">The trials carried out show that no indication is given at normal operating temperatures, but should the cut-out run hot for a period of time the indication remains visible for an inspector to raise a request for an investigation.</td></tr>
</table>

3.30 STP Module 2 : Overhead Network

<table>
<tr><td rowspan="1">Description of Project

Strategy Contribution
SUSTAINABILITY & ENVIRONMENT
NETWORK OPERATIONS
ASSET MANAGEMENT</td><td colspan="4">The STP overhead network programme aims 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 costs</td><td>£28,468.44</td><td>£0.00</td><td>£8,503.56</td></tr>
<tr><td>Internal costs</td><td>£5,835.35</td><td>£0.00</td><td>£1,743.03</td></tr>
<tr><td>Total costs</td><td>£34,304</td><td>£0</td><td>£10,247</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the length of installed overhead line.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">£38.9k was reported in the 05/06 activity report and
£22.4k was reported in the Early Start report</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The STP overhead network programme for budget year 2006/7 aimed to reduce costs and improve performance of overhead networks by increasing understanding of issues that have a negative impact on costs and performance. The programme is expected to also have a positive impact on safety and environmental performance. The projects all address real problems that have been identified by the module steering group members as significant and which require technical investigation and development.
The projects within the programme aimed to:
• S2126_3 – Undertake long-term monitoring of conductor temperature by obtaining and analysing 12 months trial data;
• S2132_2 – Validate current and proposed new ice accretion models;
• S2136_2 – Participation in European Project COST 727: Measuring and forecasting atmospheric icing on structures;
• S2138_2 – Investigate live-line jumper-cutting limitations Stage 2 is to undertake a controlled test programme;
• S2143_1 – To detect in-situ degradation of aluminium overhead line conductors;
• S2144_1 – Determine the residual strength of tower fittings through experimental means;
• S2145_1 – Explore the use of novel conductors for uprating tower line circuits;
• S2146_1 – Undertake torsion testing to evaluate possible limits for composite tension insulators;
• S2147_1 – Investigate the effect of multiple Spiral Vibration Dampers (SVD’s) on the performance of overhead line conductors; and
• S2149_1 – Explore high durability overhead line fittings. Initial stage to identify the range of fittings and materials.</td></tr>
</table>

Type(s) of innovation involved	Technical Substitution / Radical		
Expected Benefits of Project	Due to the age profile of system equipment it is inevitable that, unless significant new technology is used to extend asset life, CAPEX and possibly OPEX will need to increase significantly to maintain the present level of network reliability and safety. If these projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain benefits including: • Avoid redesign, reconstruction or refurbishment of overhead lines where this is driven by a perceived need to increase ratings or strengthen lines, and is required to conform with existing standards but which may be unnecessary; • Reduce levels of premature failure of assets; • Provide more cost effective and early identification of damaged insulators and discharging components, which if not addressed would result in faults; • Confidently extend the service life of towers and reduce potential levels of tower failures; • Reduce lifetime costs by the appropriate use of alternative materials.		
Expected Timescale to adoption	Range 1-5 years - dependent on project		
Duration of benefit once achieved	Range 3-10 years -dependent on project		
Estimated Success probability (at start of project)	Range 1-10% - dependent on project		
PV of Project Costs	£36,972 (NB. This is identified early stage cost. It does not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive.)	PV of Project Benefits	£63,564
Commentary on project progress and potential for achieving expected benefits	Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure which, if successfully addressed, would enable the expected benefits to be achieved. • S2126_3 – Undertake long-term monitoring of conductor temperature by obtaining and analysing 12 months trial data. First year form initial test site data suggests that uprating may be possible in specific circumstances. A further site has been established and is being monitored; • S2132_2 – Validate current and proposed new ice accretion models. Data has been gathered from the test site and is being		

	analysed prior to presentation to members; • S2136_2 – Participation in European Project COST 727: Measuring and forecasting atmospheric icing on structures. This is part of a much larger European collaborative project aiming to provide more accurate mapping of ice prone areas. Involvement is continuing with data exchange with other participants. This in turn will allow the most appropriate structure to be constructed; • S2138_2 – Investigate live-line jumper-cutting limitations Stage 2 is to undertake a controlled testing programme. The aim is to establish practical and safe limits for operational jumper cutting; • S2143_1 – To detect in-situ degradation of aluminium overhead line conductors. The preliminary work to explore available techniques has been completed; • S2144_1 – Determine the residual strength of tower fittings. A possible technique is being investigated which has clear financial benefits compared with traditional methods; • S2145_1 – Explore the use of novel conductors for uprating tower-line circuits. This project is determining the applicability at the distribution level of novel conductor designs used at transmission voltages to allow increased ratings using existing structures; • S2146_1 – Undertake torsion testing to evaluate possible limits for composite tension insulators. Laboratory testing has indicated torsion limits for a range of such insulators, which can be used to inform field staff; • S2147_1 – Investigate the effect of multiple Spiral Vibration Dampers (SVD's) on the performance of overhead line conductors. The application of either multiple SVD's or heavy duty SVD's could allow increased overhead line tension; and • S2149_1 – Explore high durability overhead line fittings. Initial stage to identify the range of fittings and materials. This project is at an early stage and possible materials and treatments to improve corrosion resistance have been identified.

3.31 STP Module 3 : Cable Networks

<table>
<tr><td>Description of Project

Strategy Contribution

SUSTAINABILITY & ENVIRONMENT
NETWORK OPERATIONS
ASSET MANAGEMENT</td><td colspan="4">The STP cable network programme for budget year 2006/7 aimed at identifying and developing opportunities to reduce the costs of owning cable networks. The reduction of whole life cost through greater reliability and improved performance of cables and associated accessories comes under the remit of Module 3. Where appropriate, Module 3 worked with other Modules to achieve common goals.</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 costs</td><td>£17,007.12</td><td>£8,873.28</td><td>£11,091.60</td></tr>
<tr><td>Internal costs</td><td>£3,486.05</td><td>£1,818.81</td><td>£2,273.51</td></tr>
<tr><td>Total costs</td><td>£20,493</td><td>£10,692</td><td>£13,365</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the length of installed underground cable.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">£ 49.2k was reported in the 05/06 activity report and
£22.1k was reported in the Early start report</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_6 – Addition of single core MV paper cable modelling functionality within CRATER cable rating software;
• S3132_7 – Addition of cable crossing modelling functionality within CRATER cable rating software;
• S3132_8 – Addition of load curve modelling functionality within CRATER cable rating software;
• S3132_9 – Addition of fluid filled cable modelling functionality within CRATER cable rating software;
• S3132_11 – Addition of EHV polymeric cable modelling functionality within CRATER cable rating software;
• S3140_2 – Towards Best engineering practice for ducted cable systems;
• S3145_1 – Investigate shrink back performance of PE sheath and insulation – Establish reliable test method;
• S3146_1 – Testing of fire retardant coatings and tapes;
• S3148_1 and S3148_2 – Requirements for earthing and bonding of single core MV power cables;
• S3149_1 Assessment of different HV polymeric cable designs;
• S4158_1 – Investigate user requirements for ducts; and
• S3159_1 – Series resonant testing of short lengths of HV cable.</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="4">Technical Substitution / Radical</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:
• Offset future increases in CAPEX and OPEX;
• CI/CML savings per connected customer; and</td></tr>
</table>

	• Increased safety of staff and public by reducing the number of accidents / incidents.		
Expected Timescale to adoption	Range 1-3 years - dependent on project		
Duration of benefit once achieved	Range 2-7 years -dependent on project		
Estimated Success probability (at start of project)	Range 2-20% - dependent on project		
PV of Project Costs	£36,972 (NB. This is identified early stage cost. It does not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive.)	PV of Project Benefits	£53,490
Commentary on project progress and potential for achieving expected benefits	Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure which, if successfully addressed, would enable the expected benefits to be achieved. • *S3132_6 – Addition of single core MV paper cable modelling functionality within CRATER cable rating software.* The functionality to model and analyse this cable type is now available within the CRATER software tool, allowing member companies to evaluate a wider range of circuits; • *S3132_7 – Addition of cable crossing modelling functionality within CRATER cable rating software.* Comprehensive cable crossing functionality is now available in CRATER, allowing member companies to determine their own cable ratings and the interaction with NGC cables; • *S3132_8 – Addition of load curve modelling functionality within CRATER cable rating software.* The load curve modeling functionality in CRATER now allows a more accurate representation of the loads when determining ratings; • *S3132_9 – Addition of fluid filled cable modelling functionality within CRATER cable rating software.* A user-friendly spreadsheet tool for the cable engineer was created to determine sustained, cyclic and distribution current ratings for fluid filled cable ratings, using approved methods of calculation; • *S3132_11 – Addition of EHV polymeric cable modelling functionality within CRATER cable rating software.* The functionality to model and analyse this cable type is now available within the CRATER software tool, allowing member companies to evaluate a wider range of circuits; • *S3140_2 – Towards best engineering practice for ducted cable systems.* The report will form a sound basis for the creation of engineering recommendations and guidance documents for ducted cable systems; • *S3145_1 – Investigate shrink back performance of PE sheath and*		

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

3.32 STP Module 4 : Substations

<table>
<tr>
<td>Description of Project
Strategy Contribution
SUSTAINABILITY & ENVIRONMENT
NETWORK OPERATIONS
ASSET MANAGEMENT</td>
<td>Issues with the age profile of substation assets within the UK electricity distribution system are well known. Also, both regulatory and shareholder pressures preclude substantial investments of the large scale that was seen in the 1950's to 1970's. The challenge is to constantly review and innovate new solutions to monitor and define asset condition thereby allowing risks to be clearly defined and sound investment decisions to be taken
The programme of projects which were approved for funding from the STP substations module budget and were undertaken in 2006/07 encompass both developing new innovative asset management processes and practices and developing innovative diagnostic techniques. The aim is to develop already well established themes such as life extension of aged assets within legal and heath and safety constraints, examination of new technologies, developing an understanding of, and innovative solutions for, the impact on substation assets of increasing levels of distributed generation on networks and condition monitoring techniques.</td>
</tr>
<tr>
<td>Expenditure for financial year</td>
<td>
<table>
<tr><td></td><td>EPN</td><td>LPN</td><td>SPN</td></tr>
<tr><td>External costs</td><td>£17,376.84</td><td>£8,133.84</td><td>£11,461.32</td></tr>
<tr><td>Internal costs</td><td>£3,561.83</td><td>£1,667.24</td><td>£2,349.30</td></tr>
<tr><td>Total costs</td><td>£20,939</td><td>£9,801</td><td>£13,811</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the number of primary substations</td></tr>
</table>
</td>
</tr>
<tr>
<td>Expenditure in previous (IFI) financial years</td>
<td>£36.5k was reported in the 05/06 activity report and
£22.0k was reported in the Early Start report</td>
</tr>
<tr>
<td>Technological area and / or issue addressed by project</td>
<td>Eighteen new projects were approved during the year and they aimed to:
• S4164_3 – On load tap changer monitor – Stage 3;
• S4176_2 – Comparison of available earth testing instruments;
• S4185_2 – AM Forum membership;
• S4191_1 – Update and populate CBMVAL database;
• S4193_2 – Enable effective quantification of risk and reliability;
• S4194 – Regenerative transformer breathers;
• S4197_1 – Concrete structure assessment;
• S4200_1 – Methods to assess oil bunds and intelligent pump technology;
• S4201_1 – Corrosive sulphur in transformers;
• S4202_1 – Out of phase switching;
• S4203_1 – Review of INSUCON;
• S4205_1 – Assessment of contact greases for outdoor applications;
• S4206_1– Substation security;
• S4207_1 – ERS33 switchgear rating at reduced temperature;</td>
</tr>
</table>

<table>
<tr><td></td><td colspan="3">• S4208_1– Investigate the re-assessment of switchgear ratings;
• S4209_1 – Post maintenance testing;
• S4211_1 – Management and use of actuators;
• S4215_1 – Internal arc considerations in substations.</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="3">Incremental / Significant / Technological Substitution / Radical</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="3">Due to the age profile of the current system assets it is inevitable that unless significant new technology is used to extend asset life, CAPEX and possibly OPEX will need to increase significantly to maintain the present level of network reliability and safety.

If the projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain the benefits including:
• Offset future increases in CAPEX and OPEX;
• Increased safety of staff and public by reducing the number of accidents/incidents; and
• Both preventing disruptive failures of oil-filled equipment to reduce land contamination and avoiding unnecessary scrapping of serviceable components will alleviate environmental impact.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="3">Range 1-3 years - dependent on project</td></tr>
<tr><td>Duration of benefit once achieved</td><td colspan="3">Range 2-7 years - dependent on project</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="3">Range 5-40% - dependent on project</td></tr>
<tr><td>PV of Project Costs</td><td>£36,972

(NB. This is identified early stage cost. It does not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive.)</td><td>PV of Project Benefits</td><td>£59,559</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="3">Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure which, if successfully addressed, would enable the expected benefits to be achieved.
• *S4164_3 – On load tap changer monitor – Stage 3.* The results from extending the laboratory system into a live substation have been very encouraging and a subsequent stage will allow an extended trial on a wider range of tap changers;
• *S4176_2 – Comparison of available earth testing instruments.* The project permitted cost effective comparison of four different types of electrode system to evaluate each</td></tr>
</table>

	instrument in relation to accuracy, cost, usability and robustness; • *S4185_2 – AM Forum membership.* This project allowed members to be updated on substation asset management policies and practices adopted by other European Transmission System Operators (TSOs) and Distribution Network Operators in a cost effective manner; • *S4191_1 – Update and populate CBMVAL database.* This project has delivered an up-to-date and easy-to-use software tool that enables members to make a valid assessment of the net financial benefits that might accrue from the implementation of CBM; • *S4193_2 – Enable effective quantification of risk and reliability.* The project collated and analysed the consequences of recent events (over the past 10 years) in order to establish 'benchmarks' to quantify risk; • *S4194 – Regenerative transformer breathers.* The project undertook an independent evaluation and cost benefit analysis of "maintenance-free" desiccant breathers; • *S4197_1 – Concrete structure assessment.* The project highlighted the more common types of concrete degradation and the testing that is available to assess the extent of this degradation; • *S4200_1 – Methods to assess oil bunds and intelligent pump technology.* The project will enable members to compare the different policies, practices and bund pump technologies that have been adopted and to identify best practice; • *S4201_1 – Corrosive sulphur in transformers.* The project informed members regarding the issues and consequences of the failures in transformers due to corrosive sulphur; • *S4202_1 – Out of phase switching.* The project facilitated expert debate of out of phase switching issues. It was necessary for DNOs to fully understand the underlying system conditions and agree a common approach in this matter; • *S4203_1 – Review of INSUCON.* This project provided a cost effective summary commentary of INSUCON content and its relevance to members; • *S4205_1 – Assessment of contact greases for outdoor applications.* The project will recommend suitable products for the lubrication of outdoor contacts and identify best practice for their application; • *S4206_1– Substation security.* This project will undertake a wide review of the concept of, and approach to, the physical security of substations in order to deter theft; • *S4207_1 – ERS33 switchgear rating at reduced temperature.* The project will provide guidance that may allow utilities to run switchgear above maximum normal rated current values under specific conditions;

	• *S4208_1– Investigate the re-assessment of switchgear ratings.* The project will consider the provision of a methodology for understanding the risk of re-assigning switchgear fault level ratings without type testing; • *S4209_1 – Post maintenance testing.* The project will enable members to carry out the most appropriate testing regimes both from a financial and technical perspective and to establish pass/fail criteria; • *S4211_1 – Management and use of actuators.* This project should assist the members in ensuring that the risk of actuator failure is reduced, their reliability is increased and maintenance and testing is optimised; and • *S4215_1 – Internal arc considerations in substations.* The project will enable members to better select HV/LV switchgear with respect to internal arc and ultimately lead to enhanced safety within the substation environment.

3.33 STP Module 5 : Networks for Distributed Energy Resources

<table>
<tr><td rowspan="1">Description of Project

Strategy Contribution

SUSTAINABILITY & ENVIRONMENT
NETWORK OPERATIONS
ASSET MANAGEMENT</td><td colspan="4">The projects undertaken through budget year 2006/7 were aimed at enabling cost effective connections and ensuring techniques are in place to plan, operate and manage networks with significant amounts of generation. Most projects also had positive impacts on safety and environmental performance. The projects all addressed real problems that had been identified by the module steering group members as significant and which required technical investigation and development.</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 costs</td><td>£17,746.56</td><td>£7,024.68</td><td>£12,200.76</td></tr>
<tr><td>Internal costs</td><td>£3,637.62</td><td>£1,439.89</td><td>£2,500.86</td></tr>
<tr><td>Total costs</td><td>£21,384</td><td>£8,465</td><td>£14,702</td></tr>
<tr><td colspan="4">The costs have been allocated in proportion to the amount of installed Distributed Generation.</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="4">£36.5k was reported in the 05/06 activity report and
£21.9k was reported in the Early Start report</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">Fifteen new project stages were approved during the year.
These projects aimed to:
• S5147_3 – Monitor Microgenerator Clusters;
• S5149_4 – Explore Active Voltage Control;
• S5142_2/3 – Generator Data and Structure for DG Connection Applications Stages 2 and 3;
• S5152_2 – Latest developments in the connection of distributed generation;
• S5154 –Voltage Control Policy Assessment Tool on the IPSA Platform;
• S5157_1 – Evaluate the Performance of Small Scale Reactive Power Compensators Stage 1;
• S5157_2 – Evaluate the Performance of Small Scale Reactive Power Compensators Stage 2;
• S5160_1 – ACTIV Active Voltage Control;
• S5161 – Standard risk assessment approach to DNO protection;
• S5162 – Risk assessment analysis of voltage step changes;
• S5164 – Managing network risks associated with the application of ER P2/6;
• S5167 – Assessment of enhanced ratings for overhead lines connecting wind turbines;
• S5168 – Design and operation implications for Grid Code compliance; and
• S5180 – DNMS functions to support active network management.</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="4">Incremental / Significant / Technological Substitution</td></tr>
</table>

Expected Benefits of Project	With government policy driving significant increases in generation connection to distribution networks the members need a range of innovative solutions to connection and network operation issues that are cost effective and which maintain the present level of network reliability and safety. If the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain benefits including: • Reducing the probability of voltage supply limit excursions resulting from increased distributed generation (eaVCAT interface to IPSA software tool); • Improving quality of supply and reducing risk of component failure (by understanding the effect and optimising use of impedance in the system); • A better understanding of the risk presented by the distribution assets when considered as a network rather than discrete components; • Greater use of distributed generators to meet current DNO obligations (by assessing, from a DNO perspective, the implications of pending Distribution Code provisions relating to distributed generation); and • Reducing the amount of reinforcement needed (by use of dynamic ratings to allow network components to be used to their full capability) - the use of dynamic circuit ratings is a vital step in the move towards active management of networks.		
Expected Timescale to adoption	Range 1-5 years - dependent on project		
Duration of benefit once achieved	Range 1-7 years - dependent on project		
Estimated Success probability (at start of project)	Range 5-30% - dependent on project		
PV of Project Costs	£36,972 (NB. This is identified early stage cost. It does not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive.)	PV of Project Benefits	£69,827
Commentary on project progress and potential for achieving expected benefits	Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure which, if successfully addressed, would enable the expected benefits to be achieved. • *S5147_3 – Microgenerator Clusters.* Installation of monitoring points is complete at both the substation and LV network level. A twelve month monitoring programme has commenced;		

	• *S5149_4 – Explore Active Voltage Control.* Modelling of typical radial and interconnected networks in preparation for flexing key parameters to examine limits of active voltage control; • *S5142_2/3 – Generator Data and Structure for DG Connection Applications.* A rationalised data structure has been agreed and implemented with all terms defined; • *S5152_2 – Latest Developments in the Connection of Distributed Generation.* Regular updates on new developments have been provided to members to help inform and influence the research programme; • *S5154_1 – Develop a voltage Control Policy Assessment Tool on the IPSA Platform.* An interface between the existing eaVCAT software and the widely used IPSA power system analysis software has been established with eaVCAT making use of an embedded IPSA analysis routine; • *S5157_1 – Performance of Small Scale Reactive Power Compensators.* Five devices were identified, detailed information gathered and comparisons made using key criteria measures from members; • *S5157_2 – Performance of Small Scale Reactive Power Compensators.* This project examined the usage of DStatcoms with large windfarms and explored the implications for DNOs. • *S5160_1 – ACTIV Active Voltage Control.* An initial scoping study was completed and further work will be undertaken outside of the STP programme; • *S5161 – Standard risk assessment approach to DNO protection.* This stage of the project identified possible standard risk assessment approaches that could be developed for the selection of protection systems at the DNO / User interface; • *S5162 – Risk assessment analysis of voltage step changes.* The project investigated voltage step changes in order to define possible limits used when planning network developments and generator connections; • *S5164 – Managing network risks associated with the application of ER P2/6.* The project examined the application of P2/6 across members and developed a baseline view of the network required to deliver minimum-security standards; • *S5167 – Assessment of enhanced ratings for overhead lines connecting wind turbines.* The project will determine if enhanced ratings can be safely applied to lines connected to wind-farm generators without the risk of infringing statutory line-to-ground clearances, and if so to recommend appropriate correction factors; • *S5168 – Design and operation implications for Grid Code compliance.* The project explores the network design and operational implications of the Grid Code target volts and

	slope concept. It will develop a testing procedure for DNOs to check the necessary voltage control with recommendations for 'standard' settings; and • *S5180 – DNMS functions to support active network management.* To inform members of the additional active network management functionalities available in DNMS systems that are not typically being used in the control rooms at present.

4. 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 has been asked to develop an assessment tool to determine whether GenAVC is 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 will be installing GenAVC at Steyning Primary and monitoring the results. This is the basis of this RPZ.
Expenditure for financial year	Expenditure is detailed in the GenAVC Assessment tool IFI project report contained in section 3 of this report.
Type(s) of innovation involved	The assessment tool determines whether GenAVC is an appropriate solution to a voltage rise problem at the early stage of the DG connection process. 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	Under construction
Connection cost	Connection costs will be reduced with the use of GenAVC when compared to the traditional network reinforcement methods which would involve 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 their additional gas supply to generate energy, as opposed to flaring the excess gas into the environment. They already operate two 1MW of landfill gas generators connected to distribution network supplied from Steyning Primary substation. The assessment tool estimates that approximately 1.0MW of additional generation can be connected without infringing statutory voltage or power flow limits. All connected customers will benefit from improved voltage control especially during periods of light load when higher volts are experienced.