Central Networks

A company of e·on

Regulatory report for DG Incentives, RPZ's & IFI

Reporting year 2005/6

By Central Networks

Forward

Central Networks is committed to Research & Development initiatives that will provide benefits to our shareholders, our customers' and the electricity Industry. Our approach to R&D is to identify emerging technologies and opportunities that could increase the efficiency of our operations, enhance overall safety, address environmental issues and provide a reliable network that delivers a high quality of supply.

Bob Taylor
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. IFI

The IFI is intended to provide funding for projects focused on the technical development of distribution networks, up to and including 132kV, to deliver value (i.e. financial, supply quality, environmental, safety) to end consumers. 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. RPZ

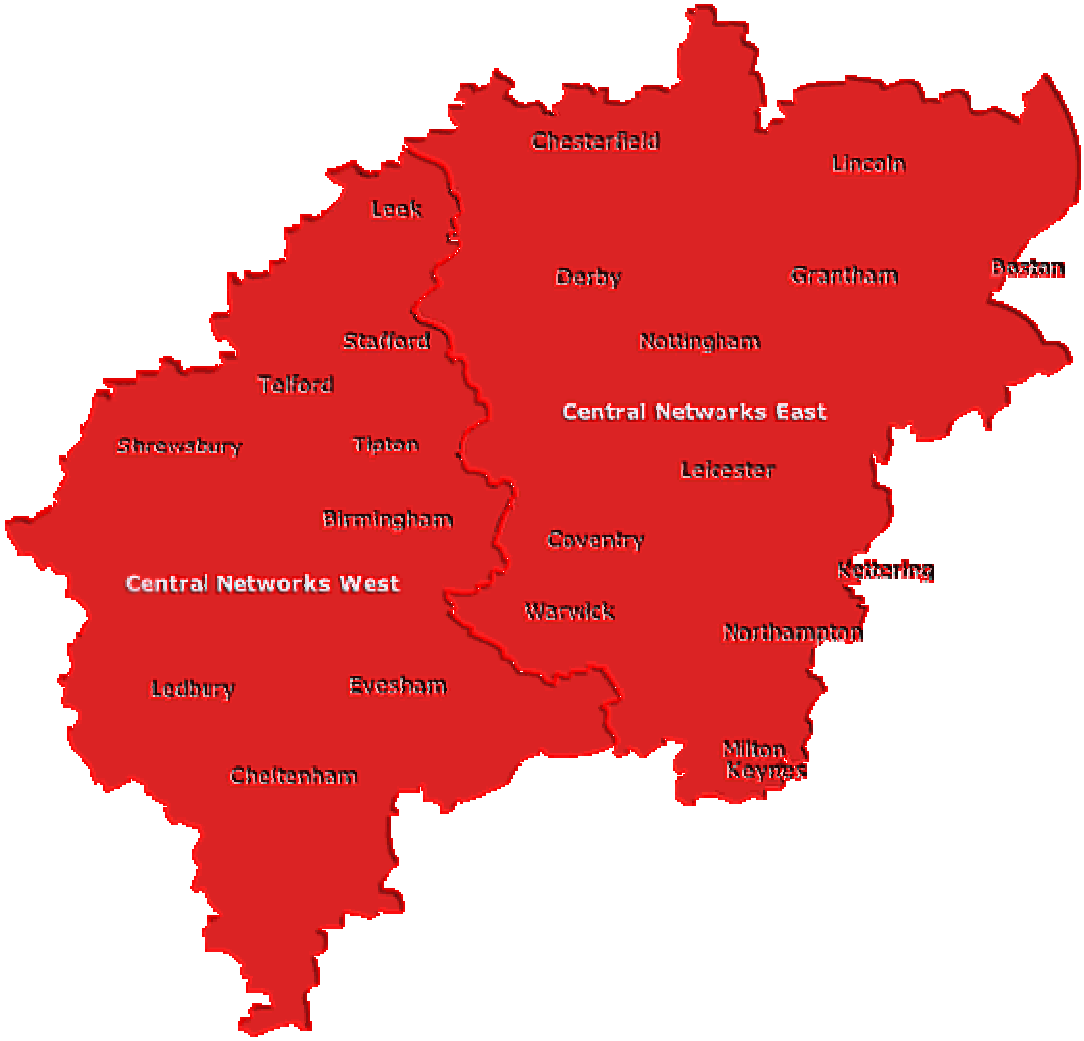
In contrast to the IFI, RPZ's are focused specifically on the connection of generation to distribution systems. The estimates made by DNOs as part of the DPCR process indicated that some 10GW of generation could be connected in the next five years. This generation could connect at every distribution 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.

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 4.8 million customers across central England from the Lincolnshire coast to the Welsh border.

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 2005/6

Central Networks

Distributed Generation (DG) Incentive	East	West	Total
Total Incentivised DG Capacity (MW)			
Total capex for DG (£m)			
Use Of System capex for DG (£m)			
Shared connection capex for DG (£m)			
Assets transferred out of DG capex to demand capex (£m)			
DG network unavailability (MWh)			
DG Network unavailability rebate payment (£m)			
Operational & maintenance costs for DG (£m)			

Innovation Funding Incentive

IFI carry forward (£m)			
Eligible IFI expenditure (£m)	£0.208	£0.208	**£0.416**
Eligible IFI internal expenditure (£m)	£0.031	£0.031	**£0.062**
Combined network revenue (£m)	£255.5	£246.7	**£505.2**

Registered Power Zones (RPZ's)

RPZ name			
RPZ DG capacity (MW)			
RPZ starting year			

3. Summary of IFI projects

3.1. Management of IFI Projects

Details of the 15 IFI projects in which Central Networks participated during this IFI reporting period are included in this report. Eight of these projects involved the collaboration of the majority of UK DNO's, one project was carried out in collaboration with two other DNO's and six projects involved 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

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) with membership from all UK DNOs utility companies.

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.

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. Expenditure from IFI Projects

In order to successfully manage an increased portfolio of Research and Development projects Central Networks planned to increase both the number of and expenditure on IFI projects in a controlled manner. The table below details the expenditure during the April 2005 – March 2006 IFI reporting period :-

Description of Project	External	Internal	Total
EA Technology – STP Overhead Module 2 & Forum	£37,680	£4,850	**£42,530**
EA Technology – STP Cable Module 3 & Forum	£37,420	£5,800	**£43,220**
EA Technology – STP Plant/Protection Module 4 & Forums	£39,335	£6,900	**£46,235**
EA Technology – STP Distributed Generation Module	£36,000	£5,400	**£41,400**
EA Technology – Protective Coatings Forum	£5,775	£1,050	**£6,825**
EA Technology - Partial Discharge Group	£5,953	£1,200	**£7,153**
ENA R&D Group Programme	£2,721	£3,050	**£5,771**
DWG Participation	Nil	£9,100	**£9,100**
Reference Network Model	£60,000	£4,500	**£64,500**
Power Technology – Advanced Distribution Automation	£22,315	£1,000	**£23,315**
Power Technology – Intelligent Universal Transformer	£20,505	£1,000	**£21,505**
Laser Scanning of Overhead Lines	£38,125	£6,500	**£44,625**
Condition Inspection of Overhead Lines	£6,251	£4,400	**£10,651**
Safety Inspections by Helicopter	£3,657	£2,800	**£6,457**
Mobile Pinging Trial – Locating Restoration Staff	£38,333	£4,800	**£43,133**
Total	**£354,070**	**£62,350**	**£416,42**

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 14.97% of the total cost.

3.4. Reporting Benefits from IFI Projects

It is too early to see actual benefits from IFI projects, but the anticipated benefits have been calculated using the methodology set down in the Good Practice Guide. For each project the NPV is calculated by taking the present value of the estimated benefits, multiplying them by the probability of success and then subtracting the present costs. These figures can be seen on the individual project reports.

Each of the EA Technology Ltd STP modules and the ENA R&D programme 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.

No NPV or benefits have been calculated for the DWG participation because the projects initiated from this work are funded by the DTI. Central Networks costs relate to participating in three work programme groups and the support / management of individual projects.

3.5. Future Research and Development

In the 2006-07 period Central Networks plans to further expand its Research and Development programme, utilising the impetus of IFI to engage in more collaborative projects and develop stronger links with Universities and Industrial partners.

Central Networks intends to be active participant in the SuperGen V (Amperes) project, which is a collaboration between six leading UK universities and several industrial partners (mainly DNOs). The majority of SuperGen funding is provided by EPSRC and each year a new SuperGen programme is established. In SuperGen V the work package was specifically tailored towards the enhanced management and performance for a sustainable energy infrastructure.

4. Individual IFI Project reports for period April 2005 – March 2006

Central Networks

Description of project	EA Technology - Strategic Technology Programme EATL STP - Overhead Network Module 2 and Forum Research and development into all aspects of Distribution Overhead Lines		
Expenditure for financial year	Internal - £4,850 External - £37,680 Total Cost - £42,530	Expenditure in previous financial period	Total cost - £23,636
Technological area and / or issue addressed by project	The STP overhead network programme for budget year 2005/6 aimed to reduce costs and improve performance of overhead networks by increasing understanding of issues that have a negative impact on costs and performance. The programme is expected to also have a positive impact on safety and environmental performance. The projects all address real problems that have been identified by the module steering group members as significant and which require technical investigation and development. The projects within the programme aimed to: • S2120_2 - Improve detection of defective surge arresters in-situ with selection and evaluation of the most promising solutions. • S2126_2 - Undertake long-term monitoring of conductor temperature by obtaining and analysing 12 months trial data. • S2132 - Validate current and proposed new ice accretion models. • S2133 - Investigate the use of sacrificial anodes for protecting tower foundations to defer or remove the need for full foundation refurbishment. • S2134_1 - Determine the susceptibility of currently used surge arresters to the principal modes of failure • S2135 - Evaluate the life expectancy of copper conductors. • S2136 - Participate in European Project COST 727: Measuring and forecasting atmospheric icing on structures. • S2138_1 - Investigate live-line jumper-cutting limitations Stage 2 is to define a realistic experimental programme. • S2139 - Begin to evaluate a new corona discharge camera system. • S2140 - Explore possible means of checking the foundations of newly installed poles		
Type(s) of innovation involved	Technical Substitution / Radical		
Expected Benefits of Project	Due to the age profile of system equipment it is inevitable that, unless significant new technology is used to extend asset life, CAPEX and possibly OPEX will need to increase significantly to maintain the present level of network reliability and safety. If these projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain benefits including: • avoid redesign, reconstruction or refurbishment of overhead lines where this is driven by a perceived need to increase ratings or strengthen lines, and is required to conform with existing standards but which may be unnecessary; • reduce levels of premature failure of assets; • provide more cost effective and early identification of damaged		

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<tr><td></td><td colspan="5">insulators and discharging components, which if not addressed would result in faults;
• confidently extend the service life of towers and reduce potential levels of tower failures;
• reduce lifetime costs by the appropriate use of alternative materials.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">Range 1-7 years - dependent on project</td><td colspan="2">Duration of benefit once achieved</td><td>Range 2-10 years - dependent on project</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">Range 5-20% - dependent on project</td></tr>
<tr><td>PV of Project Costs (see note below)</td><td>£42,530</td><td>PV of Project Benefits</td><td>£54,600</td><td>NPV of Project Costs</td><td>£12,070</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.
• S2120_2 - Improve detection of defective surge arresters with selection and evaluation of the most promising solutions. Laboratory tests have determined the most effective techniques and these have been presented to members with recommendations for further action.
• S2126_2 - Undertake long-term monitoring of conductor temperature by obtaining and analysing 12 months trial data. The trial is continuing with the expectation that the results will indicate it should be possible to re-rate (up-rate) some overhead line circuits in certain circumstances.
• S2132 - Validate current ice accretion models. The data currently being collected will be used to revise national overhead line design standards
• S2133 - Investigate the use of sacrificial anodes for protecting tower foundations to defer or remove the need for full foundation refurbishment. A practical reference document has been produced to assist in the application and specification of such devices
• S2134_1 - Determine the susceptibility of currently used surge arresters to the principal modes of failure. The findings provide a review of the capabilities of a range of surge arresters, allowing informed and more cost effective specification of these devices.
• S2135 - Life expectancy of copper conductors. The results of initial laboratory testing of samples of varying age provided from UK distribution networks will be available shortly. They should allow an initial assessment of the overall condition of copper based conductors to be made.
• S2136 - Measuring and forecasting atmospheric icing on structures. This is part of a much larger European collaborative project aiming to provide more accurate mapping of ice prone areas. This in turn will allow the most appropriate structure to be constructed.
• S2138_1 - Investigate live-line jumper-cutting limitations. Controlled testing regime has been specified and this should lead to improved working practices being adopted.
• S2139 Begin to evaluate a new corona discharge camera system. This project is at a very early stage.
• S2140 Explore possible means of checking the foundations of newly installed poles. An initial review of worldwide practice and commercially available techniques has begun.</td></tr>
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Individual IFI Project reports for period April 2005 – March 2006
Central Networks

Description of project	EA Technology - Strategic Technology Programme EATL STP - Cable Networks Module 3 and Forum Research and development into all aspects of Distribution Cables		
Expenditure for financial year 2005/06	Internal - £5,800 External - £37,420 Total Cost - £43,220	Expenditure in previous financial period	Total cost - £23,636
Technological area and / or issue addressed by project	The STP cable network programme for budget year 2005/6 aimed at identifying and developing opportunities to reduce the costs of owning cable networks. The reduction of whole life cost through greater reliability and improved performance of cables and associated accessories comes under the remit of Module 3. Where appropriate Module 3 worked with other Modules to achieve common goals. Eight new projects were approved during the year (shown in bold below). The projects undertaken within the programme during 2005-06 (include some approved in previous years) aimed to: • S3100_2 – Define better functional requirements for link boxes. • S3108_2 – Produce software for assessing earthing practice on PME systems. • S3115 – Determine the corrosion resistance of aluminium foil cables. • S3120 – Assess novel flame retardant coatings for cables in basements. • S3121 - Produce a fable fluid sniffer Stage 1(b) Feasibility study. • S3123 – Produce a guide and specify functional requirements for the selection of cable ducts. • **S3125 - Assess new degreasing products form MV and LV cables.** • **S3126 - Explore issues associated with the use of polyurethane and development of alternative jointing resins.** • S3131 – Produce a summary of CIGRE issues relating to HV cables. • S3113_2 - Addition of duct bank modelling functionality within CRATER cable rating software. • S3113_3 - Addition of paper cable modelling within CRATER cable rating product. • S3132_1 - Addition of HV polymeric cable modeling functionality within CRATER cable rating software. • S3132_2 - Addition of LV cable modelling functionality within CRATER cable rating software. • S3132_3 - Addition of cyclic and emergency rating modelling functionality within CRATER cable rating software. • **S3132_4 - Addition of limited time rating of mixed circuit modelling functionality within CRATER cable rating software.** • **S3132_5 - CRATER cable rating software, overview report.** • **S3132_6 - Addition of single core MV paper cable modelling functionality within CRATER cable rating software.** • **S3132_7 - Addition of cable crossing modelling functionality within CRATER cable rating software.** • **S3140_1 – produce a spreadsheet tool for pulling-in of cables into ducts.** • **S3144_1 – Evaluate the Hydragel process for the treatment of redundant fluid filled cables.**		
Type(s) of innovation involved	Technical Substitution / Radical		

<table>
<tr><td>Expected Benefits of Project</td><td colspan="5">If the projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain the following benefits, including:
• offset future increases in CAPEX and OPEX;
• savings of the order of 0.25 CML per connected customer;
• increased safety of staff and public by reducing the number of accidents / incidents.</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 2-10 years - dependent on project</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">Range 2-30% - dependent on project</td></tr>
<tr><td>PV of Project Costs (see note below)</td><td>£43,220</td><td>PV of Project Benefits</td><td>£59,500</td><td>NPV of Project Costs</td><td>£16,280</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.
• S3100_2 – Define better functional requirements for link boxes. A document that defines functional requirements for LV link boxes has been produced for member companies. Previously such a document did not exist.
• S3108_2 – Software for earthing practice on PME systems. An assessment tool has been produced for earthing practice on PME systems which evaluates the compliance with regulations and practices, carries out a check of LV cable circuit design.
• S3115 – Corrosion resistance of aluminium foil cables. Tests have shown that corrosion of the laminated aluminium foil sheath is likely if the outer sheath of the cable is damaged leading to moisture penetration to the cable core.
• S3120 – Flame retardant coatings for cables in basements. Findings recommended the use of a system consisting of a water-based intumescent coating and an associated water resistant topcoat. This should give valuable long-term fire protection to PE cables in basements and substations.
• S3121 - Cable fluid sniffer Stage 1(b) Feasibility study. Laboratory familiarisation has been carried out and field trials are being undertaken.
• S3123 – Guide and functional requirements for the selection of cable ducts. A report giving some advice on the use of plastic ducts in heavily loaded circuits has been produced.
• S3125 - Degreasing products for MV and LV cables. The project defined a suitable wet-wipe that will ensure satisfactory cleaning of LV, MV and HV cables without adversely affecting their performance.
• S3126 - Explore issues associated with the use of polyurethane and development of alternative jointing resins. The project concluded that under current legislation, and provided employers comply with the requirements of the COSHH Regulations, the continued use of polyurethane resin systems is acceptable. Alternative systems are available, but currently more expensive than polyurethane resins.
• S3131 – Summary of CIGRE issues relating to HV cables. An extensive report (140 pages) provides a comprehensive picture of work carried out by Cigré over the past 5 years, as well that currently underway and some that is</td></tr>
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	planned. This places the work of the Module in an international context. • *S3113_2 - Addition of duct bank modelling functionality within CRATER cable rating software.* The spreadsheet produced is a valuable tool for cable engineers. It ensures correct rating of cables installed in non-standard ducts and conditions. • *S3113_3 - Addition of paper cable modelling functionality within CRATER cable rating software.* A user-friendly spreadsheet tool for the cable engineer was created to determine sustained, cyclic and distribution current ratings for MV paper cable ratings, using approved methods of calculation. • *S3132_1 - Addition of HV polymeric cable modelling functionality within CRATER cable rating software.* A user-friendly spreadsheet tool for the cable engineer was created to determine sustained, cyclic and distribution current ratings for HV polymeric cable ratings, using approved methods of calculation. • *S3132_2 - Addition of LV cable modelling functionality within CRATER cable rating software.* A user-friendly spreadsheet tool for the cable engineer was created to determine sustained, cyclic and distribution current ratings for LV cable ratings, using approved methods of calculation. • *S3132_3 - Addition of cyclic and emergency rating modelling functionality within CRATER cable rating software.* A user-friendly spreadsheet tool for the cable engineer was created to determine cyclic and emergency current ratings for most practical mixed circuit problems. • *S3132_4 – Addition of limited time rating of mixed circuit modelling functionality within CRATER cable rating software.* The basic functionality is now incorporated into CRATER and operation with grouped circuits is being developed. • *S3132_5 - CRATER cable rating software, overview report.* The report, which is in preparation, will cover a range of practical applications for CRATER. The intention is that the report will form a handy reference to be used in conjunction with the basic operating manuals. • *S3132_6 - Addition of single core MV paper cable modeling functionality within CRATER cable rating software.* Preliminary scoping work has been carried out and a questionnaire sent out to ascertain user requirements. • *S3132_7 - Addition of cable crossing modelling functionality within CRATER cable rating software.* The method for calculating ratings of cable crossings has been established and development work is on-going. • *S3140_1 – produce a spreadsheet tool for pulling-in of cables into ducts.* Proprietary software is being evaluated for this project, which is at an early stage. • *S3144_1 – Evaluate the Hydragel process for the treatment of redundant fluid filled cables.* Information has been collected on the two available processes and further information is being gathered from members.

Individual IFI Project reports for period April 2005 – March 2006
Central Networks

Description of project	EA Technology - Strategic Technology Programme EATL STP - Substation Plant and Protection Module 4 and Forums Research and Development into all aspects of Distribution Substation Plant and Protection		
Expenditure for financial year 2005-06	Internal - £6,900 External - £39,335 Total Cost - £46,235	Expenditure in previous financial period	Total costs - £26,300
Technological area and / or issue addressed by project	Issues with the age profile of substation assets within the UK electricity distribution system are well known. Also, both regulatory and shareholder pressures preclude substantial investments of the large scale that was seen in the 1950's to 1970's. The challenge is to constantly review and innovate new solutions to monitor and define asset condition thereby allowing risks to be clearly defined and sound investment decisions to be taken. The programme of projects which were approved for funding from the STP substations module budget and were undertaken in 2005/06 encompass both developing new innovative asset management processes and practices and developing innovative diagnostic techniques. The aim is to develop already well established themes such as life extension of aged assets within legal and heath and safety constraints, examination of new technologies, developing an understanding of, and innovative solutions for, the impact on substation assets of increasing levels of distributed generation on networks and condition monitoring techniques. Eighteen new projects were approved during the year (shown in bold below). The projects undertaken within the programme during 2005-06 (include some approved in previous years) aimed to: <u>In progress Projects</u> • S0499 - Extend the TASA tap-changer diagnostic Trial. • S4107_2 – Field test on a sample of switchgear. the headspace gas testing technique to indicate the condition of oil filled switchgear • **S4180 – Develop an indicator to detect discharge activity in substations.** • **S4172 – Follow-up of S0455 paint preparation for tanks to determine the longer term performance of the technique.** • **S4173 – Enhance the Transformer thermal rating assessment system.** • **S4178 – Testing and management of substation standby batteries.** • **S4181 – Ongoing programme of transformer post mortems to provide better correlation between condition assessment tests, true condition and remaining life.** • **S4182 – Develop a better understanding of frequency response analysis of transformers.** • **S4186 – Study of PM cast resin VTs.** • **S4188_1 – Assess replacement insulator grease.** • **S4189_1 – Examine substation noise.** • **S4190_1 - Review of pad mounted substations.** • **S4193_1 - Develop a common approach to risk and reliability.** <u>Completed Projects</u> • S0497 – Transformer post mortems to assist estimation of remaining life from non-invasive tests.		

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S4130_4 – Assess wipes for HV oil filled equipment.
S4149 - Assess the quality, performance and longevity of recent substation equipment.
S4155 - Investigate ester based insulating oils.
S4162 – Extend the range of non-intrusive PD for > 90kV switchgear.
S4164 – Feasibility study into on-line tapchanger monitoring.
S4167 – Improve CBRM by use of better understanding of degradation processes.
S4172 – Scoping studies on transformer refurbishment, fault passage indicators, out of phase switching and fire legislation for substations.
S4174 - Compare a range of power system protection software.
S4175 – Assess circuit breaker cleaning techniques and materials.
S4176 – Compare available earth testing instruments.
S4179 - Explore in-situ testing of vacuum interrupters.
S4187_1 – Hold a risk modelling workshop.

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<tr><td>Type(s) of innovation involved</td><td colspan="5">Incremental / Significant / Technological Substitution / Radical</td></tr>
<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.
If the projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain the benefits including:
• Offset future increases in CAPEX and OPEX
• Increased safety of staff and public by reducing the number of accidents/incidents;
• Both preventing disruptive failures of oil-filled equipment to reduce land contamination and avoiding unnecessary scrapping of serviceable components will alleviate environmental impact.</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>2-7 years - dependent on project</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">1-20% - dependent on project</td></tr>
<tr><td>PV of Project Costs

(see note below)</td><td>£46,235</td><td>PV of Project Benefits</td><td>£64,200</td><td>NPV of Project Costs</td><td>£17,965</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.
<u>In progress Projects</u>
• S0499 - Extend the TASA tap-changer diagnostic Trial. The original trial had a low sample population and this work aims to increase the sample size. If earlier results are confirmed then the technique offers the potential for non-invasive condition assessment of tapchangers, with consequent improvements in network performance due to avoided failures and reduced OPEX from better targeted maintenance.</td></tr>
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	• S4107_2 - Headspace gas testing of oil filled switchgear. Working closely with members, the project aims to collect headspace gas samples from units within the field and resolve any GCMS issues. If correlation is successful then the project offers the prospect of targeted maintenance and reduction of invasive inspections. • S4180 – Develop an indicator to detect discharge activity in substations. Results suggest the device in its present form cannot reliable detect/indicator discharge activity in many substation environments. This development will not be pursued within STP, but related trials of an electronic NO_x detector are being undertaken by the Discharge User Group. • *S4172 – Follow-up of S0455 Surface preparation of tanks.* The performance of the paint systems are being reviewed as a follow-up to earlier work. • *S4173 – Transformer thermal rating system.* This project is to re-develop the current Transformer Thermal Rating software to enable members to assess BSP Transformer safe loading limits. • *S4178 – Testing and management of substation standby batteries.* The project aims to assess the effectiveness of Battery Impedance testing methods to replace traditional discharge testing. • *S4181 – On-going programme of transformer post mortems.* Further work in this area to build on the good results obtained in an earlier project, where a good correlation between non-invasive tests and internal examinations had been shown • *S4182 – Understanding frequency response analysis.* Frequency Response Analysis is a potentially useful condition assessment technique that can be significant in identifying and defining end of life for grid and primary transformers. Initial tests have produced some good results. • *S4186 – Study of PM cast resin VTs.* Members are completing an issues questionnaire and testing regimes are being developed. • *S4188_1 – Assess replacement insulator grease.* The project is to compare the performance of Insojell Grease with its proposed replacement, Dow Corning 3099 HVIC by performing a number of pre-specified accelerated aging tests. • *S4189_1 – Examine substation noise.* The project is investigating and clarifying the issues surrounding substation noise and develop a common, agreed framework to enable members to assess noise issues and take appropriate actions. • *S4190_1 - Review of pad mounted substations.* The project will provide an overview of members experience and identify any issues that may be arising through changing legislation. • *S4193_1 - Develop a common approach to risk and reliability.* The objective of this initial stage of work is to quantify the information requirements and determine its availability. An outline of the approach to be adopted has been produced and is currently being refined. <u>Completed Projects</u> • *S0497 – Transformer post mortems to assist estimation of remaining life from non-invasive tests.* A good correlation between non-invasive tests and internal examinations has been shown. This will assist in interpreting on-going non-invasive testing of other transformers. • *S4130_4 – Assess wipes for HV oil filled equipment.* Final development and testing of a new 3rd party high performance wipe, which was specially developed to the specification, which was developed in early stages of the project, was undertaken. This is now a product available for members • *S4149 - Assess the quality, performance and longevity of recent substation equipment.* An analysis of failure rates and reliability of modern substation equipment was undertaken and has highlighted a number of issues which warrant further investigation.

	• *S4155 - Investigate ester based insulating oils.* The project concluded that both natural and synthetic ester oils offer advantages over mineral oil in terms of biodegradability and electrical performance although oxidation stability and viscosity are poor. • *S4162 – Extend the range of non-intrusive PD for use on > 90kV switchgear.* The work identified the population of equipment suitable for PD testing, concluding that some types would benefit from such testing. • *S4164 – Feasibility study into on-line tap-changer monitoring.* The project concluded that it is possible to consistently characterise the operation of such devices using acoustic emissions techniques. • *S4167 – Improve CBRM by use of better understanding of degradation processes.* Mathematical models of asset ageing have been refined and calibrated in order to improve the accuracy of CBRM results. • *S4172 – Scoping studies on transformer refurbishment, fault passage indicators, out of phase switching and fire legislation for substations.* A series of short projects that allowed specific issues to be examined before deciding if a larger project in that area is appropriate. • *S4174 - Compare a range of power system protection software.* The available power system protection software was ranked in terms of its functionality, cost and ease of use. This will be used to assist members in making informed decisions. • *S4175 – Assess circuit breaker cleaning techniques and materials.* This project assessed different techniques and materials for cleaning circuit breaker contacts. A number of materials have been recommended together with a working practice. • *S4176 – Compare available earth testing instruments.* The project examined the operation of a number of simple clamp-on instruments and compared their effectiveness. The results showed that several instruments were quite inaccurate and could give misleading results. • *S4179 - Explore testing of vacuum interrupters.* The project investigated current and alternative methods of testing vacuum interrupters. It concluded that routine loss of vacuum testing would provide little benefit. It would be more appropriate to determine “at risk” interrupters and inspect these more frequently. • *S4187_1 – Hold a risk modelling workshop.* A workshop for members and experts to discuss risk quantification was held.

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Description of project	EA Technology - Strategic Technology Programme EATL STP - Distributed Generation Module 5 and Forums Research and development into all aspects of distributed Generation		
Expenditure for financial year 2005/6	Internal - £5,400 External - £36,000 Total Cost - £41,400	Expenditure in previous financial period	Total Cost - £19,700
Technological area and / or issue addressed by project	The projects undertaken through budget year 2005/6 were aimed at enabling cost effective connections and ensuring techniques are in place to plan, operate and manage networks with significant amounts of generation. Most projects also had positive impacts on safety and environmental performance. The projects all addressed real problems that had been identified by the module steering group members as significant and which required technical investigation and development. Fourteen new project stages were approved during the year (shown in bold below). The projects undertaken within the programme during 2005-06 (include some approved in previous years) aimed to: <u>Projects in Progress</u> • S5138 – Review of Industry Codes • **S5147_3 – Monitor Microgenerator Clusters** • **S5149_4 – Explore Active Voltage Control** • **S5150_2 – Review G59/1 and G75 Protection and identify improvements** • **S5151_3 – Model Network Risk** • **S5142 – Define Generator Data and Structure for DG Connection Applications** • **S5154_1 – Develop a Voltage Control Policy Assessment Tool on the IPSA Platform** • **S5155_1 – Explore Lower Cost Connection Solutions for Distributed Generation** • **S5157_1 – Evaluate the Performance of Small Scale Reactive Power Compensators** <u>Completed Project Stages</u> • S5144 – Workshop on Regulatory and Economic Issues • S5145 – Dynamic Circuit Ratings • S5147_1 - Microgeneration Clusters • S5149_1 - Active Voltage Control • S5150 Stage 1 – G59 and G75 Protection • S5151_1– Network Risk Modelling • **S5133 – Tapchangers Reverse Power Capabilities** • **S5143 – Produce a Draft Code of Practice on Stability** • **S5149 Stages 2 & 3 - Active Voltage Control** • **S5151 Stage 2 – Network Risk Modelling** • **S5152_1 – Examine the Latest Developments in the Connection of Distributed Generation**		
Type(s) of innovation involved	Incremental / Significant / Technological Substitution		

<table>
<tr><td>Expected Benefits of Project</td><td colspan="5">With government policy driving significant increases in generation connection to distribution networks the members need a range of innovative solutions to connection and network operation issues that are cost effective and which maintain the present level of network reliability and safety.
If the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain benefits including:
• Reducing the probability of voltage supply limit excursions resulting from increased distributed generation (eaVCAT interface to IPSA software tool);
• Improving quality of supply and reducing risk of component failure (by understanding the effect and optimising use of impedance in the system);
• A better understanding of the risk presented by the distribution assets when considered as a network rather than discrete components.;
• Greater use of distributed generators to meet current DNO obligations (by assessing, from a DNO perspective, the implications of pending Distribution Code provisions relating to distributed generation);
• Reducing the amount of reinforcement needed (by use of dynamic ratings to allow network components to be used to their full capability) - the use of dynamic circuit ratings is a vital step in the move towards active management of networks.</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>1-5 years - dependent on project</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">5-25% - dependent on project</td></tr>
<tr><td>PV of Project Costs (see note below)</td><td>£41,400</td><td>PV of Project Benefits</td><td>£57,100</td><td>NPV of Project Costs</td><td>£15,700</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.
• S5147_3 – Microgenerator Clusters. Installation of monitoring points is currently underway and a new substation is being commissioned. Monitoring will commence upon completion of installation and commissioning.
• S5149_4 – Explore Active Voltage Control. Modelling of typical radial and interconnected networks in preparation for flexing key parameters to examine limits of active voltage control.
• S5150_2 – G59/1 and G75 Protection. An initial review is complete and further work is pending results from allied university project.
• S5151_3 – Model Network Risk. Following establishment of user requirements and review of available risk models and approaches is being undertaken.
• S5142 – Define generator Data and Structure for DG Connection Applications. The generator data has been identified and a data structure agreed. Rationalisation of this data should now be considered.
• S5154_1 – Develop a voltage Control Policy Assessment Tool on the IPSA Platform. The interface between the existing eaVCAT software and the widely used IPSA power system analysis software has been developed and is currently being tested.</td></tr>
</table>

	• *S5155_1 – Explore Lower Cost Connection Solutions for Distributed Generation.* This project is at the information gathering stage, but intends to identify lower cost solutions. • *S5157_1 – Performance of Small Scale Reactive Power Compensators.* Four devices have been identified and detailed information is being collated. User requirements are being sought from members. <u>Completed Project Stages</u> • *S5144 – Workshop on Regulatory and Economic Issues.* A workshop to ensure the regulatory and economic environment is fully understood to assist selection of most appropriate technical developments. • *S5145 – Dynamic Circuit Ratings.* A report has been produced which summarises international work to date, evaluates available technologies and examines how these could be applied to UK distribution networks. • *S5147_1 – Monitor Microgeneration Clusters.* The Project Initiation Document has been prepared and approved. • *S5149_1 – Explore Active Voltage Control.* The Project Initiation Document has been prepared and approved. • *S5150 Stage 1 – G59 and G75 Protection.* The Project Initiation Document has been prepared and approved. • *S5151_1– Model Network Risk.* The Project Initiation Document has been prepared and approved. • *S5133 – Tapchangers Reverse Power Capabilities.* It was concluded that under certain conditions there is an increased probability of internal flashover for single compartment tap-changers with single transition resistors. Steps should be taken to increase the maintenance frequency or de-rate the tap-changer to negate these affects. • *S5143 – Draft Code of Practice on Stability.* The draft code of practice can be used to develop policy within each member company. It will facilitate the connection of distributed generation by providing a guideline on stability issues. • *S5149 Stages 2 & 3 - Active Voltage Control.* An overview of current control practices and how distributed generation impacts on them has been produced and a workshop held to explore the specific issues. This provides a firm basis for in depth studies of how active voltage control can be implemented and its advantages and disadvantages in different situations. • *S5151 Stage 2 – Model Network Risk.* The user requirements of a network risk model have been defined, documented and agreed and will be used to direct subsequent stages of the project. • *S5152 – Latest Developments in the Connection of Distributed Generation.* Regular updates on new developments have been provided to members to help inform and influence the research programme.

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Description of project	EA Technology - Equipment coatings Forum Research and development into all aspects of protective coatings on distribution equipment.				
Expenditure for financial year	Internal - £1,050 External - £5,775 Total Cost - £6,825		Expenditure in previous financial period	Total cost - £Nil	
Technological area and / or issue addressed by project	The projects undertaken through budget year 2005/6 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:- • Cost effective protective coatings for distribution equipment either by reducing operating costs or capital investment. • Managing the environmental impact of associated activities. • Improvements in safety. This forum is supported by the majority of UK DNOs.				
Type(s) of innovation involved	All innovation types involved (incremental, significant, technological substitution and radical)				
Expected Benefits of Project	Financial benefits derived from the reduction in operating costs and capital investment				
Expected Timescale to adoption	2 years		Duration of benefit once achieved	3 years	
Estimated Success probability (at start of project)	Success probability is expected to be 20% over the whole programme of projects.				
PV of Project Costs	£6,439	PV of Project Benefits	£15,317	NPV of Project Costs	£8,879
Commentary on project progress and potential for achieving expected benefits	Projects currently on target				

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Description of project	EA Technology – Partial Discharge Group Research and development into all aspects of partial discharge in distribution equipment.				
Expenditure for financial year	Internal - £1,200 External - £5,953 Total Cost - £7,153		Expenditure in previous financial period	Total cost - £Nil	
Technological area and / or issue addressed by project	The projects undertaken through budget year 2005/6 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:- • Reduce fault rates by early detection of insipient faults • Reduce environmental impact by early detection of faults • Improvements in safety. This forum is supported by the majority of UK DNOs.				
Type(s) of innovation involved	All innovation types involved (incremental, significant, technological substitution and radical)				
Expected Benefits of Project	Early detection of faults allows controlled remedial action and provides – • Financial benefits derived from the reduction in fault repairs • Improved network performance • Improved quality of supply for customers				
Expected Timescale to adoption	2 years		Duration of benefit once achieved	3 years	
Estimated Success probability (at start of project)	Success probability is expected to be 20% over the whole programme.				
PV of Project Costs	£6,748	PV of Project Benefits	£19,264	NPV of Project Costs	£12,516
Commentary on project progress and potential for achieving expected benefits	Projects currently on target				

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Description of project	ENA R&D Programme Four projects initiated by the ENA R&D Working Group. The Energy Networks Association (ENA) represents all UK DNOs.		
Expenditure for financial year	Internal - £3,050 External - £2,721 Total Cost - £5,771	Expenditure in previous financial period	Total cost - £Nil
Technological area and / or issue addressed by project	The projects undertaken through budget year 2005/6 addressed real problems that had been identified by the ENA Working Groups as significant and which required technical investigation and development. • ROCOF Relay functional specification – Produce an Engineering Report into the sensitivity of loss of mains relays to genuine loss of mains by determining the number of sample cycles required and the percentage change of load compared to generator ratings (of different construction and size). • SG12 – 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, so no customer supply interruption will be required • SG14 – Develop new techniques to assess the impact of lower voltage earth electrodes on higher voltage 'hot zones' and to measure the resistance of distribution substation earth systems. • SG17 - Produce a new Engineering Technical Report on lightning protection to include: Background information on lightning density across the UK, annual variations and effect of topography. Catalogue and provide a view on current practices and procedures. Determine and advise on equipment protection levels and arrangements		
Type(s) of innovation involved	All innovation types involved (incremental, significant, technological substitution and radical)		
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. • SG12 – The FLM instrument will allow fault infeed levels to be accurately assessed. This will provide an objective measurement tool that can be used to facilitate both the initial connection of distributed generation and ongoing assessment of its effects. • SG14 – This project will determine the minimum earthing separation distances required for a cost effective and safe earthing system • SG17 – Identification of required lightning protection application will reduce equipment failure and faults due to lightning. This will improve performance and reduce fault costs.		
Expected Timescale to adoption	1 - 10 years	Duration of benefit once achieved	10 - 40years

Estimated Success probability (at start of project)	25 - 75%				
PV of Project Costs	£815,569 (see note below)	PV of Project Benefits	£1,143,489	NPV of Project Costs	£347,921
Note – These project costs include implementation. Typical distribution license area costs and benefits have been used to derive these figures.					
Commentary on project progress and potential for achieving expected benefits	• ROCOF Relay functional specification – Draft final report is under review by the Protection Assessment Panel. • SG12 – Progress to date has been restricted to discussion of the specification of suitable power quality measuring instruments and potential sites in the Unitied Utilities and Manweb Distribution License Areas. • SG14 – Initial research work identified the need for further field work and sites have been made available in Central Networks and Western Power. • SG17 – Engineering Technical Report (ETR 134) is close to completion.				

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Description of project	Distribution Working Group Participation				
Expenditure for financial year	Internal - £9,100 External - £Nil Total Cost - £9,100		Expenditure in previous financial period	Total cost - £Nil	
Technological area and / or issue addressed by project	This group is a subgroup of the Electricity Networks Strategy Group which is jointly chaired by the DTI and Ofgem. The DWG continues the work of the earlier Distributed Generation Co-ordinating Group (DGCG), examining issues to enable the integration of generation onto the distribution network. The DWG manages four work programmes (three of which are participated in by Central Networks): • P01 Horizon Scanning • P02 Network Design for a Low Carbon Economy • P03 Enabling Active Network Management These groups initiate and manage a series of projects, which are completely funded by the DTI. This submission includes therefore only includes the internal Central Network costs resulting from participation and management of these projects.				
Type(s) of innovation involved	All innovation types involved (incremental, significant, technological substitution and radical)				
Expected Benefits of Project	The projects undertaken by this group aim to facilitate the governmental objectives of a low carbon environment and increased distributed generation.				
Expected Timescale to adoption	Various depending on project		Duration of benefit once achieved	Various depending upon project	
Estimated Success probability (at start of project)	20%-75%				
PV of Project Costs	Unknown	PV of Project Benefits	Unknown	NPV of Project Costs	Unknown
Commentary on project progress and potential for achieving expected benefits	Detailed project contract specifications have been formulated DTI has reviewed and agreed a number of these contract specifications Several contracts have been issued (for DTI agreed projects) and DWG groups are reviewing submissions				

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Description of project	Power Technology - Advanced Distribution Automation Electric Power Research Institute - Program 124.005 Research and Development into an Integrated Sensor and Monitoring System for Advanced Distribution Automation		
Expenditure for financial year	Internal - £1,000 External - £22,315 Total - £23,315	Expenditure in previous financial period	Total cost - Nil
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 :- • 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. • 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 :- • Distribution Reliability by providing continuous monitoring of vital system operating parameters to allow strategic operation of the distribution system. • Network Utilisation of existing infrastructure by allowing closer control of voltage profiles and maximising energy throughput. • 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

Commentary on project progress and potential for achieving expected benefits	Stages complete - • Detailed design of system Stages in progress – • Develop and test laboratory bench model • Design field prototype system • Develop field prototype system • Test and debug field prototype system • Complete Final Design • Production of product specification • Assessment of project benefits

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Description of project	Power Technology – Intelligent Universal Transformer Electric Power Research Institute - Program 124.006 Research and Development into a solid state replacement for conventional power transformers.				
Expenditure for financial year	Internal - £1,000 External - £20,505 Total - £21,505		Expenditure in previous financial period	Total cost Nil	
Technological area and / or issue addressed by project	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.				
Type(s) of innovation involved	Significant, technological substitution and radical innovation types are involved.				
Expected Benefits of Project	Intelligent Universal transformers will provide operating benefits and increased functionality over conventional transformers :- • Increased Utilisation of existing infrastructure by regulating voltage, power factor and frequency. • Active power quality functionality will eliminate dips, and harmonic distortion. • 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. • Reduced environmental and safety issues as it will contain no hazardous or harmful dielectrics.				
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	£85,089	PV of Project Benefits	£111,483	NPV of Project Costs	£31,385
Commentary on project progress and potential for achieving expected benefits	Stages complete - • Initial design of IUT • Find major power electronic equipment partner by competitive procurement • Develop modular field prototype (The principle component is the voltage stepping module, which uses insulated gate bipolar transistors for the power semiconductor switching device) Stages in progress – • Test modular field prototype IUT • Complete Final Design of IUT • Production of product specification • Assessment of project benefits				

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Description of project	Reference Network Development		
Expenditure for financial year	Internal - £4,500 External - £60,000 Total Cost - £64,500	Expenditure in previous financial period	Total cost £18,500
Technological area and / or issue addressed by project	The purpose of this project is to build on previous research work to develop a practical software tool that: • Creates optimum circuit disaggregation groups to allow analysis of relative network performance by reference to the parameters that define each of the groups and the populations of each group both within and between DNO networks. • Accurately predicts the effects of different investment options on each of the disaggregation groups to allow cost / benefit evaluation of different strategies to be undertaken. • The programme provides innovation from its design, the operation of primary plant and equipment and the control and protection of primary and secondary plant and equipment. • The other partners in this project are: United Utilities Scottish Power PB Power		
Type(s) of innovation involved	Incremental		
Expected Benefits of Project	• The facility to influence future performance regulation by providing an objective mechanism for understanding the performance drivers of different networks. • To allow the possibility of providing funding to make specific investments on identified parts of the network and remove the random factors that dominate the existing performance based incentives. • The identification of optimum improvement strategies that include fundamental changes to circuit topology as well as incremental improvements to reliability or fault restoration. In addition to the quantified financial benefits, the less tangible, benefits of greater understanding of network performance drivers, and improved regulation have the potential to be extremely large.		
Expected Timescale to adoption	2 years	Duration of benefit once achieved	3 years
Estimated Success probability (at start of project)	75%		

PV of Project Costs	£74,850	PV of Project Benefits	£202,240	NPV of Project Costs	£127,390

Commentary on project progress and potential for achieving expected benefits	Stages complete - • Input global data on real circuits and disaggregation parameters • Construct a representative network • Evaluate software derived networks to ensure comparable to real network • Analyse UU and CN networks to ascertain if more development required Stages in progress – • Analyse SP networks to ascertain if more development required (SP has joined the project in 2006 and they need to supply the required network data) • Identify variable attributes and select appropriate scenarios • Calculate projected performance of scenarios • Evaluate investment costs of scenarios • Rank development scenarios

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Description of project	Lidar - Laser Scanning of Overhead Lines Pilot trial to evaluate the benefits of aerial Laser scanning technology.				
Expenditure for financial year	Internal - £6,500 External - £38,125 Total - £44,625		Expenditure in previous financial period	Total cost N/A	
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. 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. 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 – • 132kV Tower construction overhead line • 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 – • Specific identification of sites where vegetation faults are likely • Identification of buildings or objects within specific distances of the conductors • Identification of potential statutory height infringements • 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	Stages complete - • Aerial laser scanning of 132kV Tower overhead line in Lincolnshire • Aerial laser scanning of 11kV Wood pole Overhead line in Staffordshire • Initial Assessment of data (structure locations, clearance data, etc) Stages in progress – • Interpretation of data into risk model • Confirmation of results with on site conditions • Formatting data for inclusion in GIS • Presentation of project results • Assessment of project benefits				

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Description of project	EA Technology – Condition Inspections of Overhead Lines Pilot trial to evaluate an innovative overhead line inspection and condition assessment process, which combines several technology areas.		
Expenditure for financial year	Internal - £4,400 External - £6,251 Total - £10,651	Expenditure in previous financial period	Total cost N/A
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. 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: • Helicopter Inspection using High Quality Aerial Photography • Degradation and failure mode analysis • 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 : • Consistent investment decision making process for overhead lines • Independence from outage requirements and their time constraints • Improved information from sites which can easily be reassessed if required • 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	Stages complete - • Helicopter condition inspection of 132kV Tower overhead line • Helicopter condition inspection of 33kV Wood pole and Tower overhead line • Initial Assessment of photographs Stages in progress – • Confirmation of results with on site conditions • Interpretation of data into Condition Based Risk Management model • Formatting data for inclusion in GIS • Presentation of project results • Assessment of project benefits

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Description of project	EA Technology – Safety Inspections by Helicopter 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 - £2,800 External - £3,657 Total - £6,457		Expenditure in previous financial period		Total cost N/A
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. 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. 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 : • Improved inspection records at minimal increase in cost • Availability of photographic data records for subsequent review • 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	£23,366	NPV of Project Costs	£2,870
Commentary on project progress and potential for achieving expected benefits	Stages complete - • Helicopter safety inspection of 11kV Wood Pole overhead line Stages in progress – • Initial Assessment of photographs • Formatting data for inclusion in Asset Register • Presentation of project results • Assessment of project benefits				

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Description of project	Mobile Pinging Trial – Locating Restoration Staff 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 - £4,800 External - £38,333 Total - £43,133		Expenditure in previous financial period	Total cost N/A	
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. 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 : • Customers will benefit from Improved restoration times following incidents by the dispatch of the nearest suitable restoration staff • Operational staff working in the vicinity of an incident can be advised • 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	Stages complete - • Mobile Pinging System modified for specific requirements • Equipment installed at Network Management centers • Interim Assessment Stages in progress – • 6 month trial commenced with 1000 operational staff • Assessment of 6 month trial period • Presentation of project results • Assessment of project benefits				