# Regulatory Report for DG Incentives, RPZ's & IFI

Reporting Year 2006/7

By Central Networks

## Forward – E.ON Changing Energy

We want to change how people think about energy – where we get it from, how it is brought to our customers, how it is used and how it feels to be a customer of an energy company.

We have the expertise and scale to change energy, making a difference for both our customers and the environment.

Our Research & Development initiatives will identify emerging technologies and opportunities that can increase the efficiency of our operations, enhance overall safety, address environmental issues and provide a reliable network that delivers a high quality of supply for our customers.

John Crackett
Managing Director -Central Networks

# Contents

# 1. Introduction

During the development of the Distribution Price Control Review (DPCR) that took effect on 1st April 2005, Ofgem proposed two new incentives: the Innovation Funding Incentive (IFI) and the Registered Power Zones (RPZ). This report contains both the IFI/RPZ reports for the two licensed areas of Central Networks East and Central Networks West.

## 1.1. Context

As part of the DPCR, Ofgem has introduced the IFI and RPZ incentive mechanisms. They were consulted on 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. Innovation Funding Incentive (IFI)

The Innovation Funding Incentive 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. A definition of technical within the context of this guide is given in the glossary. 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 the Special Licence Condition C3, Standard Licence Condition 51 and the DG Regulatory Instructions and Guidance (RIG's). They can be summarised as follows*:*

> A DNO is allowed to spend up to 0.5% of its Combined Distribution Network Revenue on eligible IFI projects. This GPG provides guidance on the characteristics of such 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 will not approve IFI projects but DNOs will have to openly report their IFI activities on an annual basis. These reports will be published on the Ofgem website. Ofgem reserves the right to audit IFI activities if this is judged to be necessary in the interests of customers.

## 1.3. Registered Power Zone (RPZ)

In contrast to the IFI, RPZ's 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 next five years. This generation could connect at every distribution voltage level bringing new system design and operating challenges.

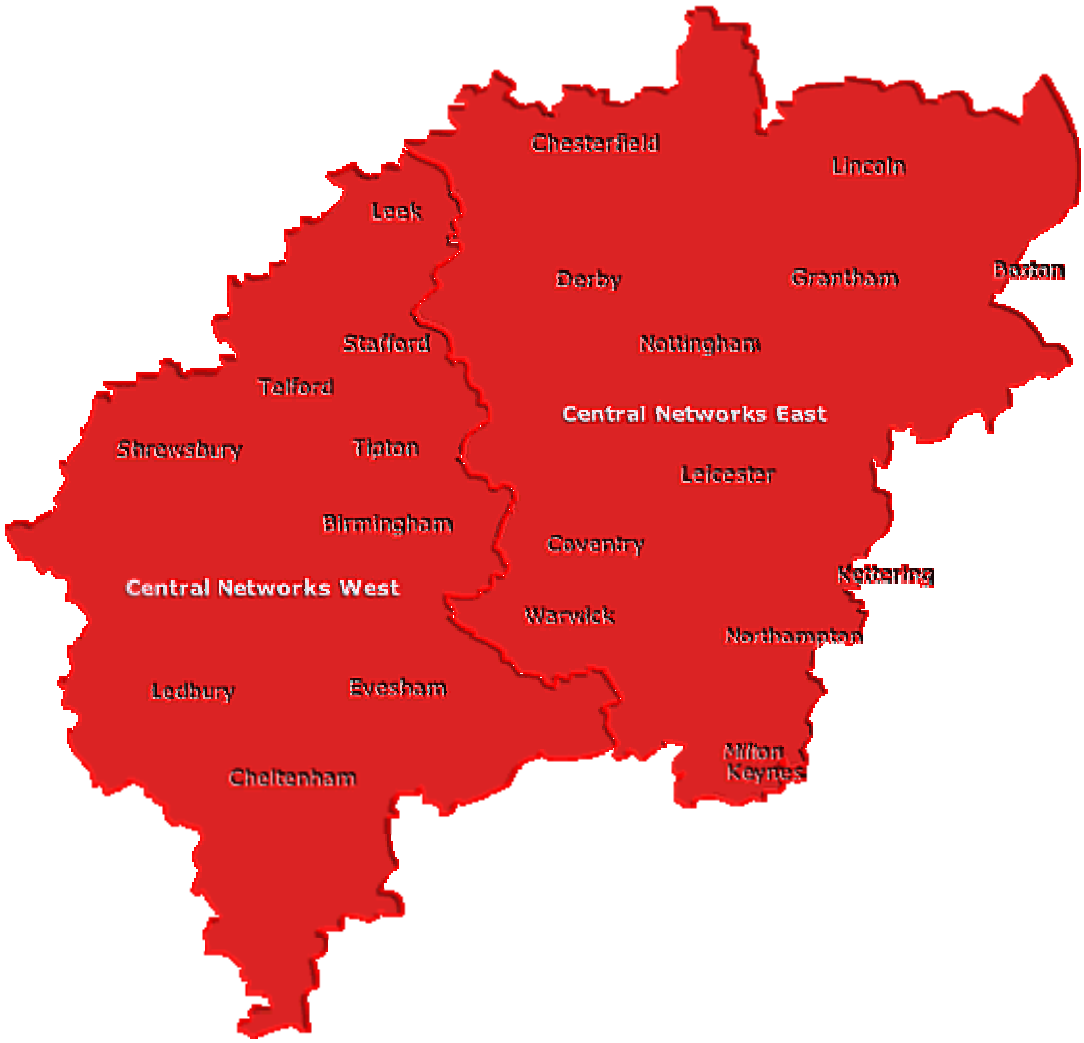
RPZ's are therefore intended to encourage DNOs to develop and demonstrate new, more cost effective ways of connecting and operating generation that will deliver specific benefits to new distributed generators and broader benefits to consumers generally. The detail of the RPZ mechanism is set out in the Special Licence Condition D2, Standard Licence Condition 51 and the DG Regulatory Instructions and Guidance (RIG's).
The RPZ mechanism is an extension of the Distributed Generation (DG) Incentive that is also being introduced as part of DPCR4. The DG incentive allows DNOs to recover their generation connection costs by a combination of pass through (80%) and incentive per kW connected (£1.5/kW). This approach is expected to deliver a higher return to a DNO for generation connection schemes than other network investments.

If a DNO employs genuine innovation in the way that it connects generation it can seek to register the connection scheme with Ofgem as an RPZ. Ofgem will decide, using published criteria, whether the scheme qualifies as an RPZ. If it does, the incentive element of the DG Incentive is increased for the first five years of operation by £3/kW.

Photograph of an installed Power Donut monitoring conductor current and temperature, see Dynamic Ratings ..... 33

## 2. Central Networks

### 2.1. Company Details




Central Networks is the name given to E.ON UK's Electricity Distribution Business formed by the combining of East Midlands Electricity and Midlands Electricity Distribution businesses. It is the second largest electricity network operator in the UK serving approximately 4.9 million customers across central England from the Peak District in the North to parts of Bristol in the South and from the Welsh Borders to the Lincolnshire coast.

Central Networks owns, operates and manages an electrical distribution network comprising more than 40,000 substations, 84,300km of underground cable and 48,600km of overhead line at various voltages from 132kV to 230V. Our core activities include the Design, Installation, Commissioning, Inspection, Maintenance and Repair of Electricity Distribution Networks.

Our aim is to give customers the best service by making Central Networks the best electricity Distribution Business in the UK.

## 2.2. End of year report for DG Incentives, RPZ's & IFI

### Regulatory report for DG Incentives, RPZ's & IFI

**Reporting year 2006/07**

**Central Networks**

| **Distributed Generation (DG) Incentive** | East | West | Total |
|---|---|---|---|
| Total Incentivised DG Capacity (MW) | 4.90 | 9.525 | 14.425 |
| Total capex for DG (£m) | 0.187 | 0.502 | 0.689 |
| Use Of System capex for DG (£m) | 0 | 0 | 0 |
| Shared connection capex for DG (£m) | 0 | 0 | 0 |
| Assets transferred out of DG capex to demand capex (£m) | 0 | 0 | 0 |
| DG network unavailability (MWh) | 3.62 | 7.40 | 11.02 |
| DG Network unavailability rebate payment (£m) | 0 | 0 | 0 |
| Operational & maintenance costs for DG (£m) | £0.06 | £0.06 | £0.12 |

**Innovation Funding Incentive**

| | | | |
|---|---|---|---|
| IFI carry forward (£m) | £0.639 | £0.617 | £1.256 |
| Eligible IFI expenditure (£m) | £0.557 | £0.557 | £0.416 |
| Eligible IFI internal expenditure (£m) | £0.08 | £0.08 | £0.062 |
| Combined network revenue (£m) | £274.29 | £277.77 | £505.2 |

**Registered Power Zones (RPZ's)**

| | |
|---|---|
| RPZ 1 name | Skegness and Fens CN(e) |
| RPZ DG capacity (MW) | 0 |
| RPZ starting year | 05-Jun |

| | |
|---|---|
| RPZ 2 name | |
| RPZ DG capacity (MW) | |
| RPZ starting year | |

# 3. Summary of IFI projects

## 3.1. Management of IFI Projects

Details of the 31 IFI projects in which Central Networks participated during this IFI reporting period are included in this report. Nine of these projects involved the collaboration of the majority of UK DNO's. Of the rest five projects involved work with Research Establishments, five with Universities, and the other projects involved collaboration with external partners, but were led by Central Networks.

The Good Practice Guide ENA Engineering Recommendation G85 (2005) details the management philosophy expected when managing IFI Projects. This is available from the ENA website.

Management of collaborative projects is normally via an overseeing Steering Group, which has representatives from the contributing parties. The contributing parties can also provide project champions to the individual project working groups to provide assistance and guidance at the project level. Central Networks recognise the importance of providing this level of input to collaborative projects and have provided a significant number of project champions for the individual project working groups.

Central Networks led projects are centrally managed within the organisation, but with the support of project champions from across the business, who are allocated to the individual projects depending upon their specialism. Where appropriate E.ON UK's Research and Development establishment 'Power Technology' has been engaged to provide technical, managerial and legal assistance.

## 3.2. IFI Project Partners

Central Networks is pleased to have developed close working relationships with its IFI project partners and look forward to developing these relationships further in the future as we address the emerging challenges and evaluate innovative and imaginative approaches to upgrading and managing electricity networks. The list below is a snap shot of some of the Research Establishments, Service Providers and Equipment Manufacturers with whom we have worked during 2006/07, but there are many other organisations, energy network distributors and academic / technical institutions with whom we have also been pleased to have worked.

**EA Technology Ltd** - originally formed as the Research & Development centre for the UK electricity industry in the 1960s, it was transformed following electricity privatisation in the1990s. The company became fully independent in 1997 with a management and employee buy-out and is now directly owned by its staff.

EA Technology is a Power Asset Management Company with a world-class reputation for delivering innovative business solutions to companies, which supply, distribute and use energy. The company operates the internationally acclaimed Strategic Technology Programme (STP), of which all UK DNOs are members.

**E.ON Power Technology** - is part of the E.ON UK group and leads the group's Research and Development activities. E.ON Power Technology is also an international consultancy to the power industry with core capabilities that span the range of interests appropriate to a vertically integrated energy company.

E.ON Power Technology prides itself for utilising excellence in scientific research and practical experience to deliver complex engineering solutions that provide real customer value. Focussed on innovation, energy technologies and engineering, it provides technical services and products as diverse as Risk-based management of technical assets and advanced technology development for a sustainable low carbon future.

**Met Office** – is one of the world's leading providers of environmental and weather related services. The Met Office's solutions and services meet the needs of many communities of interest…from the general public, government and schools, through broadcasters and on-line media, to civil aviation and almost every other industry sector in UK and around the world.

**AREVA T&D** – is a world leader in the transmission and distribution of energy. AREVA T&D provides a complete range of innovative products, systems and services across the whole energy value chain from generation to power consumption.

**Sterling Power** – is a power engineering group composed of a number of individual companies who provide a unique range of services within the utility sector. The group has been established by personnel with a wealth of experience in the utility market.

**Infoterra** – a leading provider of geo-information products and services delivers reliable geospacial knowledge to customers; from satellite and aerial data acquisition to analysis, from developing software to hosting information.

**4Energy (4e)** – is a technology start-up company which designs, develops and manufactures innovative and environmentally friendly climate control devices for industrial and utility applications.

**ICE Clean Engineering** – is a new company based in the Midlands, which provides a revolutionary alternative cleaning service for industry.

**Other Partners** - Central Networks has collaboration agreements with a number of other Academic, Industrial and Research Partners. Where possible this information is given in the individual reports, but in some cases Central Networks is bound by mutual confidentiality agreements not to disclose this.

### 3.3. IFI Project Expenditure

In order to successfully manage an increased portfolio of Research and Development projects, Central Networks has increased both the number of and expenditure on IFI projects in a controlled manner so as to ensure that support structures have been put in place.

The table below details the expenditure during the April 2006 – March 2007 IFI reporting period:

| Description of Project | External | Internal | Total |
|---|---|---|---|
| EA Technology – STP Overhead Module 2 & Forum | £38,630 | £5,618 | **£44,248** |
| EA Technology – STP Cable Module 3 & Forum | £38,213 | £4,935 | **£43,148** |
| EA Technology – STP Plant/Protection Module 4 & Forum | £41,861 | £5,985 | **£47,846** |
| EA Technology – STP Distributed Generation Module | £36,750 | £10,500 | **£47,250** |
| EA Technology – Protective Coatings Forum | £6,000 | £1,103 | **£7,103** |
| EA Technology - Partial Discharge Group | £5,953 | £3,150 | **£9,103** |
| ENA R&D Group Programme | £3,497 | £7,350 | **£10,847** |
| Power Technology – Advanced Distribution Automation | £27,991 | £2,100 | **£30,091** |
| Power Technology – Intelligent Universal Transformer | £26,192 | £2,100 | **£28,292** |
| Dynamic Ratings Project | £64,338 | £17,798 | **£82,136** |
| Energy Storage for Distribution Systems | £62,133 | £4,725 | **£66,858** |
| Optimising System Design for Performance and Losses | £76,000 | £8,820 | **£84,820** |
| Maintaining Critical Domestic Load during Power Outages | £26,615 | £1,050 | **£27,665** |
| Networks to Improve Power Quality | £60,300 | £3,675 | **£63,975** |
| Magnetic Fault Current Limiter | £7,500 | £3,780 | **£11,280** |
| Understanding Networks with High Penetrations of DG | £12,820 | £2,100 | **£14,920** |
| Protection to improve reliability in Networks with DG | £2,000 | £525 | **£2,525** |
| Effect of Electric Vehicles on Distribution Networks | £5,000 | £525 | **£5,525** |
| SuperGen V (Amperes) | £25,000 | £4,830 | **£29,830** |
| Ice Cleaning of Distribution Plant | £12,149 | £5,008 | **£17,157** |
| Passive Battery Conditioning for Rural R/C Devices | £26,170 | £7,500 | **£33,670** |
| Non Invasive Overhead Line Inspection Techniques | £4,419 | £3,255 | **£7,674** |
| Non Invasive Testing of Tower Foundations | £95,000 | £4,305 | **£99,305** |
| Lidar - Laser Scanning of Overhead Lines | £275 | £3,465 | **£3,740** |
| Condition Inspection of Overhead Lines | £39,795 | £6,195 | **£45,990** |
| Safety Inspections by Helicopter | £14,260 | £3,465 | **£17,725** |
| Substation Communication Development | £84,695 | £15,908 | **£100,603** |
| Impact of Climate Change and Weather Analysis | £25,012 | £2,940 | **£27,952** |
| Cable Detection by Radar | £30,000 | £7,455 | **£37,455** |
| Mobile Pinging Trial – Locating Restoration Staff | £6,367 | £3,938 | **£10,305** |
| Alternative Oh Earthing Arrangements and Materials | £49,215 | £6,143 | **£55,358** |
| **Total** | **£954,150** | **£160,243** | **£1,114,393** |

The expenditure on IFI projects is equally divided between the two Licensed Distribution Companies that are owned by Central Networks.

Internal expenditure varied considerably between projects, but the total internal expenditure was 14.38% of the total cost.

### 3.4. Reporting Benefits of IFI Projects

The balanced portfolio of projects includes new technologies and approaches that will eventually result in real practical benefits, along with other projects that contribute to our increasing knowledge base.

The anticipated benefits of each Research and Development Project have been calculated using the methodology set down in the Good Practice Guide. For each project the Net Present Value is calculated by taking the present value of the estimated benefits, multiplying them by the probability of success and then subtracting the Present Value costs (including where appropriate the implementation costs). Each project has the expectation that the Present Value costs will be exceeded by the Present value of the benefits that it could deliver to customers. These figures can be seen on the individual project reports.

However, although quantified financially, Research and Development project benefits do not necessarily always result in a tangible financial deliverable in terms of direct savings or deferred investment, but could have strategic or risk management value, or could be designed to avoid potential costs.

Transferring Research and Development projects from demonstration to adoption is essential if benefits are to be delivered to customers and this is often the hardest hurdle for any organisation to achieve. During the year, a number of the listed projects were successfully completed and the following two have been (or are in the process of being) adopted:-

- **EA Technology Condition Inspections of Overhead lines** – Currently Central Networks' Inspection and Maintenance documentation is being amended to adopt this condition monitoring technique.
- **Mobile Pinging Trial** – This has now been adopted and is being rolled out to operational restoration staff across Central Networks.

Note - A number of projects including the EA Technology Ltd STP modules, the ENA R&D programme and SuperGen V (Amperes) project fall below the de-minimis level set by the Good Practice Guide of £40k per licensed DNO (i.e. for Central Networks 2 x £40k = £80k) and the projects cost and benefits have therefore been aggregated.

## 3.5. Future Research and Development

Central Network has developed plans to further expand its Research and Development programme during the 2007/08 period. We will maintain a balanced portfolio of projects and engage both in more multi-collaborative projects and continue to use our links to support innovative ideas in conjunction with individual Universities, Research Establishments or Industrial partners.

A number of multi-collaborative projects have been under development during the 2006/07 period and Central Networks intends to be active participant in several of these, including:-

- ADAS Vegetation Management project
- EA technology Partial Discharge Alarm project
- Radiometric Arc Detection project
- ENA Harmonic Impedance Techniques with respect to long underground cables

In addition Central Networks will be supporting the new Power Networks Research Academy (PNRA), who will be sponsoring six post graduate student Research Projects each year at UK Universities.

These Research and Development projects will address the issues which face the Distribution Network of the future and will enable us to achieve our aspiration of 'Changing Energy' for the better to make a difference for our customers and the environment.

Example of defect recorded by stabilised photography

See EA Technology – Condition Inspections of Overhead Lines .....59

## Individual IFI Project Reports for Period April 2006 – March 2007

### Central Networks

| | | | |
|---|---|---|---|
| Description of project | EA Technology - Strategic Technology Programme<br>EATL STP - Overhead Network Module 2 and Forum<br><br>Research and development into all aspects of Distribution Overhead Lines | | |
| Expenditure for financial year | Internal - £5,618<br>External - £38,630<br>Total Cost - £44,248 | Expenditure in previous financial period | Total cost - £42,530 |
| Technological area and / or issue addressed by project | The STP overhead network programme for budget year 2006/7 aimed to reduce costs and improve performance of overhead networks by increasing understanding of issues that have a negative impact on costs and performance. The programme is expected to also have a positive impact on safety and environmental performance. The projects all address real problems that have been identified by the module steering group members as significant and which require technical investigation and development.<br>The projects within the programme aimed to:<br>• S2126_3 - Undertake long-term monitoring of conductor temperature by obtaining and analysing 12 months trial data.<br>• S2132_2 - Validate current and proposed new ice accretion models<br>• S2136_2 - Participation in European Project COST 727: Measuring and forecasting atmospheric icing on structures.<br>• S2138_2 - Investigate live-line jumper-cutting limitations Stage 2 is to undertake a controlled test programme.<br>• S2143_1 – To detect in-situ degradation of aluminium overhead line conductors<br>• S2144_1 – Determine the residual strength of tower fittings through experimental means<br>• S2145_1 Explore the use of novel conductors for uprating tower line circuits.<br>• S2146_1 Undertake torsion testing to evaluate possible limits for composite tension insulators<br>• S2147_1 Investigate the effect of multiple Spiral Vibration Dampers (SVD's) on the performance of overhead line conductors<br>• S2149_1 – Explore high durability overhead line fittings. Initial stage to identify the range of fittings and materials. | | |
| Type(s) of innovation involved | Technological 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.<br>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:<br>• 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 | | |

<table>
<tr><td></td><td colspan="5">which may be unnecessary;<br>• reduce levels of premature failure of assets;<br>• provide more cost effective and early identification of damaged insulators and discharging components, which if not addressed would result in faults;<br>• confidently extend the service life of towers and reduce potential levels of tower failures;<br>• reduce lifetime costs by the appropriate use of alternative materials.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">Range 1-5 years - dependent on project</td><td colspan="2">Duration of benefit once achieved</td><td>Range 3 - 10 years - dependent on project</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">Range 1 - 10% - dependent on project</td></tr>
<tr><td>PV of Project Costs (see note below)</td><td>£44,248</td><td>PV of Project Benefits</td><td>£63,564</td><td>NPV of Project Costs</td><td>£19,316</td></tr>
<tr><td colspan="6">Note – The project costs are identified early stage costs. They do not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive.</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="5">Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure, which if successfully addressed, would enable the expected benefits to be achieved.<br>• 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.<br>• 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.<br>• 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.<br>• 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.<br>• S2143_1 – To detect in-situ degradation of aluminium overhead line conductors. The preliminary work to explore available techniques has been completed.<br>• S2144_1 – Determine the residual strength of tower fittings. A possible technique is being investigated which has clear financial benefits compared with traditional methods.<br>• 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.<br>• S2146_1 Undertake torsion testing to evaluate possible limits for composite tension insulators. Laboratory testing has indicated torsion</td></tr>
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| | |
|---|---|
| | limits for a range of such insulators, which can be used to inform field staff.<br>• *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<br>• *2149_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. |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

| | | | |
|---|---|---|---|
| Description of project | EA Technology - Strategic Technology Programme<br>EATL STP - Cable Networks Module 3 and Forum<br><br>Research and development into all aspects of Distribution Cables | | |
| Expenditure for financial year 2005/06 | Internal - £4,935<br>External - £38,213<br>Total Cost - £43,148 | Expenditure in previous financial period | Total cost - £43,220 |
| Technological area and / or issue addressed by project | The STP cable network programme for budget year 2006/7 aimed at identifying and developing opportunities to reduce the costs of owning cable networks. The reduction of whole life cost through greater reliability and improved performance of cables and associated accessories comes under the remit of Module 3. Where appropriate, Module 3 worked with other Modules to achieve common goals.<br>The projects undertaken within the programme during 2006-07 aimed to:<br>• S3132_6 - Addition of single core MV paper cable modeling functionality within CRATER cable rating software.<br>• S3132_7 - Addition of cable crossing functionality within CRATER cable rating software.<br>• S3132_8 - Addition of load curve functionality within CRATER cable rating software.<br>• S3132_9 - Addition of fluid filled cable functionality within CRATER cable rating software.<br>• S3132_11 - Addition of EHV polymeric cable functionality within CRATER cable rating software.<br>• S3140_2 – Towards Best engineering practice for ducted cable systems.<br>• S3145_1 – Investigate shrink back performance of PE sheath and insulation – Establish reliable test method.<br>• S3146_1 – Testing of fire retardant coatings and tapes.<br>• S3148_1 and S3148_2 - Requirements for earthing and bonding of single core MV power cables<br>• S3149_1 Assessment of different HV polymeric cable designs<br>• S4158_1 – Investigate user requirements for ducts<br>• S3159_1 - Series resonant testing of short lengths of HV cable | | |
| Type(s) of innovation involved | Technological Substitution / Radical | | |
| Expected Benefits of Project | If the projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain the following benefits, including:<br>• offset future increases in CAPEX and OPEX;<br>• CI/CML savings per connected customer;<br>increased safety of staff and public by reducing the number of accidents / incidents. | | |

<table>
<tr><td>Expected Timescale to adoption</td><td colspan="2">Range 1 - 3 years - dependent on project</td><td>Duration of benefit once achieved</td><td colspan="2">Range 2 - 7 years - dependent on project</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">Range 2 - 20% - dependent on project</td></tr>
<tr><td>PV of Project Costs (see note below)</td><td>£43,148</td><td>PV of Project Benefits</td><td>£53,490</td><td>NPV of Project Costs</td><td>£10,342</td></tr>
<tr><td colspan="6">(note – The project costs are identified early stage costs. They do not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive.)</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="5">Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure, which if successfully addressed, would enable the expected benefits to be achieved.<ul><li>S3132_6 - Addition of single core MV paper cable 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.</li><li>S3132_7 - Addition of cable crossing 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.</li><li>S3132_8 - Addition of load curve 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.</li><li>S3132_9 - Addition of fluid filled cable 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.</li><li>S3132_11 - Addition of EHV polymeric cable 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.</li><li>S3140_2 –recommendations and guidance documents for ducted Towards best engineering practice for ducted cable systems. The report will form a sound basis for the creation of engineering cable systems.</li><li>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.</li><li>S3146_1 – Testing of fire retardant coatings and tapes. The project has, through testing, demonstrated an effective means of fire protection for triplex cables.</li><li>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.</li><li>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.</li></ul></td></tr>
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| | |
|---|---|
| | • *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. |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

| | | | |
|---|---|---|---|
| Description of project | EA Technology - Strategic Technology Programme<br>EATL STP - Substation Plant and Protection Module 4 and Forums<br><br>Research and Development into all aspects of Distribution Substation Plant and Protection | | |
| Expenditure for financial year 2005-06 | Internal - £5,985<br>External - £41,861<br>Total Cost - £47,250 | Expenditure in previous financial period | Total costs - £46,235 |
| Technological area and / or issue addressed by project | Issues with the age profile of substation assets within the UK electricity distribution system are well known. Also, both regulatory and shareholder pressures preclude substantial investments of the large scale that was seen in the 1950's to 1970's. The challenge is to constantly review and innovate new solutions to monitor and define asset condition thereby allowing risks to be clearly defined and sound investment decisions to be taken<br>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.<br>Eighteen new projects were approved during the year and they aimed to:<br>• S4164_3 – On load tap changer monitor – Stage 3.<br>• S4176_2 – Comparison of available earth testing instruments<br>• S4185_2 – AM Forum membership.<br>• S4191_1 – Update and populate CBMVAL database.<br>• S4193_2 – Enable effective quantification of risk and reliability.<br>• S4194 – Regenerative transformer breathers.<br>• S4197_1 – Concrete structure assessment.<br>• S4200_1 – Methods to assess oil bunds and intelligent pump technology<br>• S4201_1 – Corrosive sulphur in transformers<br>• S4202_1 – Out of phase switching<br>• S4203_1 – Review of INSUCON<br>• S4205_1 – Assessment of contact greases for outdoor applications.<br>• S4206_1 – Substation security<br>• S4207_1 – ERS33 switchgear rating at reduced temperature<br>• S4208_1– Investigate the re-assessment of switchgear ratings<br>• S4209_1 – Post maintenance testing<br>• S4211_1 – Management and use of actuators<br>• S4215_1 – Internal arc considerations in substations | | |
| Type(s) of innovation involved | Incremental / Significant / Technological Substitution / Radical | | |

<table>
<tr><td>Expected Benefits of Project</td><td colspan="5">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.<br>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:<br>• Offset future increases in CAPEX and OPEX<br>• Increased safety of staff and public by reducing the number of accidents/incidents;<br>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="2">1-3 years - dependent on project</td><td colspan="2">Duration of benefit once achieved</td><td>2-7 years - dependent on project</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">5-40% - dependent on project</td></tr>
<tr><td>PV of Project Costs<br><br>(see note below)</td><td>£47,250</td><td>PV of Project Benefits</td><td>£59,559</td><td>NPV of Project Costs</td><td>£12,309</td></tr>
<tr><td colspan="6">Note – The project costs are identified early stage costs. They do not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="5">Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure which, if successfully addressed, would enable the expected benefits to be achieved.<br>• 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.<br>• S4176_2 – Comparison of available earth testing instruments. The project permitted cost effective comparison of four different types of electrode system to evaluate each instrument in relation to accuracy, cost, usability and robustness.<br>• 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.<br>• 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.<br>• 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.<br>• S4194 – Regenerative transformer breathers. The project undertook an independent evaluation and cost benefit analysis of “maintenance-free” desiccant breathers.<br>• 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</td></tr>
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|---|---|
| | • *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.<br>• *S4201_1 – Corrosive sulphur in transformers.* The project informed members regarding the issues and consequences of the failures in transformers due to corrosive sulphur.<br>• *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.<br>• *S4203_1 – Review of INSUCON.* This project provided a cost effective summary commentary of INSUCON content and its relevance to members.<br>• *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.<br>• *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.<br>• *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.<br>• *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.<br>• *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.<br>• *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.<br>• *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. |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

<table>
<tr><td>Description of project</td><td colspan="3">EA Technology - Strategic Technology Programme<br>EATL STP - Distributed Generation Module 5 and Forums<br><br>Research and development into all aspects of distributed Generation</td></tr>
<tr><td>Expenditure for financial year 2005/6</td><td>Internal - £10.500<br>External - £36,750<br>Total Cost - £47,250</td><td>Expenditure in previous financial period</td><td>Total Cost - £41,400</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="3">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.<br>Fifteen new project stages were approved during the year.<br>These projects aimed to:<br>• S5147_3 – Monitor Microgenerator Clusters<br>• S5149_4 – Explore Active Voltage Control<br>• S5142_2/3 – Generator Data and Structure for DG Connection Applications Stages 2 and 3<br>• S5152_2 – Latest developments in the connection of distributed generation<br>• S5154 –Voltage Control Policy Assessment Tool on the IPSA Platform<br>• S5157_1 – Evaluate the Performance of Small Scale Reactive Power Compensators Stage 1<br>• S5157_2 – Evaluate the Performance of Small Scale Reactive Power Compensators Stage 2<br>• S5160_1 – ACTIV Active Voltage Control<br>• S5161 – Standard risk assessment approach to DNO protection<br>• S5162 – Risk assessment analysis of voltage step changes<br>• S5164 – Managing network risks associated with the application of ER P2/6<br>• S5167 – Assessment of enhanced ratings for overhead lines connecting wind turbines<br>• S5168 – Design and operation implications for Grid Code compliance<br>• S5180 – DNMS functions to support active network management</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="3">Incremental / Significant / Technological Substitution</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="3">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.<br>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:</td></tr>
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<tr><td></td><td colspan="5">
<ul>
<li>Reducing the probability of voltage supply limit excursions resulting from increased distributed generation (eaVCAT interface to IPSA software tool);</li>
<li>Improving quality of supply and reducing risk of component failure (by understanding the effect and optimising use of impedance in the system);</li>
<li>A better understanding of the risk presented by the distribution assets when considered as a network rather than discrete components;</li>
<li>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);</li>
<li>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.</li>
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</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">1-5 years - dependent on project</td><td colspan="2">Duration of benefit once achieved</td><td>1-7 years - dependent on project</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">5-30% - dependent on project</td></tr>
<tr><td>PV of Project Costs (see note below)</td><td>£47,250</td><td>PV of Project Benefits</td><td>£69,827</td><td>NPV of Project Costs</td><td>£22,577</td></tr>
<tr><td colspan="6">Note – The project costs are identified early stage costs. They do not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="5">Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure which, if successfully addressed, would enable the expected benefits to be achieved.
<ul>
<li>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.</li>
<li>S5149_4 – Explore Active Voltage Control. of typical radial and interconnected networks in preparation for flexing key parameters to examine limits of active voltage control.</li>
<li>S5142_2/3 – Generator Data and Structure for DG Connection Applications. A rationalised data structure has been agreed and implemented with all terms defined.</li>
<li>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.</li>
<li>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.</li>
<li>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.</li>
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| | • *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.<br>• *S5160_1 – ACTIV Active Voltage Control.* An initial scoping study was completed and further work will be undertaken outside of the STP programme.<br>• *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<br>• *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.<br>• *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.<br>• *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.<br>• *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.<br>• *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. |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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|---|---|---|---|---|---|
| Description of project | EA Technology - Protective Coatings Forum<br><br>Research and development into all aspects of protective coatings on distribution equipment. | | | | |
| Expenditure for financial year | Internal - £1,103<br>External - £6,000<br>Total Cost - £7,103 | | Expenditure in previous financial period | Total cost - £6,825 | |
| Technological area and / or issue addressed by project | The projects undertaken through budget year 2006/07 addressed real problems that had been identified by the forum members as significant and which required technical investigation and development. Projects were aimed at providing:-<br>• Cost effective protective coatings for distribution equipment either by reducing operating costs or capital investment.<br>• Reduction of the environmental impact of associated activities in preparation for EC Solvent Emission Directive (SED) 1999/13/EC and future National Emissions Ceiling Directive.<br>• Improvements in safety.<br>This forum is supported by the majority of UK DNOs. | | | | |
| Type(s) of innovation involved | Incremental, significant, technological substitution | | | | |
| Expected Benefits of Project | Development of a Volatile Organic Compound (VOC) compliant paint system that performs at least as well as the currently used solvent based systems on towers will ensure a smooth transmission to environmentally friendly paint systems as demanded by legislation.<br>This will provide financial benefits derived from the reduction in operating costs and capital investment. It will also provide ongoing environmental benefits. | | | | |
| Expected Timescale to adoption | 2 – 4 years (dependent on adoption of legislation) | | Duration of benefit once achieved | 3 – 10 years | |
| Estimated Success probability (at start of project) | Success probability is expected to be 50% over the whole programme of projects. | | | | |
| PV of Project Costs | £12,760 | PV of Project Benefits | £38,294 | NPV of Project Costs | £25,533 |
| (note – The project costs are the user group costs and the costs of carrying out the projects. They do not reflect the likely full costs of implementation of any ideas or techniques resulting from the work.) | | | | | |
| Commentary on project progress and potential for achieving expected benefits | • Field Inspections and tests on structures protected with a MIO modified primer has allowed modification to the Urethane Alkyd Tower Paint System Specification.<br>• Quality assessment and evaluation continues on a number of different Volatile Organic Compounds (VOC) compliant paint systems.<br>• Prohesion testing of single coat epoxy systems has been delayed due to problems with the test rig. | | | | |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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|---|---|---|---|---|---|
| Description of project | EA Technology – Partial Discharge Group<br>Research and development into all aspects of partial discharge in distribution equipment. | | | | |
| Expenditure for financial year | Internal - £3,150<br>External - £5,954<br>Total Cost - £9,104 | | Expenditure in previous financial period | Total cost - £7,153 | |
| Technological area and / or issue addressed by project | The projects undertaken through budget year 2006/07 addressed real problems that had been identified by the group members as significant and which required technical investigation and development. Projects were aimed at providing:-<br>• Improved management of Assets through better understanding of Partial Discharge through targeted investigative, research and development work.<br>• Reduced fault rates by early detection of insipient faults.<br>• Reduced environmental impact by early detection of faults.<br>• Improvements in safety.<br>This forum is supported by the majority of UK DNOs. | | | | |
| Type(s) of innovation involved | Technological substitution and enhanced methods of working | | | | |
| Expected Benefits of Project | Partial discharge is becoming an essential technique when assessing failure probabilities in both an aging population of traditional distribution assets and certain new equipment, which has been found to have less tolerant insulation mechanisms.<br>Early detection of faults allows controlled remedial action and provides –<br>• Financial benefits derived from the reduction in fault repairs<br>• Improved network performance and operator safety<br>• Improved quality of supply for customers | | | | |
| Expected Timescale to adoption | 2 years | | Duration of benefit once achieved | Average benefits of one years programme will last 3 years | |
| Estimated Success probability (at start of project) | Success probability is expected to be 20% over the whole programme. | | | | |
| PV of Project Costs | £14,851 | PV of Project Benefits | £24,973 | NPV of Project Costs | £10,122 |
| (note – The project costs are the user group costs and the costs of carrying out the projects. They do not reflect the likely full costs of implementation of any ideas or techniques resulting from the work.) | | | | | |
| Commentary on project progress and potential for achieving expected benefits | • Enhanced Data Management (incorporating pictures, drawings, failure records and sound files) - Database will enable significant information to be quickly drawn from a large population of historic results.<br>• Assessment and Development of Test Equipment – including calibration device, remotely monitored equipment and an investigation into the feasibility of new detection equipment.<br>• Profile of Long Term Degradation of Switchgear – Tests continue on several types of switchgear. One panel has failed and a report is in preparation. | | | | |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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|---|---|---|---|
| Description of project | ENA R&D Programme<br><br>Four projects initiated by the ENA R&D Working Group.<br>The Energy Networks Association (ENA) represents all UK DNOs. | | |
| Expenditure for financial year | Internal - £7,350<br>External - £3,497<br>Total Cost - £10,847 | Expenditure in previous financial period | Total cost - £5,771 |
| Technological area and / or issue addressed by project | The projects undertaken through budget year 2006/7 addressed real problems that had been identified by the ENA Working Groups as significant and which required technical investigation and development.<br><br>• *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.<br>• *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.<br>• *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.<br>• *SG17 Lightning Protection* - Produce a new Engineering Technical Report on lightning protection to include:<br>Background information on lightning density across the UK, annual variations and effect of topography.<br>Catalogue and provide a view on current practices and procedures.<br>Determine and advise on equipment protection levels and arrangements. | | |
| Type(s) of innovation involved | Incremental and Significant innovation types are involved. | | |
| Expected Benefits of Project | • *ROCOF Relay functional specification* – Improved understanding will allow more effective settings to be applied to these relays, which will reduce the number of spurious trips. This will improve power quality to other connected customers and the specification should reduce the cost associated with generation scheme quotes.<br>• *SG12 Fault Level Monitor* – The FLM instrument will allow fault infeed levels to be accurately assessed. This will provide an objective measurement tool that can be used to facilitate both the initial connection of distributed generation and ongoing assessment of its effects.<br>• *SG14 Earthing Project* – 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. | | |

<table>
<tr><td></td><td colspan="5">• SG17 Lightning Protection – Identification of required lightning protection application will reduce equipment failure and faults due to lightning. This will improve performance and reduce fault costs.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">1 - 10 years<br>(depending upon project)</td><td>Duration of benefit once achieved</td><td colspan="2">10 - 40years<br>(depending upon project)</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">25 - 75% (depending upon project)</td></tr>
<tr><td>PV of Project Costs</td><td>£1,143,489<br>(see note below)</td><td>PV of Project Benefits</td><td>£815,569</td><td>NPV of Project Costs</td><td>£347,921</td></tr>
<tr><td colspan="6">Note – These project costs include implementation and have been calculated assuming a typical distribution license area.</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="5">• ROCOF Relay functional specification – EA Technology published the Final report in March 2007.<br>• SG12 Fault Level Instrument – EA Technology and the University of Strathclyde have pursued the following activities<br>1. Candidate monitoring sites and Deployment of loggers– Network disturbance data has been obtained using Dranetz PX5 Power Quality instruments.<br>2. Algorithm Evaluation and assessment – The Fault Level Algorithm has been coded within the Matlab environment. A network model with known parameters has been created in Matlab/Simulink and the fault level estimated for a range of scenarios. Results from the applied scenarios (voltage and current waveforms) are passed into the Fault Level algorithm and results compared.<br>3. Dranview disturbance record analysis – Dranview data is being processed for integration into the coded Fault Level algorithm. The results from the ‘real’ data and the result from the Fault Level algorithm are to be compared to the relevant power network models supplied by the site hosts (studied in PSS/E).<br>4. Experimentation and Laboratory investigations – A fault level monitor instrument is being tested on the University of Strathclyde Micro-grid system with static and active loads. This laboratory work will enable scenario results from a very well known and modelled network to be compared against the performance of an existing Fault Level instrument.<br>• SG14 Earthing Techniques – EA Technology<br>1. Investigation at Test Facility - Report and CIRED paper completed. Measurements carried out at the S&S Ltd test facility to enable better understanding of transfer potential. The measurement results were compared to predictions using the CDEGS software.<br>2. Investigation at 11kV substations - Identification of suitable test sites is underway. Site testing has commenced at two suitable sites.<br>• SG17 Lightning Protection – Engineering Technical Report (ETR 134) awaiting final approval before publishing.</td></tr>
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## Individual IFI Project Reports for Period April 2006 – March 2007
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|---|---|---|---|---|---|
| Description of project | Power Technology - Advanced Distribution Automation<br><br>Electric Power Research Institute - Program 124.005<br>Research and Development into an Integrated Sensor and Monitoring System for Advanced Distribution Automation | | | | |
| Expenditure for financial year | Internal - £2,100<br>External - £27,991<br>Total - £30,091 | | Expenditure in previous financial period | Total cost - £23,315 | |
| Technological area and / or issue addressed by project | The distribution system of the future will be based on Advanced Distribution Automation that includes two key aspects :-<br>• Enabling new system configurations, such as looped feeders, islandable circuits and bi-directional power flows. Such capabilities will make a system more flexible, more able to operate reliably and able to recover or reduce the impact from outages.<br>• Integration and strategic use of new intelligent electric devices (IEDs) to enable the use of flexible electrical architecture to produce not only new system configurations, but also to provide a means for expanding customer service options. | | | | |
| Type(s) of innovation involved | All innovation types involved (incremental, significant, technological substitution and radical) | | | | |
| Expected Benefits of Project | The first generation of integrated sensor and monitoring system for Advanced Distribution Monitoring will increase :-<br>• Distribution Reliability by providing continuous monitoring of vital system operating parameters to allow strategic operation of the distribution system.<br>• Network Utilisation of existing infrastructure by allowing closer control of voltage profiles and maximising energy throughput.<br>• Flexibility of the network by optimising system performance under changing conditions caused by outages or demand / supply changes. | | | | |
| Expected Timescale to adoption | 7 years | | Duration of benefit once achieved | 10 years | |
| Estimated Success probability (at start of project) | 25% | | | | |
| PV of Project Costs | £158,118 | PV of Project Benefits | £236,226 | NPV of Project Costs | £78,108 |
| (note – The project costs are identified early stage costs. They do not reflect the likely full costs of implementation.) | | | | | |
| Commentary on project progress and potential for achieving expected benefits | Stages completed in 2006 -<br>• Identification of specific data collection requirements for ADA<br>• Identification of available Sensors that can fulfill these data collection requirements<br>• Identification of areas where further development of Sensors is required. | | | | |

## Individual IFI Project Reports for Period April 2006 – March 2007
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<tr><td>Description of project</td><td colspan="5">Power Technology – Intelligent Universal Transformer<br><br>Electric Power Research Institute - Program 124.006<br>Research and Development into a solid state replacement for conventional power transformers.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="2">Internal - £2,100<br>External - £26,192<br>Total - £28,292</td><td colspan="2">Expenditure in previous financial period</td><td>Total cost £21,505</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="5">The Intelligent Universal Transformer is an advanced power electronic design that can replace conventional copper and iron transformers. It has the increased functionality necessary for operating on future distribution networks.</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="5">Significant, technological substitution and radical innovation types are involved.</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="5">Intelligent Universal transformers will provide operating benefits and increased functionality over conventional transformers :-<br>• Increased Utilisation of existing infrastructure by regulating voltage, power factor and frequency.<br>• Active power quality functionality will eliminate dips, and harmonic distortion.<br>• Increased customer service options such as DC (or high frequency), three phase power from a single phase line. Remote condition monitoring and control may also provide the option for passive DSM.<br>• Reduced environmental and safety issues as it will contain no hazardous or harmful dielectrics.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">7 years</td><td colspan="2">Duration of benefit once achieved</td><td>25 years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">25%</td></tr>
<tr><td>PV of Project Costs</td><td>£85,098</td><td>PV of Project Benefits</td><td>£116,483</td><td>NPV of Project Costs</td><td>£31,385</td></tr>
<tr><td colspan="6">(note – The project costs are identified early stage costs. They do not reflect the likely full costs of implementation.)</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="5">Stages completed in 2006 -<br>• Testing of modular field prototype IUT<br>• Production of product specification<br>• Assessment of project benefits<br>• Initial development of a statement of risks for developing and commercialisation<br>• Interviewing of prospective major power electronic equipment partners<br>• Presentations to promote IUT at major conferences and workshops<br>•<br>Stages in progress –<br>• Final selection a developer for the development phase, who will stay with the project during commercialisation.</td></tr>
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## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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|---|---|---|---|---|---|
| Description of project | Dynamic Ratings<br><br>Central Networks has developed the first RPZ in the UK. This involves the application of an active rating to an 132kV overhead line based on real time measurements of ambient temperature and wind speed. | | | | |
| Expenditure for financial year | Internal - £17,798<br>External - £64,338<br>Total Cost - £82,136 | | Expenditure in previous financial period | | Total cost N/A |
| Technological area and / or issue addressed by project | The active rating calculations are carried out at our control centre as part of a load management scheme that will curtail generation in the event of the line rating becoming exceeded. In addition there are two innovative areas, which required further research and are being funded via the IFI mechanism:<br><br>• Risk Assessments identified the requirement for a local overload protection scheme, which will prevent the line rating becoming exceeded in the event of a loss of communications.<br><br>• As a verification of the derived ratings, sensors will be attached temporarily to the conductors as various positions on the overhead line. | | | | |
| Type(s) of innovation involved | Incremental and Technological Substitution | | | | |
| Expected Benefits of Project | The project will:<br>• Develop and demonstrate an overload protection system which is compatible with active rating load management scheme<br>• Verify the derived rating of the overhead line by comparing with measured real time conductor data | | | | |
| Expected Timescale to adoption | 2 years | | Duration of benefit once achieved | | 20 years |
| Estimated Success probability (at start of project) | 75% | | | | |
| PV of Project Costs | £260,880 | PV of Project Benefits | £475,256 | NPV of Project Costs | £214,376 |
| Commentary on project progress and potential for achieving expected benefits | Stages complete -<br>• Review circuit ratings based on wind speed and ambient temperature and investigate other factors which could impact circuit rating<br>• Identify suitable sensors for detecting required weather and conductor data<br>• Identify a suitable protection equipment manufacturer to act as partner on this project<br>• Develop compatible active rating algorithms for the relay<br>• Carry out Risk Assessment of system considering failure mode effects and criticality analysis | | | | |

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| | Stages in progress -<br>• Test prototype relay and install in parallel with existing protection equipment<br>• Select and Install temporary line sensors and additional monitoring equipment<br>• Monitor parameters to confirm satisfactory operation<br><br>A one page bulletin has been produced, which describes in more detail this project. This can be viewed on the Central Networks Research and Development Web page. http://www.eon-uk.com/CentralNetworksRPZ1406.pdf |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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| Description of project | Energy Storage for Distribution Systems<br><br>Energy storage is a key enabling technology for the development of innovative solutions to manage and control the electrical networks of the future. A staged research and development programme will lead to the manufacture of a prototype 1MW redox flow battery with a capacity of several MWh, which will be connected to the electricty distribution system and operated for a period of upto 24 months. | | |
| Expenditure for financial year | Internal - £4,725<br>External - £62,133<br>Total Cost - £66,858 | Expenditure in previous financial period | Total cost N/A |
| Technological area and / or issue addressed by project | The object of the project is to investigate the role of energy storage in intelligent network and power outage management by the research and development of a large scale flow battery and demonstrate its application to the distribution network.<br>The demonstration will involve installation and operation of physical plant to identify the implications of connecting large electrical storage capacity to a network and the contribution it can make to:<br>• supply reliability<br>• connection of large amounts of generation with intermittent output<br>• control of networks with large fluctuating demands<br>• a range of other network services<br>This will be the first application of a large-scale energy storage to the electricity distribution system in the UK, which will require innovation in control technology and operational strategy to understand and exploit the benefits of storage in intelligent networks. | | |
| Type(s) of innovation involved | Radical and Significant | | |
| Expected Benefits of Project | The project addresses the need to develop and apply energy storage at a scale of significant size in order to promote confidence in the technology. The work will tease out practical interface and operational issues.<br><br>This redox flow battery has a theoretically high power transfer density which will make it suitable for maintaining supplies during short duration outages, so portable units could be used to provide standby support at substations during maintenance and construction activities, allowing sufficient time for restoration by switching or connection of portable generation.<br><br>Static units could be used to smooth generation profiles to defer reinforcement requirements / prevent generation being curtailed. They could also be used to improve distribution network power quality. | | |
| Expected Timescale to adoption | 6 years | Duration of benefit once achieved | 15 years |

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| Estimated Success probability (at start of project) | 25% | | | | |
| PV of Project Costs | £449,456 | PV of Project Benefits | £614,558 | NPV of Project Costs | £165,102 |
| Commentary on project progress and potential for achieving expected benefits | Stages complete –<br>• Report into the uses of large scale energy storage on the distribution network<br>Stages in Progress -<br>• Optimise, further develop and test the redox flow fuel cell technology<br>• Scale up construction to 4MWh prototype energy storage unit and test<br>• Model network integration requirements and design control functionality<br>• Install and commission prototype unit on distribution network<br>• Carry out trials on the prototype energy storage unit<br>• Disseminate project results | | | | |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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| Description of project | Optimising System Design for Improved Performance and reduced Losses<br><br>The project aims to provide Central Networks with an optimising tool, which will consider both performance and system losses of alternative networks, under different degrees of distributed generation penetration, as well as to provide the parameters necessary to identify the financial impacts associated with each alternative. | | | | |
| Expenditure for financial year | Internal - £8,820<br>External - £76,000<br>Total Cost - £84,820 | | Expenditure in previous financial period | Total cost N/A | |
| Technological area and / or issue addressed by project | There is a need for more quantative analysis of the life cycle costs of network investment. Whereas buying cheaper network components may result in short term savings, Distribution Network Operators need to consider how to achieve both improved performance and reduced losses in the network and consider these in the environment of distributed generation.<br>We already have developed performance tools, which can be used to develop both strategic and tactical plans, but there is no clear understanding of where losses occur in the Central Networks distribution system. It is however important not to develop these tools in isolation, but to recognise that optimal network solutions are required. | | | | |
| Type(s) of innovation involved | Incremental and Significant | | | | |
| Expected Benefits of Project | The primary aims of this project are to:<br>(i) deliver better customer service<br>(ii) reduce system losses<br>(iii) lower long term operational costs<br><br>The optimising tool will be used to facilitate the following:<br>• Identification of optimum improvement strategies that could include fundamental changes to circuit topology as well as incremental improvements to design.<br>• Generate optimum network designs that are flexible enough to accommodate different levels of Distributed Generation penetration.<br>• Influence future asset replacement decisions to maximise the effectiveness and efficiency of the network design and allow the development of design guidelines.<br>• Provide a mechanism to influence future regulation by providing an objective mechanism for understanding the performance and efficiency drivers of different network designs. | | | | |
| Expected Timescale to adoption | 5 years | | Duration of benefit once achieved | 20 years | |
| Estimated Success probability (at start of project) | 25% | | | | |
| PV of Project Costs | £155,892 | PV of Project Benefits | £249,219 | NPV of Project Costs | £93,327 |

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| Commentary on project progress and potential for achieving expected benefits | Stages complete -<br>• Understand where losses exist in typical networks and carry out sensitivity analysis to understand critical parameters.<br>• Establish suitable methodologies and tools to provide technical and more accurate loss assessment of Central Network's network<br>Stages in progress -<br>• Develop a series of network representative models such that loss calculations can be carried out using network data specific to Central Networks.<br>• Verify the representative models with losses calculated from existing networks.<br>• Link the existing performance tools to enable optimisation.<br>• Optimise network design for a number of possible scenarios and consider the impact of Distributed Generation on each design. |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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| Description of project | Maintaining Critical Domestic Loads during Power Outages<br><br>Distribution network operators have an obligation to maintain supplies to customers | | | | |
| Expenditure for financial year | Internal - £1,050<br>External - £26,615<br>Total Cost - £27,665 | | Expenditure in previous financial period | Total cost N/A | |
| Technological area and / or issue addressed by project | During a power outage, power is lost to both critical and non-critical appliances. Power outages during the summer months can be inconvenient and annoying, but are rarely life-threatening. Power outages during cold weather can however have serious impacts for customers. Even central heating systems powered by other fuel sources fail, due to their reliance on mains power for control circuits and circulation pumps.<br>The aim of this project is to develop a demonstration of the micro-CHP unit operating as an islanded generator, supporting the critical domestic housing load and heating requirements.<br>A future stage of passively or remotely controlling the micro-CHP as a domestic Demand Side Management scheme could be used as a tool for better network management and allow the potential deferment of capital works, but benefits from this particular area have not been considered. | | | | |
| Type(s) of innovation involved | Incremental and Technological Substitution | | | | |
| Expected Benefits of Project | Micro-CHP can already provide a carbon efficient method of heating, but the use of micro-CHP units that generate power to support critical domestic housing load requirements during power outages, in addition to providing heating requirements, is an innovation which takes this technology one stage further and can provide significant customer benefits.<br>This technology could be especially useful for maintaining the critical domestic loads of vulnerable customers. | | | | |
| Expected Timescale to adoption | 7 years | | Duration of benefit once achieved | 20 years | |
| Estimated Success probability (at start of project) | 25% | | | | |
| PV of Project Costs | £127,100 | PV of Project Benefits | £185,805 | NPV of Project Costs | £58,705 |
| Commentary on project progress and potential for achieving expected benefits | Stages complete –<br>• Understand domestic loads and demand side management techniques in domestic houses, including a survey of domestic appliance energy requirements, power consumption and typical and deferred load profiles<br>Stages in progress -<br>• Understand the capabilities of micro-CHP units, including their ability to start under outage conditions, maintaining stable voltage output and balancing power supply requirements when heat store is full<br>• Develop mechanism to maintain supplies at the moment of supply interruption, of isolating from the distribution network to operate in island | | | | |

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| | mode and of reconnection when supplies have been restored<br>• Develop provision of status information to customer and possible interface with DNO communications<br>• Complete safety risk assessments and ensure compliance with statutory requirements and ENA ER G83<br>• Demonstration of micro-CHP island unit in a domestic property |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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| Description of project | Networks to Improve Power Quality<br><br>Power quality and reliability continue to grow in importance with deregulation of the electric power industry. Computer technology, automated processes and sensitive electronic equipment are in wide-spread use across all sectors and there is a requirement on DNOs to provide a high quality of supply and service to its customers. | | | | |
| Expenditure for financial year | Internal - £3,675<br>External - £60,300<br>Total Cost - £63,975 | | Expenditure in previous financial period | Total cost N/A | |
| Technological area and / or issue addressed by project | Short duration interruptions and voltage sags are the most frequent network disturbances and cause the greatest loss of revenue to commercial and industrial customers as they result in frequent mal-operation of equipment. The disruption of an industrial process, due to a supply interruption or voltage sag, can result in very substantial costs to the operation ranging up-to millions of pounds attributed to single disruption of the process whereas the costs to commercial customers (e.g. banks, data centres customer service centres etc.) can be just as high if not higher. | | | | |
| Type(s) of innovation involved | Incremental and significant | | | | |
| Expected Benefits of Project | Mesh distribution networks can reduce the number of short duration interruptions, but can also increase the potential for voltage sags. Understanding the feasibility of modifying existing networks and how any undesirable consequences for customers can be mitigated for or eliminated is therefore an important element in improving distribution network design.<br>The two key areas of research in this project are:<br>• Investigation of the performance benefits, economics and the technical restrictions of modifying existing radial networks into mesh distribution networks with the aim of reducing short duration customer outages.<br>• Investigation into the potential and available alternatives for a distribution company to provide a cost effective, enhanced electricity supply, which will limit the effects of voltage sags on the network to either individual or clustered groups of customers. | | | | |
| Expected Timescale to adoption | 4 years | | Duration of benefit once achieved | 20 years | |
| Estimated Success probability (at start of project) | 25% | | | | |
| PV of Project Costs | £141,875 | PV of Project Benefits | £207,988 | NPV of Project Costs | £66,113 |
| Commentary on project progress and potential for achieving expected benefits | Stages complete -<br>• Identify potential paralleling points on existing networks and model the appropriate parts of the network<br>• Using the model, investigate current flows and voltage stability during network paralleling and switching | | | | |

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| | • Report on the effects of paralleling, what actions might be taken to achieve paralleling and the benefits to Central Networks and its customers<br>Stages in progress<br>• Identify typical sensitive equipment that might lead to process interruption and consequent financial losses and classify processes based on usage of those types of equipment.<br>• Develop relevant mathematical models of representative customer plant for studies of process sensitivity to voltage disturbances.<br>• Investigate existing distribution system arrangements in terms of power quality management and other available techno-economic options for improvement of quality of electricity supplied to individual or groups of customers.<br>• Simulate sections of the Central Networks distribution system to investigate the potential improvements in customer power quality.<br>• Develop a proposal/recommendation for a full scale demonstration of a High Quality Power Zone. |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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| Description of project | Magnetic Fault Current Limiter<br><br>Development and demonstration project in partnership with AREVA T&D. | | | | |
| Expenditure for financial year | Internal - £3,780<br>External - £7,500<br>Total Cost - £11,280 | | Expenditure in previous financial period | Total cost N/A | |
| Technological area and / or issue addressed by project | Distribution networks have to manage ever increasing load demand and penetration of distributed generation, while having to maintain high security and reliability standards set out by the regulator. There are increasingly situations where fault current levels exceed the ratings of existing switchgear and transient current ratings of other equipment such as cables, lines and transformers. This overstressing can cause disruptive failure of switchgear under fault conditions.<br>The traditional method to overcome this problem is to replace relevant assets with higher rated components. Another approach is to install a fault current limiter that has the effect of reducing the current during a fault, and should have minimal voltage drop during normal operation. There have been recent developments in fault current limiters by various suppliers. AREVA T&D have been looking at two ways to limit system fault currents:<br>1. A fault current limiter using novel superconducting materials<br>2. A fault current limiter using permanent magnets.<br>Whereas the technical and economical viability of using superconducting materials is presently still questionable, the magnetic fault current limiter is expected to be more promising as it employs permanent magnet material that is easier to handle. This project seeks to evaluate how magnetic fault current limiters can facilitate fault level management in a distribution network. | | | | |
| Type(s) of innovation involved | Significant and technological substitution | | | | |
| Expected Benefits of Project | This project will investigate the exploitation of a magnetic fault current limiter as being developed by AREVA and will provide the following important information:<br>• Demonstrate whether magnetic fault current limiters are a viable technology for fault level management<br>• How to specify a fault current limiter | | | | |
| Expected Timescale to adoption | 5 years | | Duration of benefit once achieved | 20 years | |
| Estimated Success probability (at start of project) | 25% | | | | |
| PV of Project Costs | £275,011 | PV of Project Benefits | £457,885 | NPV of Project Costs | £182,874 |
| Commentary on project progress and potential for achieving expected benefits | Stages complete -<br>• Identify applications for a fault current limiter<br>• Specify suitable parameters for a fault current limiter | | | | |

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| | Stages in progress -<br>• Co-ordinate and set up collaboration with AREVA<br>• Carry out a cost/benefit analysis to evaluate how a magnetic fault current limiter could be a cheaper alternative to fault level management as compared with traditional measures.<br>• Carry out testing of a Prototype Fault Current Limiter<br>• Construct and Factory Test a Pre-production Fault Current Limiter<br>• Install and demonstrate a Pre-Production Fault Current Limiter on Central Networks System<br>• Monitor the installed Fault Current Limiter |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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| Description of project | Understanding Networks with High Penetrations of Distributed Generation | | |
| Expenditure for financial year | Internal - £2,100<br>External - £12,820<br>Total Cost - £14,920 | Expenditure in previous financial period | Total cost N/A |
| Technological area and / or issue addressed by project | New and existing developments are being promoted with the aim of achieving zero carbon communities. This challenges traditional distribution network design in a number of ways;<br>• There is a requirement to absorb large penetrations of micro generation on to the LV network. (This requirement may extend to several substations where major redevelopment is being proposed.)<br>• Other low carbon conservation measures applied in the same areas means that local generation could exceed demand at certain periods of the day.<br>Central Networks would like to support such Low Carbon initiatives by modifying network design to both minimise network losses while maximising the amount of generation that can be accommodated without infringing fault level or statutory voltage limitations.<br>A proposed major urban redevelopment has given Central Networks the opportunity to demonstrate the benefits of an innovative approach to network design and this network is to be modelled in a number of configurations. The project will include an 11kV connected wind turbine and various forms of 'green' micro generation connected in individual domestic premises and public buildings. This micro generation will be distributed across the LV networks of approximately a dozen substations on two existing 11kV feeders. Actual load and voltage profiles will also be monitored at substation level both before and after redevelopment to obtain information for future network design and verify the model's outputs.<br>This network will also be compared with the theoretical study on the Loughborough network being carried out by Loughborough University, Centre for Renewable Energy Systems Technology (CREST) using their Unbalanced Load-Flow Software. Central Networks are providing network data and monitoring actual load and voltage profiles to support this work. | | |
| Type(s) of innovation involved | Incremental | | |
| Expected Benefits of Project | • Identification of changes required to conventional network design to maximise the penetration of micro generation<br>• Understanding the effect of increasing generation output from a cluster of micro generation on the distribution network. In particular thermal rating, voltage rise and fault level.<br>• Ability to ensure that any modified design also reduces network losses | | |
| Expected Timescale to adoption | 5 years | Duration of benefit once achieved | 5 years |
| Estimated Success probability (at start of project) | 75% | | |

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| PV of Project Costs | £81,658 | PV of Project Benefits | £92,841 | NPV of Project Costs | £11,183 |
| Commentary on project progress and potential for achieving expected benefits | Stages complete -<br>• Data capture of network parameters for modelling<br>• Initial modeling of redevelopment area to find limiting criteria<br>Stages in progress<br>• Installation of Power Quality meters at substations<br>• Development of alternative network models<br>• Analysis of load and voltage data to produce load profiles<br>• Validation of network models | | | | |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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| Description of project | Protection to Improve Reliability in Networks with Distributed Generation<br><br>This project will investigate the problems imposed on existing network electrical protection schemes by the integration of new embedded generation projects. | | | | |
| Expenditure for financial year | Internal - £525<br>External - £2,000<br>Total Cost - £2,525 | | Expenditure in previous financial period | Total cost N/A | |
| Technological area and / or issue addressed by project | Existing distribution network electrical protection schemes were not designed to accommodate embedded generation connections and it is sometimes necessary to amend protection settings to allow this connection. Finding settings suitable for a generator can be time consuming and may result in compromises, which could adversely affect other parameters and introduce other risks. | | | | |
| Type(s) of innovation involved | Incremental | | | | |
| Expected Benefits of Project | Knowledge of generator and system requirements and detailed understanding of the implications of alternative setting options on existing protection schemes, together with those possible on complementary or replacement protection schemes, would allow optimum arrangements to be developed to the benefit of; existing customers, generators and the distribution network operator. | | | | |
| Expected Timescale to adoption | 4 years | | Duration of benefit once achieved | 20 years | |
| Estimated Success probability (at start of project) | 25% | | | | |
| PV of Project Costs | £42,141 | PV of Project Benefits | £67,389 | NPV of Project Costs | £25,248 |
| Commentary on project progress and potential for achieving expected benefits | Stages in progress -<br>• Identify a selection of typical network systems and generator connections to include in the study<br>• Review existing network protection schemes and policies<br>• Investigate the options for changes to the settings of existing network protection. Quantify the impact on the connection of embedded generation, reliability of supplies to customers, fault clearance times, safety and plant risk and make recommendations<br>• Investigate alternative network protection schemes that could be installed either complementary to or as a replacement for existing network protection. Quantify their impacts and make recommendations.<br>• Report on the potential benefits and disadvantages of the alternative protection options and produce protection guideline document. | | | | |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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| Description of project | Effect of Electric Vehicles on Distribution Networks | | | | |
| Expenditure for financial year | Internal - £525<br>External - £5,000<br>Total Cost - £5,525 | | Expenditure in previous financial period | Total cost N/A | |
| Technological area and / or issue addressed by project | The project is looking at the potential impact of Electric Vehicles on the UK Distribution Grid systems and considers how the energy in the car battery might be returned to the grid at times of peak load or for system support. "Vehicle-to-Grid in the UK (V2GUK)".<br>It aims to understand the requirements and limitations of the energy demands of a network-connected vehicle fleet when connected to a real distribution network.<br>Develop a system-level network management strategy to level the demand loading and maximise efficiency, and a local management strategy to control individual vehicle network connections, along with further strategies implemented on board the vehicles. | | | | |
| Type(s) of innovation involved | Technological substitution and radical | | | | |
| Expected Benefits of Project | The proposed research will provide knowledge to overcome the barriers in the use of network-connected vehicles by the development of models to represent operating conditions.<br>Identify real world demand requirements on distribution networks from charging / storage / discharging cycling as determined by actual vehicle operation and the capabilities of the distribution network load. | | | | |
| Expected Timescale to adoption | 5 years | | Duration of benefit once achieved | 10 years | |
| Estimated Success probability (at start of project) | 25% | | | | |
| PV of Project Costs | £82,503 | PV of Project Benefits | £117,661 | NPV of Project Costs | £35,159 |
| Commentary on project progress and potential for achieving expected benefits | Stages Complete –<br>Project conception Phase<br>• Develop project strategy and obtain project partners<br>• Understand distribution network criteria<br><br>Stages In progress -<br>Data collection and analysis Phase<br>• Data logging on grid-connected vehicles for vehicle energy evaluation<br>• Estimate the rating and citing of the charging infrastructure within the distribution network, and the impact on the network.<br>Phase | | | | |

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| | • Network demand evaluation using customer demand/usage profile.<br>• Investigate strategies to minimise the impact on the infrastructure.<br>• Quantify typical/potential energy flow (V2G and G2V), and evaluate limits to the practical possibilities for stored battery energy supplied to the grid.<br>• Vehicle technology aspects - cycling on the battery life, well-to-wheel fuel consumption figures, examine optimum vehicle specifications according to various scenarios.<br>• Built environment infrastructure strategy and planned charging point location<br>Future implementation/pilot Phase<br>• Pilot demonstration<br>• Model the vehicle energy aspects of cities in the future |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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| Description of project | SuperGen V (Amperes )<br><br>This Sustainable Power Generation and Supply Initiative on Asset Management and Performance of Electrical Systems is a 4 year, £2.8M project, funded by EPSRC (Engineering and Physical Sciences Research Council) in collaboration with all UK DNOs, National Grid and Advantica. | | | | |
| Expenditure for financial year | Internal - £4,830<br>External - £25,000<br>Total Cost - £29,830 | | Expenditure in previous financial period | Total cost N/A | |
| Technological area and / or issue addressed by project | EPSRC have put together a group of universities to address the UK energy infrastructure. These are:<br>Manchester University<br>Southampton University<br>Edinburgh University<br>Liverpool university<br>Strathclyde University<br>Queens University, Belfast<br>The research programme is split into 6 work packages and 25 activities. Most of the research will be carried out by the six universities.<br>• WP1; Programme delivery, outreach and implementation<br>• WP2: Enhanced network performance and planning<br>• WP3: New protection and control techniques that adapt to changing networks<br>• WP4: Infrastructure for reducing environmental impact<br>• WP5 Ageing mechanisms<br>• WP6: Condition monitoring techniques | | | | |
| Type(s) of innovation involved | Technical substitution and radical innovation | | | | |
| Expected Benefits of Project | The aims of the project are:<br>• To deliver a suite of intelligent diagnostic tools for plant<br>• To provide platform technologies for integrated network planning and asset management<br>• To progress plans to develop and implement improved and reduced environmental impact networks<br>• To develop models and recommendations for network operation and management | | | | |
| Expected Timescale to adoption | 7 years | | Duration of benefit once achieved | 20 years | |
| Estimated Success probability (at start of project) | 25% | | | | |
| PV of Project Costs | £102,221 | PV of Project Benefits | £176,231 | NPV of Project Costs | £74,010 |

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| Commentary on project progress and potential for achieving expected benefits | Progress:<br>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.<br>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.<br>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.<br>Outputs and Deliverables:<br>The following are formal outputs from the consortium.<br>Reports:<br>• Report on 'Evaluation of G59 Protection relays<br>• Discussion Document on Vision and Priorities for Industrial demonstration<br>• Condition Monitoring Specification<br>• Lessons learnt from writing consortium agreement<br>• A review of voltage control<br>• Condition monitoring -State of the art report from Activity 5.2<br>Technology:<br>• A low cost RF unit has been produced based on the chromatic methodology of deploying the RF sensors.<br>• A fibre optic based acoustic sensor for detecting abnormal signatures from plant is near completion.<br>• 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.<br>• Equipment to control power quality of a voltage supply is nearing completion.<br><br>(The above has been extracted from the full Supergen V annual report) |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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| Description of project | Ice Cleaning of Distribution Plant<br><br>Demonstration in collaboration with 'Ice Clean engineering' of a non abrasive, non solvent cleaning process which uses blasted solid $CO_2$ pellets to clean severely contaminated plant and equipment. | | | | |
| Expenditure for financial year | Internal - £5,008<br>External - £12,149<br>Total Cost - £17,157 | | Expenditure in previous financial period | Total cost N/A | |
| Technological area and / or issue addressed by project | Central Networks has several sites adjacent to industrial process plants, where significant quantities of airborne contamination settles on equipment. This contamination can cause flashovers when deposited on exposed insulators and can significantly reduce thermal efficiency of transformer radiators if deposits are allowed to accumulate. | | | | |
| Type(s) of innovation involved | Incremental and technological substitution | | | | |
| Expected Benefits of Project | Cost effective alternative to traditional methods of removing contamination with the advantages of:<br>• No abrasive or solvent damage to equipment or plant<br>• Non toxic cleaning material reduces handling and storage requirements<br>• No post cleaning residue to be removed<br>• Ice pellets vaporise after impact leaving no waste products except the dislodged contamination | | | | |
| Expected Timescale to adoption | 1 year | | Duration of benefit once achieved | 6 years | |
| Estimated Success probability (at start of project) | 75% | | | | |
| PV of Project Costs | £18,868 | PV of Project Benefits | £24,764 | NPV of Project Costs | £5,896 |
| Commentary on project progress and potential for achieving expected benefits | A trial demonstration, which involved cleaning a severely contaminated transformer bank at a site adjacent to a cement works has confirmed that the process is as effective as traditional techniques and the expected benefits can be delivered.<br><br>Other uses of this technique are also being considered. | | | | |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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| Description of project | Passive Battery Conditioning for Rural Remote Control Devices<br><br>Development and demonstration of a passive battery conditioning unit in collaboration with 4Energy. These units will be retrofitted into existing control boxes associated with remotely controlled pole mounted equipment to extend the life of the standby batteries by maintaining the battery temperature between suitably defined limits. | | | | |
| Expenditure for financial year | Internal - £7,500<br>External - £26,170<br>Total Cost - £33,670 | | Expenditure in previous financial period | Total cost N/A | |
| Technological area and / or issue addressed by project | Central Networks has approximately 4000 remotely controlled pole mounted devices installed on its network. These devices are an essential part of our automation strategy and are required to operate when the power system is de-energised. To enable this, each device has a float charged lead acid standby battery located within the devices associated control box.<br>The life of these batteries is being considerably reduced by thermal effects within these exposed control boxes and necessitates an intensive battery replacement programme to avoid a loss of performance and protection capabilities on the network. | | | | |
| Type(s) of innovation involved | Incremental and Technological Substitution | | | | |
| Expected Benefits of Project | This project aims to design and produce a passive battery conditioning unit that can be retro-fitted within the most prevalent type of existing control boxes and maintain the battery temperature between suitably defined limits such that extended battery life results.<br>The benefits are:<br>• Reduced operational costs associated with battery change programme and disposal of scrap batteries.<br>• Assurance of required performance and protection capabilities on network.<br>• Reduced environmental impact, as batteries will not need such frequent replacement. | | | | |
| Expected Timescale to adoption | 5 years | | Duration of benefit once achieved | 20 years | |
| Estimated Success probability (at start of project) | 50% | | | | |
| PV of Project Costs | £108,489 | PV of Project Benefits | £167,321 | NPV of Project Costs | £58,832 |
| Commentary on project progress and potential for achieving expected benefits | Stages complete -<br>• Thermal studies on a typical control box have identified temperature ranges during temperature extremes<br>• Calculation of battery conditioning requirements to protect battery from thermal damage<br>• Design, development and testing of a prototype battery conditioning unit<br>• Risk assessment of installation into existing control box<br>Stages in progress - | | | | |

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| | • Demonstration of performance of pre-production units with remote temperature monitoring<br>• Field trial of production units at selected sites<br>• Assessment of battery condition<br><br>A one page bulletin has been produced, which describes in more detail this project. This can be viewed on the Central Networks Research and Development Web page. http://www.eon-uk.com/Battery_Air_conditioning1.pdf |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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| Description of project | Non invasive Overhead Line Inspection Techniques | | | | |
| Expenditure for financial year | Internal - £3,255<br>External - £4,419<br>Total Cost - £7,674 | | Expenditure in previous financial period | Total cost N/A | |
| Technological area and / or issue addressed by project | Regular inspections are carried out on the Overhead Line assets, in the form of helicopter or ground foot patrols. Both these types of inspections have their limitations as they do not allow very close visual inspection or detailed measurements to be taken at the pole top. Climbing inspections are occasionally carried out where these activities can be carried out, but this normally requires an outage and incurs safety risks from working at height.<br>This project evaluates a series of innovative tools and equipment that are robust, relatively easy to carry and can be used to inspect and measure potential defects on pole top equipment without climbing the pole. | | | | |
| Type(s) of innovation involved | Incremental and technological substitution | | | | |
| Expected Benefits of Project | The expected benefits of this condition assessment tool are :<br>• Independence from outage requirements and their time constraints<br>• Measurements provide improved information from sites which allows consistent investment decision making process for overhead lines<br>• Negates need for climbing thereby reduces safety risks to staff | | | | |
| Expected Timescale to adoption | 3 years | | Duration of benefit once achieved | 10 years | |
| Estimated Success probability (at start of project) | 25% | | | | |
| PV of Project Costs | £15,584 | PV of Project Benefits | £23,164 | NPV of Project Costs | £7,580 |
| Note – The project costs are identified early stage costs. They do not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive | | | | | |
| Commentary on project progress and potential for achieving expected benefits | Stages in progress -<br>• Evaluation of innovative inspection and measurement tools under controlled conditions<br>• Demonstration trial of innovative inspection and measurement tools with field inspection teams<br>• Assessment of demonstration trial | | | | |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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|---|---|---|---|---|---|
| Description of project | Non Intrusive Testing of Tower Foundations<br><br>Demonstration to evaluate various Non Destructive Testing techniques in collaboration with Sterling Power Group Ltd. | | | | |
| Expenditure for financial year | Internal - £4,305<br>External - £95,000<br>Total Cost - £99,305 | | Expenditure in previous financial period | Total cost £18,500 | |
| Technological area and / or issue addressed by project | Central Networks owns and maintains over 9,500 steel towers supporting overhead lines at voltages from 33kV to 132kV. Some of these towers were erected over 70 years ago and a variety of different foundations were used in their construction.<br>The traditional method of examining tower foundation condition is to excavate around individual tower legs to allow detailed visual inspection. This is a time consuming procedure, which also temporarily derates the tower's structural capabilities because it disturbs the consolidated backfill around the frustum block foundation. In addition crop and land damage compensation adds further to the high costs of the excavation associated with these inspections.<br>Advances in non-destructive inspection techniques for civil engineering can be applied to Overhead Line Tower foundations to determination the condition and depth of buried foundations without the need for excavation. This project aims to evaluate and compare the following civil engineering non-destructive testing (NDT) techniques:<br>• Transient Dynamic Response Method (TDR) also known as Sonic Echo<br>• Linear Polarisation Resistance (LPR) using a Below Ground Corrosion meter (BGCMap)<br>• Pulse Velocity (Ultrasound) Measurements<br>• Ground Penetrating Radar (GPR) | | | | |
| Type(s) of innovation involved | Incremental and Technological substitution | | | | |
| Expected Benefits of Project | • Evaluation of the usability of each of the various NDT methods in different environments<br>• Comparison between the results of the various NDT methods on overhead line tower circuits of different construction types<br>• Introduction NDT should reduce both the costs and time taken in the future inspections of overhead line tower foundations. | | | | |
| Expected Timescale to adoption | 3 years | | Duration of benefit once achieved | 20 years | |
| Estimated Success probability (at start of project) | 50% | | | | |
| PV of Project Costs | £268,976 | PV of Project Benefits | £412,876 | NPV of Project Costs | £143,900 |

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| Commentary on project progress and potential for achieving expected benefits | Stages complete -<br>• Inspection of Tower Foundations on Gloucester to Ryeford 132kV O/H Line<br>Stages in progress<br>• Inspection of Tower Foundations on Bourne to Walpole 132kV O/H Line<br>• Assessment of the performance of the various NDT techniques<br>• Development of recommendations for the future inspection of Overhead Line Tower foundations |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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|---|---|---|---|---|---|
| Description of project | Lidar - Laser Scanning of Overhead Lines<br><br>Pilot trial to evaluate the benefits of aerial Laser scanning technology. | | | | |
| Expenditure for financial year | Internal - £3,465<br>External - £275<br>Total - £3,740 | | Expenditure in previous financial period | Total cost £44,625 | |
| Technological area and / or issue addressed by project | Central Networks has over 48,600km of overhead lines and has an intensive tree clearance programme to reduce the impact of tree related faults on customer's electricity supplies.<br><br>Laser scanning technology can provide a geo-spatial view of overhead line assets, which can identify object and vegetation height and their proximity to adjacent overhead lines. It could also be used to profile overhead line conductors and identify potential statutory height infringements.<br><br>The purpose of this project is to evaluate the potential benefits by undertaking two trials with a leading provider of aerial laser scanning technology. The trials will evaluate the technology on two different types of overhead lines –<br>• 132kV Tower construction overhead line<br>• 11kV Wood pole construction overhead line | | | | |
| Type(s) of innovation involved | Incremental and technological substitution | | | | |
| Expected Benefits of Project | The potential benefits from laser scanning overhead lines are –<br>• Specific identification of sites where vegetation faults are likely<br>• Identification of buildings or objects within specific distances of the conductors<br>• Identification of potential statutory height infringements<br>• Provide line profile of an overhead line | | | | |
| Expected Timescale to adoption | 2 years | | Duration of benefit once achieved | 5 - 10 years | |
| Estimated Success probability (at start of project) | 25% | | | | |
| PV of Project Costs | £40,202 | PV of Project Benefits | £100,465 | NPV of Project Costs | £60,263 |
| Commentary on project progress and potential for achieving expected benefits | On completion of the assessments of these evaluation trials, a dissemination workshop was held to compare results with other E.ON European trials of Aerial Laserscanning technology.<br>Assessment of the results of aerial laser scanning of 11kV Wood Pole Overhead lines concluded that this did not appear to be a cost effective solution to managing vegetation growth.<br>Assessment of the 132kV tower overhead line was inconclusive and will depend upon individual circumstances (such as availability of existing circuit records).<br>However areas of further development are being considered. | | | | |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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| Description of project | EA Technology – Condition Inspections of Overhead Lines<br><br>Pilot trial to evaluate an innovative overhead line inspection and condition assessment process, which combines several technology areas. | | | | |
| Expenditure for financial year | Internal - £6,195<br>External - £39,795<br>Total - £45,990 | | Expenditure in previous financial period | Total cost £10,651 | |
| Technological area and / or issue addressed by project | Central Networks has over 48,600km of overhead lines. These require regular condition inspections to determine where remedial work is required. This project, addresses the condition inspection of the 9,000km of tower and wood pole lines, which operate at 33kV or above. The height of these overhead lines makes inspection of components at the top of these structures difficult from the ground and climbing inspections are not only laborious, but normally require outages.<br><br>This project is a feasibility study of an alternative process involving trials on two types of overhead line (132kV tower line and 33kV wood pole line). The process combines the following three technology areas into a robust condition assessment tool:<br>• Helicopter Inspection using High Quality Aerial Photography<br>• Degradation and failure mode analysis<br>• Condition Based Risk Management (CBRM) | | | | |
| Type(s) of innovation involved | Incremental and technological substitution | | | | |
| Expected Benefits of Project | The expected benefits of this condition assessment tool are :<br>• Consistent investment decision making process for overhead lines<br>• Independence from outage requirements and their time constraints<br>• Improved information from sites which can easily be reassessed if required<br>• Negates need for climbing thereby reduces safety risks to staff | | | | |
| Expected Timescale to adoption | 3 years | | Duration of benefit once achieved | 10 years | |
| Estimated Success probability (at start of project) | 25% | | | | |
| PV of Project Costs | £55,579 | PV of Project Benefits | £111,397 | NPV of Project Costs | £55,818 |
| Commentary on project progress and potential for achieving expected benefits | Following completion of the initial project assessment, recommendations were made that this condition inspection technique was adopted.<br><br>Currently Central Network's Inspection and Maintenance documentation is being amended. | | | | |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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|---|---|---|---|---|---|
| Description of project | EA Technology – Safety Inspections by Helicopter<br><br>A feasibility trial to assess the potential and identify the issues associated with carrying out combined ESCQR and safety inspections of overhead lines by helicopter. | | | | |
| Expenditure for financial year | Internal - £3,465<br>External - £14,260<br>Total - £17,725 | | Expenditure in previous financial period | Total cost £6,457 | |
| Technological area and / or issue addressed by project | EA Technology has pioneered a Helicopter High Resolution Inspection Service (HHRIS), which incorporates state-of-the-art digital photography techniques, together with stabilised zoom lenses. Combined with satellite based Global Positioning System (GPS), the geographical position of each photographic image is recorded, theoretically enabling high speed inspection.<br><br>The technology has been further developed such that following assessment of the flight records, the format of the final electronic records will be presented to Central Networks in a form that will match our Asset Register measurement points, allowing automatic data download.<br><br>The purpose of this trial is to prove the feasibility of the above system by carrying an inspection of an 11kV overhead line and to assess its potential. | | | | |
| Type(s) of innovation involved | Incremental and technological substitution | | | | |
| Expected Benefits of Project | The expected benefits of this trial are :<br>• Improved inspection records at minimal increase in cost<br>• Availability of photographic data records for subsequent review<br>• Improved data handling methods allowing a better response to required remedial work. | | | | |
| Expected Timescale to adoption | 2 years | | Duration of benefit once achieved | 10 years | |
| Estimated Success probability (at start of project) | 25% | | | | |
| PV of Project Costs | £23,495 | PV of Project Benefits | £26,366 | NPV of Project Costs | £2,870 |
| Commentary on project progress and potential for achieving expected benefits | Although the project has proved the technical feasibility of the technique, the assessment of the project benefits is still ongoing. | | | | |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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| Description of project | Substation Communication Development<br><br>Demonstration of future communication options for Control, System Protection, Data Acquisition and communication to distributed intelligent electronic devices at operational sites. | | | | |
| Expenditure for financial year | Internal - £15,908<br>External - £84,695<br>Total Cost - £100,603 | | Expenditure in previous financial period | Total cost N/A | |
| Technological area and / or issue addressed by project | An extensive communications infrastructure has been developed over time to provide critical operational communications and as a result these use a wide range of different technologies and provision is from a variety of sources.<br><br>Some of these technologies are reaching the end of their life and one of our service providers has announced that they wish to withdraw some of their services by 2011 and replace it with a Next Generation Networks (NGN) which will not support the current specific requirements of the connected equipment. | | | | |
| Type(s) of innovation involved | Incremental and technological substitution | | | | |
| Expected Benefits of Project | The operational communications network which will be developed as a result of this trial will have the following benefits:<br>• Backward compatibility with existing systems and legacy equipment / protocols<br>• Forward compatibility with future systems and new applications<br>• Reduced construction costs and time than existing systems<br>• Reduced running costs from infrastructure simplification and the use of remote management software<br>• Greater reliability from robust architecture and redundancy<br>• Increased security from encryption of both encapsulated legacy protocols and modern standards<br>• Ability to connect with distributed Intelligent electronic devices (IEDs) | | | | |
| Expected Timescale to adoption | 5 years | | Duration of benefit once achieved | 25 years | |
| Estimated Success probability (at start of project) | 50% | | | | |
| PV of Project Costs | £148,683 | PV of Project Benefits | £307,970 | NPV of Project Costs | £159,287 |
| Note – The project costs are identified early stage costs. They do not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive. | | | | | |
| Commentary on project progress and potential for achieving expected benefits | Stages complete -<br>• Installation of new operational communications to 10 sites in parallel with the existing communications. This specifically included some hot sites where the site Rise of Earth Potential required isolation equipment as this may effect performance. Different installation arrangements including retrofitting existing racks were tried to provide an understanding of time and cost requirements.<br>• Installation of monitoring equipment to test communications capabilities under different conditions. | | | | |

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| | • Monitor power requirements of equipment to understand power requirements for inverter design.<br>Stages in progress –<br>• Test performance of communications equipment, including conversion of legacy system interfaces.<br>• Investigate the use of remote management software to identify system faults and network performance issues.<br>• Investigate the use of different communication mediums with the new technology.<br>• Investigate the provision of remote access points and 'hot spots' at operational sites to connect portable equipment and distributed IEDs.<br><br>During the trial it was decided to install a number of CCTV cameras to provide remote security at some of the operational sites where the trial communications had been installed. These were connected via the trial communications to test what effect would be had on the data handling, but the costs of this work was not however included in this IFI project as it was not considered to be innovative. |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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|---|---|---|---|
| Description of project | Impact of Climate Change and Weather Analysis<br><br>Sponsored by all UK DNOs and National Grid in conjunction with Met Office. Separate reports, management and funding arrangements have been arranged between Distribution and Supply Companies to ensure Business Separation requirements are maintained. | | |
| Expenditure for financial year | Internal - £2,940<br>External - £25,012<br>Total Cost - £27,952 | Expenditure in previous financial period | Total cost N/A |
| Technological area and / or issue addressed by project | In 2006 the Met office reported that the 10 hottest years on record had all occurred within the last 12 years and that 2007 was likely to be the hottest yet. E.ON UK's response to date has mainly focused on mitigating climate change, but in parallel with this there is a need to address potential adaptation issues with in Central Networks.<br>The following have been highlighted as particular areas for concern:<br>• Increased frequency of gales will affect Overhead Lines and other outdoor Plant and Equipment<br>• Reduction in soil moisture will affect both the soil's thermal resistivity, which will impact cable ratings and the soil's electrical resistivity, which will impact system earthing<br>• Increase in ambient temperature will impact overhead line conductor ratings, creep & sag limits, transformer ratings & performance and also possibly switchgear ratings<br>• Increased sea level height and probability of flooding from coastal, river or direct rainfall will require mitigation measures for equipment (especially at major substation sites)<br>• Heat Island effects in conurbations will require additional reinforcement | | |
| Type(s) of innovation involved | Incremental | | |
| Expected Benefits of Project | Using the Defra funded UKCIP08 climate projections for the UK created by the Met Office, Hadley Centre, a regional climate domain model will cover the UK at a resolution of 25km.<br>The Met Office Study Phase 2 will bridge the gap between this work and what is required by the energy industry by developing new methodologies and probalistic prediction systems to research into three themes:<br>• Energy Specific Climate and Analysis<br>• Energy Specific Land Surface and Impacts and Analysis<br>• Generation of Energy Industry Application Specific Probabilities of Change<br>Individual work packages will develop new diagnostics in each of the key areas, which will enable the effect of future weather scenarios to be generated | | |
| Expected Timescale to adoption | 3 years | Duration of benefit once achieved | 25 years |

<table>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">75%</td></tr>
<tr><td>PV of Project Costs</td><td>£3,442,043</td><td>PV of Project Benefits</td><td>£3,916,766</td><td>NPV of Project Costs</td><td>£474,723</td></tr>
<tr><td colspan="6">Note: Although adoption is likely to be in the short timescale, the initial benefits will probably not be seen until 2010. The benefits calculated here are conservative - based on avoiding a Significant Event (i.e. either an above design strength storm or flood) with a 10year reduction in return period by 2020. This allows benefits to be averaged over the ten years either side of 2020, but it should be noted that in each successive year the probability of adverse weather events is likely to increase.<br>It is assumed that the adoption costs necessary to modify infrastructure to prevent such an occurrence can be spread across a ten year programme from completion of the project.<br>The actual benefits and mitigation costs will not be known with any certainty until the project is complete. These will depend upon the actual changes in probability and the degree of mitigation work necessary to maintain infrastructure capabilities.</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="5">Stages complete -<br>• Phase 1 - Scoping study on the Impacts of Climate Change on the Energy Industry<br>• High Level study canalizing the implications of Climate Change on Central Network’s infrastructure<br>• Initial analysis correlating weather with system performance within Central Networks<br>Stages in progress –<br>• Phase 2 - Identifying Effects of Climate Change on UK Energy Industry<br>o WP1 Energy specific climate modeling<br>o WP2 Temporal resolution and modeling energy outcomes<br>o WP3 Climate models and wind projections<br>o WP4 Energy specific land surface modeling<br>o WP5 Marine modeling<br>o WP6 Down scaling temperature and urban heat island effect<br>o WP7 Project mechanics and communications<br>• Future analysis correlating weather with system performance within Central Networks</td></tr>
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## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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| Description of project | Cable Detection by Radar | | | | |
| Expenditure for financial year | Internal - £7,455<br>External - £30,000<br>Total Cost - £37,455 | | Expenditure in previous financial period | Total cost N/A | |
| Technological area and / or issue addressed by project | Incorrect records of cable locations can present a health and safety hazard for both our own staff and those of other utilities and can impact on network operations. Conventional methods of finding and tracing cables that are missing or have been incorrectly recorded are expensive, time consuming and cause inconvenience to the public. | | | | |
| Type(s) of innovation involved | Incremental | | | | |
| Expected Benefits of Project | Using a range of non-invasive techniques, including Ground Penetrating Radar (GPR) can allow cables to be traced in areas where records have been outstanding for a significant length of time. The Radar cable detection technique will allow these records to be brought up to date without the need for excavation. Provision of electronic asset location information is a requirement of the Traffic Management Act.<br>The Ground Penetrating Radar technique can provide accurate depth information and is also able to detect equipment, enabling it to identify the location of gas and water pipes in relation to our own equipment. This is particularly useful in congested areas where it can reduce the likelihood of causing damage to other utilities equipment when excavation is required. | | | | |
| Expected Timescale to adoption | 1 years | | Duration of benefit once achieved | 10 years | |
| Estimated Success probability (at start of project) | 75% | | | | |
| PV of Project Costs | £132,963 | PV of Project Benefits | £178,298 | NPV of Project Costs | £45,335 |
| Commentary on project progress and potential for achieving expected benefits | Stages complete -<br>• Locations where a lack of accurate records is creating a potential health and safety hazard have been identified. Sites of different size and complexity chosen to enable understanding of where most benefit can be gained.<br>• Joint survey of initial sites complete to understand how the technology works and verify the accuracy of the information.<br>Stages in progress<br>• Data being loaded into Asset Information Systems. | | | | |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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|---|---|---|---|---|---|
| Description of project | Mobile Pinging Trial – Locating Restoration Staff<br><br>Development and feasibility trial to assess the potential and identify the issues associated with using mobile telephone cellular technology to locate suitable operational staff nearest to an incident. | | | | |
| Expenditure for financial year | Internal - £3,938<br>External - £6,367<br>Total - £10,305 | | Expenditure in previous financial period | Total cost £43,133 | |
| Technological area and / or issue addressed by project | Central Networks aims to maximise the number of customers restored within the first 60 minutes following an incident on the network. Although Central Networks is increasing the quantity of remote control devices and automation schemes on the network, manual switching is still required to isolate the fault and restore groups of customers within the last network section. The use of technology to identify the location of suitable operational staff who can undertake this manual switching will optimise restoration performance.<br><br>New mobile pinging technology makes it possible to locate and display the approximate geographic position of a mobile telephone, but not all staff are suitable for every type of fault. In addition staff may not be available due to other commitments, holidays, etc. This project therefore develops the mobile telephone technology to meet Central Networks' specific requirements and tests its feasibility. | | | | |
| Type(s) of innovation involved | Incremental | | | | |
| Expected Benefits of Project | The expected benefits of mobile pinging are :<br>• Customers will benefit from Improved restoration times following incidents by the dispatch of the nearest suitable restoration staff.<br>• Operational staff working in the vicinity of an incident can be advised.<br>• Better utilisation of available staff will save restoration costs. | | | | |
| Expected Timescale to adoption | 1 year | | Duration of benefit once achieved | 4 years | |
| Estimated Success probability (at start of project) | 50% | | | | |
| PV of Project Costs | £47,337 | PV of Project Benefits | £164,954 | NPV of Project Costs | £117,617 |
| Commentary on project progress and potential for achieving expected benefits | Following assessment of the project trial. Mobile Pinging has been adopted and is being rolled out to operational restoration staff across Central Networks. | | | | |

## Individual IFI Project Reports for Period April 2006 – March 2007
## Central Networks

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|---|---|---|---|---|---|
| Description of project | EA Technology – Alternative Overhead Earthing Arrangements and Materials | | | | |
| Expenditure for financial year | Internal - £6,143<br>External - £49,215<br>Total Cost - £55,358 | | Expenditure in previous financial period | Total cost N/A | |
| Technological area and / or issue addressed by project | Central Networks has approximately 100,000 earthed wood poles on its 33kV and 11kV systems. Earthing is essential to ensure the effective operation of both electrical protection and lightning protection.<br>However earthing overhead line structures can also reduce system BIL, is costly to install and may not be required in all cases. In addition earthing systems incur regular wayleave payments and require regular inspection, maintenance and remedial action to ensure arrangements remain effective and safe.<br><br>Two areas of research are being undertaken to :<br>• Understanding requirements for removal of the earthing requirements from some overhead line structures<br>• Use of alternative materials which will reduce inspection, maintenance and remedial action costs | | | | |
| Type(s) of innovation involved | Incremental and Technological Substitution | | | | |
| Expected Benefits of Project | This project will identify alternative earthing solutions in the two areas of research listed above.<br>WP1 - This will entail investigating the requirements for reducing to a safe level the standing voltages that occur on low level steelwork associated with unearthed structures with plant.<br>WP2 – This will find an effective alternative material to copper for earthing systems | | | | |
| Expected Timescale to adoption | 2 years | | Duration of benefit once achieved | 40 years | |
| Estimated Success probability (at start of project) | 50% | | | | |
| PV of Project Costs | £91,202 | PV of Project Benefits | £132,129 | NPV of Project Costs | £40,927 |
| Commentary on project progress and potential for achieving expected benefits | Stages complete -<br>• Review of proposed constructional drawings for unearthed installations<br>• Measurement of electrical parameters on actual equipment<br>• Investigation into the availability and costs of alternative earthing materials<br>Stages in progress -<br>• Develop model to assess arrangements necessary for safe operation<br>• Review the suitability of proposed materials and arrangements | | | | |