CE Electric UK

2008/09 IFI Annual Report

July 2009

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2008/09 IFI annual report

July 2009

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 electricity distribution licensees, Yorkshire Electricity Distribution plc (YEDL) and Northern Electric Distribution Ltd (NEDL), on innovation. It has been prepared in accordance with standard condition 46 of the electricity distribution licence, the associated regulatory instructions and guidance (published by Ofgem) and the Energy Networks Association (ENA) Engineering Recommendation (ER) G85, issue 2, 2007 (the Good Practice Guide). It also informs our returns under standard licence condition 47.
2. The key projects in CE Electric during the reporting period are:
    - projects dedicated to local CE needs:
        - Network Risk Modelling;
        - Loss Of Mains Relays For Generation Interface Protection;
        - Stability Of LOM To Transients;
        - Zefal Generator;
        - Health Index Development, EHV Cable;
        - Asset Condition Data Strategy;
        - Remote Indicating Fault Passage Indicators;
        - Outage Risk Management.
    - collaborative projects, including:
        - Superconducting fault limiter;
        - Supergen V;
        - ACTIV project;
        - EA Technology STP.
3. Qualifying spend for the period has been £305613 and £405712 for NEDL and YEDL respectively, giving a total of £711325 across combined geographic area.

Revision Record

Version	Date	Revision Details	Author
0.5	14 July 2009	First Draft	Chris Goodhand
0.9	23 July 2009	Final Draft	Chris Goodhand
1.0	28 July 2009	Final	Chris Goodhand

Introduction

4. This report has been prepared by CE Electric UK Funding Company Ltd (CE) to inform interested parties of the activities of its electricity licensees, Yorkshire Electricity Distribution plc (YEDL) and Northern Electric Distribution Ltd (NEDL), on innovation. It covers the period from 1 April 2008 to 31 March 2009.

5. A single report has been prepared because both licensees are operated under common management, sharing best practice across the whole. Our approach to 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.

6. 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.

7. 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 operation, or their design and electrical protection.

8. The report has been prepared in accordance with standard condition 46 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...

9. The programmes and major projects that will be discussed in this report are:
   - projects led by the Energy Networks Association (ENA) R&D working group, including:
     - Climate Change;
     - Radiometric Arc Fault Location;
     - Investigation of Transfer Potentials from HV to LV Earth Systems.
   - 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;
   - collaborative projects, including:
     - Superconducting Fault Limiter;
     - Supergen V; and
     - ACTIV project;
   - internal innovation projects dedicated to local CE needs:
     - Loss Of Mains Relays (LOM) For Generation Interface Protection;
     - Stability Of Loss Of Mains Relays (LOM) To Transient Faults
     - Network Risk Modelling
     - Investigation Into Use Reverse Reactive Power Relays For Loss Of Mains Protection (LOM)
     - Asset Condition Data Strategy
     - Health Index Development, EHV Cables
     - Outage Risk Management
     - ZEFAL Generator For Active Urban Networks; And
     - Remote Indicating Fault Passage Indicators – Network Trial.

10. As permitted by the GPG, this report aggregates portfolios of projects under collaborative umbrellas such as ENA, STP, work for BUIS and predecessors, and internal costs in developing and managing projects.

11. The reporting format is mixed. Projects that commenced after the publication of the GPG issue 2 revision in December 2007 are reported using the newer format, which incorporates project scoring to take account of project benefit, risk and risk mitigation. Legacy projects that commenced before this time are predominantly reported in the format from issue 1 of the GPG.

Registered Power Zones

12. 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 distribution price control review.

13. We remain committed to developing an RPZ in the YEDL or NEDL networks, subject to delivering tangible benefits to customers and shareholders. No opportunities to consider an RPZ have arisen during the 2008-09 regulatory year.

Project Reporting

Externally-driven activities

14. In this section we would normally consider 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. For such projects we therefore effectively take the role of unpaid sub-contractors.

15. With the reduction in the innovation related activities of the Ofgem Electricity Networks Strategy Group (ENSG) there are no activities to report in this area this reporting period

16. Preparatory activities have been undertaken during the reporting period, primarily with DECC, BERR and regional development agencies, in the domain of the low-carbon agenda, although so far none of these have become a substantive project or programme.

ENA

17. The tangible outputs of collaboration with other DNOs, through the ENA R&D working group, are the major projects described in detail in the following tables.

18. In addition to the costs arising from major projects listed below, we also incurred internal costs of £2850. This was made up from £2100 incurred attending the ENA R&D steering group and £750 on the vacuum bottle end of life project. These costs have been aggregated with our internal R&D programme management costs for reporting purposes.

19. The remaining active projects are reported below:

Project Title	Investigation Of Transfer Potentials From HV To LV Earth Systems			
Description of project	To undertake a research project to establish a simple, practical method for estimating transfer potentials between HV and LV electrodes, which will account for their electrode arrangements, proximity to each other and local soil conditions.			
Expenditure for financial year	Internal £2700 External £1750 Total £4450	Expenditure in previous (IFI) financial years	Internal £2625 External £1000 Total £3625	
Total Project Costs (Collaborative + external + CE Electric UK)	£24600	Projected 2009/10 costs for CE Electric UK	Internal £5,000 External £57000 Total £62000	
Technological area and / or issue addressed by project	To better understand the interaction between HV and LV earth systems under HV fault conditions when the electrodes are not physically connected together.			
Type(s) of innovation involved	Incremental	Project Benefits Rating	Project Residual Risk	Overall Project Score
		14	-3	17
Expected Benefits of Project	The expected benefits of the project are: This project investigates the effects of LV earth systems on HV systems. The results will determine the means to provide cost effective, safe earthing systems 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.			
Expected Timescale to adoption	Year 2010	Duration of benefit once achieved	20 Years	
Probability of Success	60%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£150000	
Potential for achieving expected benefits	This project has produced encouraging results demonstrating that the transfer of potential from HV earth electrodes to LV electrodes through the soil is much lower than originally thought. The transfer is influenced by the distribution on the LV electrodes and their proximity to the HV electrode. Further studies and modelling are required to translate these studies into a technical document that can be used in the design of earthing systems.			

Project Progress to March 09	• Measurements and detailed calculations were carried out at 2 operational sites during their construction. Both sites have an LV PME earth network with one site being fed from an unearthed overhead line and the other from an HV cable network. • From the results of the site measurements and calculations computer models were produced to compare with the aid of CDEGS an earthing software tool. Comparisons have been made between actual site measurements and calculated values from the computer models. • A report of the findings has been produced and presented to the ENA engineering committee.
Collaborative Partners	ENA member companies
R&D Provider	Strategy & Solutions Ltd

Project Title	Further Investigation Into The Potential Impacts Of Climate Change On Network Resilience – Feasibility Phase
Description of project	Building on a previous project IFI project, the objective is to develop a future climate model that will enable both the transmission and distribution network operators make predictions of climatic effects on their networks in both the shorter and longer term. This will enable future network designs to be optimised to meet these conditions and ensure that the necessary operational resources are cost effectively implemented to maintain the network. Initial discussions have agreed that the project will develop a climate model to predict weather patterns for the time scales below. 1. 5 days: An operational fault risk alert system, including - high spatial resolution (licence/county level at minimum), and - at least 3 days' warning with 6-hourly updates. 2. Up to 10 years & 50 years: A report and interactive tool including - changes in fault frequencies, fault durations, CIs and CMLs, - changes in number of days where fault numbers are below the exceptional event threshold, - information provided seasonally at a licence/county level, and - all associated uncertainties quantified. The user requirements for the two longer time scales (up to 10 and 50 years) were found to be very similar and have consequently been combined. The time scales will, however, be dealt with separately when considering whether the requirements can be met since different methods may be necessary for the two time periods. In all cases faults will be normalised; this will remove any geographical differences and allow a standardised UK representation to be analysed. To progress, into 2009-10, work will be undertaken to carry out the feasibility study. During this time a literature review will be carried out to assess data availability for fault and climate variables and determine how the user requirements could be met. The output of this study will be provided in a report, which will include: • Agreed user requirements. • Literature review of similar work. • Data availability (for both fault and climate). • Assessment of the Met Office's capabilities and how the user requirements could be met, with particular focus on assessing the confidence of climate projections. • Recommendations: the minimum and optimum outputs of further study. A further workshop will be held to discuss these outputs specifically, the

<table>
<tr><td></td><td colspan="4">recommendations for further study. At this point we hope to obtain a industry consensus on the direction of further study on network resilience.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal 1000
External £0
Total £1000</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td>Total Project Costs
(Collaborative + external +
CE Electric UK)</td><td>£450000</td><td colspan="2">Projected 2009/10 costs for
CE Electric UK</td><td>Internal £2500
External £22085
Total £24585</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">Future reliability of the distribution and transmission network is important to ensure continuity of service and to minimise unforeseen costs. This work will investigate the potential impacts of a changing climate on future network fault numbers.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>14</td><td>-2</td><td>16</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The result of this work would inform Licensee's strategy with regard to IIS performance incentives which impact on price controls, system planning studies and operational preparedness for extreme weather events. For example, the benefits of intervention options such as tree cutting and installation of equipment such as lightning arrestors will be influenced by how fault numbers are expected to change. The study will also inform a debate as to whether the industry security and quality of supply standards should be adjusted to accommodate climate change</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2012</td><td colspan="2">Duration of benefit once achieved</td><td>20 Years</td></tr>
<tr><td>Probability of Success</td><td>75%</td><td colspan="2">Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td>Not calculated</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">High.</td></tr>
<tr><td>Project Progress to March 09</td><td colspan="4">The following stages have already been completed:
• An initial kick-off meeting was held on 22 September 2008 for the Met Office and the network operators to discuss the work carried out so far on the previous EP2 project and the Met Office's proposals for this project. It was agreed at this meeting that the work should focus on the development of a climatic model that will provide network operators with likely weather predictions so that they can then make the necessary design and operational actions on their networks. The Met Office agreed to make a proposal and to arrange further workshops.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">National Grid, Scottish Power Energy Networks, Scottish and Southern, ENW, Western Power Distribution, Central Networks, CE Electric UK and EDF Energy Networks.</td></tr>
</table>

R&D Provider	Met Office

Project Title	**Radiometric Arc Fault Location**			
Scope and objectives	Applied research, and follow up installation of a system to triangulate fault locations on overhead lines from the high frequency radio wave signatures produced from an arcing fault.			
Description of project	This is a fault locating system based on remote, radiometric assessment of the radio frequency (rf) energy emitted by a fault arc. The principle of operation of the system is as follows: at the fault site an arc is established by the breakdown of air. This initial breakdown causes a rate of change of current that extends into the RF region, and consequently emits an impulse of RF energy that propagates away from fault site, at the speed of light, with a circular wavefront. The impulse is detected by 3 or more RF monitoring stations that can time the arrival of the impulse wavefront to an accuracy better than 1μs. This accuracy is important: the impulse will travel 300 m in 1μs, therefore, the impulse time-of-arrival at each monitoring station is different, since each station is a different distance from the fault site. A master station accesses the impulse arrival time stored in each monitoring station. The fault location is calculated using the impulse arrival times and the geographical positions of the monitoring stations. This technique is similar to that currently used for the UK lightning monitor.			
Expenditure for financial year	Internal £500 External £20300 Total £20800	Expenditure in previous (IFI) financial years	Internal £0 External £0 Total £0	
Total Project Costs (Collaborative + external + CE Electric UK)	£222350	Projected 2009/10 costs for CE Electric UK	Internal £1250 External £7700 Total £8950	
Technological area and / or issue addressed by project	The principle of the technology is: There is a correlation between RF discharges and network faults on overhead lines with the RF signal being picked up by a radio antenna up to 70km away If antennae are spread across the network, a mesh is formed – in a similar manner to the GSM network If a fault can be accurately clocked, triangulation can be used from a number of base stations to give an approximate geographic location (accuracy ~300m) and linked to GIS / SCADA data to give a more accurate fault location.			
Type(s) of innovation involved	Incremental	Project Benefits Rating	Project Residual Risk	**Overall Project Score**
		9	-9	**18**
Expected Benefits of Project	If successful, radiometric 'cells' could be used to accurately locate fault locations on all overhead line networks within that zone.			

Expected Timescale to adoption	Year 2012	Duration of benefit once achieved	10 Years
Probability of Success	25%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£45787
Potential for achieving expected benefits	Medium.		
Project Progress to March 09	3 of the 4 monitoring sites have been brought into service: Shotts – Dec 2008; Kirkintilloch and Bellshill Feb 2009, with Dealain House to be brought online in May 2009 (some equipment issues are delaying this last site being commissioned) All 3 are collecting large amounts of radiometric data. A number of correlations have been made between SP fault records and the data collected		
Collaborative Partners	Scottish Power, Western Power Distribution, Scottish & Southern Energy, Central Networks, Electricity North West, CE Electric UK		
R&D Provider	University of Strathclyde		

EA Technology Strategic Technology Programme etc.

Project Title	Strategic Technology Programme Overhead Network Module 2		
Description of project	A DNO research & development collaboration hosted by EA Technology		
Expenditure for financial year	Internal £2750 External £46700 Total £49450	Expenditure in previous (IFI) financial years	Internal £6313 External £119054 Total £125367
Total Project Costs (Collaborative + external + CE Electric UK)	Rolling programme across 7 DNOs	Projected 2009/10 costs for CE Electric UK	Internal £3000 External £45629 Total £48629
Technological area and / or issue addressed by project	The Module 2 programme for budget year 2008/9 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. Completed Projects (March 09):- S2126_4 Monitoring conductor temperature at fixed current – at Cashlie and Queensferry; S2132_2 Validation of ice accretion models using Deadwater Fell; S2136_3 Continued involvement with European Project COST 727; S2138_2 Investigation of live-line jumper-cutting limitations; S2143_2 Develop in-situ degradation monitor for aluminium OHL conductors – Stage 2: Feasibility study; S2146_2 Torsion tests on composite insulators - Stage 2: Effect of torsion on tension insulators; S2149_2 High durability OHL fittings - Stage 2: Costing for testing prototype high durability fitting; S2150_1 Evaluation of TDR for assessment of tower foundations; S2152_1 Evaluate performance of Czech Icemeter at Deadwater Fell; S2153_1 Suitability of hand-held PD detector for condition assessment of pole-top equipment; S2154_1 Experimental investigation of novel conductors – Stage 1: Icing; S2156_1 Build Three Prototype Field Pole Leakage Current Detectors; S2159_1 LV shrouding - review of current practices and standards Projects Still In Progress (March 09):- S2110_4 Extend OHRAT to include User Defined Covered Conductor S2136_4 & 4A European Project COST 727: Measuring and forecasting atmospheric icing on structures, including Czech ice meter trial; S2143_3 Develop in-situ degradation monitor for Al OHL conductors -		

<table>
<tr><td></td><td colspan="4">Stage 3 Instrument Development;
S2147_2 Increasing vibration limit of CCs to 20%UTS using multiple std or single Hi-mass SVDs
S2151_2 Alternatives to wood poles - Stage 2: Erection and fitting trials on concrete poles
S2154_2 Experimental investigation of novel conductors at Deadwater Fell – Stage 2: Vibration;
S2157_1 Novel conductors for 132kV wood pole lines;

Updated information can be found at:- https://www.stp.uk.net</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">e.g.
Incremental, Tech Transfer, Significant, Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>15</td><td>-9</td><td>24</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Projects in this module will significantly increase the safety and reliability of the network. In certain cases the asset life may also be extended.

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:
• Cost effective and early identification of damaged insulators and discharging components, which if not addressed would result in faults;
• Reduction of levels of premature failure of assets, so avoiding risk of injury or loss of life or damage to property as a result of falling overhead lines;
• Avoidance of 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;
• Co-operation between European countries in the development of forecasting methods of atmospheric icing and for the exchange of forecasting tools;
• Comparison of new covered conductor with known performance of older types
• Extension of the service life of towers and reduce potential levels of tower failures;
• Review alternatives to wood poles;
• Reduce lifetime costs by the appropriate use of alternative</td></tr>
</table>

	materials; • Give Members a better understanding of novel conductors for new-build or re-conductoring 132kV wood pole lines that gives lower capital cost, minimum visual impact, improved environmental acceptance compared with other methods of improving power transfer.		
Expected Timescale to adoption	Range 2-5 years - dependent on project	Duration of benefit once achieved	Range 2-10 years - dependent on project
Probability of Success	Range 10-50% - dependent on project	Project NPV = (PV Benefits – PV Costs) x Probability of Success	£64624
Potential for achieving expected benefits	A number of STP Projects are at an early stage and the project cost may not always reflect the likely full costs of implementation. These will be identified provided that the outcome of the early stage is positive. However, STP has delivered a number of notable innovations since its inception.		
Project Progress to March 09	Most projects or project stages started in the module during 08/09 have been completed, but some projects span more than one year.		
Collaborative Partners	Other DNOs		
R&D Providers	EA Technology		

<table>
<tr><td>Project Title</td><td colspan="3">Strategic Technology Programme: Cables Module 3</td></tr>
<tr><td>Description of project</td><td colspan="3">A DNO research & development collaboration hosted by EA Technology</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £750
External £55000
Total £55750</td><td>Expenditure in previous (IFI) financial years</td><td>Internal £5714
External £127728
Total £133442</td></tr>
<tr><td>Total Project Costs
(Collaborative + external + CE Electric UK)</td><td>Rolling programme across 7 DNOs</td><td>Projected 2009/10 costs for CE Electric UK</td><td>Internal £1000
External £55,291
Total £56291</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="3">The STP cable network programme for budget year 2008/9 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.

<u>Completed Projects (March 09):-</u>
S3132_12 & 15: CRATER Near Real time Determination & functionality development;
S3148_4 Requirements for earthing and bonding of single core MV power cables: feasibility of earthing and bonding of single core MV cable systems ;
S3151_1 Understanding and controlling thermo-mechanical forces in cables systems: Study to assess work carried out on thermo-mechanical forces in cable systems;
S3152_1 Separable connectors and cable compartments in 11 kV switchgear;
S3153_1 & 2: Economics and environmental impacts of distribution cable losses: Model development including CO_2 burden calculation ;
S3168_1 & 2: Comparing future designs of HV and EHV polymeric cables: Review of current specifications and designs and study to determine the interaction between resin and semi-conducting layers;
S3169_1: Further studies on the retraction of insulation and over-sheath of cables;
S3171_1: Jointing on to wet cables.

<u>Projects Still In Progress (March 09):-</u>
S3132_16: CRATER annotation;
S3144_2: Comparison of processes for the treatment of redundant fluid filled cables: Comparative field trials;
S3151_2 & 3 Understanding and controlling thermo-mechanical forces in cables systems: Modelling of thermo-mechanical forces in cable systems;
S3155_1 Trial testing of triplexed cable in plastic ducts;
S3157_1 Partial discharge testing of MV cable systems to provide asset risk management data;
S3164_1: Develop fluid filled cable design tool;
S3165_1: Performance ageing tests on polymeric terminations
S3166_1 & 2: Performance of cold- and heat-applied accessories under resin: Assessing interaction between resin and semi-conducting layer;
Updated information can be found at:- https://www.stp.uk.net</td></tr>
</table>

Type(s) of innovation involved	e.g. Incremental, Tech Transfer, Significant, Radical	Project Benefits Rating	Project Residual Risk	Overall Project Score
		13	-8	21
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: • Offsetting of future increases in CAPEX and OPEX; • CI/CML savings per connected customer; • Reliable, safe and easy to use method of detecting excess moisture in paper insulation of cables; • Reduced excavation required in locating leaks from fluid-filled cables, reduce the times and costs of leak location, and also reducing outage times; • Reduced cable purchase costs; • Reduced design costs; • 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 2-10 years - dependent on project	
Probability of Success	Range 15-50% - dependent on project	Project NPV = (PV Benefits – PV Costs) x Probability of Success	£87318	
Potential for achieving expected benefits	A number of STP Projects are at an early stage and the project cost may not always reflect the likely full costs of implementation. These will be identified provided that the outcome of the early stage is positive. However, STP has delivered a number of notable innovations since its inception.			
Project Progress to March 09	Most projects or project stages started in the module during 08/09 have been completed, but some projects span more than one year.			
Collaborative Partners	Other DNOs			
R&D Providers	EA Technology			

Project Title	Strategic Technology Programme: Substations Module 4		
Description of project	A DNO research & development collaboration hosted by EA Technology		
Expenditure for financial year	Internal £14000 External £43800 Total £57800	Expenditure in previous (IFI) financial years	Internal £12188 External £115725 Total £127913
Total Project Costs (Collaborative + external + CE Electric UK)	Rolling programme across 7 DNOs	Projected 2009/10 costs for CE Electric UK	Internal £12000 External £40,400 Total £52400
Technological area and / or issue addressed by project	The aim of the 08/09 Substation Programme was 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. The majority of projects have not only resulted in essential knowledge transfer, they have enabled skills to be developed between STP 4 Members and European partners. Key examples of this were the participation in the AM Forum, (S4185_4), reviewing how transformers are connected within Europe (S4221 _2) Each of which has contributed significantly to developing better understanding of electrical plant, improving safety implications, utilisation, performance and life cycle. Some of these projects have resulted in the creation of further supplementary projects for 2009/2010. <u>Completed Projects (March 09):-</u> S4164_5: Tap changer monitor stage 5; S4178_2: Impedance Testing of Substation Batteries; S4181_3: Ongoing Programme Of Transformer Post Mortems; S4209_2: Post Maintenance Testing: Project Workshop Jan 09; S4222_2: Alternatives to ENATS 35-1 Transformers: Extension 315KVA Ground Mounted Transformers; S4233_1: 145kV Earthing switch Asset Management Manual; S4235_1: Researching New Techniques for Optimising Plant Maintenance Policies; S4237_1: Battery Cabinet Temperature Control; S4238_1: Module 4 Information Dissemination; S4239_1: Research and Testing of Electrical Contact Cleaning Products; S4241_1: Study of Circuit Breaker Timing Measurements & Methods; S4244_1: Review of methods to dissipate pressure in Substations during equipment failure; <u>Projects Still In Progress (March 09):-</u> S4164_5: Tap changer monitor stage 5; S4178_2: Impedance Testing of Substation Batteries; S4185_4: European AM Forum Membership 08/09; S4221_2: Out Of Phase Modelling Report; S4224_1: X/R Extrapolation of 12kV Vacuum circuit Breakers;		

<table>
<tr><td></td><td colspan="4">S4226_1: Environmental Corrosion, Specification, Testing of Plant & Equipment;
S4230_1: Optimisation of Operational Support and Response for Electrical Plant & Equipment;
S4236_1: Aquagen recombination system;
S4245_1: Switchgear – Effect of Low Power Factor Switching. (Joint Investigation with STP5: S5181_1).

Updated information can be found at:- https://www.stp.uk.net</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">e.g. Incremental, Tech Transfer, Significant, Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>14</td><td>-9</td><td>23</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">If the projects are technically successful and the findings and recommendations from the projects are implemented, the projects will potentially enable each DNO member of the programme to gain the following benefits, including:
• Offsetting of future increases in CAPEX and OPEX;
• CI/CML savings per connected customer;
• Prevention of disruptive failures of oil-filled equipment, tapchangers, earth switches, increasing safety and avoiding unnecessary scrapping of serviceable components, which will alleviate environmental impact.
• Liaison with European Utilities to share new technology and failure modes;
Increased safety of staff and public by reducing the number of accidents / incidents.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Range 1-5 years - dependent on project</td><td>Duration of benefit once achieved</td><td colspan="2">Range 2-8 years - dependent on project</td></tr>
<tr><td>Probability of Success</td><td>Range 10-100% - dependent on project</td><td>Project NPV = (PV Benefits – PV Costs) x Probability of Success</td><td colspan="2">£67,777</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">A number of STP Projects are at an early stage and the project cost may not always reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive. However, STP has delivered a number of notable innovations since its inception.</td></tr>
</table>

Project Progress to March 09	Most projects or project stages started in the module during 08/09 have been completed, but some projects span more than one year.
Collaborative Partners	Other DNOs
R&D Providers	EA Technology

Project Title	**Strategic Technology Programme Networks for Distributed Energy Resources Module 5**			
Description of project	A DNO research & development collaboration hosted by EA Technology			
Expenditure for financial year	Internal £3875 External £53100 Total £56975		Expenditure in previous (IFI) financial years	Internal £15188 External £124498 Total £139686
Total Project Costs (Collaborative + external + CE Electric UK)	Rolling programme across seven DNOs		Projected 2009/10 costs for CE Electric UK	Internal £4000 External £54358 Total £58358
Technological area and / or issue addressed by project	During the budget year 08/09, Module 5 has consolidated the work programme by clustering much of the work around a number of key issues of relevance in the planning, design and operation of networks for distributed energy resources; namely, fault level management, network losses, load related investment, circuit ratings, power quality and microgrids. Most of the projects aim to increase network performance and reduce risk whilst having a positive impact on DNOs' environmental performance. **Completed Projects (March 09):-** S5169_1 Route plan to transform networks from passive to active networks S5161_2 Standard Risk Assessment Approach to DNO protection requirements S5183_1 Communications for active network management S5187_1 Module 5 participation in ENARD Annex II DG System Integration S5188_1 & 2 Latest developments in issues associated with low carbon network designs S5189_1 Techniques for assessing harmonic distortion from generation plant S5193_1 Fault level management S5194_1 Load related investment - Feasibility study S5195_1 Network Losses - Feasibility study S5197_1 & 2 Power Quality Issues - voltage dips and swells S5198_1 Microgrids - Feasibility study S5200_1 LV Fuse Reach S5201_1 Distribution Network Losses – Loss Reduction Initiatives **Projects Still In Progress (March 09):-** S5147_8 Microgenerator clusters - Stage 8 - extension of monitoring / analysis S5151_5 Network Risk Modelling - Stage 5 S5181_1 Effect of low power factor switching S5190_1 Whispergen output characteristic monitoring S5204_1 Monitoring and impact of domestic heat pumps S5205_1 Fault level management - Feasibility Study. Updated information can be found at:- https://www.stp.uk.net			
Type(s) of innovation involved	e.g. Incremental,	Project Benefits Rating	Project Residual Risk	**Overall Project Score**

	Tech Transfer, Significant, Radical	9	-10	**19**
Expected Benefits of Project	Projects within this module have been cost effective and help improve reliability and safety of generation connection in distribution networks in line with government policy. 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: • Contributing to the achievement of Government white paper aims of introduction of significant numbers of micro-CHP units to UK homes by 2010 and greater numbers beyond then; • Paving the way for more actively controlled networks in support of a move to a lower carbon economy; • Enhancing the knowledge and awareness of overseas best practice in DG system integration, which can be applied as appropriate in the UK; • Reduction in the cost of connections for developers seeking to connect load and distributed generation; • Understanding of the potential to use the Senergy / IMASS connection modelling tool to simplify / reduce the cost of providing indicative connection costs; • Developing a more consistent, knowledgeable and auditable application of LV fuse reach across the network, hence a more reliable network reducing CML/CI; • Being better placed to assess the possibilities for real reductions in losses on DNO networks to reduce GB GHG emissions; • Understanding how to incorporate energy saving technologies such as heat pumps into distribution network design.			
Expected Timescale to adoption	Range 1-7 years - dependent on project		Duration of benefit once achieved	Range 1-15 years - dependent on project
Probability of Success	Range 5-60% - dependent on project		Project NPV = (PV Benefits – PV Costs) x Probability of Success	£89367
Potential for achieving expected benefits	A number of STP Projects are at an early stage and the project cost may not always reflect the likely full costs of implementation. However, STP has delivered a number of notable innovations since its inception.			
Project Progress to March 09	Most projects or project stages started in the module during 08/09 have been completed, but some projects span more than one year.			
Collaborative Partners	Other DNOs			
R&D Providers	EA Technology			

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 £6500 Total £7000	Expenditure in previous (IFI) financial years	Internal £1000 External £12740 Total £13740
Total Project Costs (Collaborative + external + CE Electric UK)	£37440	Projected 09/10 costs	Internal £1000 External £6500 Total £7500
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. 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. 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 transition 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 that may be suitable for painting towers and substation plant.		
Type(s) of innovation involved	Significant		
Expected Benefits of Project	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 £10,000 per annum, together with associated environmental benefits. In anticipation of possible changes in environmental legislation suppliers are in the early stages of developing systems that are water based and Zinc free. This project is working with suppliers by providing structures to be painted and carrying out additional tests.		
Expected Timescale to adoption	Range 2-4 years - dependent on legislation	Duration of benefit once achieved	Ongoing
Probability of success	Range 50-100% dependent on project	Project NPV	£9354
Potential for achieving expected benefits	The potential for achieving the expected benefits is considered to be fairly high.		

Project Progress to March 09	A series of batches of coatings from a variety of manufacturers have been tested received and tested. Analysis of the materials provided showed a broad range of quality issues but testing to identify these has allowed a functional specification to be developed. Updated tower paint specifications have been issued and a list of approved suppliers has been drawn up. A review of progress to date by the group has been made and recommendations to the DNO participants for new work have been made to build on previous successes.
Collaborative Partners	ENA members
R&D Provider	EA Technology, paint manufacturers

Project Title	Partial Discharge User Group		
Description of project	The Partial Discharge User Group is a technical forum where information on partial discharge related failures can be discussed.		
Expenditure for financial year	Internal £5900 External £2000 Total £7900	Expenditure in previous (IFI) financial years	Internal £6000 External £18561 Total £24561
Total Project Costs (Collaborative + external + CE Electric UK)	£66540	Projected 2009/10 costs for CE Electric UK	Internal £1000 External £6500 Total £7500
Technological area and / or issue addressed by project	Partial discharge is the primary cause of disruptive failure of HV switchgear. The Partial Discharge 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 will in turn enhance the way in which HV assets are managed and maintained and will make a positive impact on the safety of operators working in substations.		
Type(s) of innovation involved	Significant to Incremental		
Expected Benefits of Project	Due to the ageing profile of switchgear and the introduction of air insulated switchgear designs using cast resin there is less tolerance to the effects of partial discharge activity. Unless the condition of the switchgear is actively assessed and managed there will be an increase in failure rates. The expected benefits of the projects taken in the financial year 2008-09 are: Understanding of the potential partial discharge related failure points for all types of switchgear. Determining the mechanism of failure related to surface discharge. Ascertaining the end of life of switchgear found to be experiencing surface related partial discharge. Understanding of the typical sound signatures of surface related discharge by use of analysis in the time and frequency domain. Enhancing interpretation of routine partial discharge surveys. Better targeting of maintenance. Preservation or reduction of the low failure rate for HV distribution switchgear. Understanding the effect of the environment on the levels of partial discharge activity and the condition of switchgear.		

Expected Timescale to adoption	Range 1-3 years dependant on project.	Duration of benefit once achieved	Ongoing
Probability of Success	75-100% dependant on project.	Project NPV (Present Benefits – Present Costs) x Probability of Success	£11225
Potential for achieving expected benefits	Data Management. During the 208-09 the Partial Discharge User Group invested further in a database of results that enables significant key information to be quickly drawn from a large population of historical results. This greatly enhances the incident reporting facilities and helps engineers to better interpret the results of partial discharge surveys and prioritise which switchgear is in need of attention. Profile on the Long Termination Degradation of Switchgear Different types of switchgear and components commonly used are by the DNOs are sited at EA Technology and investigated for discharge activity. Discharge sources are created and monitored to determine the mechanism for failure and the end of life period. Work will also include typical sound signatures for surface discharge activity.		
Project Progress to March 09	The development of new instrumentation and the enhancement of existing instruments. Further development of the partial discharge database. Further investigation into the correlation between humidity and partial discharge.		
Collaborative Partners	DNOs		
R&D Provider	EA Technology Ltd		

Project Title	ACTIV Project		
Description of project	This project is to investigate active voltage control to increase the efficiency of the network and facilitate the connection of distributed generation. More specifically it is to undertake field trials of the Fundamentals SuperTAPP n+ automatic voltage control (AVC) relay and develop associated modelling criteria for network planners.		
Expenditure for financial year	Internal £4400 External £22900 Total £27300	Expenditure in previous (IFI) financial years	Internal £5063 External £25215 Total £30278
Total Project Costs (Collaborative + external + CE Electric UK)	£254206	Projected 2009/10 costs for CE Electric UK	Internal £4000 External £14670 Total £18670
Technological area and / or issue addressed by project	To investigate the performance of the Fundamentals SuperTAPP n+ AVC relay to regulate voltage on 33kV and 11kV network feeders with load and generation present.		
Type(s) of innovation involved	Incremental	Project Benefits Rating	Project Residual Risk	Overall Project Score
		13	-7	20
Expected Benefits of Project	The expected benefits of the project are: • Enabling the connection of distributed generation using a simple solution which requires minimal network modification; • Improving the voltage profile of supply; • Reducing the requirement for network extensions or reinforcement and increasing the capacity for the connection of distributed generation; and • Reducing the risk of voltage being outside statutory limits and thus damaging equipment and injuring personnel.		
Expected Timescale to adoption	Year 2010	Duration of benefit once achieved	10 Years
Probability of Success	75%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£ 223000
Potential for achieving expected benefits	The voltage control scheme is operating as expected over a range of operating conditions. It is likely that the expected benefits will be achieved.		

Project Progress to March 09	Three of the four trial sites are now installed and producing data for validation. These include: • A simple landfill generator on an 11kV radial network; • A 33kV lightly interconnected network with wind generation; • An 11kV radial network with load drop compensation and large amount of generation and varying load types. Over 10,000 operational hours have been recorded. A number of issues have been discovered and addressed. Desktop studies have been completed on two of the sites and indicate that more voltage headroom for generation can be created with little requirement for additional operator intervention.
Collaborative Partners	CE Electric UK, Central Networks, EDF Energy Networks, ScottishPower Energy Networks
R&D Provider	EA Technology Ltd Fundamentals Ltd

Other Collaborative Projects

Project Title	SuperGen V		
Description of project	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		
Expenditure for financial year	Internal £1813 External £25000 Total £26813	Expenditure in previous (IFI) financial years	Internal £2000 External £50000 Total £52000
Total Project Costs (Collaborative + external + CE Electric UK)		Projected 2008/09 costs	Internal £2,000 External £25,000 Total £27000
Technological area and / or issue addressed by project	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.		
Type(s) of innovation involved	Radical		
Expected Benefits of Project	The expected aims of the project are: • To deliver a suite of intelligent diagnostic tools for plant • To provide platform technologies for integrated network planning and asset management • To progress plans to develop and implement improved and reduced environmental impact networks • To develop models and recommendations for network operation and management		
Expected Timescale to adoption	5 years -	Duration of benefit once achieved	20 years
Probability of success	25%	Project NPV	£42522
Potential for achieving expected benefits	Asset management is core to DNO businesses. The appropriate use of the emerging opportunities for condition monitoring is key to optimising performance, both financially and in quality of supply. Some of the technologies being developed in this programme are likely to be utilised, however much more important is the broader window this work gives to the global research community. Through demonstration sites the true value		

	of condition monitoring will be identified, enabling appropriate business decisions on adoption of technologies.
Project Progress to March 09	Technology & trials: • The detection, control and protection synchronous islands have been demonstrated on a 50kVA diesel generator. The demonstration employs a real-time phasor measurement system. An AC optimal power flow method for assessing the maximum distributed generation (DG) penetration in distribution networks has been developed. A novel method of detection of loss of grid techniques is being developed. A low-cost system with internet broadcast capability has also been developed: four are currently in operation. An investigation into how regions of a distribution network can operate during emergency islanded mode conditions is also underway. • Optimized design of existing overhead lines of wood pole line, and a lattice tower line. The methodology has been employed to analyse the behaviour of low-sag composite conductors on a 33kV wood-pole structure. The model is now being utilised on a wood-pole line on Scottish Power and a lattice tower line on the National Grid, and may substantially improve the performance of sections of the network without major infrastructure changes. • A unique installation for transformer monitoring at National Grid comprising of two 275/132kV, 180MVA transformers, is implementing results of research on condition monitoring architectures, diagnostics and machine learning. • Development of condition monitoring architecture for power networks has progressed well and is being implemented on a National Grid transmission transformer. Diagnostic and support modules are included, and exploit a range of ageing models including those developed within this project. Work on ageing has shown that the rate of damage may not be affected by harmonic content, but resulting partial discharge signals change significantly. • PP-based alternatives to XLPE cable insulation have been characterised. Additional funding has been secured for the more applied work to develop routes to commercial exploitation. Vegetable oils have been shown to be a basis for replacement of mineral oils in HV equipment. • Strathclyde and Liverpool have been applying knowledge-based partial discharge analysis and chromatic analysis to data from EdF Energy Networks cable monitoring systems. All publications and reports are available to all the partners from a secure web site: http://www.supergen-amperes.org/
Collaborative Partners	National Grid, Scottish Power, Scottish and Southern, United Utilities, Western Power Distribution, Central Networks, NIE, Advantica & EDF Energy Networks
R&D Provider	Universities of Manchester, Southampton, Edinburgh, Liverpool, Strathclyde, Queens (Belfast).

<table>
<tr><td>Project Title</td><td colspan="3">Superconducting Fault Current Limiter</td></tr>
<tr><td>Description of project</td><td colspan="3">This project aims to design, develop and trial three 12kV Superconducting Fault Current Limiting (SFCL) devices on three different UK networks.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £1500
External £93800
Total £95300</td><td>Expenditure in previous (IFI) financial years</td><td>Internal £46875
External £123250
Total £170125</td></tr>
<tr><td>Total Project Costs
(Collaborative + external +
CE Electric UK)</td><td>£2500000</td><td>Projected 2009/10 costs for
CE Electric UK</td><td>Internal £7500
External £105000
Total £112500</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="3">The development of a non-linear ‘high-temperature’ superconducting ceramic in series with a circuit breaker for the clamping and clearance of fault energy.

When the material is operated at below its critical temperature it loses all electrical resistance, thereby allowing load current to flow with negligible losses. The increased current density, caused by fault current, or the loss of cooling medium (liquid nitrogen) causes the temperature of the superconducting material to rise and it reverts to a normal resistive state.

Being a solid state device, the SFCL has been proven to operate in a few milliseconds, after which the impedance remains high until the fault is cleared by conventional means (protection operated circuit breakers, fuses, etc.). The SFCL’s operation is sufficiently fast to ensure that the first peak of the fault current is limited. The subsequent limited current can be set to suit a specific application.

Three devices (one per DNO) will be constructed and installed covering a range of applications: transformer tails, bus section, interconnected network connection. The successful completion of this project is likely to pave the way for higher voltage devices.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>11</td><td>-4</td><td>15</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="3">To develop, understand and address the issues associated with the connection of an 11kV fault current limiting device to the network.

Successful trials will result in the development of commercially available devices that are capable of clamping fault levels to within network design limits. Once proven, this will open up another option for tackling network fault level, potentially providing an alternative to network reinforcement.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>3 years</td><td>Duration of benefit once achieved</td><td>20 years</td></tr>
</table>

Probability of Success	75%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£840000
Potential for achieving expected benefits	Pilot 1 is expected to go live in summer 2009 and work progresses on pilots 2 and 3 with installations in 2009/2010. The project is managed against milestones and future milestones include the assembly and type testing at an independent test house prior to installation and commissioning of all units.		
Project Progress to March 09	The first pilot SFCL was delivered to ENW in early March and is awaiting final commissioning once ENW have incorporated it into their network The cryogenic system was made operational in March. Some initial acoustic noise issues have been mitigated. Work on pilot 2 (SPEN) design has been completed and purchasing/assembly are due in 2009.		
Collaborative Partners	Electricity North West, Scottish Power Energy Networks		
R&D Provider	Applied Superconductor Ltd		

<table>
<tr><td>Project Title</td><td colspan="4">UltraTev Alarm Trial</td></tr>
<tr><td>Description of project</td><td colspan="4">The Ultra TEV alarm is a permanent fixed version of the Ultra TEV hand held devices that our substation inspectors are currently using. This proposal is to identify a suitable set of HV switchboards and install the Ultra TEV alarm system to provide continuous monitoring for partial discharges which could lead to a disruptive failure

It is also proposed to trial the use of GSM/GPRS connection from these units to the Nortech iHost solution. This will provide the facility to record individual events, enhancing the existing latching facility of the EA Technology hub</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £3250
External £0
Total £3250</td><td colspan="2">Expenditure in previous financial years</td><td>Internal £2500
External £35000
Total £37500</td></tr>
<tr><td>Project Value</td><td>£ 407146</td><td colspan="2">Projected 2009/10 costs</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">Partial discharge is the primary cause of disruptive failure of HV switchgear. The UltraTEV Alarm system continuously monitors for partial discharge activity and alarms, using GPRS, when levels exceed threshold limits, allowing timely intervention by the DNO. This in turn enhances the way in which HV assets are managed and maintained and is making a positive impact on the safety of operators working within substations.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td colspan="3">Project authorized under G85, issue1</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">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, there is a strong need for continuous monitoring of switchgear to reduce the likelihood of increasing failure rates.

The benefits of the project are:
• Determination of the appropriateness of both the TEV and Ultrasonic threshold levels
• Gathering of sufficient data to determine the effectiveness of this approach for the detection of partial discharge activity and hence the prevention of discharge related incidents and disruptive failures on the network through timely intervention.

The expected benefits going forward through to adoption are based on the deployment of UltraTEV Alarms in a selected 10% of Primary substations. It is envisaged that this will result in
• An avoidance of 20% of switchgear failures due to PD related causes and an avoided cost of £826k over 20 years, providing an NPV of £322k.</td></tr>
</table>

	• Savings of 123,000 CML per year and 2000 CI per year (across collaborating DNOs) • Enhancement of safety based on: increasing operator awareness of deteriorating condition of insulation, automatic restriction of access to substations with discharge problems and early warning to maintenance staff working in substations.		
Expected Timescale to adoption	2010	Duration of benefit once achieved	ongoing
Estimated success probability (at start of project)	75%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£322000
Potential for achieving expected benefits	The work to date confirms that the benefits are achievable upon more widespread adoption of the monitoring systems.		
Project Progress to March 09	In CE, three units have been purchased and installed. Two of these have subsequently been relocated a number of times, initially due to lack of activity and later due to resolution of underlying issues. One unit in particular has recorded intermittent activity that would have been missed by the hand-held alarm, although that activity has since ceased (suggesting an external cause). It was proposed to acquire a further unit to extend the trial into NEDL, but relocating existing units has proved sufficient. A number of installations in the total project have positively identified partial discharge activity using both electromagnetic and ultrasonic sensors. In two of these installations, additional more sophisticated tools that are currently employed for the purpose of condition assessment and detection of PD activity were used in conjunction with the UltraTEV alarm and in both instances the results were confirmed. The device can be considered ready for 'business as usual'. We intend to continue to monitor and share the results to continue to improve development and application of the project.		
Collaborative Partners	DNOs (WPD, Central Networks, SSE) plus additional information from UltraTEV alarm installations on international electricity networks (e.g. Ireland, Malta, Singapore, and Hong Kong) is being fed into the project.		
R&D Provider	EA Technology		

CE's internal innovation programme

Project Title	Stability Of Loss Of Mains Relays (LOM) To Transient Faults		
Description of project	A 6-month focused research investigation exercise concentrating on the task of validating a voltage phase displacement based anti-islanding detection method was undertaken. The main objectives of this first stage exercise were as follows: - to review and refine the proposed methods for the LOM detection; - to refine existing test scenarios for the LOM detection performance assessment; - to develop and test in software (using Matlab environment) an accurate transient model of the selected algorithm; - to implement the resulting algorithm on the AREVA P341 platform.		
Expenditure for financial year	Internal £1250 External £10000 Total £11250	Expenditure in previous (IFI) financial years	Internal £ 0 External £0 Total £ 0
Total Project Costs (Collaborative + external + CE Electric UK)	£11250	Projected 2009/10 costs for CE Electric UK	Internal £ 0 External £ 0 Total £ 0
Technological area and / or issue addressed by project	To develop new algorithms improve the stability of loss of mains relays to transient events.		
Type(s) of innovation involved	Incremental	Project Benefits Rating: 9	Project Residual Risk: -8 / **Overall Project Score: 17**
Expected Benefits of Project	The project will, if successful, enable more wide spread use of loss of mains relays reducing the reliance inter-tripping circuits and improving safety.		
Expected Timescale to adoption	Year 2010	Duration of benefit once achieved	10 Years
Probability of Success	75%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£ 100000
Potential for achieving expected benefits	The research and development side of this project has been completed to plan the project is now in a trial implementation phase with a high expectation of delivering on the original scope.		

Project Progress to March 09	The research and development side of the project has been completed in line with the technical scoping document. The algorithms are currently being tested for inclusion in operational relays and the next phase of the project is to conduct monitored trials at operational sites.
Collaborative Partners	AREVA, Scottish Power
R&D Provider	Institute for Energy and Environment University of Strathclyde AREVA

<table>
<tr><td>Project Title</td><td colspan="4">Loss Of Mains Relays (LOM) For Generation Interface Protection</td></tr>
<tr><td>Description of project</td><td colspan="4">To build on the loss of mains work carried out at Strathclyde University in 2006 to understand the behaviour of the loss of mains relays currently on the market under various simulated fault conditions for different generic types of generator. To produce a Technical Standard on testing procedures for loss of mains relays based on realistic simulation scenarios so that the performance of loss of mains relays can be assessed against a common standard and manufactures have a reference document to developing algorithms and relay decision making process against. To produce a risk template for risk based assessment to determine the level of interface protection required.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £6500
External £0
Total £6500</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £1000
External £28750
Total £29750</td></tr>
<tr><td>Total Project Costs
(Collaborative + external +
CE Electric UK)</td><td>£36250</td><td colspan="2">Projected 2009/10 costs for
CE Electric UK</td><td>Internal £ 10000
External £ 30000
Total £ 40000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">• To better understand the performance of the loss of mains relays currently available so that a set of typical settings can be established for the main generic types of generators and control systems for each type of relay.
• To enable a risk based assessments to be carried out when determining what generator interface protection to fit for a particular generator size and type.
• To produce a Technical Standard on testing procedures for loss of mains relays so they can be assessed in a consistent manner. This standard will specify a set of faults that the relays must be stable for these will be in the form of comtrade files. The standard will also provide guidance on the parameters to be used in the relays to provide a bench mark minimum standard for relay manufactures to work to in the development of future loss of mains relays.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>12</td><td>-6</td><td>18</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits of the project are:
• The Technical Standard will be used to assist the ENA Protection Assessment Panel to assess loss of mains relays and assist manufactures in developing loss of mains relays to a common minimum standard relevant to the Distribution Industry.
• The system study work will provide a recommended range of</td></tr>
</table>

	settings for relays currently available on the market. It will also document the sensitivity and stability of these relays to the most common fault scenarios for the main generic generator configurations. This will enable DNOs to make more informed decisions on the type of generator interface protection to fit and provide sufficient technical data for basic risk assessment criteria to be used in the relative merits of inter-tripping versus loss of mains relays		
Expected Timescale to adoption	Year 2010	Duration of benefit once achieved	10 Years
Probability of Success	90%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£ 109000
Potential for achieving expected benefits	The research and development side of this project has been completed to plan. The project is now in an implementation phase with a high expectation of delivering on the original scope.		
Project Progress to March 09	The research and development side of the project has been completed in line with the technical scoping document. The risk assessment model is currently being tested within CE Electric UK before being made available to the rest of the industry. The functional aspects of the technical standard have been drafted and are currently being assessed to align them with the ENA standard template format.		
Collaborative Partners	CE Electric UK plus ENA members from a steering group perspective only		
R&D Provider	Institute for Energy and Environment University of Strathclyde		

<table>
<tr><td>Project Title</td><td colspan="4">Reverse Reactive Power Relays for Loss of Mains Protection (LOM)</td></tr>
<tr><td>Description of project</td><td colspan="4">This project is to investigate the viability of using a reverse VAr technique for generator protection to reduce the cost of interface protection. More specifically it is to undertake a literature survey of the technique to identify the existing worldwide experience, develop a software model of the LOM relay based on the reverse VAr principle and test the relay model by means of transient simulation.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £4250
External £19876
Total £24150</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £1000
External £19875
Total £20875</td></tr>
<tr><td>Total Project Costs
(Collaborative + external +
CE Electric UK)</td><td>£45025</td><td colspan="2">Projected 2009/10 costs for
CE Electric UK</td><td>Internal £0
External £ 0
Total £0</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">To investigate the performance of the Reverse Reactive Power flows for use in detecting loss of mains at generation connections.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>9</td><td>-3</td><td>12</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits of the project are:
• Enabling the connection of distributed generation using a simple solution which requires minimal network modification;
• Improving the detection of loss of mains and stability of generator connection; and
• Reducing the risk of islanding generation and thus damaging equipment and injuring personnel.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2010</td><td colspan="2">Duration of benefit once achieved</td><td>10 Years</td></tr>
<tr><td>Probability of Success</td><td>65%</td><td colspan="2">Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td>£ 115000</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">The research project has identified that whilst this is a viable alternative use of technology it is unlikely to produce benefits over existing loss of mains detection schemes.</td></tr>
<tr><td>Project Progress to March 09</td><td colspan="4">This was a research project to investigate the viability of using a Reverse VAr technique for generator loss of mains protection. The conclusions of the software modelling and testing have validated that this is a viable technique to use, however, it has not proved to be any more stable or provide any additional benefits over existing techniques used to detect loss of mains. It is not proposed to carry out any further work in this area at this time, as it is unlikely that a manufacture will adopt this technique over those that are already in manufacture.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">Yorkshire Water</td></tr>
</table>

R&D Provider	Institute for Energy and Environment University of Strathclyde

<table>
<tr><td>Project Title</td><td colspan="5">Health Index Development, EHV Cables</td></tr>
<tr><td>Description of project</td><td colspan="5">EA Technology Limited (EATL) has previously worked with CE Electric UK on condition based risk management (CBRM) related projects. The relative successes of these projects have led to CE requesting the production by EATL of health indices for cable assets in the range of 33kV to 132kV, inclusive of fluid, gas and solid insulation types.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £9500
External £52500
Total £62000</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £ 0
External £0
Total £0</td></tr>
<tr><td>Total Project Costs
(Collaborative + external +
CE Electric UK)</td><td>£62000</td><td colspan="2">Projected 2009/10 costs for
CE Electric UK</td><td colspan="2">Internal £0
External £0
Total £0</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="5">To increase the availability of models and information across the overall installed asset base to allow the optimisation of asset design, operation and lifetime.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td colspan="2">Overall Project Score</td></tr>
<tr><td colspan="3">Project authorized under G85, issue1</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="5">This project has provided a quantifiable and risk based approach to CAPEX investment through current and projected condition and risk, based upon current and historical condition and an assessment of the consequences of failure associated with particular cable assets. The benefits are summarised below:
- As cables with poor performance are replaced with modern cables the number of outages for repair and maintenance time will be reduced introducing small benefits to CI and CML.
- There is also the environmental and financial benefit from this project of a reduced risk of legal prosecution under the Water Resources Act 1991 by preventing environmental incidents.
- It is anticipated that this project will delivery an improvement in capital efficiency in the EHV cable replacement work programme of 1%.
- It is also anticipated that this project will delivery a financial benefit through a 5% reduction of the costs associated with finding and repairing leaking cables.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>2010</td><td colspan="2">Duration of benefit once achieved</td><td colspan="2">10 Years</td></tr>
<tr><td>Probability of Success</td><td>75%</td><td colspan="2">Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£476291</td></tr>
</table>

Potential for achieving expected benefits	The data that drives the health index is effectively static and may well only receive an annual update. As such the outputs will be used to identify a number of named schemes that should be considered for replacement as part of our longer term planning process.
Project Progress to March 09	We have previously worked with EATL on condition based risk management (CBRM) related projects. The relative successes of these projects have led the production of health indices for cable assets in the range of 33 kV to 132 kV, inclusive of fluid, gas and solid insulation types. The models, information, algorithms and results are contained within CBRM spreadsheets. Three separate models/spreadsheets have been constructed, one each for fluid filled, gas and solid cables during 2008/09. The project is now complete.
Collaborative Partners	
R&D Provider	EA Technology Ltd

Project Title	Network Risk Modelling		
Description of project	Development of a methodology to quantify network risk and develop a network risk modelling assessment tool		
Expenditure for financial year	Internal £2125 External £33900 Total £36025	Expenditure in previous (IFI) financial years	Internal £3875 External £15330 Total £19250
Total Project Costs (Collaborative + external + CE Electric UK)	£108500	Projected 2009/10 costs for CE Electric UK	Internal £4,000 External £32929 Total £36929
Technological area and / or issue addressed by project	This project is a joint venture between CE Electric and Durham University. It is a three year project with the majority of the work being undertaken by a mature student working towards a PhD. The philosophy underpinning the design of distribution networks in the UK has evolved over a period of many years during the formative stages of the development of the networks. Very little work has been undertaken in recent years to review whether these fundamental principles are appropriate to meet current customer requirements. A number of factors, which have increased in prominence in recent years, suggest that a review of these principles is appropriate. These include: • Utilisation of distribution networks is increasing, and the latent network capability available to respond to unplanned events is reducing; • Increasing awareness of global warming; • Severe weather conditions are occurring more frequently; • Customer expectations of network performance both at a headline level and at times of network stress are increasing; • Customers may be more concerned about extremes of performance rather than the headline figures rewarded under IIP, and a concern that neither is properly reflected in current planning standards; • The misalignment of network planning and operational standards; • A view that network risk / resilience may be a key element in the next price control period. This project is to explore these factors and develop an up to date view of network risk The main objectives of the research project are: • To gain a deeper understanding of the risk inherent in existing distribution networks; • To determine how this translates into risk to customer supplies; • To develop a means of quantifying this risk; • To understand how this risk is likely to change in the future; • To develop risk modelling and analysis methodologies; • To make use of existing, or develop new, modelling and analysis		

<table>
<tr><td></td><td colspan="4">tools to allow the above to be achieved; and
To focus on the technical issues and then make regulatory and commercial observations at the end of the project.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>14</td><td>0</td><td>14</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits of the project are:
• The project will increase the understanding of network risk within the business and the anticipated benefits are in two key areas:
• The financial benefit per annum is estimated to be £100,000 based on deferred capital expenditure due to improved design and utilisation of network capacity for 5 years.
• There is also a supply quality benefit associated with a reduction in CML's or CI's through better management of network risk during normal operation, construction works and emergency situations.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>3 Years</td><td>Duration of benefit once achieved</td><td colspan="2">10 Years</td></tr>
<tr><td>Probability of Success</td><td>30%</td><td>Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td colspan="2">£24000</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">Early results are in line with the expected progress and the project is on target to deliver the required risk analysis.</td></tr>
<tr><td>Project Progress to March 09</td><td colspan="4">Progress reports on various aspects of network risk have been written, and their contents disseminated both within CE Electric UK and at 4 international conferences. The most recent of these reports is a Software Functional Specification, for a software tool to enable CE Engineers to make their own risk assessments. At the most recent project progress meeting, in March 2009, it was agreed to investigate future network risk under three headings: increased utilisation, increased automation, and asset replacement. These investigations are now in progress.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">None</td></tr>
<tr><td>R&D Provider</td><td colspan="4">Durham University</td></tr>
</table>

<table>
<tr><td>Project Title</td><td colspan="4">ZEFAL Generator for Active Urban Networks</td></tr>
<tr><td>Description of project</td><td colspan="4">Development of a proof of concept prototype generator that is optimised for network connectivity, including networks with fault level constraints.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £3000
External £19000
Total £22000</td><td colspan="2">Expenditure in previous financial years</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td>Total Project Costs
(Collaborative + external +
CE Electric UK)</td><td>£ 430000</td><td colspan="2">Projected 2009/10 costs for
CE Electric UK</td><td>Internal £3000
External £12000
Total £15000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">Network connection of distributed generation.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>7</td><td>3</td><td>4</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Reduced cost, network impact and man-hours involved in providing distributed generation connections.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>2013</td><td colspan="2">Duration of benefit once achieved</td><td>10 Years</td></tr>
<tr><td>Estimated success probability (at start of project)</td><td>75%</td><td colspan="2">Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td>£ 500,000</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">The proposed design seems to be viable, patentable and to provide competitive advantage over existing products.</td></tr>
<tr><td>Project progress March 2009</td><td colspan="4">The project has developed a feasible design and is progressing with simulations and the construction of a prototype. There were some delays in the design phase, however these have been resolved and the project is proceeding as planned.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">E.On; EdF EN</td></tr>
<tr><td>R&D Provider</td><td colspan="4">NaREC Development Services Ltd,
PPA Energy Ltd,
University of Nottingham,
Imperial College London</td></tr>
</table>

<table>
<tr><td>Project Title</td><td colspan="4">Asset Condition Data Strategy</td></tr>
<tr><td>Description of project</td><td colspan="4">A rigorous mathematical analysis of asset condition data sets, specifically: quantifying their robustness, making the best use of the information contained in them, and setting recommendations for sampling strategy. This will inform both the continued use and ongoing development of investment modelling tools such as health indices for improved network management and design.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £ 2625
External £22000
Total £24625</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td>Total Project Costs
(Collaborative + external +
CE Electric UK)</td><td>£24625</td><td colspan="2">Projected 2009/10 costs for
CE Electric UK</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">Specifically the research solves the problem of the best way to estimate the health index frequencies for a whole population of assets, when a sample of only some of the assets has been inspected. The delivered methodology, the “regression for proportions approach” has the flexibility to cope with a number of situations, for example where the inspections have occurred over a number of years. It gives good results and is straightforward to implement.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>5</td><td>-1</td><td>6</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Condition data collection is expensive, and we often have limited opportunity to collect it, e.g. at a 16-year maintenance. This project will provide the benefit of a strategic approach to what we collect, when we collect, and how we use what we collect. It might also provide valuable information about statistical properties of our asset population which can be of benefit in providing parameters to our long term strategic modelling capability. Specifically it will:
• Provide a methodology to derive a profile of condition grade against percentage of the relevant part of the asset base;
• Accommodate base condition data of various ages providing a single condition grade per asset;
• Accommodate only partial coverage of the relevant part of the asset base;
• Indicate the level of confidence in the overall condition profile given the nature of the base data used;
• Submit quantified proposals for how different sampling volumes and/or frequency would improve confidence in the overall condition profile.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2012</td><td colspan="2">Duration of benefit once achieved</td><td>10 Years</td></tr>
</table>

Probability of Success	50%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£50000
Potential for achieving expected benefits	Good potential especially for sparse data areas – LV network and buried assets.		
Project Progress to March 09	Completed – deliverables are in the form of a spreadsheet model and a long and short report.		
Collaborative Partners	None		
R&D Provider	Sheffield University		

<table>
<tr><td>Project Title</td><td colspan="4">Outage Risk Management</td></tr>
<tr><td>Scope and objectives</td><td colspan="4">The objective is to develop a model/tool to aid engineering staff to quantify the risk in planned outages for major construction work at extra-high-voltage and 132kV. In these circumstances the level of supply security will be reduced for the duration of the outage therefore the model aims to quantify the risk exposure and allow the costs of alternative strategies and any mitigating actions to be evaluated by a consistent method. The output of the model/tool is to be a cost to benefit analysis to allow comparison and justification of the alternative strategies.</td></tr>
<tr><td>Description of project</td><td colspan="4">This project is underway and the following stages have already been completed:
• The preparation of a prototype spreadsheet based risk assessment model to quantify the risk to the network during a planned construction outage;
• Consultations with engineering staff to assess the current outage risk assessment and mitigating action processes to ensure that these are accounted for in the spreadsheet algorithms;

To progress the following activities are planned:
• To validate the present model with a number of planned outage scenarios and modify, as necessary.
• To align the outline methodology set out through the national level discussions on outage risk management through the Energy Networks Association (ENA).
• The integration of the model into current outage risk management planning processes.
• The use of the model during the network design phase of projects to assess the impact of potential future planned outages.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £5250
External £40600
Total £45850</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td>Total Project Costs
(Collaborative + external + CE Electric UK)</td><td>£52000</td><td colspan="2">Projected 2009/10 costs for CE Electric UK</td><td>Internal 2000
External £5000
Total £7000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The project aims to provide a consistent method for carrying out the quantified risk assessment and to aid in the decision making processes associated with cost to benefit analysis of risk mitigation strategies. The tool is to be used by both network designers and network control engineers.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>13</td><td>-4</td><td>17</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits of the project are:
• To allow the consistent assessment of the proposed alternative network reinforcement strategies during construction outages, thereby arriving at the most appropriate solution in terms of costs</td></tr>
</table>

	versus the risk and cost effectively reducing the risk of interruptions to our customers; • To ensure that during the network design stages adequate contingency has been designed in for future construction outages.		
Expected Timescale to adoption	Year 2010	Duration of benefit once achieved	25 Years
Probability of Success	75%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£ 42902
Potential for achieving expected benefits	The prototype risk model/tool developed so far has demonstrated that, in principle, it will be possible to assess the costs versus risk of the alternative reinforcement strategies during construction outages. Further work is required to develop the model/tool and it is considered that we will be able to achieve the expected benefits.		
Project Progress to March 09	A prototype model/tool has been developed by Manex UK Limited in Microsoft Excel by consultation with the Asset Management and Network Control departments in CE Electric UK. This model includes the following features: • The facility for the user to enter information about the planned outage in terms of duration, alternative circuits being relied upon during the outage and any mitigating actions taken to reduce risk; • The entry of circuit configuration details of alternative circuits being relied upon during the outage and the risks of failure of these circuit components (presently extracted from NaFIRS data); • An output of the risk rating of all alternative strategies in a matrix and a cost to benefit calculation for each. At this stage of the project a pilot outage has been run through the model/tool but further evaluation is required to refine the model. In addition, collaborative work with other DNOs has begun through ENA to develop a national outage planning good practice guide which includes discussions relating to risk assessment methodology. In the coming months it is planned to run further pilots through the model to further assess its suitability.		
Collaborative Partners	CE Electric UK		
R&D Provider	CE Electric UK Manex UK Limited		

Project Title	**Remote Indicating Fault Passage Indicators – Network Trial**		
Description of project	Trial installation of Remote Indicating fault passage indicators including the development of an interface between the management software and the main NMS control system.		
Expenditure for financial year	Internal £2250 External £0 Total £2250	Expenditure in previous (IFI) financial years	Internal £24611 External £128518 Total £153129
Total Project Costs (Collaborative + external + CE Electric UK)	£155379	Projected 2009/10 costs for CE Electric UK	Internal £0 External £0 Total £0
Technological area and / or issue addressed by project	Fully prove the operation of a new type of fault passage indicator that signals (via commercial GSM/GPRS cellular communications) the presence of overhead line faults to a central location. Develop an interface between the receiving software and the main NMS control system to ensure control engineers are presented with all available fault information in a coherent way		
Type(s) of innovation involved	Incremental	Project Benefits Rating	Project Residual Risk / **Overall Project Score**
		Project authorized under G85, issue1	
Expected Benefits of Project	The expected benefits of the project are: • Will enable fault locations on overhead lines to be more quickly identified and hence provide a more rapid restoration of supplies to customers. • May also provide better information on the location of transient faults that will permit the cause of these faults to be found and rectified before they cause extended interruptions of supply to customers.		
Expected Timescale to adoption	Year 2009	Duration of benefit once achieved	20 Years
Probability of Success	95%	Project NPV (Present Benefits – Present Costs) x Probability of Success	£432000
Potential for achieving expected benefits	Two types of FFI and 2 types of communications are being trialled to determine the most reliable system. If reliable in both fault indication and communications the system will be adopted for roll out across the whole of CE's distribution network.		

Project Progress to March 09	The project is now completed and a follow up project is due to commence April 2009. some of the cost that were originally anticipated to appear here have been carried forward to the new project and a new business case has been made: • GPRS provided the most reliable form of communications; • Even though a potentially very difficult area for communications was chosen, workable communications from one provider were found at 95% of the planned locations for FFI units. • One of the two trialled FFIs proved to have a high reliability in detecting faults; • The management/communications controlling software proved to be extremely reliable with no failures during the trial period. • Links between the FFI management/communications controller software and the Enmac based control system were successfully demonstrated. Following the results of this trial the company is now installing remote indicating FFIs across the whole distribution network.
Collaborative Partners	CE Electric UK
R&D Provider	Nortech Management Ltd

Benefits Realised

20. 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. Much of the work carried out this year is part of a staged progress, with few 'final' deliverables.

21. Reviewing some of the projects in this report yields:

- Future network development. Projects such as ZEFAL and the suite of loss of mains protection will and do facilitate the process of increasing distributed generation on our network.
- Managing risk. Previous loss of mains relay work has identified means to make the system safer, and new projects in this area have continued to build upon this. Additional work to improve network risk through increased understanding is already leading to improvements in design in the area of reinforcement.
- Managing the assets. Project to improve condition monitoring through the development of health indices will have an increasingly beneficial impact on our ability to manage both the installed and future asset base effectively and efficiently. This will support the optimization both of capital investment and of network performance.
- Strategic. The climate change project and much of the STP work falls into this category, as they add to the body of knowledge without necessarily having an immediate impact.

22. As with all innovation programmes some projects do not deliver the hoped for results. The reverse reactive relays for loss of mains project fell into that category this year. Although the investigation found the technology to be viable in terms of performance, no significant economic benefit could be identified. Learning benefits are then the primary outputs from this type of project.

Programme Planning and Co-ordination

23. To co-ordinate and, as importantly, disseminate innovative activity across the business, we have previously established improved internal systems. During 2008-09 we have further enhanced the resource available through the appointment of a dedicated innovation manager. We have continued to enhance the innovation management process during 2008-09 and have undertaken a major review and upgrade of innovation processes to better align such activities with external stakeholder needs and internal business requirements. The resource expended on running the innovation process as a whole 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 group meetings and preparatory work on future projects, where such costs cannot be directly associated with a project.

24. Through the improved innovation management process we intend to increase the emphasis on producing high quality business cases for individual projects and using such cases as the primary prioritisation mechanism. Such business cases will then be supported by improved approaches to project management.

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 respective 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. The following summarises the full portfolio and the expenditure incurred during 2008-09.

		Expenditure			
Project	No. of Projects	External	Internal	Total	Project NPV
Radiometric Arc Fault Location	1	£20300	£500	£20800	£45787
Investigation of Transfer Potentials	1	£2700	£1750	£4450	£150000
Potential Impacts Of Climate Change On Network Resilience	1		£1000	£1000	
STP Module 2 - Overhead lines	20	£46700	£2750	£49450	£64624
STP Module 3 - Underground Cables	16	£55000	£750	£55750	£87318
STP Module 4 - Substations & Plant	21	£43800	£14000	£57800	£67777
STP Module 5 - Embedded Generation	19	£53100	£3875	£56975	£89367
ACTIV Project	1	£22900	£4400	£27300	£223000
Protective Coatings Forum	2	£6500	£500	£7000	£9354
Partial Discharge Users Group	1	£5900	£2000	£7900	£11225
Superconducting Fault Current Limiter	1	£93800	£1500	£95300	£840000
Supergen V	21		£2500	£2500	£42522
Ultratev Alarm Trial	1		£3250	£3250	£322000
Reverse Reactive Power Relays for LOM Protection	1	£19900	£4250	£24150	£115000
Network Risk Modelling	1	£33900	£2125	£36025	£24000
Loss of mains relays (LOM) for Generation interface protection	1		£6500	£6500	£109000
Stability of LOM to transients	1	£10000	£1250	£11250	£100000
ZEFAL Generator	1	£17000	£3000	£20000	£500000
Health Index Development, EHV Cable	1	£52500	£9500	£62000	£476291
Asset Condition Data Strategy	1	£22000	£2625	£24625	£50000
Remote Indicating Fault Passage Indicators	1		£2250	£2250	£432000
Outage Risk Management	1	£40600	£5250	£45850	£42902
Oil degradation	1	£4200		£4200	£97000
Programme management			£85000	£85000	
Total	116	£550800	£160525	£711325	£3899167

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

Number of active IFI projects	116
NPV of current project portfolio	£3899167
Summary of other benefits anticipated from active IFI projects	Marginal improvement in reliability
Total expenditure in reporting period.	£711325
Total expenditure to date	£2812074
Benefits actually achieved from IFI projects to date	see text

Summary of 2008/09 IFI investment

29. We can also summarise the discussion above to provide the data specifically requested in the RIGs, split in direct proportion to revenue in each of the two licence areas:

Summary IFI Expenditure 2008-09

Eligible Project Spending (external)	£550,800
Eligible Project Spending (internal)	£160,525
IFIEt, Grand Total	£711,325
Revenue YEDL	£236,700,000
Revenue NEDL	£178,300,000
CBRt, Combined Revenue 08-09	£415,000,000
ptrit, Pass Through Rate 08-09	75%
IFI Maximum (0.5% of CBR)	2,075,000
KIFIt, Carry forward to 2009-2010	1,037,500
Incentive revenue adjustment, IFIt	£533,494

30. In proportion to the revenue split across the two licences, eligible project spending is;

	Eligible Spending	Carry Forward
YEDL	£405,712	£591,750
NEDL	£305,613	£445,750

Outlook for 2009/10

31. We envisage that the portfolio of IFI projects to be worked on in 2009/10 will be largely made up from:

- continuing to support the 'in progress' projects listed in this report, notably:
  - EA Technology STP programme;
  - Supergen / Flexnet;
  - ENA collaborative work;
  - ASL fault current limiter;
  - Network risk;
  - ZEFAL generator for active urban networks;
  - GM Fault passage indicator;
  - Energy Innovation Centre, Capenhurst
- developing new projects, collaboratively, such as through the ENA, where possible but alone if not, including:
  - Tree growth retardants;
  - Impact of consumer behaviour on design and risk models with respect to the low carbon agenda;
  - Environmental monitoring in substations;
  - Innovative fault passage indicator demonstration/field trials;