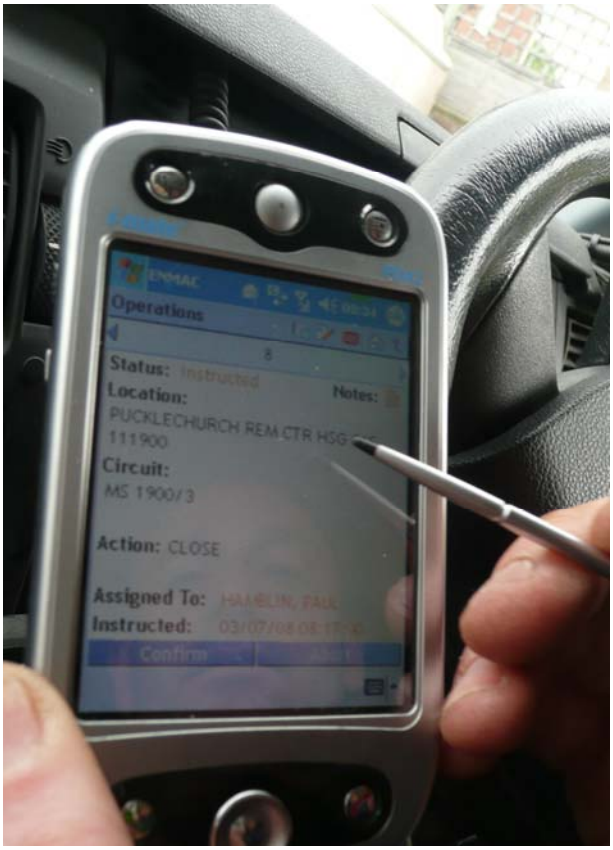
WESTERN POWER DISTRIBUTION

Serving the South West and Wales

Report on 2007/08 work undertaken under Ofgem Innovation Funding Incentive



Western Power Distribution (South West) plc
Western Power Distribution (South Wales) plc

WESTERN POWER DISTRIBUTION

CONTENTS

Cover picture - WPD “Enmac Mobile” in use. It provides for remote updating of SCADA status of switching schedules, and was developed under a previous WPD Innovation Funding Incentive project.

1.0 INTRODUCTION

1.1 Western Power Distribution (South Wales) plc and Western Power Distribution (South West) plc hold electricity distribution licences issued by Ofgem under the Electricity Act (as amended). For brevity, "WPD" is used to refer to both licenced areas in this report.

1.2 During 2004, the Energy Regulator, Ofgem introduced an "Innovation Funding Incentive" (IFI) to encourage Distribution Network Operators (DNOs) to apply innovation in the way they pursue the technical development of their networks. This report describes WPD's IFI activities in 2007/8 and provides additional comments on use of previous research & development (R&D). WPD are required under the IFI scheme to compete a number of pro-forma report sheets, and these are included in Section 7 of this report.

2.0 OFGEM INNOVATION FUNDING INCENTIVE

2.1 The introduction of the Ofgem IFI mechanism in 2004 recognised that the risk/reward balance for research, development and innovation, differed from that applying to normal Distribution Network Operator (DNO) core business. IFI funded projects had to meet eligibility rules set out in Ofgem / DNO agreed documents.

2.2 Qualifying IFI projects have to meet criteria set out in the Ofgem IFI Regulatory Instructions and Guidance (RIG) and a Good Practice Guide which had to be developed by IFI parties and agreed by Ofgem. IFI work is partially funded, on a reducing sliding scale. Whilst DNOs could submit their own individual GPGs, there has been collaboration between DNOs in consultation with Ofgem, and a common GPG produced, as Energy Networks Association Engineering Recommendation G85 which received Ofgem agreement.

2.3 Building on experience gained during these initial projects, the RIGs and GPG were revised, and issue 2 of Engineering Recommendation G85 was issued in December 2007. As a consequence, of this, we have projects in 2007/8 which were commenced under different GPGs, with different definitions and reporting requirements.

2.4 The RIGs published by Ofgem and applicable to the 2006/7 financial year provided the following definition of an Eligible IFI Project:

A project will qualify as an eligible IFI project provided that it is designed to enhance the technical development of distribution networks (up to and including 132kV). Eligible IFI projects will embrace all aspects of distribution system asset management from design through to construction, commissioning, operation, maintenance and decommissioning.

2.5 The definition of technical development contained in the initial GPG, is as follows -

" In this context:

- "Technical" means "Being of a scientific and/or engineering nature and benefiting the design, construction, commissioning, operation, maintenance and decommissioning of the primary plant and equipment employed in the distribution of electrical energy and/or of the secondary plant and equipment employed to control, protect and maintain such Primary plant and equipment"

- "primary" means "heavy current equipment that carries power currents at voltages from LV up to and including 132kV"

2.6 Issue 2 of "G85" the definition of "technical" was revised as follows -

- "Technical" means "Being of a scientific and/or engineering nature and benefiting the design, construction, commissioning, operation, maintenance and decommissioning and / or improving the direct environmental interactions of the Primary plant and equipment employed in the distribution of electrical energy, transmission or electrical energy and transmission of gas and / or the secondary plant and equipment employed to control, protect and maintain such Primary plant and equipment"

2.7 Ofgem have -

- established new RIGs with a rolling 5 year commitment to IFI,
- introduced a constant % support rather than a sliding scale reduction

2.8 This 2007/8 WPD IFI report uses the relevant GPG depending on date the project was initiated.

3.0 WPD's APPROACH TO RESEARCH AND DEVELOPMENT

3.1 Having regard to the need for prudent investment and use of resource, WPD's approach is to undertake targeted research on a range of short to medium term projects not having a high cost / high risk profile, normally through collaborative projects or programmes to gain added value and gearing. However, it is sometimes the case that collaboration in more speculative and blue sky research is pursued where the programme content is appropriate and there is very high gearing. The Supergen V EPSRC funded Amperes programme and Meteorological Office lead research, on climate change impacts are examples. It is worthy of note that the Amperes programme was established under different EPSRC qualifying criteria than are now in place. Currently EPSRC focus is on Technology Readiness Levels (TRL) 1-3 where 1 is effectively "blue sky research" with no target development.. The current GPG comments that Blue Sky research projects would not normally be considered eligible for IFI unless it can be demonstrated that there is an extremely good potential case and leverage from other funding is sufficiently great that it reduces the risk to the Network Operator to an acceptable and attractive level.

3.2 WPD have, in common with other DNOs, a long association of collaborative research working with EA Technology, Capenhurst, arising from the former Electricity Council Research Centre and the establishment of areas of UK expertise in specific and pertinent spheres of electricity distribution which are of relevance to WPD. Collaborative working has been undertaken with other UK DNOs and overseas partners in Strategic Technology Programme (STP) modules on substation, overhead line and underground cable subject areas. The costs of these are well below the de-minimis £80k per licence holder group as set in the GPG (section 5) for reporting at individual project level; programme level reporting is required.

3.3 In addition to work with EATL, WPD has previously engaged ERA Leatherhead and a wide range of other providers including Universities to undertake specific research work. Since April 2005, WPD has committed to supporting a large research proposal to EPSCR on Enhanced Management and Performance for a Sustainable UK Energy Infrastructure (Supergen V Amperes project), which would be heavily geared and involve collaboration with the Universities of Edinburgh, Liverpool, Manchester, Queens Belfast, Southampton and Strathclyde together with Industrial partners and other UK DNOs and transmission companies.

3.4 WPD recognises that it is sometimes valuable to commission research to provide a platform to facilitate debate on major issues. A current example has been the environmental life cycle research project with the University of Bath to provide data in support of network loss reduction issues, described more fully below. Under previous IFI work, WPD engaged in research on charging methodologies.

3.5 It is recognised that whilst research can often lead in the long term to real financial benefits, there are also significant benefits to the wider community through -

- network performance - improved reliability and resilience
- environmental - emissions, waste, visual impact etc
- safety to employees and public
- external risk mitigation
- knowledge transfer - acquisition and dissemination of knowledge, enhancing the quality and relevance of research through direct linkage with industry, development of the available "pool" of expertise, greater exposure of own staff to direct engagement with research activity

4.0 COMMENTARY ON 2007/8 PROJECTS

4.1 WPD's 2007/8 IFI Programme contained the following projects -

- EATL STP Module 2 - Overhead Networks
- EATL STP Module 3 - Cable Networks
- EATL STP Module 4 - Substations
- Supergen V Amperes - extensive EPSRC joint funded programme
- ENA – Fault Level Monitor & Earthing projects
- Met Office – climate change impact on energy networks

- University of Bath - life cycle assessment 11kV overhead line and underground cable
- EATL - Remote ultrasonic / discharge monitoring and development of associated algorithms

Commentaries on these projects have been provided by research providers. In some instances, WPD have edited the reports to provide a more consistent style and balance of expression of expected benefit.

4.2 EATL STP Module 2 - Overhead Networks 2007/8

The second phase of monitoring overhead conductor temperatures at steady rated current was carried out during the year. The data have yet to be analysed. In contrast to the first phase, when four different types of conductor, all with similar ratings, were monitored at a single location, phase two monitored two different-sized conductors of the same type (so different design temperatures for the same current) simultaneously at two very different locations, one near sea level and one high up in the Scottish Highlands. Phase 1 found that day time ratings could probably be increased; it is hoped that analysis of the Phase 2 data will provide confirmation of this and possibly find other location-dependent benefits.

An experimental investigation of live-line jumper cutting was carried out to determine whether or not it was acceptable to cut 11kV jumpers carrying load. The work is likely to lead to changes in working practices and may lead to time and cost savings for DNOs.

Three projects were carried out at our severe weather site on Deadwater Fell, all concerned with icing of conductors. Two “novel” conductors with higher ratings than conventional conductors (one with a gap between core and conducting strands, the other with a carbon-fibre based composite core) have been monitored for ice loading alongside a conventional aluminium alloy conductor. Preliminary analysis indicates little difference in ice loads but big differences in creep between the three conductors. At the same time, two ice meters have been tested, one as a stand-alone STP2 project and the other as part of a European project on conductor icing. The former performed very well and could provide DNOs with real-time information on ice build-up on exposed conductors.

A non-destructive device for detecting defects in concrete has been assessed for its applicability to HV tower foundations. Subsequent excavations of the tested foundations indicated that the device is a useful and sufficiently accurate tool for assessing foundation integrity. Its use could result in significant time and cost savings for DNOs.

A study of alternatives to wood poles for HV OH lines, looking at the advantages and disadvantages, and the practical applicability within UK DNOs, suggested that there were benefits to be gained from using concrete poles in certain situations. A test rig has been designed to investigate the practical problems of erecting and working on lines mounted on concrete poles.

4.3 EATL STP Module 3 - Cable Networks 2007/8

In 2007/08 projects were completed to allow the calculation of current ratings of crossing cables (S3132_7), gas compression cables (S3132_10) and dynamic ratings (S3132_12). This almost finishes the creation of a comprehensive suite of cable rating tools for network designers and cable engineers. The outputs are of particular benefit in solving difficult multi-circuit problems. Without them there are risks of overloading the circuits.

The cable rating work is being extended to the accurate modelling and calculation of technical losses in cable networks. The S3148 project has delivered a tool for comparing the merits of cross-bonding and solid bonding of MV polymeric cable systems, including outputs of annualized energy losses, as well as current ratings, circulating currents and elementary section length. Further work on the economic and environmental impacts of losses is continuing in the 2008/09 STP programme.

Work is ongoing to assess the mechanical and thermal integrity of plastic ducts (S3155). This builds on previous experimental work carried out within the STP to underpin conduit specification, important to ensure that the Electricity Industry is not faced with a serious problem of duct collapse in the future.

Trials have been arranged to compare the effectiveness of three different processes for the treatment of oil filled cables at end-of-life. This work (S3144) on oil removal has been held up by difficulties in obtaining suitable sites and gaining agreement from all parties to take part, but the problems have now been resolved. The outputs of the project should allow DNOs to select the best and most cost effective process, ensuring that long term impact on the environment of redundant oil filled cables is minimised.

Significant progress is being made in determining the most effective system (on-line and off-line) for Partial Discharge (PD) testing of MV cable systems (S3157). When complete it should give the DNOs useful asset risk management data.

4.4 EATL STP Module 4 - Substations 2007/8

The programme included a wide range of projects, seeking benefits spanning safety, network performance, risks to plant, and environment.

Projects relating to condition assessment, underpin asset risk management and improved forward investment planning; contributing to all the above areas of benefit. Current examples have included the On –Load Tap Changer Monitor, (S4164_4) and the Programme of Transformer Post Mortems, (S4181_2).

Knowledge has been developed and exchanged between STP 4 Members and also European partners; examples being participation in the AM Forum, (S4185_3), the sponsoring of the Ferro-Resonance Seminar, (S4234_1), the Out Of Phase Workshop, (S4221_1) and the Substation Maintenance Seminar, (S4212_1). Each of these have contributed to developing improved understanding of electrical plant, its application, utilisation, performance and life cycle. These projects have resulted in the creation of further supplementary projects for 2008/2009.

4.5 SUPERGEN AMPERES - 2007/8

SUPERGEN is an initiative managed and led by UK research councils and the Carbon Trust to support strategically important research in power engineering. It aims to help the UK meet its environmental emissions targets through a radical improvement in the sustainability of power generation and supply. The Energy Infrastructure Programme, one of 14 within SUPERGEN, is known as AMPerES (Asset Management and Performance of Electrical Systems).

The UK has a need to maintain reliability of energy supply at minimum cost in the context of ageing plant and a drive to deploy renewable and distributed generation. New forms of generation are changing loading characteristics of plant and system load flows. Increased use of power electronics will also change the nature of the waveforms that plant needs to cope with. The need to load particular parts of the system to maximise renewable output will also change the logistics of maintenance outages. To cope with this, a more rigorous view of risk is required which links individual items of plant, system requirements and system performance. In addition there is a need to address the environmental impact of transmission and distribution networks.

All the major UK Electricity network operators are involved in the project and in addition to their technical knowledge and network data, are contributing financial support. The Universities involved are those of Manchester, Southampton, Edinburgh, Liverpool, Strathclyde, and Queens University Belfast.

The two key aims of the project are; firstly to provide platform technologies and tools for integrated network planning and asset management; and secondly to identify methods to develop and implement networks with reduced environmental impact.

Core to the structure of this project is the integrated use of demonstration sites and activities. This provides a path of vertical integration through the project, bringing together the people working on the areas of material ageing, plant modelling, data acquisition and interpretation and optimal decision making. These demonstrators will pull together the world class research being carried out in the laboratories and allow the true value of condition monitoring to be identified, enabling appropriate business decisions on adoption of technologies.

The four-year project started in 2006 and is now fully resourced in all the universities. The high quality PHD students and RAs are naturally receiving training which will eventually make them highly employable in our industry. A number of demonstrators have been identified and are being implemented. This is somewhat ahead of schedule which is very pleasing. The high-level work to develop optimal asset replacement and network expansion methodologies is progressing well, and it has been agreed that this project should become one such demonstrator, the form of which is being agreed by the management team. More physical demonstrators are being built at both distribution and transmission substations. The initial evaluation of data analysis techniques is complete and machine learning techniques have been selected for implementation. The more fundamental work on ageing of plant which is necessary to underpin the more applied activities is also progressing according to plan, with development of methods to characterise ageing plant being developed. Studies of ‘greener’ technologies have already resulted in a spin-off project being funded to develop recyclable cable insulation.

Many of the technologies being developed in this programme are likely to be utilised, however equally important is the broader window this work gives UK utilities to the global research community. In addition utilities and universities are learning to work in partnership, and developing young engineers who will provide the necessary skills base for the future.

(The Consortium membership and contact details are included in the related pro-forma in Section 7 of this IFI Report)

4.6 ENA Fault level monitor and Earthing (Transfer Potential) Projects - 2007/8

The Fault Level Monitor (FLM) project had the goal of developing an on-line instrument that can successfully measure / estimate fault level on a distribution network with repeatability and reliability. Stages of work included testing an earlier FLM against known parameters on a micro-grid and validation of the algorithm prior to further development. The algorithm validation work has cast doubt that it is technically feasible to develop an FLM with the required degree of accuracy, and focus has moved back to the Algorithm.

The earthing - transfer potential .project has examined the interaction of separate electrode systems. It assessed HV/LV electrode separation and compared results with the current Engineering Recommendation S34 approach. The work has found that transfer potential can be measured, and that accurate calculation is possible, though may require detailed analysis. The research output has already been of benefit in supporting argument on a proposed EN Standard which, if pursued, could significantly increase earthing costs associated with HV / LV earth separation.

4.7 Met Office - climate change impact on energy networks “EP2” Project - 2007/8

The UK Energy Industry has become increasingly concerned about their strategy in the face of climate change and the impacts of their long and short term profitability. More importantly how they can adapt successfully to the effects and limit their risk exposure.

The Met Office and the energy industry have developed a programme of work - “EP2” - that will allow the energy industry to anticipate the impacts of climate change and plan adaptation strategies to capitalise on these opportunities. The study will research predicted weather extremes of a future climate, not merely changes in averages of temperature and rainfall, making this the most relevant study commercially commissioned to date.

From a Distribution business viewpoint, key issues will relate to findings in relation to climate change impacts on -

- Overhead line wind loading
- Overhead line conductor ratings
- Transformer ratings
- Underground cable performance
- Urban heat island effects

- How to use the outputs of the forthcoming UKCIP08 climate change scenarios.

(The Met Office Hadley Centre is the UK's leading climate centre and a major contributor to IPCC reports with a number of its scientists acting as lead authors within the UN organisation.)

4.8 **University of Bath - life cycle assessment 11kV overhead line and underground cable - 2007/8**

Recognising that there would be increased focus on the contribution that reduction of system losses could provide in overall UK carbon reduction measures, WPD commissioned the University of Bath to undertake Life Cycle Assessment research on benchmark examples of 11kV overhead line and underground cable installations, to provide a platform to support debate.

The aim was to gain a clearer understanding of the relative values of "embedded" CO2 / energy in the manufacture, shipping, installation, operation, maintenance and end of life of three sizes of 11kV overhead line and the closest equivalent rating of underground cable, for 1km route in open country. This assessment would assist debate on the merits of using larger conductor sizes, or early intervention to up-size conductors to save losses, by assessing the CO2 "payback" time.

Whilst the work is to be completed in 2008/9, early output has already assisted WPD in making proposals to stakeholders for loss reduction actions, as part of the Distribution Price Control 5 business plan development.

4.9 **EATL - Remote ultrasonic / discharge monitoring and development of associated algorithms - 2007/8**

This collaborative project builds on previous partial discharge monitoring using transient earth voltage (TEV) and Ultrasonic techniques, by proposing a centrally monitored hub of continuously monitored remote UltraTEV alarms fitted with GPRS data communication equipment. WPD installed one unit as part of this trial.

Research has encompassed remote monitoring, by EATL, and derivation of appropriate thresholds for alarm, having regard to the extent of spurious external electromagnetic events.

5.0 COMMENTARY ON PREVIOUS PROJECTS

5.1 The following list provides brief comment on the deployment and use of past project outputs

Cable fault sniffer - successfully deployed across WPD resulting in faster and more efficient fault location.

End of life de-oiling of fluid filled cables - treatment of several WPD circuits has been included in WPD's DPCR5 stakeholder consultation on the business plan submission.

Remote updating of switching schedules by mobile communications - this real time communication link between Field staff and WPD's GE Enmac SCADA system has been rolled out across WPD. WPD have since shown the system to several other DNOs. The front cover of this Report shows a status update screen on a hand held device.

Improved specification of cable jointing resin - improved adhesion performance. Adopted in WPD specification.

CRATER underground ratings package - employed in WPD, resulting in improved accuracy cable ratings.

Shrink back testing of polymeric cable insulation - test results being used to argue for change in International Standard.

"Head Space Gas Testing" on oil switchgear - WPD originally deployed this technology to provide non-invasive check for onset on oil sludging on a population of over 2,000 units of oil filled distribution switchgear. The same tests have been repeated on sample basis as part of risk management. Current research aims to extend the capability to determine need to maintain switchgear.

Electrical wipes and contact greases - WPD have moved purchase to the identified improved performance products.

Lightning protection - output used to re-write the national document ACE Report 55. WPD lightning protection policy embraces outputs.

Condition monitoring of tapchangers - two trial units deployed at Crumlin.

New Conductors for Overhead Lines - This project involved significant input from WPD. Report covered the use of the gap-type conductor technology which has just been deployed by WPD on the 132kV Ernesettle - Prince Rock B-Route refurbishment, which is described in more detail in section 6 of this IFI report. The use of this new conductor avoided undergrounding and, coupled with the use of Balfour Beatty Utility Solutions Catenary Support System (CSS), used in its erection, saved in excess of £3M + cost of easements over some 5km of route over the alternative undergrounding option. The CSS was not IFI funded, and avoided extensive use of scaffolding. It is estimated that the saving attributable to the use of gap conductor was in excess of £2.5M.

Alternatives to Wood Poles for Overhead Lines - The completion of this project conveniently coincided with the recent review of the European Biocides Directive which suggested the possible banning of creosote as a preservative. This work informed WPD's comments as to the impact of such a ban, and also confirmed that current policy was appropriate.

Grading Rings and Arc Gaps for Long Rod (132kV) Polymeric Insulators - Polymeric insulators have many advantages over ceramic (glass or porcelain) units, but have very different material properties which require particular attention. The output of this project confirmed certain design and application requirements which are reflected in WPD policy/specifications. 132kV applications of polymeric insulators include the B Route, currently being re-strung with gap-type conductor. Incorporated into WPD specification.

Surge Arrestors - A project examining the principal failure modes of polymeric surge arrestors allowed the key design features of such units to be identified, which in turn has informed WPD's specification. All 11kV and 33kV surge arrestors currently purchased by WPD are polymeric. Incorporated into WPD specification.

Non-intrusive Foundation Testing for Steel Towers - Linear Polarisation Resistance (LPR) or "Half-Cell" testing has been part of policy for some time. This technique was used to assess the foundations of the B Route towers. In addition, Transient Dynamic Response (TDR) testing has also been trialled. The former method detects corrosion in the steel stub within a foundation, while the latter, which has recently been developed, detects the integrity of the concrete. Part Incorporated into policy / part trialled.

Helicopter-Based Inspection of Steel Tower Lines - Condition Assessment, Health Indices, and End-of-Life Criteria for OHLs
Several projects have been undertaken examining the use of helicopter-based photographic inspection of steel tower overhead lines coupled with the application of "health index" principles to enable Condition Based Risk Management (CBRM) to be applied. A trial was recently carried out on the 132kV J Route in Wales to assess the benefits to WPD of adopting such an approach.

Whilst the trial confirmed the quality of the information obtained, it was also apparent that further refinement and consideration will be required to ensure cost-effectiveness. This assessment by WPD is on-going.

Involvement in COST 727 Project on Icing of Overhead Lines - Coupled with other STP work looking at ice accretion on overhead line conductors, the output of this on-going project may enable the re-drawing of the UK's icing map, used to derive design loads for overhead lines. The likelihood for WPD, due to its geographical location, is a reduction in the ice loading requirements for lines.- Possible Review of National Standards.

Thermal Ratings of Overhead Lines - A long-term project monitoring the temperature of test spans of conductor is nearing completion. This data will then be used to assess the suitability of the current approach to the derivation of overhead line ratings. It is anticipated that this project will complement the output of the recent EP2 project undertaken by the Met Office, examining the impacts of climate change on the energy industry. Will facilitate future investment planning and debate on pre-emptive actions. Possible Review of National Standards.

Condition based risk management studies Undertaken initially for u/g cables under an IFI project, and subsequently on switchgear and transformer assets. Feeding into forward investment planning and now widely recognised.

Economic Charging Method for Electricity Distribution Networks completed - Ofgem consulted and approved and now in use. It has received widespread interest, not only by UK Network Operators and Ofgem, but also overseas.

6.0 CASE STUDY ON DEPLOYMENT OF PAST R&D

Parts of WPD's 132kV steel tower overhead line system follow routes and tower positions from the original 1930's grid. One such example is the 132kV single circuit "B" route around Plymouth. When originally built, it passed over largely undeveloped land, save for a section over extensive railway sidings. Following the post war development of Plymouth the route now passes predominantly through housing development, and contains one major valley span over the A38 trunk road; a major route into Cornwall.

The construction of a major 1320 MW generating station on the outskirts of Plymouth, though connected at 400kV, would impose increased power flows through the adjacent 132kV network under certain outage conditions, leading to overload of the above existing 132kV “B” route. It was necessary to deliver a solution for uprating the network between the end nodes of this 11km section of overhead line.

Undergrounding the route would have been extremely costly and the necessary excavation work potentially disruptive, as it would have to pass through dense urban development. The use of a larger conventional conductor on the existing towers would have impinged on required electrical clearances and this, together with increased mechanical loading, would have required a major rebuild of the route, changing towers and possibly their position; a very difficult prospect given the constraints of the current built environment.

The answer was to employ a range of new technologies, drawing on the fruit of previous investment in research and development; not only that of ESI funded work, but of the selected contractor, Balfour Beatty Utility Solutions plc. WPD examined the potential use of a special overhead line conductor known as “GAP”, which had been the subject of an EATL STP research project on novel conductors for the 132kV distribution system. Unlike conventional steel cored aluminium conductor, the GAP conductor is manufactured with a small space between the aluminium and the steel, giving it a different and very beneficial low sag characteristic coupled with significantly increased current rating, for a conductor size and weight that could be used on the existing steel towers. Because of the gap, special fittings and erection techniques are required. To date, such conductor had only been employed in the UK on a number of 400kV circuits.

Detailed surveying using LiDAR (Laser imaging) was undertaken and the towers suitability for the mechanical loading checked against the latest, recognised European Standard (BSEN 50341). This work showed that GAP could be employed, provide the required clearances and circuit rating, with minimal need for structural modifications to existing towers. Pre-existing strings of overhead line glass and porcelain insulators were to be replaced with modern polymeric insulators, which also provide improved visual appearance. The challenge then moved to that of erecting the conductor over some 9km route length of housing, major roads and a large valley span.

Balfour Beatty Utility Solutions (BBUS) had previously developed and patented a "catenary support system" (CSS). This system uses the existing overhead conductors as a transport path for a small self powered, remotely controlled overhead line "tug" which pulls along a pilot "draw wire", and a series of pulley blocks through which the new conductor is pulled. This system avoids the need for scaffolding over houses, roads etc and drastically reduces disruption to the public. It had never been used with GAP conductor previously, and also faced deployment over a 700m long valley span over the A38 road.


STOP


Balfour Beatty
Utility Solutions
PTEN 033

The project which was successfully completed within one week of target, was commissioned in July 2008.

Headline features -

- First use of GAP in UK on 132kV towers
- First use of BBUS developed CSS with GAP
- Longest span of GAP in UK at any voltage
- Substantial cost savings over rebuild (if actually possible), or undergrounding
- Minimised disruption to public

7.0 PRO-FORMA REPORTS

WPD South West Summary report of IFI Project activities year ending March 31st 2008

Number of active IFI projects	8 (2 included in ENA Programme)
NPV of costs and anticipated benefits from committed IFI projects	NPV of costs - £ 214,000 NPV of benefits - £895,900 Positive NPV - £ 681,900 (rounded from information on following sheets)
Summary of other benefits anticipated from active IFI projects	Provision of timely expert information on lifetime carbon impact of overhead line and underground cable to inform current DPCR5 debate on loss reduction and carbon footprints. Provision of timely expert information on climate change impacts on electricity network assets to inform forward investment planning and debate. Reductions in CMLs through improved reliability, resilience and speed. Maintaining or improving safety to the public and staff. Reduction of environmental risk of oil loss from plant and cables.
Total expenditure to date on IFI projects	£0.568 M up to end March 2008
Benefits actually achieved from IFI projects to date	Estimated £2.5M avoided capital cost through use of a novel overhead line conductor, deployed for the first time at 132kV, and, following tower strength assessments to BS EN 50341, needing minimal structural strengthening of existing towers. Knowledge on life cycle assessment carbon impact of 11kV o/h line and u/g cable has already proved valuable in DPCR5 discussion with Ofgem in EWG. The Climate Change impact collaborative Met Office project has provided an authoritative, fundamental, consistent industry wide basis for assessing future network rating impacts on the basis of best available forward projections. This work now facilitates debate on future investment planning. Economic Charging Method for Electricity Distribution Networks completed - Ofgem consulted and approved and now in use. Remote updating of switching schedules rolled out and delivering anticipated benefits in switching time.

Regulatory report for DG incentive, RPZs and IFI **Reporting year 2007/08** **Western Power Distribution - South West**	
Innovation Funding Incentive	**£M**
IFI carry forward (£m)	**0.550**
Eligible IFI expenditure (£m) *	**0.129**
Eligible IFI internal expenditure (£m)	**0.010**
Combined distribution network revenue (£m)	**220.56**
* includes internal expenditure	

WPD South Wales Summary report of IFI Project activities
Year ending March 31st 2008

Number of active IFI projects	8 (2 included in ENA Programme)
NPV of costs and anticipated benefits from committed IFI projects	NPV of costs - £ 214,000 NPV of benefits - £895,900 Positive NPV - £ 681,900 (rounded from information on following sheets)
Summary of other benefits anticipated from active IFI projects	Provision of timely expert information on lifetime carbon impact of overhead line and underground cable to inform current DPCR5 debate on loss reduction and carbon footprints. Provision of timely expert information on climate change impacts on electricity network assets to inform forward investment planning and debate. Reductions in CMLs through improved reliability, resilience and speed. Maintaining or improving safety to the public and staff. Reduction of environmental risk of oil loss from plant and cables.
Total expenditure to date on IFI projects	£0.568 M up to end March 2008
Benefits actually achieved from IFI projects to date	Knowledge on life cycle assessment carbon impact of 11kV o/h line and u/g cable has already proved valuable in DPCR5 discussion with Ofgem in EWG. The Climate Change impact collaborative Met Office project has provided an authoritative, fundamental, consistent industry wide basis for assessing future network rating impacts on the basis of best available forward projections. This work now facilitates debate on future investment planning. Economic Charging Method for Electricity Distribution Networks completed - Ofgem consulted and approved and now in use. Remote updating of switching schedules rolled out and delivering anticipated benefits in switching time.

Regulatory report for DG incentive, RPZs and IFI **Reporting year 2007/08** **Western Power Distribution - South Wales**	
Innovation Funding Incentive	**£M**
IFI carry forward (£m)	**0.410**
Eligible IFI expenditure (£m) *	**0.129**
Eligible IFI internal expenditure (£m)	**0.010**
Combined distribution network revenue (£m)	**163.92**
* includes internal expenditure	

WPD S West and WPD S Wales *
IFI Project report for Year ending March 31st 2008

<table>
<tr><td>Description of project</td><td colspan="5">Strategic Technology Programme Overhead Network Module 2</td></tr>
<tr><td>Expenditure for financial year 07/08 per WPD Licence area</td><td>Total

£22,873</td><td>External

£21,505</td><td>Internal

£1,368</td><td>Expenditure in previous financial years per WPD Licence area</td><td>£20,651 *
* NB only some of the projects span both 06/7 and 07/8</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="5">The STP overhead network programme for budget year 2007/8 aimed to reduce costs and improve performance of overhead networks by increasing understanding of issues that have a negative impact on costs and performance. The programme is expected to also have a positive impact on safety and environmental performance. The projects all address real problems that have been identified by the module steering group members as significant and which require technical investigation and development.

The projects within the programme covered:

• S2126_3 - Completion of long-term monitoring of conductor temperature by obtaining and analysing 12 months trial data.
• S2126_4 - Monitoring overhead line conductor temperature at two trial sites at constant current.
• S2136_3 - Continued participation in European Project COST 727: Measuring and forecasting atmospheric icing on structures.
• S2140_2 - Field trials of techniques for checking the foundations of newly installed poles.
• S2143_2 - Feasibility study to detect in-situ degradation of aluminium overhead line conductors.
• S2146_2 - Undertake torsion testing to evaluate possible limits for composite tension insulators.
• S2148_1 - Re-appraisal of ACE104 methodology.
• S2150_1 - Evaluation of TDR for assessment of tower foundations using actual field data.
• S2151_1 - Investigate alternatives to wood poles.
• S2152_1 - Evaluate performance of ice recording solution at severe weather test site.
• S2154_1 - Experimental investigation of ice loading of novel conductors.
• S2155_1 - Comparative performance of available pole-top shrouds.</td></tr>
</table>

Type(s) of innovation involved	Technical Substitution / Radical				
Expected Benefits of Project	Due to the age profile of system equipment it is inevitable that, unless significant new technology is used to extend asset life, CAPEX and possibly OPEX will need to increase significantly to maintain the present level of network reliability and safety. If these projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain benefits including: • avoid redesign, reconstruction or refurbishment of overhead lines where this is driven by a perceived need to increase ratings or strengthen lines, and is required to conform with existing standards but which may be unnecessary; • reduce levels of premature failure of assets; • provide more cost effective and early identification of damaged insulators and discharging components, which if not addressed would result in faults; • confidently extend the service life of towers and reduce potential levels of tower failures; • reduce lifetime costs by the appropriate use of alternative materials.				
Expected Timescale to adoption	Range 1-5 years - dependent on project		Duration of benefit once achieved	Range 3-7 years - dependent on project	
Estimated Success probability (at start of project)	Range 2-50% - dependent on project				
PV of Project Costs	£22,873 #	PV of Project Benefits	£42,958	NPV of Project	£20,085
	#.(nb. This is identified early stage cost. It does not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive.)				
Commentary on project progress and potential for achieving expected benefits					

***The above figures are the same for each licence area. Ofgem have agreed (meeting 09-08-05) that both may be shown together**

WPD S West and WPD S Wales *
IFI Project report for Year ending March 31st 2008

<table>
<tr><td>Description of project</td><td colspan="5">Strategic Technology Programme Cable Networks Module 3</td></tr>
<tr><td>Expenditure for financial year 07/08 per WPD Licence area</td><td>Total

£27,129</td><td>External

£26,058</td><td>Internal

£1,071</td><td>Expenditure in previous financial years per WPD Licence area</td><td>£19,849* NB only some of the projects span both 06/7 and 07/8</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="5">The STP cable network programme for budget year 2007/8 aimed at identifying and developing opportunities to reduce the costs of owning cable networks. The reduction of whole life cost through greater reliability and improved performance of cables and associated accessories comes under the remit of Module 3. Where appropriate, Module 3 worked with other Modules to achieve common goals.

The projects undertaken within the programme covered:

• S3132_10 - Further development in cable ratings to address gas compression cables.
• S3132_12 - Further development in cable ratings.
• S3140_3 - Develop best practice for the installation of Ducted Cable systems.
• S3144_2 & 3 - Comparison of processes for the treatment of redundant fluid filled cables.
• S3151_1, 2 & 3 - Understanding and controlling thermo-mechanical forces in cable systems.
• S4152 - Separable connectors and cable compartments in 11kV switchgear.
• S3159_1 - Investigation of current ratings of triplexed cable in plastic ducts.
• S3157_1 - PD testing of MV cable systems to provide asset risk management data.
• S3163_1 - On-going testing of sensors for cable fluids.</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="5">Technical Substitution / Radical</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="5">If the projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain the following benefits, including:

• offset future increases in CAPEX and OPEX;
• CI/CML savings per connected customer;
• increased safety of staff and public by reducing the number of accidents / incidents.</td></tr>
</table>

Expected Timescale to adoption	Range 1-3 years - dependent on project		Duration of benefit once achieved	Range 3-5 years - dependent on project	
Estimated Success probability (at start of project)	Range 2-50% - dependent on project				
PV of Project Costs	£27,129	PV of Project Benefits	£41,034	NPV of Project	£13,905
	# (nb. This is identified early stage cost. It does not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive.)				

WPD S West and WPD S Wales *
IFI Project report for Year ending March 31st 2007

<table>
<tr><td>Description of project</td><td colspan="5">Strategic Technology Programme Substation Module 4</td></tr>
<tr><td>Expenditure for financial year 07/08 per WPD Licence area</td><td>Total

£21,980</td><td>External

£19,040</td><td>Internal

£2,940</td><td>Expenditure in previous financial years per WPD Licence area</td><td>£21,286 * NB only some of the projects span both 06/7 and 07/8</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="5">Issues with the age profile of substation assets within the UK electricity distribution system are well known. Also, both regulatory and shareholder pressures preclude substantial investments of the large scale that was seen in the 1950’s to 1970’s. The challenge is to constantly review and innovate new solutions to monitor and define asset condition thereby allowing risks to be clearly defined and sound investment decisions to be taken.

The programme of projects which were approved for funding from the STP substations module budget and were undertaken in 2007/08 encompass both developing new innovative asset management processes and practices and developing innovative diagnostic techniques. The aim is to develop already well established themes such as life extension of aged assets within legal and heath and safety constraints, examination of new technologies, developing an understanding of, and innovative solutions for, the impact on substation assets of increasing levels of distributed generation on networks and condition monitoring techniques.

Eighteen new projects were approved during the year and covered:

• S4164_4 - On load tap changer monitor - develop and install trial systems.
• S4176_3 - Assessment and inspection of substation earthing systems.
• S4181_2 - Transformer Post Mortems.
• S4185_2 - AM Forum membership.
• S4212_1 - Dissemination Seminar to ensure wider appreciation of STP module outputs.
• S4219_1 - Management of substation batteries.
• S4220_1 - Management of 145kV Disconnectors.
• S4221_1 - Investigate Out of Phase Switching.
• S4222_1 - Explore Alternatives to ENATS 35-1 Transformers.
• S4223_1 - Review of Underground Substation design.
• S4225_1 - Assessment of BS148 and IEC60296 Insulating Oils.
• S4228_1 - Investigate Alternative Measuring Techniques for Insulation Materials.
• S4234_1 - Exploration of Ferroresonance Issues.</td></tr>
</table>

<table>
<tr><td>Type(s) of innovation involved</td><td colspan="5">Incremental / Significant / Technological Substitution / Radical</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="5">Due to the age profile of the current system assets it is inevitable that unless significant new technology is used to extend asset life, CAPEX and possibly OPEX will need to increase significantly to maintain the present level of network reliability and safety.

If the projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain the benefits including:

• Offset future increases in CAPEX and OPEX;
• Increased safety of staff and public by reducing the number of accidents/incidents;
• Both preventing disruptive failures of oil-filled equipment to reduce land contamination and avoiding unnecessary scrapping of serviceable components will alleviate environmental impact.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>1-2 years - dependent on project</td><td colspan="2">Duration of benefit once achieved</td><td colspan="2">1-10 years - dependent on project</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="5">5-50% - dependent on project</td></tr>
<tr><td>PV of Project Costs</td><td>£21,980 #</td><td>PV of Project Benefits</td><td>£31,824</td><td>NPV of Project</td><td>£9,844</td></tr>
<tr><td></td><td colspan="5"># (nb. This is identified early stage cost. It does not reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive.)</td></tr>
</table>

WPD S West and WPD S Wales *
IFI Project report for Year ending March 31st 2008

Description of project	SuperGen V Amperes				
Expenditure for financial year 07/08 per WPD Licence area	Total £15,145	External £12,500	Internal £2,645	Expenditure in previous financial years per WPD Licence area	£41,834
Technological area and / or issue addressed by project	The EPSRC (Engineering and Science Research Council) is the major research-funding agency for Universities in its area, and is run by DTI. One of its initiatives is funding work in the area of Sustainable Power Generation and Supply. A call was put out in 2004 and EPSRC have put together a group of universities to address the UK energy infrastructure. EPSRC, which addresses UK emission targets, produces step changes in technology, and has active collaboration with UK industry. This call is intended to focus on plant, systems aspects having been addressed in other Supergen calls. Six Universities involved in the £2.8M project. In essence there are 5 main activities: • improving knowledge of plant ageing. • developing condition monitoring techniques. • developing plant with reduced environmental impact. • developing new protection and control techniques. • enhanced network performance and planning tools. The project is now fully resourced in all the universities (PhD and RAs). A number of demonstrators have been identified and are being implemented ahead of schedule. The high-level work to develop optimal asset replacement and network expansion methodologies is progressing well, and it has been agreed that this project should become a demonstrator, the form of which is being agreed by the Steering Group. More physical demonstrators are being built at both distribution and transmission substations. The initial evaluation of techniques is complete and machine learning techniques have been selected for implementation. The more fundamental work on ageing of plant which is necessary to underpin the more applied activities is also progressing according to plan, with development of methods to characterise ageing plants being developed. To date 14 reports and 38 publications have arisen from this work.				

Technical documents produced:

- Loss of Mains Detection and Amelioration on Networks.
- Loss-of-Mains detection by differential ROCOF Protection using internet protocol.
- Interim report on protection and control of distribution networks with synchronous islands.
- Reducing the Environmental Impact of Electrical Plant - Annual report.
- First report on use of high temperature conductors on distribution networks.
- Final report on high temperature low sag conductors.
- Report on ICSD 2007.
- Report on literature on non-power frequency ageing in dielectrics.
- Condition monitoring -State of the art report version 2.

27 technical publications have been submitted or published since in the last year.

Technology & trials:

The following demonstrator projects are presently being implemented in both Transmission (due to finish mid-June) and Distribution substations:

- Monitoring of two 275/132kV National Grid transformers.
- Monitoring of 6 Scottish Power Substations.
- Processing of Partial discharge data from EDF Energy substations.

These will be used to prove data acquisition technology and develop interpretation tools.

Consortium membership

The University of Manchester
The University of Southampton
The University of Edinburgh
The University of Liverpool
The University of Strathclyde
Queens University Belfast
National Grid
SP Power Systems Ltd
Scottish Hydro-Electric Power Distribution plc
North West Electricity plc
Western Power Distribution (South West) plc
Central Networks
Yorkshire Electricity Distribution Plc
Northern Ireland Electricity plc
Advantica Limited
EDF Energy Networks Limited

For further information please see the Supergen Amperes web site
www.supergen-amperes.org

Type(s) of innovation involved	Technical Substitution / Radical				
Expected Benefits of Project	The consortium expect to deliver: a suite of intelligent diagnostic tools for plant integrated network planning and asset management improved and reduced environmental impact plant models and recommendations for network operation and management				
Expected Timescale to adoption	12 Years				
Estimated Success probability (at start of project)	25%				
PV of Project Costs	£56,979 (taking past now as yr 1)	PV of Project Benefits	£70,536	NPV of Project	£13,557

WPD S West and WPD S Wales *
IFI Project report for Year ending March 31st 2008

Project Title	ENA Earthing Project		
Description of project	To develop new techniques to assess the impact of lower voltage earth electrodes on higher voltage 'hot zones', and to measure the resistance of distribution substation earth systems.		
Expenditure for financial year (per DNO)	Internal £ 0 External £ Total **£**	Expenditure in previous (IFI) financial years	Internal £ External £ 2037 Total **£**
Project Value (Collaborative + external + [company])	£25k+VAT - external	Projected [2008 year] costs for [company]	Internal £0 External £0 Total **£0**
Technological area and / or issue addressed by project	a. The advantage of this work will be that if successful the project will deliver a clear rationale describing the correct location of LV earth electrodes with respect to HV earth electrodes. This will have potential benefits in improving understanding of the safety of the earth installations. ESQC Regulation 8(2) (b) requires that HV electrodes are installed and used in such a manner so as to prevent danger in the LV network due to a fault in the HV network. Currently the safety of the LV electrode is assured by maintaining a separation between the HV and LV earth electrode such that the LV earth electrode is situated outside the 430V Rise of Earth Potential (ROEP) contour. This is based on longstanding requirements to ensure that the LV electrode has <430V imposed upon it under HV fault conditions. b. All designs for earthing systems consider the effects of touch and step potentials under fault conditions. However the quantity of concern is actually the current flowing through a human body when in contact with metalwork subject to this potential and the time the current flows for. An electrode simply sited in soil which has a surface potential cannot be regarded as presenting the same hazard as metalwork with a direct metallic connection to the earth fault current return path. However there exists at this time no methodology for assessing the either the hazard posed by such an earth electrode or the possible effects of the earth when connected to a distributed system on the ROEP contours. c. This project will if successful determine these effects and provide a means to provide cost effective safe earthing systems without the need for extensive separations between HV and LV electrodes which in a PME system may be impractical to achieve and maintain.		

Type(s) of innovation involved	**Incremental**	Significant	Technological substitution	Radical
	Y	N	N	N
Expected Benefits of Project	The project will determine the effects of LV earth systems on HV systems. The results of this should determine the means to provide cost effective, safe earthing systems without the need for extensive separations between HV and LV electrodes which in a PME system may be impractical and costly to achieve and maintain.			
Expected Timescale to adoption	2 years	Duration of benefit once achieved	10 years	
Probability of Success	75%	Project NPV (Present Benefits - Present Costs) x Probability of Success	£ *	
Potential for achieving expected benefits	High. The results from tests and simulations can be used to propose a recommended procedure for measuring transfer potential between HV and LV systems, suitable for inclusion in a DNO policy document. *No NPV benefits are currently claimed by WPD, in the light of counter proposals currently in draft to amend a related EN Standard; the consequence of which would be to increase separation, not decrease it. However, the outputs of this research will be used to influence those EN proposals.			

Project Progress **[March'08]**	Project completed. Part 1 (Investigation at Test Facility) report delivered in 2007. The first stage of the project involved measurements and calculations on a test electrode system and it was found that the transfer potential to a distributed LV electrode is much lower than previously thought. Rather than being the potential picked up from the soil at the closest electrode portion (i.e. as based on the present method of calculation), it is in fact an average of the soil potential picked up by each connected electrode, but accounting also for their relative size and location in relation to the HV electrode source. Part 2 `Investigation at two live substations' completed during 2007/08. Measurements conducted at two substations in WPD area. Complete post-installation analysis including interpretation of results and recommendations for use in DNOs policy documents presented. The substations selected for the study each have an isolated (self-contained) low voltage distribution cable network and are supplied at 11kV via unearthed overhead lines. The low voltage networks use Protective Multiple Earthing and CNE type cables. The computer model was developed so as to represent the actual sites' main electrical characteristics to a reasonable degree of accuracy. The computer model also contains the soil structure, but at this stage, it is used only to enable a comparison with the measured values and cannot be used with the traditional formulae because these are based upon a uniform soil. Both stages of the project have revealed the previously unknown effect that the LV electrode system can have on the shape of the HV voltage contours in the soil, that results in a lower than predicted average transfer potential on the LV neutral/earth. This has important consequences for distribution system design and could result in a reduction in the required HV: LV separation distances. For example, it means that new installations could be situated closer to a HV site than previously thought. It also goes some way towards explaining why there are far fewer reports of damage on LV networks co-incident with an HV fault, when their earthing systems are separate, but not by the 3m to 9m distance required in DNO policies.
Collaborative Partners	All GB DNOs and National Grid
R&D Provider	Strategy & Solutions Ltd

WPD S West and WPD S Wales *
IFI Project report for Year ending March 31st 2008

<table>
<tr><td>Project Title</td><td colspan="3">Electricity Supply Fault Level Instrument</td></tr>
<tr><td>Description of project</td><td colspan="3">An ENA co-ordinated project the objective of which is the development of an on-line instrument that can successfully measure / estimate fault level on a distribution network with repeatability and reliability.</td></tr>
<tr><td>Expenditure for financial year (per DNO)</td><td>Internal £ 312
External £
Total £</td><td>Expenditure in previous (IFI) financial years</td><td>Internal £ 888
External £ 4000
Total £ 4888</td></tr>
<tr><td>Project Value (Collaborative + external + [company])</td><td>£190,000</td><td>Projected [2008 year] costs for [company]</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="3">The device will connect to the network, and establish the network source impedance from small-scale disturbances / perturbations resulting from transformer tap changer operation, etc. This impedance can accurately be correlated to a true network fault level for that location, providing near real-time information to network control and planning engineers alike.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td>Incremental</td><td>Significant</td><td>Technological substitution</td><td>Radical</td></tr>
<tr><td>N</td><td>Y</td><td>N</td><td>N</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="3">The developed unit will allow the DNOs to accurately assess fault infeed levels and design distribution networks appropriately. The particular benefits of this project are seen to be:

• Provide a realtime and consistent estimation of fault level;
• Accurately take into account all connected network elements (e.g. Motors);
• Facilitate the connection of distributed generation by providing a standardised methodology for the assessment of network fault levels;
• Enable an ongoing assessment of the effects of connected distributed generation to be made;
• Provide reassurance to generator developers that decisions to upgrade networks are not subjective but based on objective measurement.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>3 years</td><td>Duration of benefit once achieved</td><td>10 years</td></tr>
<tr><td>Probability of Success</td><td>25%</td><td>Project NPV (Present Benefits - Present Costs) x Probability of Success</td><td>£ £92,045
NPV for ENA projects calculated on a per Licence basis</td></tr>
</table>

Project Progress to **March 08**	A number of activities have been pursued by both EA Technology and the University of Strathclyde in the progression of this project. These are summarised as: • **Experiment & Laboratory Investigation** - The performance of the previous Fault Level Monitor was tested against the known parameters of the University of Strathclyde's microgrid. In general a reasonable level of agreement was achieved. • **Algorithm Validation** – The algorithms from the Fault Level Montor coded within Matlab were tested using a network model in Matlab/Simulink to provide the sampled data to the algorithm. The results were compared to values of source infeed and motor infeed calculated directly from the parameters of the disturbances used. This resulted in an assessment of the potential accuracy of the instrument under a variety of load and disturbance conditions. At the power factor and load disturbance conditions which were most likely to be experienced in a real power system the results were not within the required accuracy band. • **Comparison of Real Site** – In contrast to the results obtained under the algorithm validation section, comparison of measurements made on a real network with the Fault Level Monitor exhibited a much closer agreement with the results expected.

Potential for achieving expected benefits	To progress to stage 2 of the project as originally defined the results obtained from stage 1 had to support a statement that it was technically feasible to develop a Fault Level Measuring Instrument capable of deriving answers within ±5% of the actual Source and Motor Infeed values. The Algorithm Validation work has cast some doubt over the achievability of that goal. The good agreement of the existing Fault Level Monitor with expected values does however offer some signs that the results obtained in the algorithm validation phase are not unequivocal. The proposed testing of the existing Fault Level Monitor within a defined third party test network has not been pursued at this time since although this might provide further data supporting the instrument's capabilities it would not answer the question as to why the differences exist between the apparent capability of the existing instrument and the performance of the algorithms implemented in Matlab. As the results of Stage 1 do not support an unequivocal statement that it is technically feasible to develop a Fault Level monitor with the required degree of accuracy this project will conclude at Stage 1. Proposals are being prepared for consideration to carry out further work to resolve questions about the apparent differences in performance of the existing Fault Level Monitor and the Fault Level Monitor Algorithms implemented in Matlab.
Collaborative Partners	ENA Member companies
R&D Provider	University of Strathclyde, EA Technology

WPD S West and WPD S Wales *
IFI Project report for Year ending March 31st 2008

Description of project	Impact of Climate Change on the UK Energy Industry In 2006 the Met Office carried out a scoping study on the impacts of climate change on the UK energy industry. The report was the result of a collaboration between E.ON UK, EDF Energy, National Grid and the Met Office Hadley Centre to scope the impacts of climate change on the UK energy industry. This Phase 2 project was industry-funded; it involved 11 UK energy companies and was undertaken by the Met Office. It focussed on the priorities identified by the earlier scoping study. During the project new tools and methods required to understand the impact of climate change on the energy industry were developed and new data resources designed to address gaps in underpinning information were produced.		
Expenditure for financial year	Internal £ 1,334 External £14,653 Total £15,987	Expenditure in previous (IFI) financial years	Internal £0 External £ Total £
Project Value (Collaborative + external + [company])	£554,000	Projected [2008 year] costs for [company]	Internal £0 External £0 Total £0
Technological area and / or issue addressed by project	The project has been run as a series of work packages (WP). Those WPs relevant to distribution and transmission are described below. WP1 - Modelling Energy Impacts. Models created to assess impacts of climate change on Electricity Demand, Conductor Performance, Transformer Performance, Cables, Overhead Network, and Wind Power. WP2 - Guidance for the Energy Industry on the use of the United Kingdom Impacts Programme new scenarios of climate change (UKCIP08). UKCIP08 is planned for released in November 2008. WP3 - Climate Models and Wind Projections. Investigating methods of including estimated of future wind resource in wind farm viability. WP4 - Climate Change and Underground Cable Performance. Modelling future soil conditions to increase understanding of the impacts of climate change on cables. WP6 - Climate change and the Urban Heat Island Effect. Producing information on the urban heat island for use when panning infrastructure in cities. WP7 - Final reporting and presentation of the results to each company. WP8 - Predicted climatologies for the UK: 2008 – 2018		

<table>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental
Significant
Technological substitution
Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>13.6</td><td>-2.0</td><td>15.6</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The expected benefits of project are:
• For the elements assessed an understanding of the sensitivity to climate change and key meteorological drives of the impacts. This will highlight priorities for adaptation.
• New models for projecting impacts suitable for inclusion in climate models or for application to climate model output.
• Guidance on the application of climate models to energy industry applications which should results in appropriate use of climate information by Networks.
New information on urban heat islands and climatologies for the next 10 years to assist infrastructure design and planning.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>Year 2011</td><td>Duration of benefit once achieved</td><td colspan="2">20 Years</td></tr>
<tr><td>Estimated Success probability (at start of project)</td><td colspan="4">50%</td></tr>
<tr><td>PV of Project Costs</td><td>£ 15,987</td><td>PV of Project Benefits</td><td>£</td><td>NPV of Project</td><td>£ 0</td></tr>
<tr><td>Commentary on project progress and potential for achieving expected benefits</td><td colspan="4">There is a good chance of achieving the expected benefits. This was a year long project that finished at the end of May on time and to budget and specification. Project outputs and reports are now available via the project website. The project has highlighted some areas of Networks where no change to existing practice is required because of climate change and other areas where adaptation may be beneficial. The new models that have been developed and used in this project will be a useful legacy. The new information produced specifically for the energy industry has been demonstrated to have significant benefits over what was available previously.

WPD comment on NPV of benefits – indications are that the work will point to reducing current ratings being applicable due to, for example, future increased ambient temperatures. This work facilitates debate on the timing of investment to meet a rating situation that applies many years hence. It appears from work to date, that wood pole o/h line ratings would be adversely impacted by ambient temperature rise, but other work, reported under EATL O/H STP Module may provide some offset.
Given that current uncertainty , no npv benefit is currently included.</td></tr>
</table>

Project Progress **March 2008**	In March 2008 the status of the project work packages was as follows: WP1 - Complete WP2 - 50% Complete WP3 - Complete WP4 - 90% Complete WP6 - 90% Complete WP7 - 50% Complete WP8 - 80% Complete Overall the project was 75% complete.
Collaborative Partners	All the network operators and most energy supply businesses
R&D Provider	Met Office

WPD S West and WPD S Wales *
IFI Project report for Year ending March 31st 2008

Description of project	Life cycle assessment of 11kV overhead line and underground cable				
Expenditure for financial year 07/08 per WPD Licence area	Total £ 702	External £ 0	Internal £ 702	Expenditure in previous financial years per WPD Licence area	£ 0
Technological area and / or issue addressed by project	To gain an understanding of the "embedded" carbon and carbon emission associated with the material extraction, treatment, manufacture, shipping, installation, operation, inspection, maintenance, and end of life action for three ratings of 11kV overhead line and two nearest equivalent ratings of underground cable.				
Type(s) of innovation involved	Incremental				
Expected Benefits of Project	The purpose of the project is to inform debate on - • Initial sizing of conductor to reduce losses and carbon footprint. • The merits of early replacement intervention to reduce losses and carbon footprint. • The merits of amending the current loss incentive mechanism, having regard to carbon.				
Expected Timescale to adoption	1 year				
Estimated Success probability (at start of project)	100% - in providing data, 25% in radical change to loss incentive				
PV of Project Costs	£ 7,700	PV of Project Benefits	£510,000	NPV of Project	£500,000
	The above NPV benefit is derived from this work supporting a move to a "holistic" NPV life time assessment view of the treatment of losses. NPV assessments in relation to low loss t/fs and non tapered LV cables has been passed to Ofgem and on these a lifetime NPV saving (using full costed losses) amounts to > £2M per Licence, or > £500K if a 25% "success" factor is applied				
R&D Provider	University of Bath				

WPD S West and WPD S Wales *
IFI Project report for Year ending March 31st 2008

<table>
<tr><td>Description of project</td><td colspan="5">EATL - UltraTEV Alarm
The UltraTEV Alarm measures transient earth voltage and ultrasonic partial discharge activity at s/s sites, and employs an algorithm to detect p.d. anomalies which it then provides location tagged alarm to a central hub.</td></tr>
<tr><td>Expenditure for financial year per WPD licence area</td><td>Total

£13,725</td><td>External

£13,725</td><td>Internal

£0</td><td>Expenditure in previous financial years</td><td>£0</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="5">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>Incremental</td><td>Significant</td><td>Technological substitution</td><td colspan="2">Radical</td></tr>
<tr><td>Yes</td><td>Yes</td><td>No</td><td colspan="2">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="5">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 switchgear to reduce the likelihood of increasing failure rates.

The expected benefits of the project during FY08 are:

• Determine the appropriateness of both the TEV and Ultrasonic threshold levels.

Gather 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 incremental benefit to WPD from such an alarm is currently viewed to be the saving of one switchgear failure every two years, having regard to current failure rates and the routine use of portable p.d monitors.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">Years 1</td><td>Duration of benefit once achieved</td><td colspan="2">20 Years</td></tr>
</table>

Estimated Success probability (at start of project)	75%				
PV of Project Costs	£ 13,725	PV of Project Benefits	£24,021	NPV of Project	£10.300
Project Progress to **March 08**	Results to March 2008 have largely demonstrated that the UltraTEV Alarm systems are not greatly affected by spurious external electromagnetic events. A number of installations in the 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. Additional investigation and remedial work has not yet been completed.				
Collaborative Partners	DNOs 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 Providers	EA Technology				

WPD S West and WPD S Wales *
IFI Project report for Year ending March 31st 2008

Description of project	EATL - Condition based risk management of underground cable systems (CBRM)				
Expenditure for financial year per WPD licence area	Total £11,147	External £11,147	Internal £0	Expenditure in previous financial years	£36,058
Technological area and / or issue addressed by project	The creation of condition based risk management model that develops theoretical concepts into a real application covering all WPD underground cable systems.				
Type(s) of innovation involved	Incremental and radical.				
Expected Benefits of Project	1. To move CBRM from the theoretical base to real use, requiring significant and innovative steps. (The knowledge gained by EATL will also assist other DNOs.) 2. To target future investment on cable systems to deliver required performance and risk at minimum cost.				
Expected Timescale to adoption	Years 1	Duration of benefit once achieved	40 Years		
Estimated Success probability (at start of project)	75%				
PV of Project Costs	£ 47,205	PV of Project Benefits	£83,000	NPV of Project	£35,800
Commentary on project progress and potential for achieving expected benefits	The project was completed in 2006/7, with the provision of populated software and report. *Final invoicing from EATL was made in 2007/8*. The work has, for the first time, provided a pan cable asset assessment of condition based risk and delivered a risk management tool to inform long term asset management and investment. This is consistent with Ofgem's desire for longer term horizons and with a PAS 55 approach.. During the course of the work it was necessary to also innovate approaches to quantification of related environmental risk, and network security risk of assets employed in an n-1 planning standard configuration. These aspects have been shared with industry partners at a CBRM risk workshop arranged by EA Technology in April 2007.				

8.0 NOTE ON NET PRESENT VALUE

8.1 There are several approaches to net present value assessments of research type work. One approach is to scale up test discount rates to reflect the “riskiness” of a project whilst another is to employ a standard test discount rate and employ a success probability factor, for example 25, 50 75% . The latter was described in a report commissioned by Ofgem on Innovation in Electricity Distribution Networks and prepared by Mott MacDonald/BPI in March 2004, and is the approach employed by WPD.

8.2 Experience of the typical payback of successful projects undertaken within an STP Module is typically in the range of 6 – 8 X investment, which success probabilities of the programme projects tends to be at the 25% band. Timescales of individual projects within an STP Module are of the order of 3 years, with break milestones built in. The test discount rate employed is the WPD cost of capital from DPCR4, i.e. 6.9%. The average duration of benefit once a successful project has been achieved has been assessed as 10 years.

8.3 Whilst it is possible that the effect of some financial benefits might be taken into account by Ofgem in a subsequent Distribution Price Control Review (DPCR), Customers would continue to receive the benefits of such successful research and so our NPV benefit calculations do not terminate at 2010, the date of the next DPCR.