CE Electric UK

2006/07 IFI Annual Report

July 2007

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Executive summary

1. This report has been prepared by CE Electric UK Funding Company Ltd (CE) to inform interested parties of the activities of its licensees, Yorkshire Electricity Distribution plc (YEDL) and Northern Electric Distribution Ltd (NEDL), on innovation. It has been prepared in accordance with standard condition 51 of the electricity distribution licence, the associated regulatory instructions and guidance (published by Ofgem) and the Energy Networks Association (ENA) Engineering Recommendation (ER) G85 (the Good Practice Guide). It also informs our returns under standard condition 50.

2. The key projects in CE Electric during the reporting period are:

   - a novel specification to replace Woodhouse steel girder mast overhead lines,
   - the development of a superconducting fault limiter,;
   - proving, at a theoretical level, the concept for an innovative fault passage indicator for cable systems; and
   - collaborative projects including:
     - Reference Networks;
     - Supergen V; and
     - EATL STP.

3. In terms of commitment to the development of innovation, it is also worth noting that we have committed some **£11,000** of engineering resource to support the activities of the Electricity Networks Steering Group (ENSG). We hold this work to be of national importance and as such have committed resource to the work on an equal basis to our own R&D contracts, inevitably displacing some in-house activity.

4. Qualifying spend for the period has been £267,611 and £401,417 for NEDL and YEDL respectively, of which £40,142 and £60,213 respectively relates to internal costs. This total eligible spend of £669,028 compares to £464,333 for the twelve months to 31 March 2006, an increase of over 45%.

5. There remains a delicate balance in taking work forward, between either:

   - exploiting the existing ENA and EATL STP frameworks or alternative collaborative forums, where the need for consensus extends the process but collaborative specification and support will improve the finished product; and
   - proceeding on our own, where we can commission more quickly but would lose some of the up-front benefits of collaboration.

Revision Record

Version	Date	Revision Details	Author
0.1	3 July 2007	first draft for QA	Dave Miller
0.2	12 July 2007	second draft to management	Dave Miller
1.0	26 July 2007	final draft for approval	Dave Miller

Introduction

6. This report has been prepared by CE Electric UK Funding Company Ltd (CE) to inform interested parties of the activities of its licensees, Yorkshire Electricity Distribution plc (YEDL) and Northern Electric Distribution Ltd (NEDL), on innovation. It covers the period from 1 April 2006 to 31 March 2007.

7. A single report has been prepared because both licensees are operated under common management, sharing best practice across the whole. Research and development is no exception, and we draw no arbitrary distinction between innovation carried out for the two licensees. Projects and programmes are therefore discussed only once. Finally, the report breaks out the relevant expenditure by licensee to support regulatory reporting requirements.

8. The report focuses upon research and development work eligible for Ofgem's innovation funding incentive (IFI). The IFI is intended to provide funding for projects focused on the technical development of distribution networks, up to and including 132 kV, to deliver value (i.e. financial, supply quality, environmental, safety) to end consumers. IFI projects can embrace any aspect of distribution system asset management from design through to construction, commissioning, operation, maintenance and decommissioning.

9. In this context, 'technical' requires both that there is a significant engineering intellectual content and that projects involve load-carrying assets or their control and electrical protection.

10. The report has been prepared in accordance with standard condition 51 of the electricity distribution licence, the associated regulatory instructions and guidance (RIGs) and the Energy Networks Association (ENA) Engineering Recommendation (ER) G85 (the Good Practice Guide (GPG)), which states:

    3.4 Annual Regulatory Reporting Requirements for IFI Projects

    Ofgem requires a report to be published annually (i.e. by no later than the 31 July immediately following the end of the reporting year as required by the RIGs) by each distributor on its IFI [Innovation Funding Incentive] project activity…distributors will normally be required to provide the following information at the end of the reporting year and by no later than the immediately following 30 June [sic]:

    • IFI budget carry-forward

    • eligible IFI expenditure

    • eligible IFI internal expenditure

    • combined distribution network revenue

    • the IFI annual report.

    The minimum level of accuracy required when reporting to Ofgem is as follows:

    • IFI carry- forward nearest £1k

    • eligible IFI expenditure nearest £1k

• eligible IFI internal expenditure nearest £1k

• combined distribution network revenue nearest £0.1m

The IFI annual report will describe the IFI projects for which the distributor has incurred expenditure. The report should provide a summary of IFI project activities and details of costs and anticipated benefits of individual projects. A distributor may undertake one or more discrete programmes of IFI projects that are best grouped together to ease administration and reduce overheads. For each such programme a de minimis level of expenditure by an individual distributor of £40k per programme will apply. Individual projects with an annual expenditure below this level may be aggregated and reported as a programme…

11. The programmes and major projects that will be discussed in this report are:
    - CE's internal innovation programme;
    - externally-driven activities, including the DTI/Ofgem Energy Networks Strategy Group (ENSG) and subsidiary workstreams;
    - collaborative projects, including:
        - ASL superconducting fault limiter;
        - Supergen V; and
        - Imperial College reference networks;
    - projects led by the Energy Networks Association (ENA) R&D working group, including:
        - ENA P2: fault level monitor;
        - ENA P8: loss of mains protection (RoCoF relays); and
        - ENA P9: earthing (grids & transfer potentials);
    - the EA Technology Limited (EATL) Strategic Technology Programme (STP), including
        - module 2 (overhead networks);
        - module 3 (cables);
        - module 4 (substations);
        - module 5 (distributed energy);
        - protective coatings forum; and
        - partial discharge user group;
    - projects dedicated to local CE needs:
        - Woodhouse steel girder mast replacement specification;
        - an innovative fault passage indicator for cable systems;
        - Health Indices for switchgear and transformers; and
        - integration of substation relay information.

12. As permitted by the GPG, this report aggregates portfolios of projects under ENA, STP, work for DTI, and internal costs in developing and managing projects.

13. In preparing this year's report, the opportunity has been taken to review the projected benefits of ongoing projects. This has led to some revisions, none of which damage the business case for each project.

CE R&D Programme Highlights: Condition-Based Risk Management for Steel Towers

INTRODUCTION

This paper describes how CE Electric UK employed EA Technology Limited through the Innovation Funding Incentive to develop & trial an innovative helicopter inspection and condition based assessment technique. This technique was then used in an extensive trial to asses the condition on four hundred 132kV steel towers in the Yorkshire region.

Within the United Kingdom, distributors are required to inspect, maintain and manage large numbers of geographically dispersed overhead line assets at voltages up to and including 132kV. At the higher voltages these lines predominately employ steel towers to support the live conductors. The effective asset management of overhead lines is essential in order to meet safety, statutory, operational and regulatory requirements.

TRADITIONAL INSPECTION TECNIQUES

The simplest form of inspection is a foot patrol where a one or two man team will walk the length of the route and perform a visual inspection from the ground. With this method, it is difficult to make a detailed assessment of the top of the structure, which is where most of the critical equipment and fittings of interest are located.

To be able to assess the fittings at the top of the towers the conventional approach was to perform a climbing inspection. The conventional climbing inspection technique has been utilised by DNOs for many years, however this is a time consuming task. The electrical switching required to allow safe access involves disturbing the equilibrium of the network operation and there is always an element of safety and operational risk associated with any climbing activity.

OVERVIEW OF THE HELICOPTER INSPECTION PROCESS

The helicopter inspection and condition assessment regime developed by EA Technology is based on combining three areas of EA Technology's expertise; enhanced aerial power line inspections, understanding degradation and failure mechanisms for electrical plant and the development of Condition Based Risk Management (CBRM) to link asset information and engineering knowledge to investment decision making.

Following detailed discussions with staff from CE Electric UK and EA Technology to identify the exact requirements of the inspection, the picture acquisition phase was undertaken with up to 30 images acquired per tower. Figure 1 shows the typical level of detail that can be achieved by the high resolution digital images taken from a helicopter.

Figure 1: Image showing typical level of detail

The use of the satellite-based Global Positioning System (GPS) and moving map displays on board the helicopter means that every photograph is position tagged and geo-referenced back to the tower. When the photography from the helicopter was complete, all the captured images were examined by a team of experienced engineers at EA Technology to assess the condition of each of the towers inspected. Each tower was divided up into condition points and each condition point category was assigned a numerical Condition Rating (CR) of 1 to 4 depending upon its state of health (4 indicating worst condition).

It was evident from the initiation of the project that a bespoke condition proforma was necessary to maximise the quality and consistency of data to be gathered. Each row on the proforma represents an individual tower. Each column represents a component or condition category that is assessed as part of the inspection. In the example in Figure 2, the CRs have been colour coded to give an immediate impression of the overall condition of the towers on the particular route inspected.

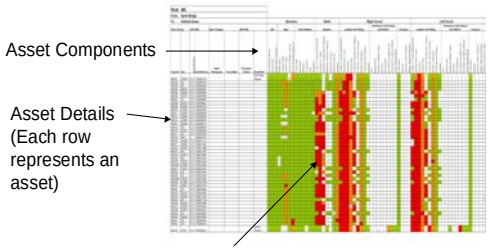


Figure 2: Condition assessment proforma

CONCLUSION

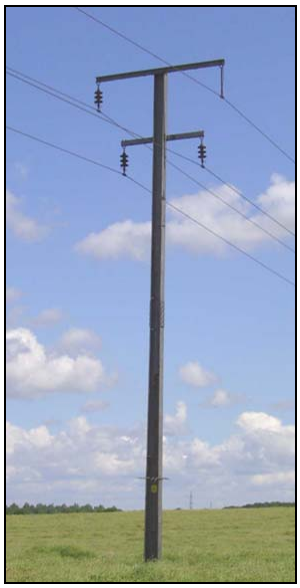
The benefits derived from this project include an improved understanding of asset risk, increasing confidence in the CBRM process for prioritising tower lines for refurbishment / replacement. Another advantage is that the study gave a permanent auditable record of the tower conditions at the time of the survey through the catalogue of digital images it produced. This allowed a consistent approach to be taken when assessing the tower condition, because the same data was assessed for each tower. Historically reports from site were always subjective and depended largely on the experience of the inspector collecting the data. It was difficult to ensure a consistent approach when different inspectors were used.

As a result of the success of this IFI project the CBRM process has now been implemented as standard practice within CE Electric UK for 132kV tower inspections. The results of the process are now influencing CE Electric UK's short, medium and long term asset renewal plans.

CE R&D Programme Highlights: Woodhouse Mast Replacement Spec'

INTRODUCTION

This paper describes how CE Electric UK has used the Innovation Funding Incentive to develop a replacement specification for a now obsolete design of overhead line support widely used by its predecessor Yorkshire Electricity during the 1930's at voltages of 11kV, 33kV and 66kV.



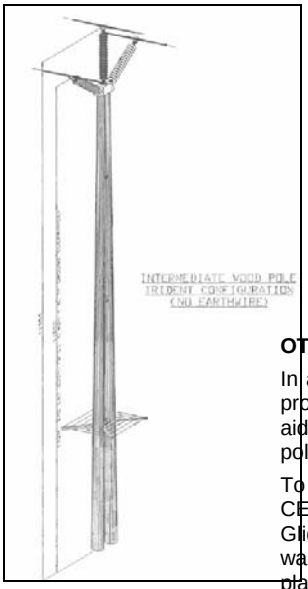


Figure 1 Shows a Woodhouse mast and the proposed replacement

The Woodhouse mast was a steel structure that was designed to have a particularly long span of up to 220m. The legacy design cannot be re-used because it does not comply with the general specifications for new OHL structures.

It was decided to develop an equivalent design that would act as a direct replacement for the existing structures which are now reaching a condition that replacement is necessary.

DEVELOPMENT OF A REPLACEMENT SPECIFICATION.

The first stage of the project was to commission a third party design house to create the design for the new structure in line with the CE Electric functional specification. For this specialist consultant, P B Power was used to develop the design specification. Key features of the design were that it should be capable of:

- Working at voltages of 33kV, 66kV and 132kV, so that in future it would be possible to raise the voltage of a circuit without having to replace the line.
- The new design should fit within the same silhouette (+/- 10%) and footprint to avoid wayleave and consents issues.
- The new structure should carry 200mm² AAAC conductors with a rating of 75°c. This will allow a maximum load current of 568A when compared to the original structures that were designed to carry 509A, facilitating the connection of generation and demand.

TYPE TESTING

To prove the strength of the new structures CE Electric employed TRADA (Timber Research and Development Association) to perform flexural strength tests in accordance with BS EN12509:2001.

Figure 2 Shows the new design being tested

OTHER DEVELOPMENTS

In addition to the development of the main structure the project has also had to consider access and construction aids. Because of the size of the structures (up to 17m poles) existing climbing equipment was not suitable.

To overcome this problem HCL safety has worked with CE Electric to develop a climbing solution using their GlideLoc ladder system. As well as the climbing aid it was also necessary to develop a pole top working platform with lifting aid.

Figure 3 Shows the GuideLoc Ladder

Following the successful completion of the type test series and development of the assembly aids it is planned during 2007 to build a trial line at CE Electric's Swillington training school. This line will be used to try out the design and then will be used by safety staff to develop training courses for people who have to work on the new structures in the field.

CONCLUSION

When the new specification is delivered to the business as well as providing a lower cost solution for the Woodhouse mast replacement project it will also offer an alternative to steel towers for 132kV circuits. The new design will also offer environmental benefits as it has a lower visual impact than currently-available alternative designs.

IFI has brought forward: the design of a structure; the development of safe methods of work on the new structure, testing and trialling that might not otherwise have been achieved.

Registered Power Zones

14. Registered Power Zones (RPZs) are intended to encourage distributors 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 RPZ mechanism provides for an enhanced rate of return for distributors, by extending the general generation funding mechanism introduced by Ofgem at the last periodic review.

15. We remain committed to developing an RPZ in the YEDL or NEDL networks, subject to delivering tangible benefits to customers and shareholders. We have again reviewed a number of opportunities during the year, in the areas of:

- the potential for active management of constraints on the existing system to facilitate more efficient generator connections by avoiding reinforcement; and
- the potential for active management of constraints on system extensions to facilitate more efficient generator connections by reducing the amount of new infrastructure required.

16. Each of these opportunities (and we have had several in each basket) has arisen from genuine customer enquiries. None has been developed speculatively, on the basis that an opportunity might arise on the network. However, each has failed, generally due to a combination of lack of customer commitment and unfavourable economics. One application that we pursued with some vigour looks likely to be implemented, but a 'conventional' solution will be more economic than artificially pursuing something sufficiently innovative to clear the RPZ threshold.

Externally-driven activities

17. This section considers those projects driven by bodies outside the distribution sector where, although we have the choice as to whether or not we become involved, they fall outside our direct governance. We are, therefore, effectively unpaid sub-contractors.

18. We have committed significant resource to support projects under the DTI technology programme in previous years, but there has been no material contribution in this reporting year. Therefore, the only area covered in this report is the DTI-Ofgem Electricity Networks Strategy Group (ENSG).

Project Title	**ENSG – DWG**		
Description of project	This is the first expert group to have a remit to look at issues of generation, transmission and distribution in the context of the Government's energy policy.		
Expenditure for financial year	Internal £11,000 External £0 Total **£11,000**	Expenditure in previous (IFI) financial years	Internal £18,875 External £0 Total **£18,875**
Project Value	Rolling programme	Projected 07/08 costs	Internal £12,000 External £0 Total **£12,000**

Technological area and / or issue addressed by project	The Electricity Networks Strategy Group (ENSG) provides advice to DTI, Ofgem, Defra, the Scottish Executive and the Welsh Assembly on issues associated with the development of the electricity distribution and transmission networks. The ENSG has a number of sub-groups, specially the Distribution Working Group (DWG), chaired until recently by our President and Chief Operating Officer, and the Transmission Working Group (TWG). The Distribution Working Group (DWG) continues the work of the earlier Distributed Generation Coordinating Group's (DGCG) Technical Steering Group (TSG), examining the issues to enable the integration of generation onto the distribution network. The DWG manages four work programme areas and CE Electric have been actively involved in three out of four of the current modules, as follows: **Work Programme 01: Horizon Scanning** To assess the current state of technology, likely developments, R&D progress, actual and forecast trends in penetration levels and future scenarios, regulatory and political policy to guide and formulate the programmes of work that would commence in approximately 18-24 months' time, on a rolling basis. **Work Programme 02: Network Design for a Low-Carbon Economy** To evaluate the technology, tools, techniques, processes and standards that would be required to construct power systems compatible with the developing trends in low-carbon energy technology. **Work Programme 03: Enabling Active Network Management** Developing the technologies, protocols, tools, processes, techniques and standards that would be needed to ensure that low-carbon compliant power systems could be operated on an active basis to ensure efficient use of investment and an effective contribution from potential market participants.		
Type(s) of innovation involved	Significant though Radical		
Expected benefits of project	DTI/Ofgem have not published a PV benefit for the DWG/TSG projects. We have modelled a cost/benefit ratio for the DTI Technology Programme, then assumed that this should also apply to CE Electric investment.		
Expected timescale to adoption	2-10 years, dependent on projects.		
Estimated success probability (at start of project)	Estimated 25%		
PV of project costs to date	£27,283	PV of anticipated project benefits from work to date	£51,371
Commentary on project progress and potential for achieving expected benefits	Debates over funding have delayed meaningful work on many projects, although some work has been progressed The DWG now has 22 substantive projects, representing a total direct cost of approximately £700,000		
Collaborative Partners	DTI, Ofgem, TSO, DNOs, generators, energy suppliers, equipment manufacturers and independent consultants		

ENA

19. The tangible outputs of the ENA R&D working group are the major projects described in detail in the following tables. Significant effort has also been committed to updating ER G85, the IFI GPG, although this will not be published until 2007/8.

20. In addition to the major projects we also incurred internal costs of £3,875. This was made up from £1,000 incurred attending the ENA R&D steering group and £2,875 on these specific projects:

    - ENA dc time constants (X/R ratio) working group;
    - G78-1 Working Group; and
    - Vacuum bottle end of life.

21. These costs have been aggregated with our internal R&D working group for reporting purposes.

22. The remaining active projects are, like STP, reported together:

Project Title	**ENA collaborative R&D projects**		
Description of project	Four projects initiated by the Energy Networks Association (ENA) R&D Working Group. The ENA represents all UK DNOs.		
Expenditure for financial year	Internal £10,019 External £3,000 Total **£13,019**	Expenditure in previous (IFI) financial years	Internal £3,500 External £6,085 Total **£9,585**
Project Value	Rolling programme	Projected 07/08 costs	Internal £3,500 External £10,644 Total **£14,144**
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. • **ROCOF Relay functional specification** – Produce an Engineering Report into the sensitivity of loss of mains relays to genuine loss of mains by determining the number of sample cycles required and the percentage change of load compared to generator ratings (of different construction and size).The test information will be used to develop a matrix of optimum settings and test procedures for relay specification. • **SG12 Fault Level Monitor** – Develop a Fault Level Monitor (FLM) that can successfully measure fault level on a distribution network with repeatability and reliability. The FLM instrument shall use the underlying methodology proven with EA Technology's existing Extended Supply Monitor and shall measure normally occurring events (e.g. small scale disturbances resulting from tap changer operation), so no customer supply interruption will be required. • **SG14 Earthing Project** – Develop new techniques to assess the impact of lower voltage earth electrodes on higher voltage 'hot zones' and to measure the resistance of distribution substation earth systems.		

<table>
<tr><td></td><td colspan="3">

- **SG17 Lightning Protection** - Produce a new Engineering Technical Report on lightning protection to include:

  Background information on lightning density across the UK, annual variations and effect of topography.

  Catalogue and provide a view on current practices and procedures.

  Determine and advise on equipment protection levels and arrangements.

</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="3">Incremental and Significant innovation types are involved.</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="3">

- **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 investigate the effects of LV earth systems on HV systems. The results of this should determine the means to provide cost effective, safe earthing system without the need for expensive separations between HV and LV electrodes which in a PME system may be impractical and costly to achieve and maintain.
- **SG17** – Identification of required lightning protection application will reduce equipment failure and faults due to lightning. This will improve performance and reduce fault costs.

</td></tr>
<tr><td>Expected Timescale to adoption</td><td>1 - 10 years</td><td>Duration of benefit once achieved</td><td>10 - 40years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="3">25 - 75%</td></tr>
<tr><td>PV of Project Costs</td><td>£1,143,489
(see note below)</td><td>PV of Project Benefits</td><td>£815,569</td></tr>
<tr><td colspan="4">Note – These project costs include implementation and have been calculated assuming a typical distribution license area.</td></tr>
</table>

Commentary on project progress and potential for achieving expected benefits	• **ROCOF Relay functional specification** – EA Technology published the Final report in March 2007. • **SG12 Fault Level Instrument** – EA Technology and the University of Strathclyde have pursued the following activities 1. Candidate monitoring sites and Deployment of loggers– Network disturbance data has been obtained using Dranetz PX5 Power Quality instruments. 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. 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). 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. • **SG14 Earthing Techniques** – EA Technology 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. 2. Investigation at 11kV substations - Identification of suitable test sites is underway. Site testing has commenced at two suitable sites. • **SG17 Lightning Protection** – Engineering Technical Report (ETR 134) awaiting final approval before publishing.

EATL Strategic Technology Programme etc.

Project Title	**Strategic Technology Programme Overhead Network Module**		
Description of project	Applied R&D into reducing the costs and risks associated with overhead lines		
Expenditure for financial year	Internal £3,563 External £38,167 Total **£41,730**	Expenditure in previous (IFI) financial years	Internal £875 External £36,000 Total **£36,875**
Project Value	rolling programme over seven distributors	Projected 07/08 costs	Internal £4,000 External £45,000 Total **£49,000**
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. The projects within the programme were: • S2126_3 - Undertake long-term monitoring of conductor temperature by obtaining and analysing 12 months trial data. • S2132_2 - Validate current and proposed new ice accretion models • S2136_2 - Participation in European Project COST 727: Measuring and forecasting atmospheric icing on structures. • S2138_2 - Investigate live-line jumper-cutting limitations Stage 2 is to undertake a controlled test programme. • S2143_1 – To detect in-situ degradation of aluminium overhead line conductors • S2144_1 – Determine the residual strength of tower fittings through experimental means • S2145_1 Explore the use of novel conductors for uprating tower line circuits. • S2146_1 Undertake torsion testing to evaluate possible limits for composite tension insulators • S2147_1 Investigate the effect of multiple Spiral Vibration Dampers (SVDs) on the performance of overhead line conductors • S2149_1 – Explore high durability overhead line fittings. Initial stage to identify the range of fittings and materials.		
Type(s) of innovation involved	Incremental		

<table>
<tr><td>Expected Benefits of Project</td><td colspan="3">Due to the age profile of system equipment it is inevitable that, unless significant new technology is used to extend asset life, CAPEX and possibly OPEX will need to increase significantly to maintain the present level of network reliability and safety.
If these projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain benefits including:
• avoid redesign, reconstruction or refurbishment of overhead lines where this is driven by a perceived need to increase ratings or strengthen lines, and is required to conform with existing standards but which may be unnecessary;
• reduce levels of premature failure of assets;
• provide more cost effective and early identification of damaged insulators and discharging components, which if not addressed would result in faults;
• confidently extend the service life of towers and reduce potential levels of tower failures;
• reduce lifetime costs by the appropriate use of alternative materials.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Range 1-5 years - dependent on project</td><td>Duration of benefit once achieved</td><td>Range 3-10 years - dependent on project</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="3">Range 1-10% - dependent on project</td></tr>
<tr><td>PV of Project Costs</td><td>£3,704[1]</td><td>PV of Project Benefits</td><td>£63,564</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="3">Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure which, if successfully addressed, would enable the expected benefits to be achieved.
• S2126_3 - Undertake long-term monitoring of conductor temperature by obtaining and analysing 12 months trial data. First year form initial test site data suggests that uprating may be possible in specific circumstances. A further site has been established and is being monitored.
• S2132_2 - Validate current and proposed new ice accretion models. Data has been gathered from the test site and is being analysed prior to presentation to members.
• S2136_2 - Participation in European Project COST 727: Measuring and forecasting atmospheric icing on structures. This is part of a much larger European collaborative project aiming to provide more accurate mapping of ice prone areas. Involvement is continuing with data exchange with other participants. This in turn will allow the most appropriate structure to be constructed.
• S2138_2 - Investigate live-line jumper-cutting limitations Stage 2 is to undertake a controlled testing programme. The aim is to establish practical and safe limits for operational jumper cutting.</td></tr>
</table>

[1] This is identified early stage cost. It does not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive
This also reflects only the value of the current portfolio of projects, not the wider programme to date

	• S2143_1 – To detect in-situ degradation of aluminium overhead line conductors. The preliminary work to explore available techniques has been completed. • S2144_1 – Determine the residual strength of tower fittings. A possible technique is being investigated which has clear financial benefits compared with traditional methods. • S2145_1 Explore the use of novel conductors for uprating tower-line circuits. This project is determining the applicability at the distribution level of novel conductor designs used at transmission voltages to allow increased ratings using existing structures. • S2146_1 Undertake torsion testing to evaluate possible limits for composite tension insulators. Laboratory testing has indicated torsion limits for a range of such insulators, which can be used to inform field staff. • S2147_1 Investigate the effect of multiple Spiral Vibration Dampers (SVDs) on the performance of overhead line conductors. The application of either multiple SVDs or heavy duty SVDs could allow increased overhead line tension • S2149_1 – Explore high durability overhead line fittings. Initial stage to identify the range of fittings and materials. This project is at an early stage and possible materials and treatments to improve corrosion resistance have been identified.
Collaborative Partners	All GB DNOs
R&D Provider	EATL

Project Title	**Strategic Technology Programme Cable Networks Module**		
Description of project	Applied R&D into reducing the costs and risks associated with underground cables		
Expenditure for financial year	Internal £2,188 External £38,167 Total **£40,355**	Expenditure in previous financial years	Internal £1,650 External £35,924 Total **£37,574**
Project Value	rolling programme over seven distributors	Projected 07/08 costs	Internal £3,000 External £54,000 Total **£57,000**
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. The projects undertaken within the programme during 2006-07 were: • S3132_6 - Addition of single core MV paper cable modelling functionality within CRATER cable rating software. • S3132_7 - Addition of cable crossing modelling functionality within CRATER cable rating software. • S3132_8 - Addition of load curve modelling functionality within CRATER cable rating software. • S3132_9 - Addition of fluid filled cable modelling functionality within CRATER cable rating software. • S3132_11 - Addition of EHV polymeric cable modelling functionality within CRATER cable rating software. • S3140_2 – Towards Best engineering practice for ducted cable systems. • S3145_1 – Investigate shrink back performance of PE sheath and insulation – Establish reliable test method. • S3146_1 – Testing of fire retardant coatings and tapes. • S3148_1 and S3148_2 - Requirements for earthing and bonding of single core MV power cables • S3149_1 Assessment of different HV polymeric cable designs • S4158_1 – Investigate user requirements for ducts • S3159_1 - Series resonant testing of short lengths of HV cable		
Type(s) of innovation involved	Incremental		
Expected Benefits of Project	If the projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain the following benefits, including: • offset future increases in CAPEX and OPEX; • CI/CML savings per connected customer; • increased safety of staff and public by reducing the number of accidents / incidents.		

Expected Timescale to adoption	Range 1-3 years - dependent on project	Duration of benefit once achieved	Range 2-7 years - dependent on project
Estimated Success probability (at start of project)	Range 2-20% - dependent on project		
PV of Project Costs	£35,704[2]	PV of Project Benefits	£53,490
Commentary on project progress and potential for achieving expected benefits	Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure which, if successfully addressed, would enable the expected benefits to be achieved. • *S3132_6 - Addition of single core MV paper cable modelling functionality within CRATER cable rating software.* The functionality to model and analyse this cable type is now available within the CRATER software tool, allowing member companies to evaluate a wider range of circuits. • *S3132_7 - Addition of cable crossing modelling functionality within CRATER cable rating software.* Comprehensive cable crossing functionality is now available in CRATER, allowing member companies to determine their own cable ratings and the interaction with NGC cables. • *S3132_8 - Addition of load curve modelling functionality within CRATER cable rating software.* The load curve modelling functionality in CRATER now allows a more accurate representation of the loads when determining ratings. • *S3132_9 - Addition of fluid filled cable modelling functionality within CRATER cable rating software.* A user-friendly spreadsheet tool for the cable engineer was created to determine sustained, cyclic and distribution current ratings for fluid filled cable ratings, using approved methods of calculation. • *S3132_11 - Addition of EHV polymeric cable modelling functionality within CRATER cable rating software.* The functionality to model and analyse this cable type is now available within the CRATER software tool, allowing member companies to evaluate a wider range of circuits. • *S3140_2 – Towards best engineering practice for ducted cable systems.* The report will form a sound basis for the creation of engineering recommendations and guidance documents for ducted cable systems. • *S3145_1 – Investigate shrink back performance of PE sheath and insulation – Establish reliable test method.* The project has demonstrated that shrink back can occur at lower temperatures and proposed a test to predict in service shrink back. • *S3146_1 – Testing of fire retardant coatings and tapes.* The project has, through testing, demonstrated an effective means of fire protection for triplex cables.		

[2] This is identified early stage cost. It does not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive
This also reflects only the value of the current portfolio of projects, not the wider programme to date

	• *S3148_1 and S3148_2 - Requirements for earthing and bonding of single core MV power cables.* Cable engineers can now determine the size of circulating currents and losses for their cable networks and use this information to determine, if appropriate, a cable size based on whole life costs. • *S3149_1 Assessment of different HV polymeric cable designs.* The initial stage of this project has not identified a suitable replacement design to lead sheaths for use as an effective moisture barrier in HV XLPE insulated cables rated at 66kV and higher. • *S4158_1 – Investigate user requirements for ducts.* This project will allow DNOs to better tender for all types of plastic cable ducts since the requirements have been agreed between all users and all the major manufacturers • *S3159_1 - Series resonant testing of short lengths of HV cable.* This project will determine whether the use of variable frequency test sets is too onerous for the commissioning of short lengths of HV cable.
Collaborative Partners	All GB DNOs
R&D Provider	EATL

<table>
<tr><td>Description of project</td><td colspan="3">Strategic Technology Programme Substation Module</td></tr>
<tr><td>Description of project</td><td colspan="3">Applied R&D into reducing the costs and risks associated with substation plant</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £4,813
External £38,167
Total £45,000</td><td>Expenditure in previous financial years</td><td>Internal £4,500
External £36,000
Total £40,500</td></tr>
<tr><td>Project Value</td><td>rolling programme over seven distributors</td><td>Projected 07/08 costs</td><td>Internal £5,000
External £40,000
Total £45,000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="3">Concerns over the age profile of substation assets within the UK electricity distribution system are well known. Also, both regulatory and shareholder pressures preclude substantial investments of the large scale that was seen in the 1950’s to 1970’s. The challenge is to constantly review and innovate new solutions to monitor and define asset condition thereby allowing risks to be clearly defined and sound investment decisions to be taken
The programme of projects which were approved for funding from the STP substations module budget and were undertaken in 2006/07 encompass both developing new innovative asset management processes and practices and developing innovative diagnostic techniques. The aim is to develop already well established themes such as life extension of aged assets within legal and heath and safety constraints, examination of new technologies, developing an understanding of, and innovative solutions for, the impact on substation assets of increasing levels of distributed generation on networks and condition monitoring techniques.
Eighteen new projects were approved during the year:
S4164_3 – On load tap changer monitor – Stage 3.
S4176_2 – Comparison of available earth testing instruments
S4185_2 – AM Forum membership.
S4191_1 – Update and populate CBMVAL database.
S4193_2 – Enable effective quantification of risk and reliability.
S4194 – Regenerative transformer breathers.
S4197_1 – Concrete structure assessment.
S4200_1 – Methods to assess oil bunds and intelligent pump technology
S4201_1 – Corrosive sulphur in transformers
S4202_1 – Out of phase switching
S4203_1 – Review of INSUCON
S4205_1 – Assessment of contact greases for outdoor applications.
S4206_1– Substation security
S4207_1 – ERS33 switchgear rating at reduced temperature
S4208_1– Investigate the re-assessment of switchgear ratings
S4209_1 – Post maintenance testing
S4211_1 – Management and use of actuators</td></tr>
</table>

	• S4215_1 – Internal arc considerations in substations		
Type(s) of innovation involved	Incremental		
Expected Benefits of Project	Due to the age profile of the current system assets it is inevitable that unless significant new technology is used to extend asset life, CAPEX and possibly OPEX will need to increase significantly to maintain the present level of network reliability and safety. If the projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain the benefits including: • Offset future increases in CAPEX and OPEX • Increased safety of staff and public by reducing the number of accidents/incidents; • Both preventing disruptive failures of oil-filled equipment to reduce land contamination and avoiding unnecessary scrapping of serviceable components will alleviate environmental impact.		
Expected Timescale to adoption	1-3 years - dependent on project	Duration of benefit once achieved	2-7 years - dependent on project
Estimated Success probability (at start of project)	5-40% - dependent on project		
PV of Project Costs	£35,704[3]	PV of Project Benefits	£59,559
Commentary on project progress and potential for achieving expected benefits	Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure which, if successfully addressed, would enable the expected benefits to be achieved. • *S4164_3 – On load tap changer monitor – Stage 3.* The results from extending the laboratory system into a live substation have been very encouraging and a subsequent stage will allow an extended trial on a wider range of tap changers. • *S4176_2 – Comparison of available earth testing instruments.* The project permitted cost effective comparison of four different types of electrode system to evaluate each instrument in relation to accuracy, cost, usability and robustness. • *S4185_2 – AM Forum membership.* This project allowed members to be updated on substation asset management policies and practices adopted by other European Transmission System Operators (TSOs) and Distribution Network Operators in a cost effective manner. • *S4191_1 – Update and populate CBMVAL database.* This project has delivered an up-to-date and easy-to-use software tool that enables members to make a valid assessment of the net financial benefits that might accrue from the implementation of CBRM.		

[3] This is identified early stage cost. It does not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive
This also reflects only the value of the current portfolio of projects, not the wider programme to date

	• *S4193_2 – Enable effective quantification of risk and reliability.* The project collated and analysed the consequences of recent events (over the past 10 years) in order to establish 'benchmarks' to quantify risk. • *S4194 – Regenerative transformer breathers.* The project undertook an independent evaluation and cost benefit analysis of "maintenance-free" desiccant breathers. • *S4197_1 – Concrete structure assessment.* The project highlighted the more common types of concrete degradation and the testing that is available to assess the extent of this degradation • *S4200_1 – Methods to assess oil bunds and intelligent pump technology.* The project will enable members to compare the different policies, practices and bund pump technologies that have been adopted and to identify best practice. • *S4201_1 – Corrosive sulphur in transformers.* The project informed members regarding the issues and consequences of the failures in transformers due to corrosive sulphur. • *S4202_1 – Out of phase switching.* The project facilitated expert debate of out of phase switching issues. It was necessary for DNOs to fully understand the underlying system conditions and agree a common approach in this matter. • *S4203_1 – Review of INSUCON.* This project provided a cost effective summary commentary of INSUCON content and its relevance to members. • *S4205_1 – Assessment of contact greases for outdoor applications.* The project will recommend suitable products for the lubrication of outdoor contacts and identify best practice for their application. • *S4206_1– Substation security.* This project will undertake a wide review of the concept of, and approach to, the physical security of substations in order to deter theft. • *S4207_1 – ERS33 switchgear rating at reduced temperature.* The project will provide guidance that may allow utilities to run switchgear above maximum normal rated current values under specific conditions. • *S4208_1– Investigate the re-assessment of switchgear ratings.* The project will consider the provision of a methodology for understanding the risk of re-assigning switchgear fault level ratings without type testing. • *S4209_1 – Post maintenance testing.* The project will enable members to carry out the most appropriate testing regimes both from a financial and technical perspective and to establish pass/fail criteria. • *S4211_1 – Management and use of actuators.* This project should assist the members in ensuring that the risk of actuator failure is reduced, their reliability is increased and maintenance and testing is optimised. • *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.

Collaborative Partners	All GB DNOs
R&D Provider	EATL

<table>
<tr><td>Project Title</td><td colspan="3">Strategic Technology Programme Networks for Distributed Energy Resources Module</td></tr>
<tr><td>Description of project</td><td colspan="3">Applied R&D into the network integration of distributed energy</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £4,188
External £36,972
Total £41,160</td><td>Expenditure in previous financial years</td><td>Internal £8,000
External £36,286
Total £44,286</td></tr>
<tr><td>Project Value</td><td>rolling programme over seven distributors</td><td>Projected 07/08 costs</td><td>Internal £5,000
External £51,000
Total £56,000</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.
Fifteen new project stages were approved during the year:
• S5147_3 – Monitor Microgenerator Clusters
• S5149_4 – Explore Active Voltage Control
• S5142_2/3 – Generator Data and Structure for DG Connection Applications Stages 2 and 3
• S5152_2 – Latest developments in the connection of distributed generation
• S5154 –Voltage Control Policy Assessment Tool on the IPSA Platform
• S5157_1 – Evaluate the Performance of Small Scale Reactive Power Compensators Stage 1
• S5157_2 – Evaluate the Performance of Small Scale Reactive Power Compensators Stage 2
• S5160_1 – ACTIV Active Voltage Control
• S5161 – Standard risk assessment approach to DNO protection
• S5162 – Risk assessment analysis of voltage step changes
• S5164 – Managing network risks associated with the application of ER P”/6
• S5167 – Assessment of enhanced ratings for overhead lines connecting wind turbines
• S5168 – Design and operation implications for Grid Code compliance
• S5180 – DNMS functions to support active network management</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="3">Incremental</td></tr>
</table>

<table>
<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.

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>1-5 years - dependent on project</td><td>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="3">5-30% - dependent on project</td></tr>
<tr><td>PV of Project Costs</td><td>£34,586[4]</td><td>PV of Project Benefits</td><td>£69,827</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="3">Some projects within the programme are at an early stage, whilst others are complete. Issues have been identified relating to both operational and capital expenditure which, if successfully addressed, would enable the expected benefits to be achieved.
• S5147_3 – Microgenerator Clusters. Installation of monitoring points is complete at both the substation and LV network level. A twelve month monitoring programme has commenced.
• S5149_4 – Explore Active Voltage Control. Modelling of typical radial and interconnected networks in preparation for flexing key parameters to examine limits of active voltage control.
• S5142_2/3 – Generator Data and Structure for DG Connection Applications. A rationalised data structure has been agreed and implemented with all terms defined.</td></tr>
</table>

[4] This is identified early stage cost. It does not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive
This also reflects only the value of the current portfolio of projects, not the wider programme to date

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

Project Title	**Protective Coatings Forum**		
Description of project	Quality control and consultancy services related to protective coatings for overhead line towers and substation plant.		
Expenditure for financial year	Internal £500 External £6,000 Total **£6,500**	Expenditure in previous (IFI) financial years	Internal £0 External £0 Total **£0**
Project Value	£36,000	Projected 07/08 costs	Internal £500 External £6,240 Total **£6,740**
Technological area and / or issue addressed by project	EA Technology has been actively involved in work on surface coatings for overhead line towers and substation plant for a number of years, primarily sponsored by the DNOs and the National Grid. Specifications for tower and plant paint systems have been produced for use by the sponsoring companies. For overhead line towers, most companies currently use two-coat paint systems based on urethane alkyd or modified vinyl resins, manufactured to specifications produced by EA Technology and the National Grid. To ensure satisfactory quality control throughout the industry, a batch certification scheme has been set up and paint samples from manufacturers and painting contracts are checked on a regular basis. As a result, problems relating to paint application have been largely eliminated and the performance of the paint systems has been much improved. Other services provided include troubleshooting, evaluation of various new products and special purpose paint systems, surveys of coatings on new plant and general guidance on surface coatings. In recent years, European legislation has been introduced with the aim of reducing emissions of Volatile Organic Compounds (VOCs), such as the solvents in paint systems, to the atmosphere. The Process Guidance Note PG6/23 (97): Coating of Metal and Plastics, introduced the concept of EPA Compliant Coatings and proposed alternative approaches for surface coatings to reduce VOC emissions. In July 2003, a draft revised version of PG6/23 was issued for consultation, PG6/23A. The main change is the inclusion of requirements specified in EC Directive 1999/13/EC, known generally as the Solvent Emission Directive (SED). The aim of the SED is to reduce emissions of VOCs from specified industrial processes. Full implementation of SED is required by October 2007. This will not immediately affect the use of the solvent based paints currently used for painting towers and plant, because the directive is applicable only to factory applied coatings and does not include coatings applied to outside installations, such as bridges, refineries, towers etc. However, The European Commission and EU Member States have recognised that they need to do even more to improve air quality, and hence two new directives are being prepared. One refers to ozone. The other, the future National Emissions Ceiling Directive will require Member States to reduce their emissions of several air pollutants including VOCs to lower levels from 2010. These directives may well lead Member States to require the Protective Coatings sector to further reduce emissions arising from the use of its products.		

<table>
<tr><td></td><td colspan="3">This suggests that current tower paints may be acceptable until 2010. However, the availability of suitable low solvent paint systems as substitutes for the currently used solvent based systems must be seen as a priority for all users of large quantities of paints.
In anticipation of the proposed legislation, EA Technology developed an environmentally friendly water based tower paint system as part of the NORUST project, part funded by the Commission of European Communities, in conjunction with a paint manufacturer, a resin manufacturer and an overseas (Spanish) utility company. Field trials were carried out on overhead line towers in six UK DNOs. These were completed in 1998, and one of the tasks of the project is to continue to monitor the field performance of the paint system, with a view to ensuring a smooth transmission to environmentally friendly paint systems as demanded by legislation.
Other VOC compliant paint systems, which have been evaluated, through laboratory test programmes and field trials, have included water based and high solids two-pack epoxy coatings. A stated task within the project is to continue to assess VOC compliant paint systems which may be suitable for painting towers and substation plant.</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="3">Incremental</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="3">It is anticipated that the majority of overhead lines will be needed along existing routes for the foreseeable future. Present lines will remain in service as long as the structures can be maintained economically.
Currently, the National Grid owns and operates some 7000 route-km of 400kV and 275kV transmission lines with approximately 28,000 towers. The DNOs operate and maintain the 132kV system which comprises approximately 48,000 towers in total.
Current paint systems are expected to last for 10 to 12 years, provided the towers have been previously well maintained and the steelwork is in good condition. Life expectancy of the paint systems on rusty substrates will be lower, possibly 5 years.
It is essential that any new VOC compliant paint systems proposed for use on overhead line towers should perform at least as well as the currently used solvent based systems, since they are likely to be more expensive, although material costs account for a relatively small proportion of total contract costs. For a typical DNO, a small improvement in performance would generate financial benefits in the region of £5,000 per annum, together with associated environmental benefits.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>3 - 5years
dependent on legislation</td><td>Duration of benefit once achieved</td><td>Ongoing</td></tr>
<tr><td>Probability of Success</td><td>50% - 100%</td><td colspan="2"></td></tr>
<tr><td>PV of Project Costs</td><td>£6,080</td><td>PV of Project Benefits</td><td>£9,355</td></tr>
<tr><td>Collaborative Partners</td><td colspan="3">All GB DNOs and National Grid</td></tr>
<tr><td>R&D Provider</td><td colspan="3">EATL</td></tr>
</table>

Project Title	**Partial Discharge User Group**		
Description of project	The PD User group is a technical forum where information on partial discharge related failures can be discussed.		
Expenditure for financial year	Internal £1,000 External £6,654 Total **£7,654**	Expenditure in previous (IFI) financial years	Internal £1,000 External £5,953 Total **£6,593**
Project Value	£66,540	Projected 07/08 costs	Internal £1,000 External £5,954 Total **£6,594**
Technological area and / or issue addressed by project	Partial discharge is the primary cause of disruptive failure of HV switchgear. The PD User group is a technical forum where information on partial discharge related failures can be disseminated and the understanding of partial discharge on switchgear can be enhanced through targeted investigative, research and development work. This in turn will enhance the way in which HV assets are managed and maintained and make a positive impact on the safety of operators working within substations.		
Type(s) of innovation involved	Incremental		
Expected Benefits of Project	Due to the ageing profile of switchgear and the introduction of air insulated switchgear designs using cast resin insulation, which is less tolerant to the effects of partial discharge activity, unless the condition of switchgear is actively assessed and managed there is a likelihood of increasing failure rates. The expected benefits of the projects undertaken during FY07 are: • Understanding of the potential partial discharge related failure points for all types of switchgear. • Enhanced interpretation of the results of routine PD surveys. • Better targeting of maintenance teams to switchgear in need of attention. • Preservation or reduction of the low failure rate for HV distribution switchgear. • Understanding the effect of the environment on the levels of PD activity and condition of switchgear.		
Expected Timescale to adoption	1-3 years	Duration of benefit once achieved	Ongoing
Probability of Success	50%		
PV of Project Costs	£7,160	PV of Project Benefits	£11,225

Potential for achieving expected benefits	**Enhanced data manager** During FY06 the PD User Group invested in the formation of a database of results that enables significant and key information to be quickly drawn from the large population of historical results. The database can now incorporate pictures, drawings, failure records, sound files (for the analysis of heterodyned ultrasonic activity). This greatly enhances the incident reporting facilities which helps engineers to better interpret the results of partial discharge surveys and make an assessment on whether switchgear is in need of immediate attention. The database requires fine tuning and a new PD Template has been made available to all members and the input of additional data will now be the key to realising best use of the functionality. **Profile of the long term degradation of switchgear** Another 11kV switchgear panel has been installed into a test cage and long term testing has begun. Further knowledge on the relationship between surface discharge and relative humidity and profile through to failure will be gained.
Project Progress to March 07	• The panel of 11kV switchgear eventually failed due to Partial Discharge activity, a lot has been learnt regarding the relationship between surface discharge and relative humidity levels. • Outdoor switchgear trials completed as per schedule. • Several new instruments / accessories developed to be tested by members. • New PD database demonstrated, some fine tuning required.
Collaborative Partners	DNOs
R&D Provider	EATL

Other Collaborative Projects

<table>
<tr><td>Project Title</td><td colspan="3">SuperGen V</td></tr>
<tr><td>Description of project</td><td colspan="3">This is a 4 year major (£3M) multi party collaborative project
Industrial Participants: National Grid, Scottish and Southern, SP Power Systems, United Utilities, Western Power Distribution, Central Networks, CE Electric UK, NIE, Advantica & EDF Energy Networks
Universities: Manchester, Southampton, Edinburgh, Liverpool, Strathclyde, Queens (Belfast).
The research programme is split into 6 work packages & 21 activities. Most of the research will be carried out by the universities</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £2,000
External £50,000
Total £52,000</td><td>Expenditure in previous (IFI) financial years</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td></td><td></td><td>Projected 07/08 costs</td><td>Internal £2,000
External £25,000
Total £27,000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="3">WP 1: Programme delivery, outreach and implementation
WP 2: Enhanced network performance and planning
WP 3: New protection and control techniques that adapt to changing networks
WP 4: Infrastructure for reducing environmental impact
WP 5: Ageing mechanisms
WP 6: Condition monitoring techniques.</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="3">Technological Substitution to Radical</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="3">The aims of the project are to:
• deliver a suite of intelligent diagnostic tools for plant
• provide platform technologies for integrated network planning and asset management
• progress plans to develop and implement improved and reduced environmental impact networks; and
• develop models and recommendations for network operation and management.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>10 years</td><td>Duration of benefit once achieved</td><td>20 years</td></tr>
<tr><td>Probability of Success</td><td>10%</td><td colspan="2"></td></tr>
<tr><td>PV of Project Costs</td><td>£83,923</td><td>PV of Project Benefits</td><td>£124,961</td></tr>
</table>

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

Project Title	**Reference Networks – Phase 2**		
Description of project	The overall aim of the project is to develop and implement a framework for assessing the impact of network investment strategies on the reliability of UK distribution system in order to provide a common basis for comparing alternative network planning approaches and assessing the quality of service provided to customers.		
Expenditure for financial year	Internal £3,000 External £62,496 Total **£65,496**	Expenditure in previous (IFI) financial years	Internal £0 External £0 Total **£0**
Project Value	£255,200	Projected 07/08 costs	Internal £3,000 External £2,000 Total **£5,000**
Technological area and / or issue addressed by project	On the basis of concept, techniques and tools to be developed in the Project, quantitative assessments of alternative DNO investment plans in terms of costs and benefits will be made, which is critical for justifying expenditure associated with improvements in service quality.		
Type(s) of innovation involved	Incremental		
Expected Benefits of Project	Ensuring that capital expenditure on improving performance of the network will be optimised both in respect of the type of improvement work to be considered and in applying the improvements to circuits where the greatest benefit can be obtained. Providing a standardised method for comparing the performance of different types of circuit, both internally within CE Electric and externally between DNOs.		
Expected Timescale to adoption	3 years	Duration of benefit once achieved	10 years
Probability of Success	25%		
PV of Project Costs	£53,614	PV of Project Benefits	£100,616
Potential for achieving expected benefits	The project remains on track to achieve the expected deliverables. The impact of those deliverables upon the distribution networks is indirect, as it seeks to inform the development of investment strategies. Nonetheless, we expect that this work will change the way we work, helping us continue to improve service to customers.		
Project Progress to **March 07**	Network reduction methodologies to generate appropriate reference networks have now been developed. These have been used to generate reference networks for both CN East and UU. Both sets of results have been validated for correct prediction of both CI and CML performance. Work is underway on modelling CE Electric's systems with delivery expected in July 2007.		
Collaborative Partners	United Utilities, Scottish Power, Central Networks, PB Power		
R&D Providers	Imperial College London		

Project Title	**Superconducting Fault Current Limiter**		
Description of project	Development of a novel resistive super-conducting fault current limiter for applications up to 2000A 12kV		
Expenditure for financial year	Internal £38,775 External £32,500 Total **£6,275**	Expenditure in previous financial years	Internal £5,100 External £4,000 Total **£9,100**
Project Value	£2,000,000	Projected 2007/8 costs	Internal £15,000 External £335,000 Total **£350,000**
Technological area and / or issue addressed by project	This project is a joint venture between CE Electric, United Utilities and Scottish Power. The project is planned to run until 2010 and will see three superconducting fault current limiters installed, one at each participating DNO. The total estimated cost of the project to CE Electric is £500,000: with four equal partners, total project value is around £2m. Development in the area of fault current limiting devices has been carried out by a number of leading manufacturers and research establishments for several years as an alternative to network reconfiguration / asset replacement in tackling rising fault levels. Whilst a number of devices are now becoming available, the UK has been slow to react and trial such devices over concerns of fail-safety. The superconducting fault current limiter (SCFCL) is perceived to be a lower-risk device, utilising a non-linear 'high-temperature' superconducting ceramic rather than any electronic, electromechanical or mechanical components. When the material is operated at around 65K it loses all electrical resistance, thereby acting as a short circuit to load current. Both the increased current density caused by fault current and the loss of cooling medium (liquid nitrogen) cause the device to heat and the ceramic to revert to its 'normal' resistive state. This added resistance has the effect of clamping the fault current to lower / acceptable limits where it will remain until the fault is cleared by conventional means (circuit breakers, fuses, etc.). The SCFCL has been proven to operate in around 10ms.		
Type(s) of innovation involved	Radical		
Expected Benefits of Project	It is envisaged that in the future CE Electric would be required to replace plant at a 33kV/11kV primary substation every two years to accommodate the increased fault level due to the connection of new distributed generation sites. The estimated cost of each plant replacement is £500,000		
Expected timescale to adoption	The project is due for completion by 2010. Take-up thereafter will depend upon customer-driven network need, but the goal is to have an approved item of plant ready to install on real systems.		
Estimated success probability (at start of project)	50%		
PV of project costs	£417,012	PV of project benefits	£513,759

Commentary on project progress and potential for achieving expected benefits	The project has been substantially delayed because the contractor failed to secure sufficient funding and, as a consequence, the DTI offer letter (for grant funding under the Technology Programme) lapsed. The contractor has now resolved its issues, to the extent that it is now taking a direct stake in the project, offsetting the loss of DTI grant funding. Development of the prototype is now in progress. The first trial site has been identified for the installation of the first SCFL device. It is planned that CE Electric will be used for the trial of the second device
Collaborative Partners	UU, SP
R&D Provider	Applied Superconductors Ltd

CE's internal innovation programme

Project Title	**Woodhouse Steel Girder Mast Replacement Specification.**		
Description of project	Development of a novel long-span 132/66kV OHL design		
Expenditure for financial year	Internal £231,056 External £198,181 Total £32,875	Expenditure in previous financial years	Internal £16,200 External £50,900 Total **£67,100**
Project Value	£320,000	Projected 2007/8 costs	Internal £30,000 External £0 Total **£30,000**
Technological area and / or issue addressed by project	In the 1930s, YEDL's predecessor, the Yorkshire Electric Power Company, built a range of long-spanned 11, 33 & 66 kV steel girder mast lines, commonly known as the "Woodhouse mast designs". The "Woodhouse steel mast" supports were originally designed to accommodate 0.15" (7/.166") HDBC & 0.1" (7/.136") HDBC conductors using three basic design spans of 500 ft, 650 ft and 700 ft. A number of the circuits were later reconductored with 0.175" (37/.110") conductors designed on a 700 ft basic span. This was achieved without the need to carry out any alterations to the existing supports. Over time the majority of 11 kV supports have been replaced with traditional wood pole alternatives, the majority of them resulting in interpoling as a means to reduce the long span lengths. A similar approach has been applied to the 33 and 66 kV circuits, but difficult wayleaves situations mean that around 300 km still remain. The original specification cannot be re-used as it does not conform to current overhead line design requirements. Existing current designs such as AP1 or our proprietary OHL 9 and CE/C/37 specifications are limited to a span length of around 150m. The challenge facing us is that we have around 300 km of an asset that is critical to system security and, dependent on land use, a hazard to the public as it deteriorates. The absence of a like-for-like replacement renders it difficult to obtain wayleaves for routes using current designs. This has already led to our undergrounding one circuit in its entirety (Thurcroft-Mexborough-Edlington) and a high-risk section of another (the tee to Crowle). The high costs involved were justified by the pressing need to replace these lines before they posed an unacceptable risk to public safety.		
Type(s) of innovation involved	Technological Substitution		
Expected benefits of project	The estimated benefit of a direct replacement for the Woodhouse masts is estimated at £5k per km of circuit and there are 300km of circuits using the Woodhouse masts. The PV benefit calculation has been spread over a 20-year period, which is in line with the current replacement plan for the Woodhouse masts.		
Expected timescale to adoption	The design will be delivered during 2007, followed by a trial build and proving tests. The first full circuit will be built in 2008, with the remaining circuits planned for a phased replacement over the next 20 years.		

Estimated success probability (at start of project)	75%		
PV of project costs	£270,831	PV of project benefits	£337,191
Commentary on project progress and potential for achieving expected benefits	The new specification was originally expected to be delivered to CE Electric by PB Power mid 06. However, the first specification failed type tests, requiring a revised design. We have also extended the scope to provide for: • a self-supporting steel mast version; and • platforms etc. to aid assembly, in line with the requirements of the work at height regulations The revised wood pole design has now passed type test, and a trial line has been built. We expect the specification for both versions to be signed off by July 2007, allowing us to proceed to tender for the first full circuit rebuild.		
Collaborative Partners	None		
R&D Provider	PB Power		

Project Title	**Health Indices for Switchgear and Transformers.**		
Description of project	Better to understand aging mechanisms of primary plant, and to link this to measured condition to project forward likely performance and hence investment need		
Expenditure for financial year	Internal £11,250 External £40,625 Total £51,875	Expenditure in previous financial years	£0[5]
Project Value	£52,000	Projected 2007/8 costs	Internal £0 External £0 Total **£0**
Technological area and / or issue addressed by project	Techniques that EATL have evolved through STP and similar projects with other firms make it possible to model the condition of the data at the time of the survey and also create a predicted health of the asset into the future. This project took those methods through a further evolutionary step, both developing the underlying methodology (there are differences even between the two models developed here) and modifying them for CE's particular circumstances. A key theme of this project is taking the work on aging rates and key condition factors developed in STP and elsewhere, and developing a model from that base. This differs from simply constructing condition-based models: we have carried out such work in house for the 'Woodhouse' steel girder mast lines and HV plant. We do not believe such work to be eligible for IFI funding. Using this information it is possible to make a better-informed decision on the actual end of life of the equipment and the correct time to intervene with refurbishment/replacement decisions. This information has been fed back into the strategic investment plan.		
Type(s) of innovation involved	Incremental		
Expected benefits of project	• Implementation of Health Indices (HI) - creation of a solid link between asset condition and asset health for defining 'end of life' and understanding probability of failure • Aids investment appraisal to define, justify and target future investment at a strategic level – ensures robust decision making. • The project will support the development within the business of a methodology for condition-based risk assessment which is being rolled out across the asset base, in a mix of in-house and brought-in tools		
Expected timescale to adoption	This project was completed in 2006/7. The outputs: • for switchgear have been used to inform the investment planning process from the 2006 round onwards; and • for transformers, are being used to inform the 2008 investment planning process.		

[5] some was expenditure incurred in 2005/6 but not then claimed: it has been included in 2006/7 costs here

Estimated success probability (at start of project)	75%		
PV of project costs	£42,464	PV of project benefits	£1,058,424[6]
Commentary on project progress and potential for achieving expected benefits	Previous HI work on high-resolution OHL inspections has led to the development of a tender specification for the staged survey of the entire steel tower and lattice mast population. This will not be submitted as eligible for IFI, but will continue the enhancement of our asset management processes The HI work outlined here has already, in part, informed one planning process and is being used in full this year Developing this process with EATL has also allowed us to develop similar models in house for 'Woodhouse' steel girder OHL masts and HV plant. Again, these models are being used to inform the 2007 planning process		
Collaborative Partners	None		
R&D Provider	EATL		

[6] note that this is a gross benefit: a large part of this efficiency gain has been re-invested

Project Title	**Innovative Fault Passage Indicator for Cable Systems (GM FPI)**		
Description of project	To develop a novel FPI that does not require the cable sheath to be broken, easing installation		
Expenditure for financial year	Internal £1,500 External £10,725 Total **£12,225**	Expenditure in previous financial years	Internal £0 External £0 Total **£0**
Project Value	£75,000	Projected 07/08 costs	Internal £5,000 External £50,000 Total **£55,000**
Technological area and / or issue addressed by project	This project is intended to develop a practical and reliable, while novel in design, fault passage indicator for HV cable networks. Initial work carried out by CE Electric and EA Technology has indicated that a fault passage indicator using measurements of the magnetic fields at the surface of a HV cable may be feasible. Its main benefit will be in the retro-fit situation where it can be simply clamped round an existing cable and provide both earth and phase-to-phase fault passage indication. There will be no need to neutralise the effects of sheath currents which is the main problem with existing indicators. The potentially higher reliability of this type of instrument in indicating the position of all types of faults will greatly assist with the introduction and effectiveness of fully automated switching on the underground HV network.		
Type(s) of innovation involved	Significant		
Expected Benefits of Project	This will reduce restoration times, particularly in conjunction with automated switching, by improving the availability of fault pre-location data. This comes from providing: • a retro-fit solution for where no indicators are currently fitted; • phase-to-phase faults, as well as the phase-to-earth faults to which conventional indicators are limited; • a generally more robust solution than conventional indicators We estimate that the full benefit could be as much as 4 CML		
Expected Timescale to adoption	5 years	Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	10%		
PV of Project Costs	£52,124	PV of Project Benefits	£1,494,760[7]
Commentary on project progress and potential for achieving expected benefits	We have received the first phase feasibility report, assessing the mathematical theory on which the proposed indicator would be based. Once we have reviewed this paper, we will know whether or not to proceed to full laboratory testing to confirm the theory and the construction of a prototype device.		

[7] This is based upon the ensuing QoS benefits, using the value currently deemed by Ofgem to be placed upon performance by customers. These will be realised in full only when a successful indicator has been developed and deployed on the distribution system in conjunction with automated switching.

Collaborative Partners	None
R&D Provider	EATL

Project Title	**Integration of substation relay information (Skerneside trial)**		
Description of project	This project is intended to enhance our understanding of switchgear operations by integrating the information available from modern electronic relays.		
Expenditure for financial year	Internal £5,000 External £0 Total **£0**	Expenditure in previous financial years	Internal £0 External £0 Total **£0**
Project Value	£10,000	Projected 07/08 costs	Internal £5,000 External £0 Total **£5,000**
Technological area and / or issue addressed by project	Modern relays capture a great deal of information on faults and switchgear operation. They also contain more advanced communications than earlier devices. This trial is intended to develop a real-world solution that first allows these communications to reduce the amount of wiring required (hence reducing both installation cost and the risk of mal-operation), and second provides a platform for the kind of advanced analysis being developed by Strathclyde under (e.g.) Supergen V		
Type(s) of innovation involved	incremental		
Expected Benefits of Project	The provision of better information will: • aid the understanding of individual faults, through more complete date on protection and switchgear operation; and • help reduce maintenance requirements, through better knowledge of both the duty actually undertaken by switches and by monitoring parameters such as operating time profile		
Expected Timescale to adoption	5 years	Duration of benefit once achieved	20 years
Estimated Success probability (at start of project)	5%		
PV of Project Costs	£7,922	PV of Project Benefits	£50,181
Commentary on project progress and potential for achieving expected benefits	The relays have been installed. Significant effort has been expended to allow the devices to communicate across the substation LAN		
Collaborative Partners	None		
R&D Provider	Microsol		

Benefits Realised

23. An essential part of any R&D programme is that the outcome of completed projects is rolled out into 'business as usual' products and processes. Reviewing projects listed as complete in this and previous reports yields:

- Econnect/NaREC RPZ feasibility study (for DTI). That report concluded that it would be difficult to establish RPZs, 'partly because of the time taken to establish the site requirements and partly due to the difficulty in finding the right combination of generation site, network issue and innovation that will solve that network issue. The fact that the normal rules of network operation apply in an RPZ in the same way as they do outside an RPZ may increase the difficulty of this task'.

  The report has helped us focus our search for an RPZ, as it has shown that the most likely areas of succeed are those where constrained generation connections can be offered, linked to a management scheme driven by dynamic assessment of power flows and asset capability. Although we have submitted one such application, it was not deemed sufficiently innovative to clear the RPZ threshold. A 'conventional' solution will be more economic in this case, and has therefore been accepted by the customer.

- Engineering Recommendations G78 (Recommendations for Low Voltage Supplies to Mobile Phone Base Stations with Antennae on High Voltage Structures) & P2 (Security of Supply). The R&D work behind these, but not the preparation of the documents themselves, was claimed in last year's report. These now form part of our design policy baseline and be reflected in investment appraisals

- ETR 134 (Lightning Protection for Networks up to 132kV). The R&D work behind this, but not the preparation of the document, was claimed in last year's report. This report is due to be finalised and published in 2006/07, at which point it will form part of our design policy baseline

- Condition-Based Risk Management (CBRM) using helicopter inspections. This process has now been accepted as business as usual. We aim to let a contract in 2007/08 to survey the entire steel lattice mast & tower population

  The initial survey was also used to refocus our investment plans in the 2006 round. The results showed we needed to increase investment in this asset class by £2.8m over a ten-year window (2006-15), and tilt the profile to increase investment in this asset class by £3.8m over the first five years.

- Health Indices for switchgear. This analysis was used to refocus our investment plans in the 2006 round, and has been revisited for the 2007 round. The first (2006) analysis suggested that 23 schemes, totalling around £30m, could be deferred. It also suggested bringing forward 13 schemes totalling around £21m. overall, this gave a net benefit of £9m reduced capex

- Remote-Indicating Fault Passage Indicator (RIFPI) trial. This project was intended to trial a new development from Nortech where the standard OHL FPI unit has been enhanced by the inclusion of a GSM modem. With this system when a fault is indicated the units that have operated call in to a base station which then can be used by the control engineer to direct the fault restoration team directly to the faulty section of circuit.

  The scope of the project was to perform a stand-alone trial on one OHL circuit by fitting twenty of the new Nortech units. This was successful, and the benefits seen during the trial were greater than expected. In addition to the faults that were logged by the main protection the FPIs also detected several low-level transient faults.

The agreed next stage is to integrate the Nortech host with the main SCADA system. Progress on this has been delayed, not least due to rolling out a common SCADA system across the two licensees.

Programme Planning and Co-ordination

24. To co-ordinate and, as importantly, disseminate R&D activity across the firm, we have established an internal working group. The resource spent on running the R&D process within CE Electric is not a project within its own right: however, without this commitment no R&D would be possible within the company. This cost includes project administration, project management, reporting, internal working group meetings and preparatory work on future projects.

NPV methodology

25. We have adopted a simple, robust and transparent approach to assessing costs and benefits. For each project, we have assessed both costs and potential benefits over a 20-year window, discounted back at 6.9% pre-tax real. Figures for collaborative projects have been provided by the contractor. These have been scrutinised to validate estimated benefits.

26. The benefit valuations are necessarily a matter of engineering judgement, but generally take the form of assessing the size of the issue and a credible reduction in unit costs. To reduce subjectivity, we seek to benchmark these assessments externally (e.g. through comparison to STP figures).

Summary of current portfolio

27. We can summarise the discussion above to yield a set of costs and benefits for ongoing projects across the portfolio:

Programme	Number of projects	External costs	Internal costs	PV cost	PV Benefit	Cost/ Benefit Ratio
DTI support: ENSG etc.	22	£0	£11,000	£27,283	£51,371	0.53
ENA R&D WG projects	4	£10,019	£3,000	£182,702	£364,555	0.50
STP2 Overhead Network Module	10	£38,167	£3,563	£35,704	£63,564	0.56
STP3 Cable Networks Module	12	£38,167	£2,188	£35,704	£53,490	0.67
STP4 Substation Module	18	£38,167	£4,813	£35,704	£59,559	0.60
STP5 Networks for Distributed Energy Resources Module	15	£36,972	£4,188	£34,586	£69,827	0.50
EATL painting forum	1	£6,000	£500	£6,080	£9,355	0.65
EATL partial discharge user group	2	£6,654	£1,000	£7,160	£11,225	0.64
Supergen V	21	£50,000	£2,000	£83,923	£124,961	0.67
Imperial Reference Networks	1	£62,496	£3,000	£53,614	£100,616	0.53
ASL SCFL	1	£32,500	£6,275	£417,012	£513,759	0.81
Woodhouse mast	1	£198,181	£32,875	£270,830	£600,573	0.45
GM FPI	1	£10,725	£1,500	£807,684	£1,331,339	0.61
CBRM for switchgear and transformers	2	£40,625	£11,250	£42,464	£1,058,424	0.04
Integration of Substation relay information (Skerneside trial)	1	£0	£5,000	£15,332	£25,091	0.61
Innovation administration / project management.	-	£0	£43,375	£40,575	£0	-
Unconstrained Total	**111**	**£568,674**	**£135,525**	**£2,049,774**	**£4,390,750**	**0.47**
Constrained Total		**£568,674**	**£100,354**			

28. We can also derive the overall portfolio summary required by G85:

Number of active IFI projects	111
NPV of costs and anticipated benefits from committed IFI projects	£2,340,976
Summary of other benefits anticipated from active IFI projects	Marginal improvement in reliability
Total expenditure in reporting period.	£669,028
Total expenditure to date	£1,232,950
Benefits actually achieved from IFI projects to date	see text

Summary of 2006/07 IFI investment

29. We can also summarise the discussion above to provide the data specifically requested in the RIGs, split 40:60 in proportion to size of licensee:

IFI Costs 2006/07	NEDL	YEDL
eligible IFI expenditure	£267,611	£401,417
eligible IFI internal expenditure	£40,142	£60,213
combined distribution network revenue	£175,273,000	£243,821,000
carry-forward to 2007/8	£427,218	£575,150

Outlook for 2007/08

30. We envisage that the portfolio of IFI projects to be worked on in 2007/08 will be largely made up from:

- continuing to support:
  - ENSG and subsidiary workstreams;
  - EATL STP;
  - Supergen V;
  - ENA collaborative work; and
  - ASL fault current limiter;
- further projects, collaborative where possible but alone if not, including:
  - sponsoring a PhD student at Durham University to investigate network risk;
  - the next stage of development of the Innovative Fault Passage Indicator for Cable Systems (GM FPI);
  - the next stage of development of the Remote-Indicating (OHL) Fault Passage Indicator;
  - completing the production of a ‘technology roadmap’, begun in 2006/07. This will develop detailed future scenarios as they relate to the development of distribution networks into a prioritised set of opportunities for R&D and other enhancements to the network architecture;
  - completing a feasibility study into automatic voltage control at distribution substations, begun in 2006/07; and
  - understanding the restrictions on using long (over 30km) EHV underground cables, and developing solutions thereto.