Innovation Funding Incentive
Annual Report

Issue 1 – 31st July 2012

IFI Projects
April 11 – March 12

For SP Distribution Ltd, SP Manweb plc and SP Transmission Ltd

Foreword

SP Energy Networks (SPEN) welcomes the increasing importance Ofgem has placed on innovation through both the new RIIO (Revenue = Incentives + Innovation + Output) TI and ED1 business regulation models for transmission and distribution networks commencing 1st April 2013 and 2015 respectively.

During the reporting year 2011/12, we realised our ambition of maintaining a balanced portfolio of forty IFI projects that embraced the range of Technology Readiness Levels from concept through to trial and demonstration, which are presented in this annual report.

Once again we have acheived significant leverage of R&D spend through collaboration and, alongside these projects, we have progressed Low Carbon Network Funded (LCNF) projects at both Tier 1 and 2 level. For all projects we will maintain our focus to ensure early adoption and commercialisation, as appropriate.

SPEN has continued its strategic deployment of wide ranging IFI projects including new and existing projects with academic and industrial partners. Of particular note are two separate projects aimed at accurately measuring fault level from network disturbances and the management of fault level through the development and trial of a Super Conducting Fault Current Limiter. If both prove successful they will enable DNOs to improve network security without exceeding fault level rating of switchgear and enable optimisation of switchgear replacement programmes.

Keenly awaited is the opening of the world-class Power Networks Demonstration Centre (PNDC) at Cumbernauld, adjacent to SPEN's existing training centre. This is a project that SPEN has been actively championing for a number of years in recognition of the need to test and demonstrate new technologies in a controlled and safe environment under a range of operating scenarios prior to their deployment on the Distribution network. We anticipate this facility will be completed by the end of 2012.

In addition we are delighted to have become a major partner in the Technology and Innovation Centre which represents the cornerstone of the University of Strathclyde's single-biggest investment in its research capacity. The industry-led research aims to accelerate the pace of research and development, attracting new jobs and inward investment and will provide graduates with the necessary knowledge to meet our industry needs.

In a rapidly changing energy sector we continue to scan the technology horizon for innovation and invest in appropriate research and development activities that will help to realise the low carbon vision for the benefit of all.

Frank Mitchell
CEO, SP Energy Networks

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1. Introduction & Background

1.1 Context

Ofgem introduced the Innovation Funding Incentive (IFI) as a mechanism to promote and encourage network related Research & Development (R&D). The primary aim of the incentive is to encourage the electricity network operators to apply innovation in the way they pursue the technical development of their networks.

Ofgem recognised that innovation has a different risk/reward balance compared with a network operators' core business. The incentive provided by the IFI mechanism is designed to create a risk/reward balance that is consistent with research, development and innovation. The two main business drivers for providing this incentive at this time are the growing need to efficiently manage the renewal of network assets and to provide connections for an increasing capacity of renewable generation at all voltage levels. These are significant challenges that will both benefit from innovation.

1.2 Innovation Funding Incentive (IFI)

The IFI is intended to provide funding for projects focused on the technical development of distribution and transmission networks, to deliver value (i.e. financial, supply quality, environmental, safety) to end consumers. IFI projects can embrace any aspect of the distribution / transmission system asset management from design through to construction, commissioning, operation, maintenance and decommissioning. The detail of the DNO IFI mechanism is set out in the Special Licence Condition C3, Standard Licence Condition 51 (for the Distribution Licences), the Electricity Transmission Licensees' IFI mechanism is set out in the special licence condition J5 Part 3 or special licence condition D5 part 2, and standard licence condition B16 Part C.

With the extension of IFI to the transmission licences, agreement at the ENA R&D Working Group was given to the creation of a common Good Practice Guide (GPG) considering IFI for electricity distribution, transmission and gas transmission networks; Version 2 of Engineering Recommendation G85 issued in December 07.

2. SP Energy Networks Structure

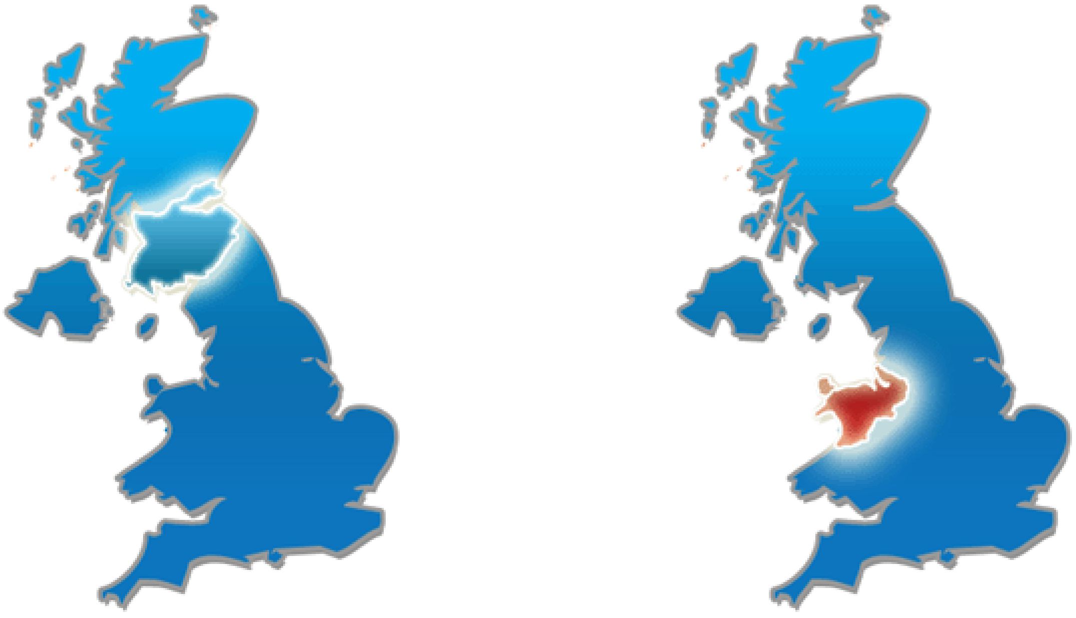
SP Energy Networks (SPEN) is the part of ScottishPower UK Ltd, which owns and operates the electricity transmission and distribution network of southern Scotland and the electricity distribution network of Merseyside and North Wales. Day-to-day operation of our network, approaching 112,000 km, is conducted by SP Energy Networks, a wholly owned subsidiary of ScottishPower Ltd. Since April 2007 ScottishPower has been part of the Iberdrola Group.

Our transmission and distribution licence assets come under three wholly owned subsidiaries:

- SP Distribution: The electricity network of 33kV and below in southern Scotland
- SP Manweb: The electricity network of 132kV and below in Merseyside and North Wales
- SP Transmission: The electricity network of 132kV and above in southern Scotland

IFI activity is co-ordinated centrally on behalf of these licences, this report relates to R&D activity undertaken on:

- SP Distribution Ltd, referred to as SP-D in this report
- SP Manweb plc, referred to as SP-M in this report
- SP Transmission Ltd, referred to as SP-T in this report



(a) (b)

Figure 1: UK Map showing the territory of (a) SP Distribution & SP Transmission and (b) SP Manweb

3. Overview

3.1 IFI Overview

A total of 40 IFI projects are being reported by SP Energy Networks on behalf of the three ScottishPower Network licence areas for the period 1st April 11 – 31st March 12.

At time of writing SPEN has a total of c.£5.5m authorised IFI projects, representing a levered portfolio of over £35m. The projects cover a breadth of R&D providers from academia, to consultants, to manufacturers with projects ranging in investment from £4k to £250k IFI input, and development timescales of between 6 months and 4 years.

Our R&D activity has increased significantly since the introduction of the IFI. We have continued to focus on leveraging our programme through collaboration with funding bodies, other network operators or external suppliers / manufacturers. In 2011/12 every £1 of SP IFI money invested in a project was levered by c.£5 from other sources:

R&D growth in SPEN (SP-D, SP-M and SP-T) since the introduction of the IFI

SP-D, SP-M and SP-T	Expenditure (Internal + External)	No. Of Reported Projects	Yearly Programme Leverage
2004/05 (Early Start)	£223k	12	c. £1.5m
2005/06	£546k	36	c. £3m
2006/07	£1,282k	41	c. £5m
2007/08	£1,793k	50	c. £7m
2008/09	£1,978k	38	c. £9m
2009/10	£1,462k	35	c. £7m
2010/11	£1,621k	27	c. £8m
2011/12	£1,975k	40	c. £11m

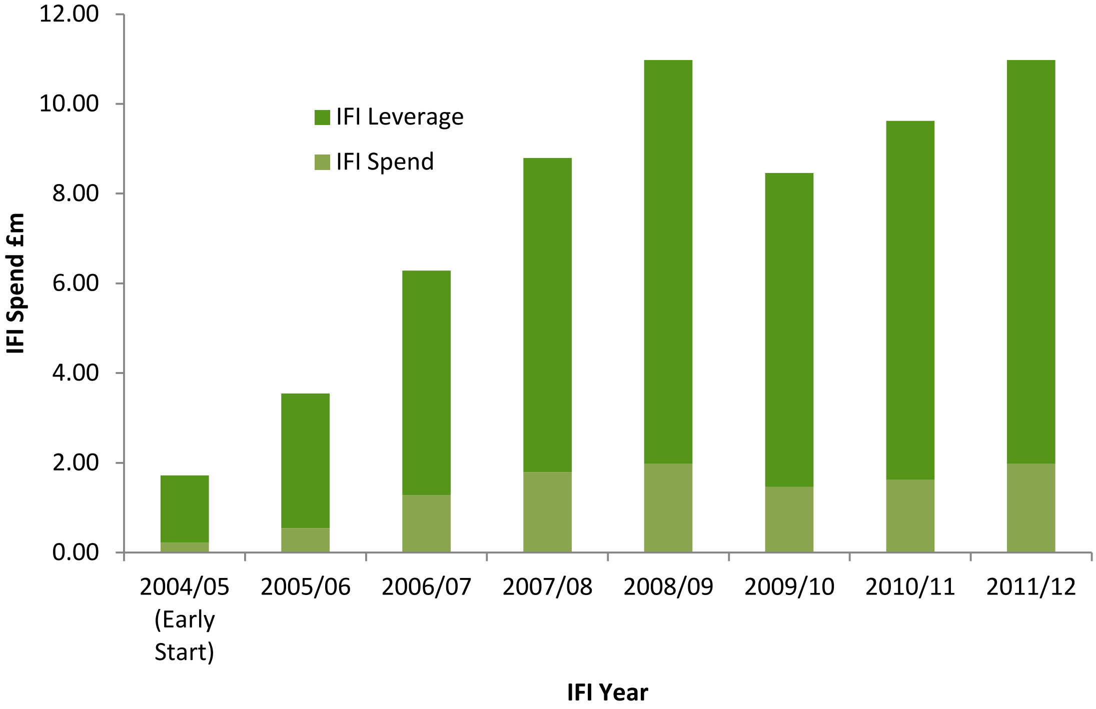


Figure 2 IFI Spend

4. Summary Tables

The following tables have been adapted from the Regulatory Instructions and Guidance documents (RIGs).

IFI Summary - SP Distribution Ltd Licence Area 11/12	
SP Distribution Ltd Network Revenue	£346,000,000
IFI Allowance	£1,730,000
Unused IFI Carry Forward to 2011/12	£968,400
Number of Active IFI Projects	28
Summary of benefits anticipated from IFI projects 2011/12	[1]
External expenditure [2011/12] on IFI projects	£680,674
Internal expenditure [2011/12] on IFI projects	£218,955
Total expenditure [2011/12] on IFI projects	**£899,629**

IFI Summary - SP Manweb plc Licence Area 11/12	
SP Manweb plc Distribution Network Revenue	£301,270,000
IFI Allowance	£1,506,350
Unused IFI Carry Forward to 2011/12	£646,600
Number of Active IFI Projects	33
Summary of benefits anticipated from IFI projects 2011/12	[1]
External expenditure [2011/12] on IFI projects	£453,777
Internal expenditure [2011/12] on IFI projects	£196,937
Total expenditure [2011/12] on IFI projects	**£650,714**

IFI Summary - SP Transmission Ltd Licence Area 11/12	
SP Transmission Ltd Distribution Network Revenue	£207,380,000
IFI Allowance	£1,036,900
Unused IFI Carry Forward to 2011/12	£501,200
Number of Active IFI Projects	14
Summary of benefits anticipated from IFI projects 2011/12	[1]
External expenditure [2011/12] on IFI projects	£349,281
Internal expenditure [2011/12] on IFI projects	£75,658
Total expenditure [2011/12] on IFI projects	**£424,939**

Further detail on these tables is provided in Appendix A of this report.

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[1] Summary of benefits are available in Section 6 “Highlights from 11/12”

5. Achievements for 2011/12

At the end of 2011/12 the highlights from the SPEN IFI portfolio included:

- Every IFI project undertaken by SP is taken before a panel of senior experts from across the business. Through this process we have:
    - 40 live projects
    - 11 new projects were authorised during the 2011/12
    - Of the 40 projects, 7 are now complete and either awaiting adoption or formal closure
- Over £11m of leverage obtained

5.1 Development of Partnerships

The current programme consists of the following collaborative projects:

- EPSRC – 2x industry roles in Supergen programmes: Supergen 1 - Flexnet; HiDef.
- DNO specific – 25 collaborative projects with some / all UK DNOs via EA Technology, ENA or through direct collaboration (see Appendix B for details).
- Direct university partnership – 1x ScottishPower Advanced Research Centre (SPARC) with the University of Strathclyde.
- Capenhurst Energy Innovation Centre – A non-profit trust that over sees the management of the centre in collaboration with ScottishPower, Electricity North West, CE Electric, Scottish & Southern Energy and the North West Development Agency.
- Entering into our 3rd year of participation in the Electrical Power and Research Institute which has been strategically positioned to engage with our western link HVDC project.

5.2 Power Networks Demonstration Centre

This project initially proposed and led by SPEN, was to develop the first of its kind, in the UK, a full scale 11kV and LV prototyping network as a test-bed for active network management techniques and other 'high risk' technologies.

Whilst not a technological development in itself, this project is a fundamental enabler of technology, with significant potential to accelerate adoption of significant / radical developments across a range of IFI projects. The centre can be used to investigate the impact of intermittent generation and penetration of EV technologies on the LV network as well as testing of new tools and training.

Since late 2008, SPEN have been working with collaborative partners (University of Strathclyde, Scottish & Southern Energy and Scottish Enterprise) to develop the design.

The building of the Centre commenced in 2011 and handover of the facility to the University of Strathclyde will occur in November 2012. The University will then finish equipment installation with the aim of officially opening the building for business early January 2013.

Figure 3 Artists Impression of the Demonstration Facility

Figure 4 Construction Progress March 2012

6. Highlights from 11/12

Whilst not all benefits have a direct monitory value, we have indicated the benefits brought to SPEN in improvements to customer service, reductions to capital cost of equipment and the reduction in energy usage/carbon emissions.

6.1 Prototype Low Voltage Jumpers with Integral Circuit Breaker

When work is undertaken on Low Voltage (LV) busbars it often necessitates that an outage is taken on the whole LV board and in most circumstances this will result in an outage for the customers supplied by the circuits off the board. In these circumstances the DNO will energise as many of the LV circuits as possible via either a mobile generator or a back feed from an LV interconnected substation. Unfortunately these solutions are not always feasible and some circuits will have to remain de-energised during the work even when adjacent circuits are energised as shown opposite in Figure 5.

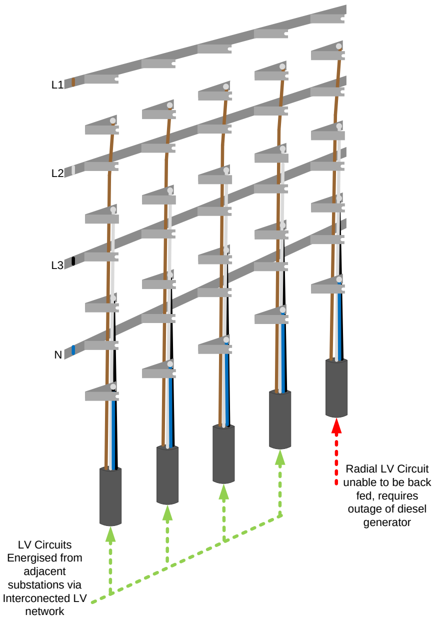


Figure 5 LV Board with Fuse removed

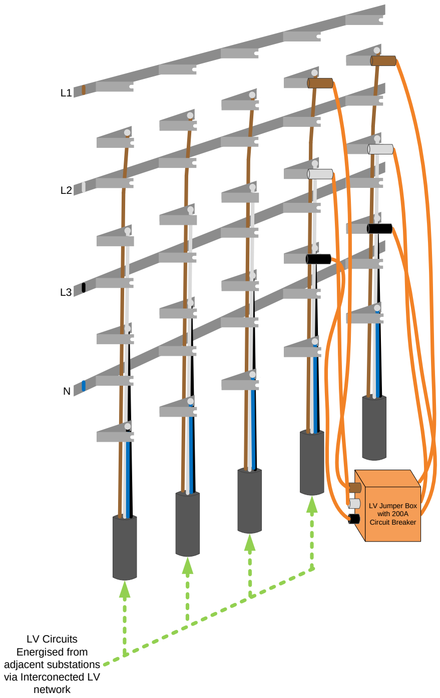


Figure 6 LV Board Feeding Radial Circuit

This project is looking to develop a safe and simple solution that will reduce the number of outages and requirement for mobile generators in the aforementioned scenario.

Based on a technical specification drawn up by operational field staff SPEN have developed a prototype LV Jumper that will safely energise an LV circuit by linking it to the spill of an adjacent circuit that is energised by a back feed, as shown in Figure 6.

The prototype includes an integrated 200A 3-phase LV circuit breaker enclosed in a ruggedized housing and utilises industry standard connectors that will enable the device to be connected securely and in a short space of time.

Over the next 6-12 months SPEN working alongside the manufacturer Ten47 expect to further refine the design of the LV Jumper (shown in Figure 7) and carry out the necessary safety tests. This will be followed by live tests of the jumper in a controlled environment enabling guidelines for its usage to be drawn up. Assuming this goes to plan the project will be extended to include the

Figure 7 LV Jumper Applied

widespread testing of several units in real outage scenarios.

6.2 EPRI - High Voltage Direct Current Programme Engagement

EPRI | ELECTRIC POWER RESEARCH INSTITUTE 2011 Research Portfolio

The power industry is faced with the difficulty of acquiring rights-of-way for new transmission lines, the need to improve the reliability of the power grid, and the challenges of integrating renewable power sources into power networks. High voltage direct current (HVDC) and flexible ac transmission system (FACTS) technologies offer some effective schemes to meet these demands.

SPEN is currently engaged in two significant HVDC deployments, the Western and Eastern Links. The Western Link, which is by far the most progressed, will link Scotland and Wales with a 2GW HVDC interconnector. The northern converter station will be located at Hunterston, adjacent to EDF Energy's nuclear site, with the southern convertor station planned for Deeside. The options for an Eastern Link are currently being developed by SPEN in conjunction with Scottish Hydro Electric Transmission Ltd (SHETL) and National Grid Electricity Transmission (NGET). This link will be around 2GW and will further increase the transfer capability between Scotland and England.

With this increasing focus on HVDC technology SPEN has been able to benefit from the research work undertaken by the Electric Power Research Institute (EPRI) in this area.

HVDC connections perform differently to ac connections during steady-state, dynamic, and transient conditions, and EPRI has a project studying these differences. This project will consider the coordination between HVDC links and ac lines in parallel for the most effective utilisation of these assets. System planning studies will be performed as a first step before considering HVDC interconnections in the existing ac grid to assess the impacts of HVDC. There is a growing need for systematic evaluation of the impacts of HVDC on the ac grid using the HVDC models for the latest convertor technologies. This project will address the HVDC impact evaluation studies using benchmark test systems and the necessary model developments. The project is coordinated with a supplemental project on the same topic in which application studies are conducted for the Great Britain Network for National Grid and Scottish Power.

Given EPRI's global reach and extensive research programme SPEN has been able to significantly leverage its research investment.

EPRI's current year HVDC and FACTS activities include:

- Providing a technology watch newsletter with the latest developments in HVDC and FACTS technologies
- Updating the leading reference guide for the design and operation of HVDC systems
- Resolving operational concerns of owners and operators of existing HVDC and FACTS systems, and those considering the addition of HVDC or FACTS to their systems
- Evaluating HVDC system performance and conduct component testing
- Evaluating HVDC electrical effects such as electromagnetic interference, fields, and corona in laboratory test settings

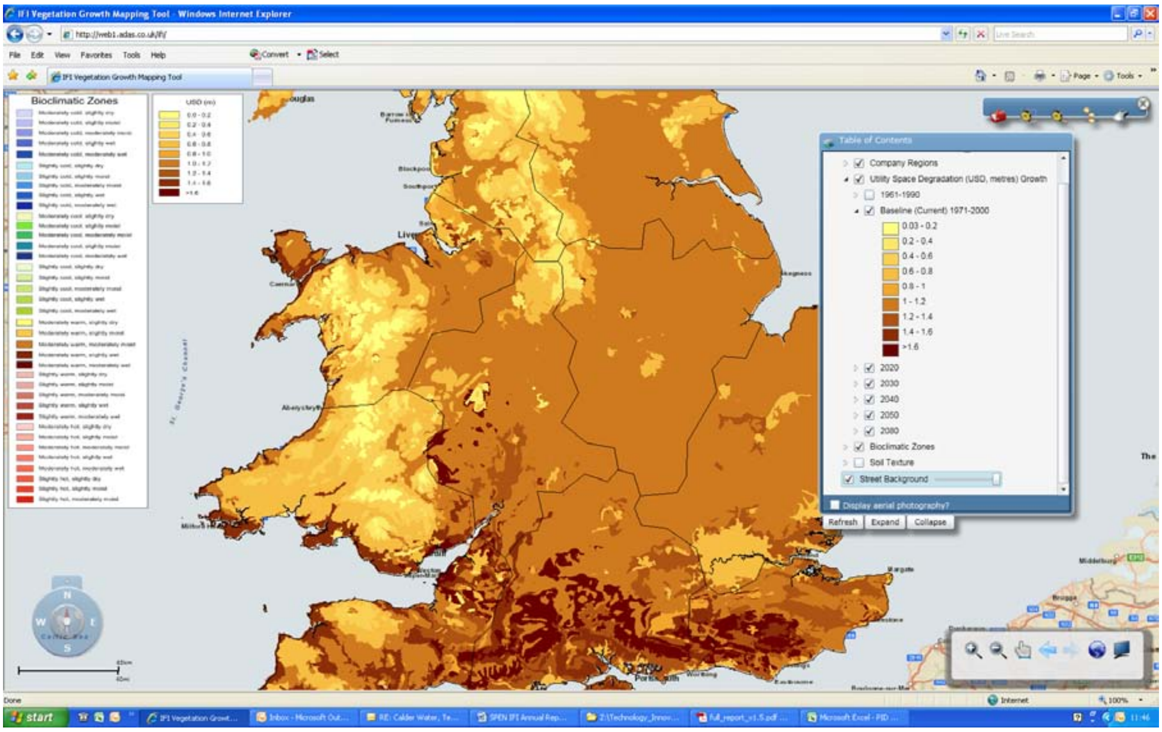
- Developing conversion of ac lines to dc lines to increase transfer capability on existing transmission corridors, including hybrid solutions where ac and dc lines share corridors or structures
- Developing schemes for power flow management using FACTS
- Demonstrating HVDC and FACTS technology options at utility sites

6.3 Vegetation Management

Effective vegetation management is a critical component in assuring a safe and reliable electricity supply and represents a significant maintenance requirement and associated budget spend. Long term analysis of networks faults shows a significantly increasing trend in vegetation related faults in the UK electrical network. Given this trend a four year project was set up to gain an improved understanding of utility space (US) degradation, that is the physical volume occupied by overhead lines and additional space required to ensure safe and reliable operation.

ScottishPower along with other utility companies engaged in a vegetation management project with the aim of gaining an improved understanding of vegetation growth, in the UK, and in particular the closure of the safety space around electrical equipment over time. As part of this project meteorological record covering the UK for the past 40 years were analysed to create a complete set of bioclimatic zone maps for the UK. A network of approximately 1300 sites participated in the study and US closure in the spring and autumn of 2008, 2009 and 2010 was measured at all sites and a substantial database created that describes the spatial variation of vegetation growth across the UK during this period.

From the analysis of the results a national annual average change in US was determined. There was considerable variation by electrical distribution company and therefore by geographic region. In broad terms the project found that sites located in the warmer areas of southern England, experienced the average highest rates of growth with the lowest observed at relatively cooler Scottish Power Scotland sites.



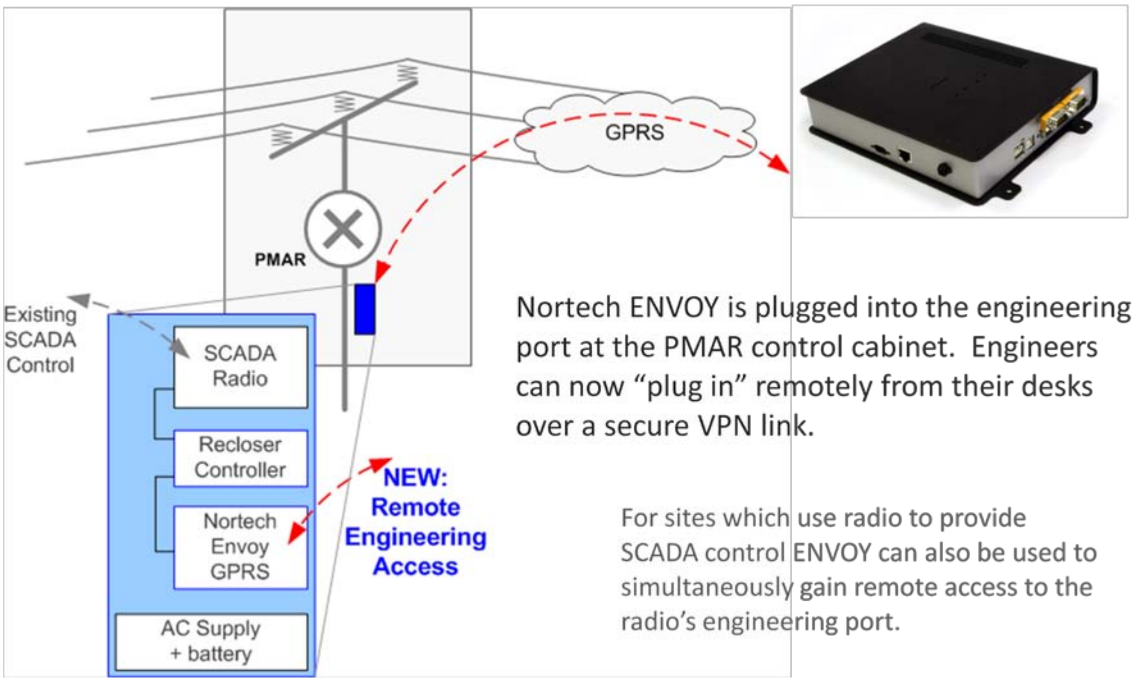
Future climate predictions from the United Kingdom Climate Impacts Programme (UKCIP, 2009) were combined with US observations to predict future growth rates in the period 2020-2080 for a variety of climate impact scenarios. Results indicate a substantial change in bioclimatic zones in the UK for all UKCIP scenarios. It was predicted that the high vegetation growth rates associated with rapid US degradation that were observed in the warmer southern areas of England, including the south coast, parts of Cornwall and Devon will extend much further north and may reach as far as the North Midlands within the next decade or so. This indicates that climate change could have a substantial impact on the cost of vegetation management over the next 10 years if current levels of safety and reliability are to be maintained in a period of increasing growth rates.

A utility company has a duty to maintain safe clearances from overhead lines and the findings from this project can be used to help shape future vegetation management practices including the frequency and depth of cut used in maintenance regimes.

6.4 Remote Engineering Access To Pole Mounted Auto Reclosers

SPEN has a population of Noja pole mounted auto reclosers (PMAR) that are monitored and controlled via their SCADA system using a radio system. Limitations within the SCADA system mean that only a small number of data points can be monitored and controlled on the Recloser controller.

SPEN is working with Nortech to implement a system using GPRS that allows much more data to be returned from the Noja units. This data will provide further information about both ScottishPower's network and the Noja units themselves.



Nortech ENVOY is plugged into the engineering port at the PMAR control cabinet. Engineers can now "plug in" remotely from their desks over a secure VPN link.

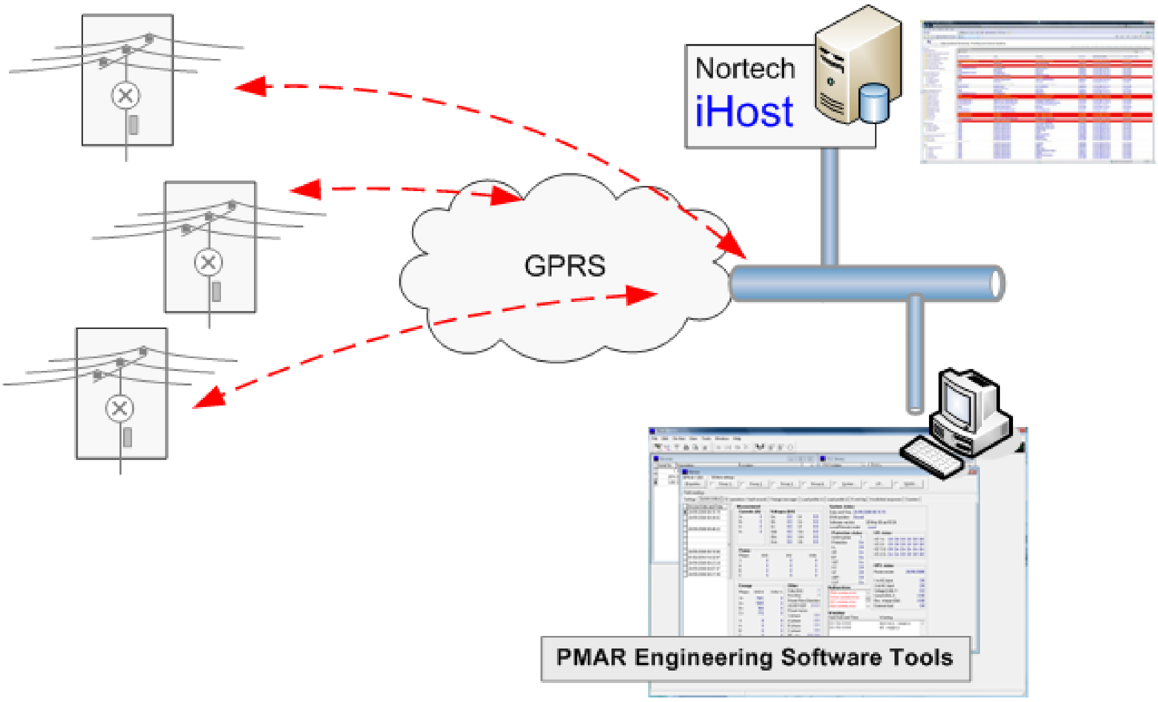
For sites which use radio to provide SCADA control ENVOY can also be used to simultaneously gain remote access to the radio's engineering port.

The Noja device incorporates a protection module which can be accessed to retrieve active and historical data relating to both protection activity and statistical metering.

This can only be accessed via an RS232 port within the Noja Control Panel that is mounted below the Main Tank, out with the Safety Distance, and above the Anti-climber. Consequently, there are several benefits that can be gained from this project including:

- The Health and Safety benefit of not having to climb the pole to access PMAR information;
- Ability to record short time interruptions (<1min);
- Current and voltage values could be taken from the Noja during a fault event and incorporated into impedance maps for speedier fault locations; and
- Negating the need to visit each PMAR twice a year with subsequent OPEX savings.

Remote access via iHost will provide a dashboard screen showing key performance figures for the population of Noja PMAR.



Event logs from all PMARs will be collected automatically, removing the need to drive to site, so that there are no delays in getting data. There will be central storage of event logs and a summary analysis of PMAR activity with the dashboard showing a league table of operations.

6.5 Outram Fault Level Monitor

If the fault current passing through any network ever exceeds its designed fault level there is a possibility that the switchgear will fail disruptively. This is highly undesirable, at best the failure will necessitate the switchgear is replaced which will likely result in prolonged customer outages, however, of even greater concern is the potential for the failure to impact upon the health and safety of persons within the proximity of the substation.

Because of these reasons it is vital that DNOs ensure the network fault level is not exceeded. At present this is done using established connection rules and more often through network modelling packages such as IPSA and DigSILENT. These fairly complex models are built by experienced engineers and can take several days to build, however, despite their complexity every model will have some assumed parameters, particularly regarding the fault level contribution customers have. Whilst this approach will continue to serve DNOs well, due to the expected challenges faced by the network in the future it would be prudent to have an alternative method, particularly one that would complement existing models.

Through existing relations with Outram Research Ltd, SPEN discussed the possibility of developing an existing power quality instrument to measure / calculate fault level from naturally occurring network disturbances. These discussions lead to the demonstration of a single phase low voltage device that proved the feasibility of the approach. Subsequently SPEN and Outram have spent the last 18 months developing a portable Fault Level Monitor (FLM) that is applicable to every network voltage.

To date SPEN have deployed six FLMs on the network and through the analysis of the results obtained the FLM firmware has been revised several times. The results obtained are also extremely encouraging as they in the range expected and consistently within 5-10% of the fault level result produced by the network model.

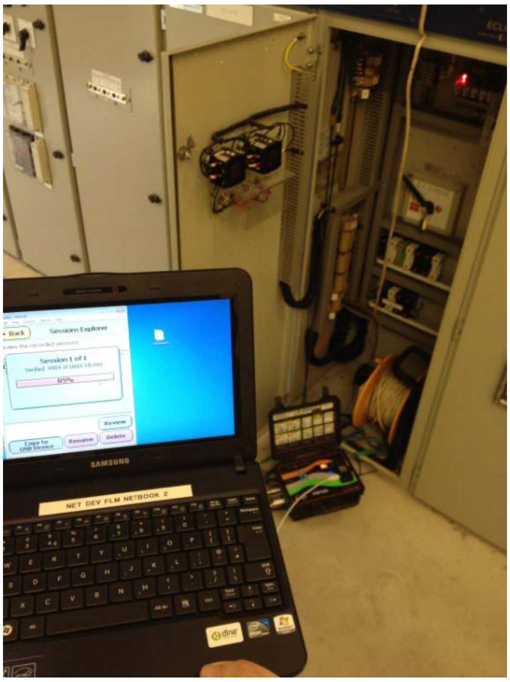
The remaining stage of the project will concentrate on the revision of the final version of the FLMs firmware, the development of its user interface and the production of support literature. It is also hoped that a suitable test facility can be identified to complete definitive tests on the FLM against a known fault level.

FLMs have two immediate uses to DNOs:

- To validate and refine existing system analytical models by obtaining visibility of actual system fault levels and contributions from customer equipment under a wide range of real-world scenarios
- The identification of the fault level in areas of network where network modelling may be difficult or problematic, e.g. sections of the 11kV or Low Voltage network.

The potential benefits associated with the above are as follows:

- The **Health and Safety** benefits of identifying and subsequently managing fault level issues which were previously unknown due to inaccurate or non-existent models.
- **Operational** benefits that are gained from the ability for optimal operation or interconnection of the network which could be restricted due to a perceived fault level issue.
- **Financial** rewards associated with an improved Regulatory Performance rectifying fault level issues, e.g. removal of perceived fault level issues by accurate monitoring as opposed to conventional equipment-based solutions.
- **New Connection** – the benefits associated with facilitating new network connections which previously may have been problematic or financially prohibitive due to modelling, scenario and data inaccuracies.
- **Environmental** benefits associated with the connection of renewable generation as detailed above and the moth-balling of equipment ahead of its end of life due to fault level upgrades.



Appendix A – Expenditure Breakdown of Projects between Licences

Summary Table Notes

During the collation of the 05/06 report we revised our methodology for NPV assessments for IFI projects. It is noted that the figures described in the tables should be interpreted with caution, as the figures quoted in the NPVs will only be realised upon completion of the project, and once fully adopted into the business.

Cost Breakdown

As SP Energy Networks operate distribution and transmission licenses for the SP-D, SP-M and SP-T areas, successful developments relating to distribution and/or transmission assets undertaken in one part of the business will equally apply to the other. In line with this, costs have been split against each licence based on the turnover and hence size of each network area.

Cost Breakdown between Licence Areas

Licence Area	Annual Turnover (11/12)	Percentage Split Distribution	Percentage Split Transmission
SP-Distribution	£346.00 million	~60%	NA
SP-Manweb	£301.27 million	~40%	~15%
SP-Transmission	£207.38 million	NA	~85%

Projects identified as only applying to one licence, or ones that apply in favour of one, two or all three licences have been scaled accordingly (See Table A1). This is defined when the project inception document is developed.

Programme Management Costs

Internal costs for projects detailed in Appendix B are based on SP's input to a project through meetings, correspondence, trials, etc scaled by the appropriate hourly rate for an individual's grade.

Net Present Value (NPV) source

It is noted that IFI projects address a range of issues, and the benefits achieved, and those accounted for in the NPV can be categorised into the following areas:

- Avoided cost – A successful development may negate the need to spend money on network components. As an example the development of a high capacity circuit, would avoid the need for duplicate traditional circuits for a given network application.
- Direct savings – Successful development could result in a direct financial benefit, e.g. through reductions in operating costs, reduced exposure to Regulatory penalties, etc.
- Managing risk – A successful development would assist in reducing the risk profile of the company, either through greater understanding of causes / effects of actions on, or as a result of, network operation (equipment failure, etc.)
- Strategic – These projects impact on the longevity of the network, either through external influences such as changes in load / generation patterns, the impact of climate change or even skills / resources.

NB. Whilst an NPV calculation if possible for any project, and across any of these areas, it is recognised that as the assessment looks further to the future (as is the case for strategic projects), the benefits are more susceptible to risk, more uncertain, and consequently less robust.

As of 31st March 2012 the status of the 40 projects reported as well as those that have stopped is detailed below.

IFI Project Status			
No.	*Phase*	*Definition*	*External Cost*
6	*Proposals in development*	*Agreeing scope / objectives, setting up contracts, etc.*	*None Direct (small external £ associated with management cost)*
27	*Live projects*	*Projects in progress*	*Yes (if milestones have been met)*
2	*Completed projects*	*Projects which have completed their trial phase*	*Yes*

This breakdown accounts for reasons why not all projects have significant external spend.

Project Progress Curves

Expenditure profiles are described below to give an appreciation of costs that will be required prior to a project realising a stated benefit through the development cycle. Figure A1 shows a hypothetical expenditure profile for a development project. Expenditure is defined as:

- **External** – Money paid to 3rd parties for work (consultancy, purchase of equipment, monitoring, etc)
- **Internal** – SP Energy Networks' staff time on eligible IFI development work multiplied by the appropriate hourly rate. The success of a project is highly dependent on the levels of internal support a project is given.
- **Overall investment** - The total cost of a project (predominantly external cost) of which the company is accessing through collaborative or external funding leverage. This is the combined investment from SP Energy Networks and other collaborative partners.

In line with sound project management, all IFI projects have been staged into milestones, i.e. the R&D provider will only receive payment upon successful completion of a defined stage.

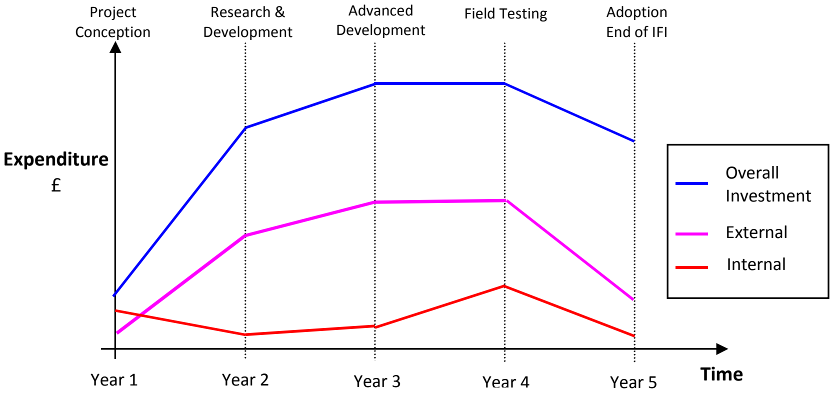
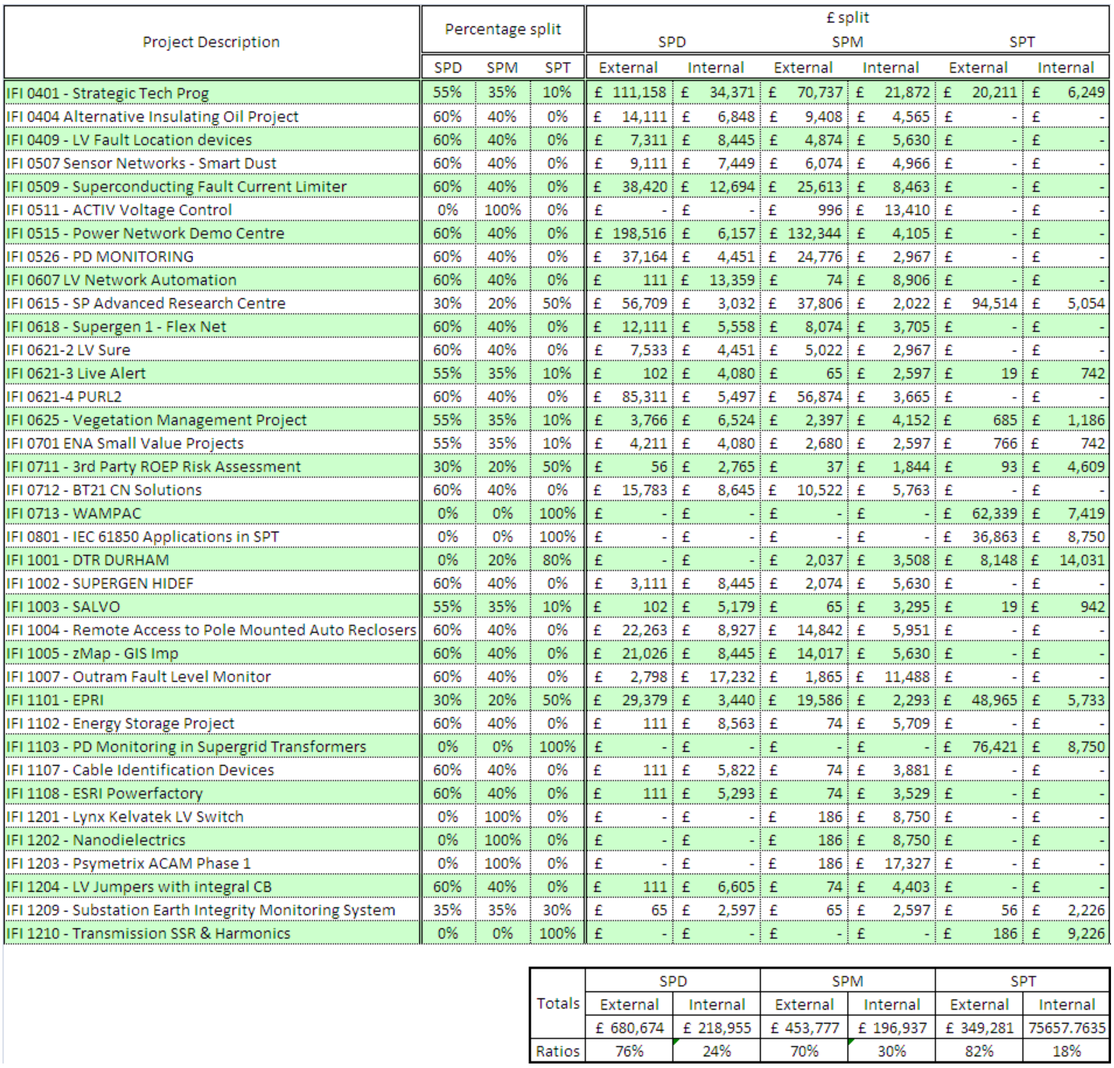


Figure A1: Example Expenditure Profile for an IFI Project

Table A1 is ordered chronologically.



Project Description	Percentage split			£ split					
				SPD		SPM		SPT	
	SPD	SPM	SPT	External	Internal	External	Internal	External	Internal
IFI 0401 - Strategic Tech Prog	55%	35%	10%	£ 111,158	£ 34,371	£ 70,737	£ 21,872	£ 20,211	£ 6,249
IFI 0404 Alternative Insulating Oil Project	60%	40%	0%	£ 14,111	£ 6,848	£ 9,408	£ 4,565	£ -	£ -
IFI 0409 - LV Fault Location devices	60%	40%	0%	£ 7,311	£ 8,445	£ 4,874	£ 5,630	£ -	£ -
IFI 0507 Sensor Networks - Smart Dust	60%	40%	0%	£ 9,111	£ 7,449	£ 6,074	£ 4,966	£ -	£ -
IFI 0509 - Superconducting Fault Current Limiter	60%	40%	0%	£ 38,420	£ 12,694	£ 25,613	£ 8,463	£ -	£ -
IFI 0511 - ACTIV Voltage Control	0%	100%	0%	£ -	£ -	£ 996	£ 13,410	£ -	£ -
IFI 0515 - Power Network Demo Centre	60%	40%	0%	£ 198,516	£ 6,157	£ 132,344	£ 4,105	£ -	£ -
IFI 0526 - PD MONITORING	60%	40%	0%	£ 37,164	£ 4,451	£ 24,776	£ 2,967	£ -	£ -
IFI 0607 LV Network Automation	60%	40%	0%	£ 111	£ 13,359	£ 74	£ 8,906	£ -	£ -
IFI 0615 - SP Advanced Research Centre	30%	20%	50%	£ 56,709	£ 3,032	£ 37,806	£ 2,022	£ 94,514	£ 5,054
IFI 0618 - Supergen 1 - Flex Net	60%	40%	0%	£ 12,111	£ 5,558	£ 8,074	£ 3,705	£ -	£ -
IFI 0621-2 LV Sure	60%	40%	0%	£ 7,533	£ 4,451	£ 5,022	£ 2,967	£ -	£ -
IFI 0621-3 Live Alert	55%	35%	10%	£ 102	£ 4,080	£ 65	£ 2,597	£ 19	£ 742
IFI 0621-4 PURL2	60%	40%	0%	£ 85,311	£ 5,497	£ 56,874	£ 3,665	£ -	£ -
IFI 0625 - Vegetation Management Project	55%	35%	10%	£ 3,766	£ 6,524	£ 2,397	£ 4,152	£ 685	£ 1,186
IFI 0701 ENA Small Value Projects	55%	35%	10%	£ 4,211	£ 4,080	£ 2,680	£ 2,597	£ 766	£ 742
IFI 0711 - 3rd Party ROEP Risk Assessment	30%	20%	50%	£ 56	£ 2,765	£ 37	£ 1,844	£ 93	£ 4,609
IFI 0712 - BT21 CN Solutions	60%	40%	0%	£ 15,783	£ 8,645	£ 10,522	£ 5,763	£ -	£ -
IFI 0713 - WAMPAC	0%	0%	100%	£ -	£ -	£ -	£ -	£ 62,339	£ 7,419
IFI 0801 - IEC 61850 Applications in SPT	0%	0%	100%	£ -	£ -	£ -	£ -	£ 36,863	£ 8,750
IFI 1001 - DTR DURHAM	0%	20%	80%	£ -	£ -	£ 2,037	£ 3,508	£ 8,148	£ 14,031
IFI 1002 - SUPERGEN HIDEF	60%	40%	0%	£ 3,111	£ 8,445	£ 2,074	£ 5,630	£ -	£ -
IFI 1003 - SALVO	55%	35%	10%	£ 102	£ 5,179	£ 65	£ 3,295	£ 19	£ 942
IFI 1004 - Remote Access to Pole Mounted Auto Reclosers	60%	40%	0%	£ 22,263	£ 8,927	£ 14,842	£ 5,951	£ -	£ -
IFI 1005 - zMap - GIS Imp	60%	40%	0%	£ 21,026	£ 8,445	£ 14,017	£ 5,630	£ -	£ -
IFI 1007 - Outram Fault Level Monitor	60%	40%	0%	£ 2,798	£ 17,232	£ 1,865	£ 11,488	£ -	£ -
IFI 1101 - EPRI	30%	20%	50%	£ 29,379	£ 3,440	£ 19,586	£ 2,293	£ 48,965	£ 5,733
IFI 1102 - Energy Storage Project	60%	40%	0%	£ 111	£ 8,563	£ 74	£ 5,709	£ -	£ -
IFI 1103 - PD Monitoring in Supergrid Transformers	0%	0%	100%	£ -	£ -	£ -	£ -	£ 76,421	£ 8,750
IFI 1107 - Cable Identification Devices	60%	40%	0%	£ 111	£ 5,822	£ 74	£ 3,881	£ -	£ -
IFI 1108 - ESRI Powerfactory	60%	40%	0%	£ 111	£ 5,293	£ 74	£ 3,529	£ -	£ -
IFI 1201 - Lynx Kelvatek LV Switch	0%	100%	0%	£ -	£ -	£ 186	£ 8,750	£ -	£ -
IFI 1202 - Nanodielectrics	0%	100%	0%	£ -	£ -	£ 186	£ 8,750	£ -	£ -
IFI 1203 - Psymetrix ACAM Phase 1	0%	100%	0%	£ -	£ -	£ 186	£ 17,327	£ -	£ -
IFI 1204 - LV Jumpers with integral CB	60%	40%	0%	£ 111	£ 6,605	£ 74	£ 4,403	£ -	£ -
IFI 1209 - Substation Earth Integrity Monitoring System	35%	35%	30%	£ 65	£ 2,597	£ 65	£ 2,597	£ 56	£ 2,226
IFI 1210 - Transmission SSR & Harmonics	0%	0%	100%	£ -	£ -	£ -	£ -	£ 186	£ 9,226

Totals	SPD		SPM		SPT	
	External	Internal	External	Internal	External	Internal
	£ 680,674	£ 218,955	£ 453,777	£ 196,937	£ 349,281	75657.7635
Ratios	76%	24%	70%	30%	82%	18%

Table A1: Overview of 11/12 projects showing application between licences

Appendix B – Project Reports IFI Projects

April 11 – March 12

Project Title	***IFI 0401 STP 2 Overhead Lines***			
Description of project	A DNO research and development collaboration hosted by EA Technology			
Expenditure for 11/12 financial year	Internal £15,623 External £50,526 Total £66,149	Expenditure in previous (IFI) financial years	Internal £43,178 External £275,028 Total £318,206	
Project Cost (Collaborative + external + [DNO])	£288,650	Projected 12/13 costs	Internal £10,000 External £50,000 Total £60,000	
Technological area and / or issue addressed by project	The Module 2 programme for budget year 2011/12 aimed to improve operational performance, maximise potential benefits, improve financial performance, and minimise risk associated with overhead lines. A full list of projects and deliverables are available from SPEN or EA Technology			
Type(s) of innovation involved	Incremental	Project Benefits Rating	Project Residual Risk	Overall Project Score
		16	9	25
Expected Benefits of Project	If successful projects in this Module may increase the performance and reliability of cable networks			
Expected Timescale to adoption	Range 1-5 years - dependent on project	Duration of benefit once achieved	Range 3-5 years - dependent on project	
Probability of Success	Range 49-95% - dependent on project	Project NPV = (PV Benefits – PV Costs) x Probability of Success	£42,652	
Potential for achieving expected benefits	Collectively, the 11/12 work programme demonstrates the development of innovative products, processes and techniques that improve the management of overhead lines. A full list of projects and deliverables are available from SPEN or EA Technology			
Project Progress to March 12	Only a small number of projects or project stages started in the Module during 11/12 have been completed since the majority are multi-stage projects that span more than one year			
Collaborative Partners	Other DNOs			
R&D Providers	EA Technology			

Project Title	***IFI 0401 STP 3 Cable Networks***			
Description of project	A DNO research and development collaboration hosted by EA Technology			
Expenditure for 11/12 financial year	Internal £15,623 External £50,526 Total £66,149	Expenditure in previous (IFI) financial years	Internal £45,915 External £342,042 Total £387,957	
Project Cost (Collaborative + external + [DNO])	£748,550	Projected 12/13 costs	Internal £10,000 External £60,000 Total £70,000	
Technological area and / or issue addressed by project	The Module 3 programme for budget year 2011/12 aimed to improve operational performance, maximise potential benefits, improve financial performance, and minimise risk associated with cable networks. A full list of projects and deliverables are available from SPEN or EA Technology			
Type(s) of innovation involved	Incremental	Project Benefits Rating	Project Residual Risk	Overall Project Score
		14	8	22
Expected Benefits of Project	If successful projects in this Module may increase the performance and reliability of cable networks			
Expected Timescale to adoption	Range 1-2 years - dependent on project	Duration of benefit once achieved	Range 3-5 years - dependent on project	
Probability of Success	Range 45-100% - dependent on project	Project NPV = (PV Benefits – PV Costs) x Probability of Success	£42,013	
Potential for achieving expected benefits	Collectively, the 11/12 work programme demonstrates the development of innovative products, processes and techniques that improve the management of cable Networks. A full list of projects and deliverables are available from SPEN or EA Technology			
Project Progress to March 12	Only a small number of projects or project stages started in the Module during 11/12 have been completed since the majority are multi-stage projects that span more than one year			
Collaborative Partners	Other DNOs			
R&D Providers	EA Technology			

Project Title	***IFI 0401 STP 4 Substations***			
Description of project	A DNO research and development collaboration hosted by EA Technology			
Expenditure for 11/12 financial year	Internal £15,623 External £50,526 Total £66,149	Expenditure in previous (IFI) financial years	Internal £43,396 External £255,512 Total £298,908	
Project Cost (Collaborative + external + [DNO])	£243,061	Projected 12/13 costs	Internal £10,000 External £40,000 Total £50,000	
Technological area and / or issue addressed by project	The Module 4 programme for budget year 2011/12 aimed to improve operational performance, maximise potential benefits, improve financial performance, and minimise risk associated with substations. A full list of projects and deliverables are available from SPEN or EA Technology			
Type(s) of innovation involved	Incremental	Project Benefits Rating	Project Residual Risk	Overall Project Score
		16.5	9.5	26.0
Expected Benefits of Project	If successful projects in this Module may increase the performance and reliability of substations			
Expected Timescale to adoption	Range 1-4 years - dependent on project	Duration of benefit once achieved	Range 1-6 years - dependent on project	
Probability of Success	Range 30-95% - dependent on project	Project NPV = (PV Benefits – PV Costs) x Probability of Success	£32,721	
Potential for achieving expected benefits	Collectively, the 11/12 work programme demonstrates the development of innovative products, processes and techniques that improve the management of substations. A full list of projects and deliverables are available from SPEN or EA Technology			
Project Progress to March 12	Only a small number of projects or project stages started in the Module during 11/12 have been completed since the majority are multi-stage projects that span more than one year			
Collaborative Partners	Other DNOs			
R&D Providers	EA Technology			

Project Title	***IFI 0401 STP 5 Networks for Distributed Energy Resources***			
Description of project	A DNO research and development collaboration hosted by EA Technology			
Expenditure for 11/12 financial year	Internal £15,623 External £50,526 Total £66,149	Expenditure in previous (IFI) financial years	Internal £41,120 External £305,377 Total £346,497	
Project Cost (Collaborative + external + [DNO])	£276,875	Projected 12/13 costs	Internal £10,000 External £50,000 Total £60,000	
Technological area and / or issue addressed by project	The Module 5 programme for budget year 2011/12 aimed to improve operational performance, maximise potential benefits, improve financial performance, and minimise risk associated with networks for distributed energy resources. A full list of projects and deliverables are available from SPEN or EA Technology			
Type(s) of innovation involved	Incremental	Project Benefits Rating	Project Residual Risk	Overall Project Score
		13.5	8.5	22.0
Expected Benefits of Project	If successful projects in this Module may increase the performance and reliability of substations			
Expected Timescale to adoption	Range 1-3 years - dependent on project	Duration of benefit once achieved	Range 2-5 years - dependent on project	
Probability of Success	Range 51-100% - dependent on project	Project NPV = (PV Benefits – PV Costs) x Probability of Success	£28,841	
Potential for achieving expected benefits	Collectively, the 11/12 work programme demonstrates the development of innovative products, processes and techniques that improve the management of networks for distributed energy resources. A full list of projects and deliverables are available from SPEN or EA Technology			
Project Progress to March 12	Only a small number of projects or project stages started in the Module during 11/12 have been completed since the majority are multi-stage projects that span more than one year			
Collaborative Partners	Other DNOs			
R&D Providers	EA Technology			

<table>
<tr><td>Project Title</td><td colspan="9"><i>IFI 0404 - Alternative Insulating Oils – Phase 1</i></td></tr>
<tr><td>Description of project</td><td colspan="9">Applied research programme consisting of a series of investigations designed to make a thorough evaluation of the electrical/ageing properties of alternative fluids for use in both aged power transformers and new plant.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="3">Internal £11,413
External £23,519
Total £34,932</td><td colspan="3">Expenditure in previous (IFI) financial years</td><td colspan="3">Internal £19,995
External £77,668
Total £97,664</td></tr>
<tr><td>Project Cost (Collaborative + external + SPEN)</td><td colspan="3">£142,290</td><td colspan="3">Projected 12/13 costs for SPEN</td><td colspan="3">Internal £0
External £0
Total £0</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="9">Evaluation of the Characteristics of Alternative Fluids is being undertaken to access the relative merits for Retro-Filling Power Transformers and filling New Transformers with alternative fluids have over using standard mineral oils.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="2">Incremental</td><td colspan="2">Significant</td><td colspan="3">Technological substitution</td><td colspan="2">Radical</td></tr>
<tr><td colspan="2">No</td><td colspan="2">No</td><td colspan="3">Yes</td><td colspan="2">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="9">• Reduced environmental risk associated with oil/fluid spills and fires.
• Potential to up-rate transformers at strategic sites.
• Opportunity to improve SPEN credibility with SEPA and other governing bodies and reputation with regards environmental awareness.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>4 years</td><td colspan="4">Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">50%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td colspan="4">→</td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="5">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£98,922</td></tr>
<tr><td>Project Progress March 12</td><td colspan="9">The output of the project indicates that differences in electrical strength between ester liquids and mineral oil are clearly shown in non-uniform electric fields. The observation that the lightning impulse and AC strengths of ester liquids are comparable with the mineral oil in a quasi-uniform field certainly moves the application of ester liquids in large power transformers a step forward. It implies that the designed operation electric stresses and therefore the basic size and configuration of an ester-filled transformer can be similar to that of a mineral oil filled unit.
Nevertheless, additional considerations should be given to ester-filled power transformers. First, since streamers in the ester liquids, once incepted, propagate faster and further, the avoidance of streamer/discharge inception is more important for design and construction of an ester-filled power transformer so as to avoid breakdown, particularly under the factory test stresses; second, to compensate for the lower breakdown strength of the ester liquids in a large divergent field gap, additional pressboard barriers (in a direction perpendicular to the field) may be required to partition large oil gaps in an ester-filled power transformer.
30 journal and conference papers have been published out of the research project ‘Applications of Alternative Oils in Large Power Transformers’.</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="9">This project has given confidence in the deployment of ester based oils. SPEN has used Midel in 33kV transformers and the work undertaken in this project has reinforced SPEN’s understanding that alternative fluids can be used in large power transformers, as long as it is considered at the design stage due to the difference in clearance, insulation and cooling requirements.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="9">National Grid, EDF Energy, Areva T&D, TJH2B, M&I Materials, EPSRC, TJH2B</td></tr>
<tr><td>R&D Provider</td><td colspan="9">University of Manchester</td></tr>
</table>

<table>
<tr><td>Project Title</td><td colspan="4"><i>IFI 0409 - LV Fault Location Devices</i></td></tr>
<tr><td>Description of project</td><td colspan="4">A device for use on the Low Voltage networks to capture transient fault information and correlate to an associated fault location.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £ 14,075
External £ 12,186
Total £ 26,261</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £53,729
External £101,439
Total £155,168</td></tr>
<tr><td>Project Cost (Collaborative + external + SP-EN)</td><td>£184,800</td><td>Projected 12/13 costs for SP-EN</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="4">The device is being developed preliminary for transient/intermittent LV cable fault location.</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>Yes</td><td>No</td><td>No</td><td>No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Preliminary use of the device for fault location on persistent LV faults is expected to:
• Reduce the number of repeated fuse replacements
• Minimise the number of joint holes
• Remove the fault from the system in a shorter timescale than traditional ‘cut-and-test’ methods</td></tr>
<tr><td>Expected Timescale to adoption</td><td>1 Year</td><td>Duration of benefit once achieved</td><td colspan="2">Typically 8-10 years depending on technology development</td></tr>
<tr><td>Probability of Success</td><td>50%</td><td colspan="3"><table><tr><td colspan="9">TRL Development (Start – Current)</td></tr><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr><tr><td></td><td></td><td></td><td></td><td>→</td><td>→</td><td>→</td><td>→</td><td>→</td></tr></table></td></tr>
<tr><td>Project NPV</td><td colspan="2">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="2">£349,240</td></tr>
<tr><td>Project Progress March 12</td><td colspan="4">The final stage of the project has now been completed with the units being rolled out into the business</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">This project has now closed</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">Uk PowerNetworks, Electricity North West</td></tr>
<tr><td>R&D Providers</td><td colspan="4">Kehui (UK) Ltd, Nortech</td></tr>
</table>

Project Title	***IFI 0507 - Sensor Networks (Smart Dust) – Phase 2***
Description of project	"Smartdust" is a concept developed by the University of California that is based on a self-configuring wireless sensor network, capable of transmitting low bandwidth information in a series of short hops. Data acquired and transmitted from sensors is relayed through a gateway for data interpretation. ScottishPower led a feasibility study into the use of this technology for detecting the passage of fault currents on 11kV overhead line networks. Following on from this work, a collaborative project has been scoped between EDF-Energy, Central Networks and SPEN to develop a product based on this principle for the remote signalling of fault passage indication on OH networks.

Expenditure for financial year	Internal £12,415 External £15,186 **Total** **£27,600**	Expenditure in previous (IFI) financial years	Internal £77,907 External £192,098 **Total** **£270,005**
Project Cost (Collaborative + external + SPEN)	Phase 1 = £16k Phase 2 = £191k	Projected 12/13 costs for SPEN	Internal £15,000 External £19,000 **Total** **£34,000**

Technological area and / or issue addressed by project	A cheap and reliable method of collection of fault passage indication data a centralised location for Overhead Line Faults would significantly reduce the time required to resolve faults on the network and consequently reduce CML associated penalties. This technology would be especially suited to transitory fault location. Significant analysis has been undertaken on the deployment characteristics of GSM/GPRS Fault Passage Indicators Vs Radio communicating sensors, using SP-D fault histories. The analysis considering the relationship between sensor cost, deployment penetration and improvement to CML figures. The key conclusion is that a cheap, low power semi-mesh radio based system: • Allows a much higher percentage of locations of be monitored economically than any other option, across all price points and time savings • Offers SP a much higher NPV than any other option Owing to these factors, a significantly higher percentage of network can be monitored (from 10% for GSM devices to above 70% coverage for radio sensors), increasing the likelihood that they will be targeting faults (rather than solely focussing on worst performing circuits).

Type(s) of innovation involved	Incremental	Significant	Technological substitution	Radical
	No	No	No	Yes

Expected Benefits of Project	Sensor Networks implemented as a method of fault passage indication (FPI) could have an enormous effect on how faults on the overhead network are located. They could have a huge impact on CI/CML figures as the technology would be effectively pin pointing faults on the network. This results in a significant financial saving

Expected Timescale to adoption	5 Years	Duration of benefit once achieved	10 Years

Probability of Success	50%	TRL Development (Start – Current)								
		1	2	3	4	5	6	7	8	9
					→	→	→			

Project NPV	(Present Benefits x Probability of Success) – Present Costs	£554.5k
Project Progress March 12	Progress in 2011/2012: Phase B has now started and final adjustments are being made to the devices to enable the construction of field ready trial devices. There have been some technical difficulties adapting the prototype lab part of the project into a device that can be trialled on the DNO's networks. This will hopefully be rectified Q3 of 2012 to enable a field trial early 2013.	
Potential for achieving expected benefits	This new approach will allow control engineer's to identify the location of a fault more quickly than is presently possible and hence rapidly deduce the best supply restoration strategy. It will also allow linesmen to be sent directly to the source of the fault to identify and fix the problem. Whilst the overall effect should be a reduction in Customer-Minutes-Lost for permanent faults, it will more importantly be able to capture the source of transient fault activity that can cause multiple supply interruptions. In the longer term, this system can become duplex, allowing control commands to be sent to specific wFPI locations.	
Collaborative Partners	Central Networks	
R&D Providers	Willow, E.ON Power Technology	

<table>
<tr><td>Project Title</td><td colspan="10">IFI 0509 - Superconducting Fault Current Limiter</td></tr>
<tr><td>Description of project</td><td colspan="10">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 colspan="3">Internal £21,157
External £64,033
Total £85,190</td><td colspan="3">Expenditure in previous (IFI) financial years</td><td colspan="4">Internal £41,699
External £388,693
Total £430,395</td></tr>
<tr><td>Project Cost (Collaborative + external + SPEN)</td><td colspan="3">£2,345,967</td><td colspan="3">Projected 12/13 costs for SPEN</td><td colspan="4">Internal £6,000
External £12,000
Total £18,000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="10">The development of a non-linear ‘high-temperature’ superconducting ceramic in series with a circuit breaker for the clamping and clearance of fault energy.

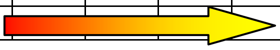
When the material is operated at below its critical temperature it loses all electrical resistance, thereby allowing load current to flow with negligible losses. Either the increased current density caused by fault current, or the loss of cooling medium (liquid nitrogen) causes the temperature of the 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 colspan="2">Incremental</td><td colspan="3">Significant</td><td colspan="3">Technological substitution</td><td colspan="2">Radical</td></tr>
<tr><td colspan="2">No</td><td colspan="3">Yes</td><td colspan="3">No</td><td colspan="2">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="10">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 colspan="5">Duration of benefit once achieved</td><td colspan="4">20 years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">25%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td colspan="5">⟶</td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="5">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="5">£-267,191
Project NPV is negative due to the low TRL / high costs upon commencement</td></tr>
</table>

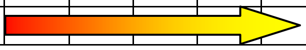
Project Progress March 12	Work has now been carried out at Ainsworth Lane to install the FCL. The energisation date is now going to be August 2012
Potential for achieving expected benefits	Learning from this project will be able to help SPEN make strategic decisions on the future of fault level management
Collaborative Partners	Electricity North West, CE Electric UK, Applied Superconductor Ltd
R&D Providers	Applied Superconductor Ltd

Project Title	***IFI 0511 - Voltage Control ACTIV (EATL)***			
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 £13,410 External £996 **Total £14,405**	Expenditure in previous (IFI) financial years	Internal £40,069 External £97,944 **Total £138,013**	
Project Cost (Collaborative + external + SPEN)	£254,206	Projected 12/13 costs for SPEN	Internal £0 External £0 Total **£0**	
Technological area and / or issue addressed by project	It is proposed that this relay could provide a viable alternative for voltage control across SP-M / SP-D in areas where the ratios of generation to load is high.			
Type(s) of innovation involved	Incremental	Significant	Technological substitution	Radical
	Yes	No	No	No
Expected Benefits of Project	• 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	<2 Years	Duration of benefit once achieved	10 Years	
Probability of Success	75%	TRL Development (Start – Current) 1 2 3 4 5 6 7 8 9 5 ➔ 7		
Project NPV	(Present Benefits x Probability of Success) – Present Costs	£67,445		
Project Progress March 12	This project has now closed			
Potential for achieving expected benefits	This project has now closed			
Collaborative Partners	Central Networks, Scottish & Southern Energy, Electricity North West			
R&D Providers	EATL, Fundamentals			

<table>
<tr><td>Project Title</td><td colspan="9"><i>IFI 0515 - Power Network Demonstration Centre (PNDC)</i></td></tr>
<tr><td>Description of project</td><td colspan="9">Development of a full scale 11kV and LV prototyping network as a test-bed / proving ground for active network management techniques and other ‘high risk’ technologies. Whilst not a technological development in itself, this project is a fundamental enabler of technology, with significant potential to accelerate adoption of significant / radical developments across a range of IFI projects.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="3">Internal £10,261
External £330,860
Total £341,121</td><td colspan="3">Expenditure in previous (IFI) financial years</td><td colspan="3">Internal £44,189
External £99,659
Total £143,848</td></tr>
<tr><td>Project Cost (Collaborative + external + SPEN)</td><td colspan="3">£7,200,000</td><td colspan="3">Projected 12/13 costs for SPEN</td><td colspan="3">Internal £20,000
External £250,000
Total £225,000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="9">In partnership with collaborators, this project aims to:
• Provide a demonstration network to allow the testing of new technologies on a ‘real’ network
• Offer a real network that will incorporate 11kV and low voltage equipment, containing real loads, real generation and test real technologies
• Create a facility which will be open to Academia, R&D Establishments, Manufacturers, and Network Operators
The vision is to create a physical scale model that can represent different urban, suburban and rural electrical networks. The proposed system will incorporate real network components: cables, overhead lines, switchgear, transformers, protection and control equipment, in order to ensure it is both representative and credible to the real thing. Real Time Digital Simulators (RTDSs) will be used in parallel to model an underlying, more comprehensive network, effectively expanding the scale of the system.
Technologies coming more prominently into play over the next 15 years, e.g. micro-generation, storage, fault current limiters, etc., will be included on the test network so as to test their effect, and vice-versa, on both marine and distribution systems.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="2">Incremental</td><td colspan="2">Significant</td><td colspan="3">Technological substitution</td><td colspan="2">Radical</td></tr>
<tr><td colspan="2">Yes</td><td colspan="2">Yes</td><td colspan="3">Yes</td><td colspan="2">Yes</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="9">Benefits to DNOs from such a facility include:
Safety – A test network with dedicated staff will offer a facility to train staff in the operation of a more complicated network. Specific what-if scenario courses can be run through repeatable simulation, in the same manner as flight simulators are used to train pilots.
Risk mitigation – A real time simulator, with likely penetrations of high volume DG and microGen will indicate the technologies that will need to be developed in order to manage the increased risk this might pose to the network and/or our customers.
Acceleration of trials / increased adoption rate – The ability to operate the whole network through a vast range of loading conditions in a short period of time, will lead to the end of long duration (12-24mth) network trials of new technologies.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">1 Years</td><td colspan="3">Duration of benefit once achieved</td><td colspan="4">20 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">25%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td colspan="5"></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="6">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="3">£709,171</td></tr>
</table>

Project Progress March 12	**Activity Apr 2011 - March 2012** • The main building is completed. Work on the network has commenced. • Initial research Agenda completed, three projects are now underway. • One Director has been appointed as well as one full-time research manager. • Value proposition and growth plan has been proposed to the board. **Timescales for completion** • Handover of the facility to the University will occur in November 2012. The University will then finish equipment installation with the aim of officially opening the building for business early January 2013.
Potential for achieving expected benefits	**Facility – Operation and SP role** Overall governance will be carried run by the PNDC Directors, Operational and Research (UoS staff). The Core Research Programme, will be planned and approved by the PNDC board which comprises of the PNDC directors, UoS finance director and Tier 1 members. There are three classes of membership: Founder Tier 1, Tier 1 and Tier 2, each having different voting rights on the PNDC board. For SPEN to get maximum value out of the PNDC we will be seeking to use our place on the PNDC board to our maximum advantage in guiding the PNDC core programme to benefit our IFI programme. We also anticipate that SPEN will have various projects that will require the use of the Centre to reduce their time to adoption within SP.
Collaborative Partners	Scottish & Southern Energy, Scottish Enterprise and University of Strathclyde
R&D Providers	See Collaborative Partners

<table>
<tr><td>Project Title</td><td colspan="4">***IFI 0526 - PD Monitoring of Cables (11 & 33kV)***</td></tr>
<tr><td>Description of project</td><td colspan="4">Partial discharge (PD) monitoring technology is a tool often used for identifying HV cable sections that are at risk of failing in the near future. There are two distinct methods of testing for PD:
• Long term monitoring to identify the degradation of the cable which signals the increase in risk of failure; and
• PD mapping which pinpoints the location of any discharge along the route of the cable.
Developing the technology to apply these methods gives a network operator the evidence required to assist in targeting investment / cable replacement, with a net improvement in network performance.

This project will develop a portable PD monitoring product that can be moved around the network, as tool in the prioritisation in cable replacement.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £7,419
External £61,941
Total **£69,359**</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £20,444
External £72,232
Total £92,676</td></tr>
<tr><td>Project Cost (Collaborative + external + SPEN)</td><td>£160,000</td><td>Projected 12/13 costs for SPEN</td><td colspan="2">Internal £5,000
External £13,000
Total £47,650</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">This project will develop partial discharge monitoring hardware which will initially be tested on the SP 11kV network with the following aims:
• To develop a suitable portable monitoring solution with the ability to identify any cable sections which are emitting a level of discharge, which could lead to faults in the short term. The portable monitor will allow SP to test for a period of a few minutes to many weeks.
• Following initial testing in 10 primary substations, partial discharge mapping of those cable sections, which are registering the highest level of discharge, will be undertaken.
• Based on the PD maps obtained, any areas of concentrated PD activity, which are identified as critical, will be subject to review and selected cable sections will be replaced. The cable/joints removed will then be tested to validate PD test results.
It is planned that the test results will be collated in a database, which, in conjunction with results from the testing carried out by other UK DNOs, will allow for advancements in the knowledge rules for future PD testing technology.</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>No</td><td>Yes</td><td>No</td><td>No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">• Developing PD monitoring techniques and understanding of PD activity with respect to cable degradation will assist with cable replacement decision-making. It will also aid justification and prioritising of capital spend.
• Anticipated key benefits will be in the area of CML and CI improvements and cost savings through targeted cable section replacement programmes.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>1-2 Years</td><td>Duration of benefit once achieved</td><td colspan="2">5 Years</td></tr>
<tr><td>Probability of Success</td><td>50%</td><td colspan="3"><table><tr><td colspan="9">TRL Development (Start – Current)</td></tr><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr><tr><td></td><td></td><td></td><td colspan="5"></td><td></td></tr></table></td></tr>
</table>

Project NPV	(Present Benefits x Probability of Success) – Present Costs	£108,661
Project Progress March 12	Work is been carried out to analyse the top 20 worst performing circuits in SPM and SPD for faulted cable section so that a more targeted application of cable monitoring can be carried out.	
Potential for achieving expected benefits	Having correctly verified sources of PD in cable and identified cables with PD in the area of concern, the next stage is to monitor the top 20 most problematic circuits in both SPM and SPD. If these cable sections are found to have high levels of PD it is planned to identify location of PD section, expose cable section and replace with healthy cable.	
Collaborative Partners	N/A	
R&D Providers	HVPD (Formally IPEC HV)	

Project Title	***IFI 0607 - LV Network Automation***
Description of project	The aim of a Low Voltage Automation (LVA) project is to provide a trial system on Scottish Power Energy Networks (SPEN's) LV network, which will prove the benefits of implementing a larger scale LVA system across the LV networks. The trial system will consist of one LVA CCU (modified old CCU) and one phase LVA switch. It is two major parts that will be validated in the project. The first one is the communication from the control point to the LVA switch. The communication technique will be the Power Line Communication (PLC). The second part is the mechanical behaviour and the control of the Magnetic vacuum Switch from EPS.

Expenditure for financial year	Internal £22,265 External £186 **Total £22,451**	Expenditure in previous (IFI) financial years	Internal £153,358 External £205,950 **Total £359,308**
Project Cost (Collaborative + external + SP-EN)	**£257,775**	Projected 12/13 costs for SP-EN	Internal £15,000 External £95,000 **Total £110,000**

Technological area and / or issue addressed by project	The Low Voltage networks contribute ~11% CI and ~15.5% CML between the SP-D / SP-M networks (taken from 2003/04 NaFIRs report). • Both proposals aim to produce, install and test prototype systems on a trial network, providing a proof of concept and evaluating performance of the installation on the LV distribution network. • Application will be to focus on high customer density, worst performing LV circuits.

Type(s) of innovation involved	Incremental	Significant	Technological substitution	Radical
	No	Yes	No	No

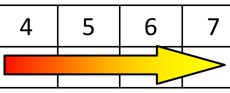
Expected Benefits of Project	Application of the technology should provide the following benefits: • Reduction of CMLs on the LV network • Increased asset life of circuit elements by the reduction of both fault currents and stresses during fault location • Reduced cost and time of fault location through rapid identification of faults location • Elimination of repeated intermittent faults

Expected Timescale to adoption	3 Years	Duration of benefit once achieved	10 Years

Probability of Success	50%	TRL Development (Start – Current)								
		1	2	3	4	5	6	7	8	9
										

Project NPV	(Present Benefits x Probability of Success) – Present Costs	£526,7k

Project Progress March 12	Due to problems with the supplier Radius, this project has been delayed. Work has continued with the switching device through EPS. A production run of 9 units have been manufactured and are awaiting installation on the network on a trial basis.
Potential for achieving expected benefits	Having proved the LVA could perform in this environment, coupled with the control and network behaviour data capability, we have now embarked on a continuation IFI project to further develop this prototype into a final product that will enable the Smart Grid concept.
Collaborative Partners	None
R&D Providers	RADIUS

<table>
<tr><td>Project Title</td><td colspan="9">***IFI 0615 - ScottishPower Advanced Research Centre (SPARC)***</td></tr>
<tr><td>Description of project</td><td colspan="9">Three workstreams have been proposed:
• ***Asset Engineering***: Field based activities, concentrating on the technologies used to gather and interpret data then control and manage individual assets.
• ***Asset Strategy***: Office, desktop, PC based analytical activities including the analysis of data, concentrating on underlying trends of asset populations (from asset ageing to network performance).
• ***System Development***: Forward looking network design activities considering the connectivity between the assets. It should consider both the medium term (5 years) and longer-term trends (>10 years), which will affect the design of the network (e.g. load, generation, standards, regulations, Ofgem incentives/penalties).
A number of related projects will be developed within each workstream.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="3">Internal £10,108
External £189,029
Total £199,136</td><td colspan="3">Expenditure in previous (IFI) financial years</td><td colspan="3">Internal £30,683
External £481,067
Total £511,750</td></tr>
<tr><td>Project Cost (Collaborative + external + SP-EN)</td><td colspan="3">**£460,083**</td><td colspan="3">Projected 12/13 costs for SP-EN</td><td colspan="3">Internal £10,000
External £160,000
Total £170,000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="9">• Asset Engineering research stream focuses on methods and technologies that enable better use of individual assets.
• Asset Strategy research stream focuses on methods and tools that enable better management of populations of assets.
• System Development research stream focuses on analytical techniques that provide SP with better capability to plan and design the power system.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td colspan="3">Project Benefits Rating</td><td colspan="3">Project Residual Risk</td><td colspan="2">**Overall Project Score**</td></tr>
<tr><td colspan="3">18</td><td colspan="3">1</td><td colspan="2">**17**</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="9">Research activities will seek to realise business benefits across a range of areas including system performance, OPEX and CAPEX. Key areas have been identified in the SPARC proposal, which are being used to form the basis of a more comprehensive programme of deliverable projects.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>3 Years</td><td colspan="4">Duration of benefit once achieved</td><td colspan="4">10 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">Varies per project</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td colspan="4"></td><td></td><td></td></tr>
<tr><td>Project NPV</td><td>(Present Benefits x Probability of Success) – Present Costs</td><td colspan="9">TBC
In development for the core projects in each workstream</td></tr>
</table>

Project Progress March 12	**'Investment Strategy' Theme: Automated analysis of SCADA data and digital fault records for analysis of power system protection performance** • Develop, implement and test a prototype Post-Fault Protection Performance Analysis Suite: 1. The prototype is currently within the final testing stage with testing conducted on an ongoing basis. The storms of January 2012 have become the final case studies and the preliminary results produced by the prototype are currently available for validation. 2. Updates carried out to web-front end to improve performance and carry out general view improvements. 3. Writing and drafting of journal paper for submission in March/April 2012. **'Investment Strategy' Theme: Smart Power Network Asset Management Strategies and Tools** • Develop a method to optimise targeting of investment for asset replacement over a given period of time. 1. Investigated existing approach to asset investment planning, including identification of constraints. 2. Investigated Markov Chain asset deterioration modelling technique. 3. Investigated optimization techniques for application to investment planning. 4. Selected, applied and evaluated suitable optimisation technique to specified assets. 5. Developed and tested 'proof of concept' application of selected optimisation approach for asset investment planning. This involves development of spreadsheet tools to test the 'proof of concept'. **'System Development' Theme: Optimal Distribution Network Architectures** • Develop algorithm and tool for network reconfiguration for loss and reliability optimisation prototype: 1. Produced a document detailing the reconfiguration arrangements output by the loss minimisation algorithm. This was sent to Geoff Murphy to obtain feedback from network planners on how closely this matches existing running arrangements and how practically feasible these switching arrangements would be to implement. 2. Developed a software user interface by using QT. (QT is a open source gui tool). 3. Developed a report function which can generate a report of the optimization results. 4. Developed reliability analysis function using FMEA method and optimised for CI and CML analysis.

Project Progress March 12	**'Asset Technology' Theme: PD Diagnostics in MV Cables** Develop firmware and hardware for double sided PD monitoring system and signal processing algorithms: 1. Firmware developed for the double sided PD monitoring system previously developed has been improved to increase the accuracy of PD location and has been verified in laboratory tests. Also, additional circuitry was incorporated in the double-ended system to provide immunity to external interferences so that the system can be installed in harsh environments. 2. EMD and SGWT based de-noising algorithms has been developed using novel thresholding methods. These algorithms were tested with analytical and on-site data. Accuracy of these methods has been compared with existing de-noising methods in terms of PD magnitude and PD location accuracies and the results are encouraging. **Additional (non-PhD) research projects:** Anglesey PV Penetration Study: • The study established a generic methodology for assessing threshold levels for PV generating capacity connecting to the LV network, indicating where voltage quality and phase imbalance issues become problematic for the LV network. The study involved: 1. The development of a methodology for modelling the PV system and analysing the voltage profile along the feeder based on limited measuring data (phase connection, PV output, customer consumption). 2. The development of a network case study to assess the voltage level along a feeder, using DIgSILENT *PowerFactory* software. 3. The development of an 'easy to use' voltage assessment tool in MS-Excel (based on a simplified model derived from the observations made from the more sophisticated network study). 4. A final report detailing the approach taken to the network modelling, simulations (including assumptions) and PV penetration assessment tool development.

Potential for achieving expected benefits	• The **'Automated analysis of SCADA data and digital fault records for analysis of power system protection performance'** PhD project of the Investment Strategy theme is expected to deliver significant enhancements to the PEDA system developed from previous research conducted by the University of Strathclyde in collaboration with SPEN protection engineers. Following discussions with SPEN and Iberdrola, the focus of this work changed from that originally defined to ensure that the proposed system leverages the network and protection scheme information now available from the newly developed 'Protection Database'. The use of accurate representations of network and scheme connectivity will significantly improve the reliability and accuracy of the protection assessment output delivered and offer valuable decision support to protection engineers. • The **'Smart Power Network Asset Management Strategies and Tools'** PhD project of the Investment Strategy theme will develop a methodology involving asset deterioration modelling and optimisation techniques to enable asset managers to establish desirable optima balancing of asset health, risk and investment, providing a more robust scientific basis for justifying asset investment. In addition to optimizing the level of investment required to manage risk satisfactorily, the methodology will also attempt to identify which assets provide the best return on investment, in terms of risk management. • The **'Optimal Distribution Network Architectures'** PhD project of the System Development theme is expected to deliver a method of minimising network losses by actively managing power flow through network reconfiguration within operational, planning and design timescales. The research will search for an optimal solution that respects multiple objectives, i.e. the need to minimise losses without compromising reliability, while respecting network constraints, e.g. fault levels. This will allow SPEN to implement operationally 'smarter' and more cost effective solutions to minimise active power losses as an alternative to costly network reinforcement. • The **'PD Diagnostics in MV Cables'** PhD project of the Asset Technology theme is expected to deliver a cost effective method of detecting partial discharge present in medium voltage cables. This phenomenon is responsible for the degradation of cable insulation and ultimately failure. Using existing protection CTs to also perform a secondary function as PD cable sensors affords asset managers with an unprecedented level of cable PD monitoring capability across the network, without the need to develop or install dedicated PD cable sensors. It is expected that this PhD will prove this concept while further work will be required to assess the robustness and commercialisation prospects of this approach. • Key SPEN personnel are engaged at technical and strategic levels though regular project meetings and SPARC strategy meetings to ensure that research is progresses along the TRL development scale towards deployment within the organisation. In addition, a key function of these strategy meetings (involving all SPARC personnel, and held bi-annually) is to ensure that the pipeline of prospective research projects is maintained and that they remain relevant to the strategic objectives of SPEN.
Collaborative Partners	N/A
R&D Providers	University of Strathclyde

<table>
<tr><td>Project Title</td><td colspan="10">***IFI 0618 - Supergen 1 – FlexNet***</td></tr>
<tr><td>Description of project</td><td colspan="10">FlexNet is a four-year EPSRC funded programme that takes forward the process of preparing electricity networks for a low carbon future and builds on an initial programme of works, **FutureNet** that is nearing completion.
The programme recognises the interdependence of many factors in achieving change through its integration of the work of internationally recognised researchers from disciplines such as social psychology, economics, power systems analysis, power systems technology and public policy and the long-term, radical nature of the changes needed and is not dependant on any particular form of generation</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £9,263
External £20,186
Total **£29,448**</td><td colspan="4">Expenditure in previous (IFI) financial years</td><td colspan="5">Internal £13,696
External £73,517
Total **£87,214**</td></tr>
<tr><td>Project Cost (Collaborative + external + SP-EN)</td><td>**£7.4m**</td><td colspan="4">Projected 12/13 costs for SP-EN</td><td colspan="5">Internal £0
External £0
Total **£0**</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="10">**FlexNet's** intention is to put in place a substantial body of work that will build on the achievements of **FutureNet** and lay out the major steps, technical, economic, market design, public acceptance and others, that will lead to flexible networks, including starting to showcase these so that they can be taken up by the commercial sector, Government and Regulators for practical implementation.

Some of the key issues to be addressed by the programme include:
How can we judge the degree of flexibility needed?
How can flexibility be achieved?
How much flexibility should come from primary plant giving margin and how much from secondary plant giving enhanced controllability?
What constrains or encourages flexibility, what technologies are acceptable and what economic frameworks and public policies provide flexibility at the least overall long-term cost?</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Radical</td><td colspan="3">Project Benefits Rating</td><td colspan="3">Project Residual Risk</td><td colspan="3">**Overall Project Score**</td></tr>
<tr><td colspan="3">7.2</td><td colspan="3">-2</td><td colspan="3">**9.2**</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="10">Understanding of flexible network requirements able to cost-effectively deal with a wide range of possible futures
Develop networks that can 'think' for themselves
Engagement with stakeholders in progressing the research ideas toward deployment
Research that forms the basis of policy advice
Inputs to the UK government's Energy Review, the UKERC assessment of Intermittency, evidence to select committees of parliament and submissions to OFGEM consultations.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>2012 onwards</td><td colspan="4">Duration of benefit once achieved</td><td colspan="5">20 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">25%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td colspan="4">→</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="6">(Present Benefits – Present Costs) x Probability of Success</td><td colspan="4">£2M</td></tr>
</table>

Project Progress March 12	The project has completed its 4-year programme (plus an extension period to close out a small number of the PhD projects). All work streams essentially completed their programme of work. As with any large R&D project, some task were modified in the light of results that emerged including the termination of unpromising avenues of research and the refocusing onto others. Conclusions have been drawn in all areas and the work written up for academic use and presented and demonstrated for research users. The training programme completed a series of discipline crossing training courses and industrial placements undertaken for researchers. The annual report to RCUK gives a more detailed account of progress and outcomes. Many outcomes are written up at www.supergen-networks.org.uk
Potential for achieving expected benefits	The breadth of FlexNet gives confidence that several of its activities will have enduring benefits. All the research partners have strong relationships with the DNOs/TSOs through which to pursue the ideas to higher TRLs and make them part of the network planning option set of the future. The ideas will also be pursued with equipment/software vendors and be subject of further research.
Collaborative Partners	EPSRC, National Grid, Scottish and Southern Energy, Central Networks, EDF Energy Networks, SP Energy Networks and CE Electric UK
R&D Providers	University of Bath, University of Birmingham, University of Cambridge, Cardiff University, University of Durham, University of Edinburgh, University of Exeter, University of Manchester, University of Strathclyde and Imperial College London.

<table>
<tr><td>Project Title</td><td colspan="4">***IFI 0621-2 LV Sure***</td></tr>
<tr><td>Description of project</td><td colspan="4">The development of LV Sure will take the SignalSure concept of circuit restoration and consider whether it could be applied to low voltage distribution networks. The project’s objectives are to:
• Produce functional specification, detailed product development project plan & test plan for the LVSure system
• Production of a prototype LVSure System and laboratory testing of the system
• Installation and testing of prototype on a representative test circuit
• Monitoring, evaluation and reporting of the performance of the trial system against functional specification
• Installation and demonstration of a number of prototypes on a selection of LV Networks</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £7,419
External £12,556
Total £19,974</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £0
External £0
Total £0</td></tr>
<tr><td>Project Cost</td><td>£260,980</td><td>Projected 2012/13 costs for SPEN</td><td colspan="2">Internal £4,000
External £26,380
Total £30,380</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The LVSure system comprises a source breaker, the Intelligent Fuse Unit (IFU); plus a number of mechanical isolating switches, or Intelligent Link Units (ILUs) installed at strategic positions along the LV circuit.
Isolation of the faulted section and restoration of supply to un-faulted sections of the circuit is fully automated and does not require communication between the devices which comprise the LVSure system.
When a fault occurs on the LV network the IFU disconnects supply to the entire circuit. The ILUs along the route, sense no voltage and automatically open, in effect sectioning the circuit. Both the IFU and the ILU incorporate sensing circuitry which tests for the presence of a fault on the electrical section downstream of each Unit. The IFU would commence the restoration process by testing downstream and if healthy would restore supply to the first section. Each ILU in turn would initially sense it has an incoming voltage, then test downstream and again, if healthy, restore supply. This would continue until the faulted section was reached when testing would inhibit the ILU from closure. Circuits with an alternative supply from a remote end could complete the restoration process until all sections had supply restored except the faulted section.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Tech Transfer
Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>16</td><td>-1</td><td>17</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Successful completion of the project will result in:
• Knowledge of how to reconfigure and redesign LV networks to obtain optimum performance will be developed and transferred to the DNO.
• Avoid potential hazard of operator installing a replacement fuse of a live LV board with a faulted circuit.
• Assuming installation on worst performing (Rogue) LV circuits avoiding CML and CI associated with up to 5 transient interruptions per year per LV circuit would substantially and sustainably improve network performance for worst served customers.
• Reduction in potential risks from loss of traffic controls, street lighting, general lighting in public areas etc.</td></tr>
</table>

Expected Timescale to adoption	1 years	Duration of benefit once achieved	15 years
Probability of Success	10%	Project NPV = (PV Benefits – PV Costs) x Probability of Success	£245,517
Potential for achieving expected benefits	During the initial Stage 2 phase it was agreed that the project had delivered successful functional results but issues of thermal dissipation due to the use of power electronic switching components in a very small device envelope represented an additional design challenge. An alternative operational technology has been identified which will allow the use of a much smaller contractor to switch off the residual current. If this technology is tested and is confirmed as being suitable for use on LV networks the next steps will be to test the technology at high power laboratories and to develop a prototype.		
Project Progress to March 12	• The initial prototype design and testing as outlined in Stage 2 was completed in June 2011 • An extension to Stage 2 (Stage 2a) was proposed. The proposal was to carry out a feasibility study to investigate if reducing the physical size of the power electronics device was possible, by applying alternative technologies. • Stage 2a was completed successfully and has led to the next stage being about to start which is to design a fault current limiter based on the alternative operational technology which has already been identified as part of Stage 2a.		
Collaborative Partners	Scottish Power, SSE, Surenet Technology Ltd, Energy Innovation Centre		
R&D Providers	Surenet Technology Ltd		

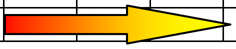
<table>
<tr><td>Project Title</td><td colspan="4">***IFI 0621-3 Live Alert – Energised Alert***</td></tr>
<tr><td>Description of project</td><td colspan="4">The Energised Alert is a high voltage detection device, currently capable of detecting voltages of above 2kV. The project's objectives are to:
• To extend the voltage sensing range downwards from 2000 Volts
• To undertake a full market appraisal
• To undertake full evaluation of technology whilst in operation
• This project aims to take the Energised Alert from TRL 4 to 8.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="2">Internal £7,419
External £186
Total £7,604</td><td>Expenditure in previous IFI financial years</td><td>Internal £8,440
External £17,382
Total £25852</td></tr>
<tr><td>Project Cost (Collaborative + external + [DNO])</td><td colspan="2">£ 65,815</td><td>Projected 12/13 costs for SPEN</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The Energised Alert senses any increase in electrical potential, above a predetermined threshold, of devices to which it is attached. Once triggered it is linked to an audible alarm, allowing the recognition and management of this potentially deadly hazard in a controlled manner. Its use will, therefore protect the operator, other employees and any members of the public in the vicinity from casual, but more importantly, avoidable electrocution.</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>-5</td><td>19</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Successful development of the Energised Alert would:
• Help prevent electrocution accidents and fatalities
• Ensure 'live line' maintenance can be carried out in a safe manner
• Allow operators to proactively respond to incidents on their network</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">1 Year</td><td>Duration of benefit once achieved</td><td>25 Years</td></tr>
<tr><td>Probability of Success</td><td colspan="2">75%</td><td>Project NPV = (PV Benefits – PV Costs) x Probability of Success</td><td>£227,017</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">The project is on target to achieve the expected benefits.</td></tr>
<tr><td>Project Progress to March 12</td><td colspan="4">• Stage One of the project, to design and develop the sensing system was completed successfully and met the deliverable set at the start of the project.
• Stage Two, to design and develop a refined was completed successfully and met the deliverable set at the start of the project.
• Stage Three, to manufacture and evaluate 10 energised alerts units is nearing completion. All units have now been manufactured however Stage Three can't be completed until the pilot sites for Stage Four have been agreed.
• The scope of Stage 4 is currently under review.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">Northern PowerGrid, Electricity North West, Scottish Power, SSE, Energy Innovation Centre, Live Alert</td></tr>
<tr><td>R&D Providers</td><td colspan="4">Live Alert</td></tr>
</table>

Project Title	***IFI 0621- 4 PURL2***			
Description of project	EA Technology currently offers the PURL instrument to allow condition assessment of wooden poles and while the instrument performs this function well it is slow and complex to use and only makes use of a single measurement technique to make the assessment. Other instruments are currently available, however, these also base the estimate of pole strength on a single measured parameter; a few instruments use two (for example moisture content and fibre strength). A further major disadvantage with many of these instruments is that they physically damage the pole in order to make the measurement, therefore requiring ongoing maintenance e.g. annual Boron treatment. PURL2 will make use of four measured parameters to increase measurement accuracy and reduce uncertainty. The techniques used for all measurements will have no more effect on the surface of the pole than standard climbing spikes so minimising ongoing maintenance requirements. All measurements will also be time and location stamped which, when combined with wired and wireless connectivity, will allow integration into field and office based asset management systems.			
Expenditure for financial year	Internal £9,162 External £142,186 Total £151,347	Expenditure in previous (IFI) financial years	Internal £0 External £0 Total £0	
Project Cost (Collaborative + external + SPEN)	£ 284,000	Projected 2012/13 costs for SPEN	Internal £12,500 External £120,000 Total £132,500	
Technological area and / or issue addressed by project	The new PURL will combine the existing ultrasonic attenuation measurement technique with measurements of ultrasonic time of flight, water content and surface hardness to provide a more accurate and reliable assessment over a wider range of degradation types and environmental conditions. More advanced coupling techniques would be used to speed up and simplify the measurement process compared to the current instrument.			
Type(s) of innovation involved	Significant	Project Benefits Rating	Project Residual Risk	Overall Project Score
		16	3	19
Expected Benefits of Project	PURL 2 will represent a real advance on the current technology available and should result in more efficient, more accurate and less damaging condition assessment of wood poles. The benefits of this should be: • Better use of inspection team resource • More effective identification of failing poles and therefore:- • Reduced failure of wood poles which will result in:- • Reduced CMIs/CLs, which in combination with the above will result in:- reduction in overall cost			
Expected Timescale to adoption	1 Year	Duration of benefit once achieved	10 Years	
Probability of Success	10%	Project NPV = (PV Benefits – PV Costs) x Probability of Success	£738,046	

Potential for achieving expected benefits	Project started in September 2011, potential for achieving expected benefits as per above probability of success.
Project Progress to March 12	Stage One of the project to develop a PURL2 prototype has started. Four of the six tasks of stage one have been started.
Collaborative Partners	SP Power Systems, SHEPD, Energy Innovation Centre
R&D Providers	EA Technology Limited

<table>
<tr><td>Project Title</td><td colspan="12">IFI 0625 - Vegetation Management - ADAS</td></tr>
<tr><td>Description of project</td><td colspan="12">Vegetation management in the vicinity of overhead lines represents a significant maintenance requirement and associated budget spend. While there is an on-going commitment to this issue, it is recognised that a better understanding of vegetation growth rates would greatly assist in vegetation management strategies and decision making; helping direct the focus of activity.

The project will seek to develop a software model that will analyse the relationships between key environmental variables (including the potential impact of climate change) and vegetation growth rate, for different vegetation types. The model will be used to consider the costs and benefits of undertaking vegetation management to different specifications.

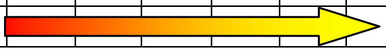
Following tree cutting at selected sites the model will be validated against the first year of growth data, which will be determined by laser measurement. The model will subsequently be optimised based on annual growth rates determined over a further three-year period.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="3">Internal £11,863
External £6,848
Total £18,710</td><td colspan="4">Expenditure in previous (IFI) financial years</td><td colspan="5">Internal £21,376
External £351,537
Total £371,914</td></tr>
<tr><td>Project Cost (Collaborative + external + SPEN)</td><td colspan="3">£1,744,000</td><td colspan="4">Projected 12/13 costs for SPEN</td><td colspan="5">Internal £0
External £0
Total £0</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="12">• This project is a UK wide study into the differing growth rates experienced in the 26 “bio-climatic” zones that are found across the country.
• It will involve cuts made to 2000 sample areas across the identified zones to a common specification, followed by monitoring to confirm growth.
• The output is expected to lead to modelling software that can portray different cut cycles.
• The common UK project should provide further evidence / justification in future Price Control Reviews.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="3">Incremental</td><td colspan="3">Significant</td><td colspan="3">Technological substitution</td><td colspan="3">Radical</td></tr>
<tr><td colspan="3">No</td><td colspan="3">Yes</td><td colspan="3">No</td><td colspan="3">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="12">• The model developed will identify areas that will require more frequent tree cutting to maintain safe clearance distances and meet legal requirements.
• Evidence-based decisions on the frequency and location of tree cutting will enhance network resilience and therefore improve security of supply and associated regulatory performance (CI and CML savings).
• Improved targeting of OPEX may be realised through proactive cutting and extending the cutting cycle in high and low growth areas respectively.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="3">2 Years</td><td colspan="4">Duration of benefit once achieved</td><td colspan="5">20 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td colspan="3" rowspan="3">75%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td colspan="3"></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="7">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="5">£681.3k</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="12">The software model is now available for application by the project partners. The developed software model will help to inform decision making with regard to current and future vegetation management optimisation.</td></tr>
</table>

Project Progress March 12	A full report describing this four year project and its findings was issued in February 2012. The work undertaken determined the average annual growth rate of vegetation with respect to utility space, the physical volume occupied by a utilities facilities and the additional space required to ensure its safe and reliable operation, degradation (USD). Regional variations in USD where calculated with sites located in the warmer areas of southern England, experiencing the average highest rates of vegetation growth and the lowest observed at relatively cooler ScottishPower sites in Scotland. The impact of Climate change predictions out to 2080 on USD across the UK were considered along with different species growth rates. These and other variables that impact the vegetation growth rates were included in a software model that can be used to shape future vegetation strategies in utility areas.
Collaborative Partners	Electricity North West, Scottish and Southern Energy, Central Networks and National Grid.
R&D Providers	ADAS

<table>
<tr><td>Project Title</td><td colspan="5"><i>IFI 0701 - ENA IFI Projects</i></td></tr>
<tr><td>Description of project</td><td colspan="5">The Energy Networks Association (ENA) represents all the UK network operators. Several projects have been initiated by the ENA R&D Working Group and have been funded through the IFI.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal
External
Total</td><td>£7,419
£7,657
£15,076</td><td>Expenditure in previous (IFI) financial years</td><td>Internal
External
Total</td><td>£16,516
£62,609
£79,126</td></tr>
<tr><td>Project Cost</td><td colspan="2">c£50,000</td><td>Projected 2012/13 costs for SP-EN</td><td>Internal
External
Total</td><td>£7,500
£35,000
£42,500</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="5">
Harmonic Impedance Modelling – The project addresses the detailed modelling of cable and overhead line components, to develop cable models appropriate for distribution networks.
Earthing Project – The aim is 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.
KEMA "Cool Use of Energy" Reports 1 and 2 - Support a number of ENA/ERA (Energy UK) joint Demand Response workshops which developed a list of requirements that can be considered as key tasks to transform the traditional power sector.
KEMA Smart Grids Standards Review – Aim to focus on the impact of developments of the above standards (excluding commercial standards), on the UK electricity networks community, which will be affected profoundly by these activities.
KEMA Cyber Security Report - Provide an approach and management framework to address the cyber security challenges face nationally by the Distribution Network Operators (DNOs) as the current network infrastructure is developed with new Smart Grid systems and technologies.
Redpoint Scenarios - Survey the studies of future energy provision in the UK currently in the public domain and produce a common stance on investment requirements.
Engage Access to Data - Identify the key smart metering and smart grid benefits that network operators will need to deliver to support the Government’s low carbon agenda efficiently.
Engage Privacy Impact Assessment - Assess the privacy issues surrounding the use of smart meter data by NOs and identify measures that can be taken to mitigate stakeholder concerns.
Telent Smart Grid Communications - Survey the DNO communications managers to understand both the extent of existing communications deployment/penetration on electricity networks and their aspirations for extending that deployment.
KEMA LCNF Catalogue – Develop the first stages of a GB Smart Grid Coverage Catalogue, focussing on Low Carbon Network Fund (LCNF) Tier 1 and Tier 2, and the Innovation Funding Incentive (IFI) funded Registered Power Zones (RPZ) projects.
KEMA OTEG Report - Explore a number of innovative Web based solutions to presenting the progress of LCNF projects including video recordings by engineers and managers involved in the process.
Smart Grid Forum Workstream 3 Phase 1 & 2 – Takes the impact of UK’s future energy scenarios into key strategic directions for network development, identifying the needs for network expansion and the opportunities for smart grid techniques to drive cost-efficiency and deliver new services. It considers the enablers for change, including the necessary development of commercial and regulatory frameworks.
</td></tr>
</table>

<table>
<tr><td rowspan="2">Type(s) of innovation involved</td><td>Incremental</td><td colspan="3">Significant</td><td colspan="3">Technological substitution</td><td colspan="3">Radical</td></tr>
<tr><td>Yes</td><td colspan="3">Yes</td><td colspan="3">No</td><td colspan="3">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="10"><u>Earthing Project:</u>
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.

<u>Climate Change and Network Resilience Project:</u>
The result of this project and subsequent benefits will inform Licensee's strategy with regard to IIP performance incentives which impact on Price Controls, system planning studies and operational preparedness for extreme weather events.

<u>Smart metering studies:</u>
Analysis work by Imperial College into the expectation of demand increases due to the penetration of Electric Vehicles and Heat Pumps and impact on the network and the benefits of a smart grid.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>1 - 10 Years</td><td colspan="4">Duration of benefit once achieved</td><td colspan="5">10 – 40 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">25 - 75%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td colspan="6"></td><td></td><td></td></tr>
<tr><td>Project NPV</td><td>(Present Benefits x Probability of Success) – Present Costs</td><td colspan="9">£255,876
Note – Project costs include implementation and have been calculated by the ENA assuming a typical distribution license area.</td></tr>
<tr><td>Project Progress March 12</td><td colspan="10">Project progress is available on the ENA website or by emailing SPinnovation@spenergynetworks.com</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="10">Work on the Harmonic Impedance Modelling (G5/4) will help DNOs understand harmonics issues on distributed networks and produce a revised revision of G5/4. The Earthing Transfer Potential projects will assist transmission operators to understand earthing issues in differing situation.

The remaining projects are still in progress and it is hoped they will demonstrate the benefits explained.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="10">National Grid, ScottishPower Energy Networks, Scottish and Southern Energy, Electricity North West, Western Power Distribution, Northern Powergrid</td></tr>
<tr><td>R&D Providers</td><td colspan="10">TNEI, Engage Consulting Limited, Imperial College London, Met Office, EA Technology Ltd, Earthing Solutions, KEMA, Redpoint Energy</td></tr>
</table>

<table>
<tr><td>Project Title</td><td colspan="4">***IFI 0711 - 3rd Party ROEP Risk Assessment***</td></tr>
<tr><td>Description of project</td><td colspan="4">The development of the so-called ‘Stage I’ for risk assessment of earthing systems, using a new concept of safety limit curves, where standard fault clearance times are used, was achieved under National Grid research project NSETS180 in collaboration with Scottish Power, and was completed in Autumn 2006. The Stage I risk assessment enables broad classification of substations into low/high risk categories for Rise of Earth Potential (ROEP). The theoretical studies to develop a Stage II probabilistic-based risk assessment, which includes the use of historical operational clearance times, are now under development at Cardiff University.

In this project, it is proposed to conduct pilot studies, which allow initial implementation of the developed ‘Stage I’ technique at identified key National Grid substations (4 to 5 sites). This will allow a refined quantification of risk in relation to the ALARP levels. In addition, a user-friendly procedure will be developed to allow easy and quick assessment of sites. The ultimate purpose of the research is to provide better information to engineers making decisions on investment for earthing reinforcement schemes.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £ 9,218
External £ 186
Total **£ 9,403**</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £ 30,018
External £ 88,890
Total **£ 118,909**</td></tr>
<tr><td>Total Project Costs</td><td>Stage 1 - £100,000
Stage 2 - £150,000</td><td>Projected 2012/13 costs for SPEN</td><td colspan="2">Internal £ 10,000
External £40,000
Total **£ 50,000**</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">This software package will allow SPEN to assess current sites to determine whether or not there is a touch/step issues within the substation and a danger of third party exposure to ROEP.</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>**10**</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">There are many sites in Scotland and Manweb where the existing sites do not have earthing that has been installed to the current standard. System fault levels have been increasing due to the significant amounts of renewable generation that has been connected (with bigger schemes in the construction and planning stages). If current system fault levels are applied to these sites there is a potential that the touch/step voltage levels will be too high to allow work to commence without further costly mitigation measure being implemented. This tool would allow an assessment to be made of what the probability would be of a life-threatening fault appearing at the substation so that the appropriate corrective action can be taken. The user friendly interface package will allow SPEN staff to carry out assessments of earthing systems using statistical fault levels and clearance times values as opposed to worst case.
By being better equipped to assess the potential risk posed by existing substation earthing arrangements appropriate steps can be taken, which could be the avoidance of unnecessary expenditure on inappropriate mitigation measures.
The software analysis will help to justify Third party mitigation measures.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>1 Year</td><td>Duration of benefit once achieved</td><td colspan="2">4 Years</td></tr>
</table>

<table>
<tr><td>Probability of Success</td><td>75%</td><td>Project NPV = (PV Benefits – PV Costs) x Probability of Success</td><td>£ 15,562</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="3">Potential – The project is progressing to a next stage where the following items will incorporated into the software:
- Set up of fault clearance time database
- Calculate variation in fault current magnitude and its effect on prediction of individual risk
- Apply extended computer procedure to several case</td></tr>
<tr><td>Project Progress March 2012</td><td colspan="3">This project is now complete. Follow up research works have been commissioned and agreed (April 2012) with Cardiff University to investigate the following:
1. Apply the approach developed in this study to the following situations:
- Potentials exported out with the substation.
- Locations or point within the substation.
2. Update the software for revised IEC/CENELEC standards.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="3">National Grid</td></tr>
<tr><td>R&D Provider</td><td colspan="3">Cardiff University High Voltage Energy Systems research group (Manu Haddad & Huw Griffith).</td></tr>
</table>

Project Title	***IFI 0712 - BT 21st Century Protection Solutions (BT21CN)***			
Description of project	The change of BT's network to an IP based system (BT21CN) is posing some significant risks to the performance reliability of the SP-M and SP-D electricity networks. In particular SP-M relies heavily on 3rd Party leased services from BT as the communications for the 33kV network protection in rural areas. The strategy to mitigate the problem has been developed based on the utilisation of a range of communications solutions (fibre, radio, power line carrier in addition to technically/commercially suitable BT services) in a coordinated manner. Whilst this strategy has been agreed in principle, there are several technical challenges associated with several of the solutions. This project aims to provide the detailed and engineered communications channels that underpin the toolbox of solutions to mitigate the problems associated with BT21CN.			
Expenditure for financial year	Internal £14,408 External £26,305 **Total £ 40,713**	Expenditure in previous (IFI) financial years	Internal £ 66,254 External £ 197,724 **Total £ 264,005**	
Total Project Costs	**£114,000**	Projected 2012/13 costs for SPEN	Internal £ 0 External £ 0 **Total £ 0**	
Technological area and / or issue addressed by project	This project aims to access the feasibility of using alternative communications solutions to mitigate the problems associated with BT21CN. Scope currently under consideration includes: • Power Line Carrier deployment at 33kV combining protection and SCADA signalling • Small development works to facilitate intra-substation communications • IP based protection signalling mediums and associated security implications • Options for alternative communication channels for shared services • Implications for the network in no cost effective solutions are realised			
Type(s) of innovation involved	Significant / Technology Transfer	Project Benefits Rating	Project Residual Risk	Overall Project Score
		21	2	19
Expected Benefits of Project	There are many sites in SP-M where there is no Line-of-Site for radio communications and fibre installations are extremely expensive due to excessive circuit lengths. In such sites Power Line Carrier (PLC) or Leased services are the only feasible communication mediums for protection signalling. PLC is typically deployed at higher voltage levels, additionally some development work facilitated in a trial would be required to accommodate protection and SCADA data on the same link however this could deliver a more cost effective alternative to fibre or BT SDH leased services. Power Line Carrier although a viable solution has some limitations, which restrict its use on the network, mainly mid-circuit transitions (OHL – Cable), which cause the signals to reflect. Where PLC cannot be deployed alternative will require consideration. Leased services (or no communications at all) are the only alternatives to expensive infrastructure at some sites. SDH services can be expensive in terms or both CAPEX and OPEX. BT are likely to offer IP based products in the future (products not currently used with protection). If development is carried out to facilitate the use of IP based products for signalling purposes factoring in security considerations then it may be possible to leases services at significantly reduced CAPEX and OPEX costs.			
Expected Timescale to adoption	1.5 Year	Duration of benefit once achieved	15 Years	

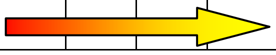
<table>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">50%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>—</td><td>→</td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="5">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="5">£951,763</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="10">In areas of the network where protection signalling cannot be delivered via channels currently considered for use with protection devices without significant expense, leased communications are the only option. Should a suitable leased or alternative communication bearer be unavailable then significant investments in fibre optic installation will be required.</td></tr>
<tr><td>Project Progress March 2012</td><td colspan="10">In accordance with the output from the Desktop and Line-of-Sight Surveys, Airwave has provided the Teleprotection circuit between substation sites located at Kilbirnie and Stewarton.

The circuits have been provided by dedicated multiplexed channels offering a bandwidth of 64Kbps. The circuit has been designed such that the expected latency should be not greater than 30 milliseconds.

At each end of the circuit, a 1.4GHz narrow band radio link was used from the SPEN’s premises to the most suitable Airwave Base Station, and thenceforth across the Airwave network to the other substation site.

The technical trial of Airwave has concluded however there are significant commercial issues with the productisation of the service by Airwave that have precluded further deployment. The next phase of the project is to establish the feasibility of low cost fibre solutions; so far the use of fibre in sewer pipes has been explored via a desk top exercise with Scottish Water. Unfortunately only sewer pipes of a significant diameter can be considered, these are typically within urban areas SPENs BT 21CN requirements are typically within rural areas and hence there are little or no synergies.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="10">N/A</td></tr>
<tr><td>R&D Provider</td><td colspan="10">RFL / C & W / Radius / Tait / others TBC, AIRWAVE</td></tr>
</table>

Project Title	***IFI 0713 - Wide Area Monitoring, Protection & Control (WAMPAC) for GB and IRL***			
Description of project	Market driven grid management has increased the number of renewable/distributed generation sources, introduced complexities to address reactive support and progressively stress transmission networks. This has increased the complexity of operation, monitoring, control and protection of large interconnected electric power systems considerably. The penetration of renewable generation is increasing and there are targets set for connection of future renewable sources. At the same time the Transmission Owner (TO) is faced with an increasing need for construction outages to deliver network reinforcement and existing asset replacement which will result in reduced circuit availability. These factors will lead to much less predictable operating scenarios and therefore greater dependence on real-time support tools to observe and manage the condition of the network. The increase in this uncertainty could result in transmission instability in the near future, however Wide Area Measurement Systems (WAMS) employing SynchroPhasor Measurement Units (PMUs) are becoming increasingly deployed world wide as a cost effective commercially available technology. A trial using the Psymetrix Phasorpoint Monitoring System will be installed to gather data from up to 15 sites with PMU capability. This will involve the installation of Psymetrix software on a server that will connect to the PMU's and recover in real time phasor data. This data will be stored for post transient evaluation so that system performance can be analysed and determine the frequency modes present in the network. A WEB interface will be installed at the Operational Control Centre (OCC), Cambuslang and Bellshill to evaluate the real time delivery of the data and visualise the system performance in real time and post event.			
Expenditure for financial year	Internal £ 7,419 External £ 62,339 **Total £ 69,757**	Expenditure in previous (IFI) financial years	Internal £ 16,537 External £ 5,060 **Total £ 21,597**	
Total Project Costs	**£ 59,715**	Projected 2012/13 costs for SPEN	Internal £5,000 External £ 27,000 **Total £ 32,000**	
Technological area and / or issue addressed by project	SPT is obliged under its licence and the Electricity Act to develop an efficient, co-ordinated and economic system of electricity supply. Power-grid congestion issues and disturbances worldwide have emphasized the need to enhance power grids with smart applications (SmartGrids, Flexnet, and Intelligrid), providing decision support to operators and automation to ensure optimum use of assets, whilst maintaining system security and plant and circuit thermal limits. This work will support the development of next generation data and communications infrastructures for smart applications.			
Type(s) of innovation involved	Incremental	Project Benefits Rating	Project Residual Risk	**Overall Project Score**
		13	-9	**22**

<table>
<tr><td>Expected Benefits of Project</td><td colspan="10">As a safety net for the management in future uncertainties in system stability particularly on the England-Scotland interface. This is achieved by better understanding of the current capability and stability of the GB and Irish transmission networks, considering constraints, intermittent generation and changing generation and demand patterns.
Knowledge of the current network conditions will allow future development of smart protection, control and automation applications and will ensure the network is ready and able to accommodate new generation in line with SmartGrid and Intelligrid initiatives.
The successful application of Wide Area Monitoring is seen to be a major factor in managing the risks and opportunities and to facilitate the connection of renewable and intermittent generation.
A better understanding of system conditions and margins will enable better use of available network capacity and constraints and ensure that plant operates safely within its capability and design limits
This project has the potential to create a cost effective method of predicting and identifying a very high impact, low probability event and contributes to better informed asset management.
The project will support the system reinforcement programme, ensure better use of existing assets and provide an alternative to Operational Tripping and Remedial Action schemes, which are required to manage thermal and stability constraints.
Typically the Financial Benefits will be achieved through avoided investment in infrastructure reinforcement and replacement as part of the current Capital programme.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>4 Years</td><td colspan="4">Duration of benefit once achieved</td><td colspan="5">10 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">75%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td colspan="4"></td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="3">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="7">No NPV calculated for this limited trial</td></tr>
<tr><td>Project Progress March 2012</td><td colspan="10">The University of Manchester project has been extended for a further 6 months, with the PhD thesis summary due in July.</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="10">While existing network development and management is well developed, increasing operating uncertainties due to increasing renewable penetration will lead to a greater dependence on real-time support tools.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="10">National Grid, Scottish Power, Scottish and Southern Electricity, Northern Ireland Electricity and ESBI (Ireland).</td></tr>
<tr><td>R&D Provider</td><td colspan="10">University of Manchester
Areva, Siemens and ABB who will supply and install the phasor measurement units.</td></tr>
</table>

<table>
<tr><td>Project Title</td><td colspan="4">IFI 0801 - IEC 61850 Application in SP - Transmission</td></tr>
<tr><td>Description of project</td><td colspan="4">The key objective of this project is to maximise economic and effective utilisation of the transmission asset and network. The deployment of the technology advocated for this IFI project will allow ongoing substation secondary equipment retrofitting (refurbishment) projects to proceed whilst limiting the duration and frequency of circuit outages, required to facilitate the work.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £8,750
External £36,863
Total £45,612</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £24,937
External £65,271
Total £90,209</td></tr>
<tr><td>Total Project Costs</td><td>£455,000</td><td colspan="2">Projected 2012/13 costs for SPEN</td><td>Internal £4,000
External £12,000
Total £16,000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">Project 1 (IFI 0801-1) – Microsol
This proposal is twofold, to develop, test and commission the IEC Protocol on the Microsol RTU to allow us to trial interfacing to two specific devices at two specific locations, namely:
a) Busby 275kV Hathaway Fault Recorder.
b) Strathaven 400kV Operational Intertripping Relay.
At Busby 275kV we propose to recover all the Analogue information from the fault recorder, this will allow us not only to present more information to the Control Engineers in real time, it will eliminate any issues with faulty transducers, faulty resistor scaling and faulty wiring.
Project 2 (IFI 0801-2) - University of Manchester and NGC
This IFI application aims to investigate, quantify and optimise the level of security, dependability and speed in secondary schemes using IEC 61850. This project is strategically aligned with Iberdrola Networks and will provide procurement benefits.
Project3 (IFI 081-3) – “Hardfibre” Process Bus Field Trial & RTDS Testing
GE Multilin are first to market with IEC61850-9-2 products and the proposal is to undertake a field trial at the new Inverarnan 275kV substation and to perform RTDS testing of the scheme. This will achieve the following objectives:
Proof that the protection performance of a process bus system is at least equal to conventional schemes
To gain experience of the installation, configuration and operation of a process bus system.
To measure the time and cost benefits of process bus.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental
Tech Transfer
Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>17</td><td>-7</td><td>24</td></tr>
</table>

<table>
<tr><td>Expected Benefits of Project</td><td colspan="10">In summary, if this protocol is developed, implemented and tested and commissioned successfully on our Microsol RTU then it gives us some real flexibility for the future and will fundamentally influence decisions regarding substation design and choice of relay manufacturer, and will have the added advantage of allowing us to cease the highly expensive option of flood wiring with multi-core copper cables within the substation environment and adopting a LAN approach to comms and data capture.

However, IEC61850 also offers benefits in the protection realm. The use of GOOSE services has been demonstrated (in the West Coast operational Intertrip scheme) to provide significant performance benefits over hard-wiring and significantly reduced installation and testing times as much of the scheme functionality can be factory tested. Additionally, part 9-2 permits the use of a process bus which can, in addition to reduced wiring, provide additional reliability and the future promise of outage-free protection replacement.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>1 Year</td><td colspan="4">Duration of benefit once achieved</td><td colspan="5">10 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">75%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td colspan="5">→</td><td></td></tr>
<tr><td>Project NPV</td><td colspan="6">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">No NPV calculated for this limited trial</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="10">The University project Evaluation of IEC61850-9-2 Process Bus and Its impact on Substation Protection and Control Reliability is now coming to a close with the final report due mid 2012.

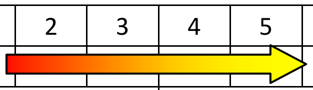
It is hoped than the learning from the project will give guidance on SPs direction in the use of IEC61850</td></tr>
<tr><td>Project Progress March 2012</td><td colspan="10">Project 1 and 3 are now closed and have proven to be successful. There is still some work to be carried out to fully integrate within SPENs networks</td></tr>
<tr><td>Collaborative Partners</td><td colspan="10">Project 1 and 3 none, Project 2 Manchester University, SSE, NGC</td></tr>
<tr><td>R&D Provider</td><td colspan="10">Manchester University</td></tr>
</table>

<table>
<tr><td>Project Title</td><td colspan="12">***IFI 1001 – Offline Planning Tool for Dynamic Thermal Rating***</td></tr>
<tr><td>Description of project</td><td colspan="12">The dynamic thermal rating (DTR) concept is based on the observation that the first limit for the current carrying capacity of a circuit is its temperature, influenced by its ability to dissipate to the environment the heat produced by the joule effect, and by external conditions such as ambient temperature, or wind speed, which are constantly varying. Even though the mechanisms of heat exchange involved are well understood, determination of the correct value of the circuit temperature is non-trivial. For this reason, static ratings based on the worst case scenario are often used.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="4">Internal £17,539
External £10,186
Total **£27,724**</td><td colspan="4">Expenditure in previous (IFI) financial years</td><td colspan="4">Internal £6,092
External £11,700
Total **£17,793**</td></tr>
<tr><td>Project Cost</td><td colspan="4">**£121,500**</td><td colspan="4">Projected 12/13 costs for SPEN</td><td colspan="4">Internal £3,000
External £10,000
Total **£13,000**</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="12">The implementation of a DTR system in an electrical network could potentially increases its average rating whilst also reducing, the risk of component thermal overload. However, successful implementation requires a number of challenges to be overcome. Not least the measurement, estimation and communication of real time component temperatures and prevailing weather conditions over a wide geographical area containing a significant number of power system components distributed around a complex terrain.

A successful DTR system could be used as a decision support tool for Distribution Network Operators (DNO). This tool could be used both at the planning stage and in real time within potential future active network management philosophies in order to safely increase the utilization of power systems and facilitate distributed generation (DG).</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="3">Incremental</td><td colspan="3">Significant</td><td colspan="3">Technological substitution</td><td colspan="3">Radical</td></tr>
<tr><td colspan="3">No</td><td colspan="3">No</td><td colspan="3">Yes</td><td colspan="3">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="12">Durham University are already working with Scottish Power and Astrium on a TSB project to investigate the use of DTRs for electrical distribution networks in order to accommodate increased levels of DG safely and cost effectively.
The aim of this phase of the work is to carry out further research and development work to build upon the achievements so far, ensure continuity and to avoid the loss of vital knowledge gained by the PhD researchers. The primary deliverable will be an offline tool to:

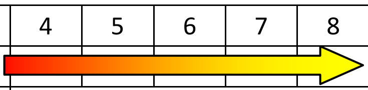
1. Allow SP planning engineers to evaluate the likely headroom which could be exploited through the adoption of DTR systems over a wide range of existing SP distribution networks.
2. Make use of historical power flow and meteorological data as well as terrain and vegetation information.
3. Estimate the ratings of overhead lines, underground cables and transformers over a wide area of distribution network and present these estimates in the form of a probability distribution function. **(In this document ‘Distribution Network’ refers to networks with voltages up to and including 132kV)**
4. Carry out thermal estimates for a wide range of types and configurations of overhead lines, underground cables and power transformers.
5. Allow calculations to be made regarding the potential additional energy that could be accommodated by the power system when dynamic ratings are adopted.</td></tr>
</table>

<table>
<tr><td>Expected Timescale to adoption</td><td>4 Years</td><td colspan="4">Duration of benefit once achieved</td><td colspan="5">10 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">Projects with various probabilities of success will be considered</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td>→</td><td>→</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="5">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="5">£58,587</td></tr>
<tr><td>Project Progress
March 12</td><td colspan="10">Significant simulation work has been carried out so far using state-of-the-art computational fluid dynamic (CFD) techniques and high resolution terrain topology mapping (primarily height and surface roughness) in order to model the wind behaviour. The current work is focussing on developing wind-speed/direction look-up tables based on the above, with the aim of enhancing the accuracy of the current inverse distance interpolation method of wind speed/direction estimation. Further sensitivity analysis is being carried out to identify the key factors which determine the accuracy of the new estimation algorithms and further refine the techniques currently being employed in order to optimise their performance.</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="10">Having an offline planning tool for analysing the dynamic ratings of circuits will enhance our ability in understanding the impact of utilising these technique in real time and power flow analysis. The tool will assist in the analyses and management of constraints in the network and also support design engineers to make informed decisions with regards to enhanced dynamic rating for circuits and their impact on the network, power flow and constrains on embedded generation.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="10">Astrium, Durham University</td></tr>
<tr><td>R&D Providers</td><td colspan="10">Durham University</td></tr>
</table>

<table>
<tr><td>Project Title</td><td colspan="10"><i>IFI 1002 - Supergen HiDEF</i></td></tr>
<tr><td>Description of project</td><td colspan="10">The Highly Distributed Power Systems Consortium have developed plans for renewal that will demonstrate a radical vision of a highly distributed energy future that enables all end users to participate in system operation and real time energy markets and thereby more fully exploits the potential of distributed generation and active load resources to deliver a more sustainable and resilient provision of energy for the future</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="2">Internal £14,075
External £5,185
Total £19,260</td><td colspan="4">Expenditure in previous (IFI) financial years</td><td colspan="4">Internal £6,092
External £15,380
Total £21,472</td></tr>
<tr><td>Project Cost</td><td colspan="2">£4,492,000</td><td colspan="4">Projected 12/13 costs for SPEN</td><td colspan="4">Internal £3,000
External £20,000
Total £23,000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="10">This Highly Distributed Energy Future (HiDEF) programme researches the essential elements of a decentralised system that could be implemented over the period 2025 & 2050, but at the same time has been structured to support the evidence base relating to key questions of current concern within the stakeholder community and in this way its relevance extends beyond the limits of its decentralised system vision. In concept, the research vision is one of decentralised resources, control and market participation extending to include end users at system extremities.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="2">Incremental</td><td colspan="3">Significant</td><td colspan="3">Technological substitution</td><td colspan="2">Radical</td></tr>
<tr><td colspan="2">Yes</td><td colspan="3">No</td><td colspan="3">No</td><td colspan="2">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="10">The project has a strong academic and industrial representation and will strengthen SPEN’s engagement into the future of network systems and the influences of developments across the supply chain. In general the benefits will entail:
• The engagement with academia and industry into the understanding of the impact of a future decentralised system.
• The impact of a decentralised system on networks infrastructure, operation and control.
• The impact of a decentralised system on regulatory and commercial frameworks.</td></tr>
<tr><td>Expected Timescale to Adoption</td><td>9 years</td><td colspan="4">Duration of benefit once achieved</td><td colspan="5">7 years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">25%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td colspan="4"></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="4">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="6">£78,648</td></tr>
<tr><td>Project Progress March 2012</td><td colspan="10">PV Penetration study – a study and working tool has been developed to enable planners to quickly assess the impact of connecting small scale PV in housing estates in the Manweb area. This report has now been delivered along with an Excel based PV voltage rise tool that has been used by SP Manweb to allocate >2,000 ‘clustered’ PV installations.</td></tr>
</table>

Potential for achieving expected benefits	SP Distribution and SP Manweb networks, and to some extent SP Transmission will benefit from the insight into a power network well into the future and the challenges that it might bring. It is envisaged that this applied research project will be useful for future Price Control discussions, particularly in the areas of smart applications, regulatory and commercial structures. The project is academic in nature but at the same time taking into consideration current developments in areas such as smart meters, demand side management and micro generation among many others. **Project Addition** The PV report and voltage rise tool has been used by SP Manweb to allocate >2,000 ‘clustered’ PV installations delivering significant benefit to SP Manweb and the UKs energy targets.
Collaborative Partners	EDF, Areva, Rolls Royce and many other SMEs
R&D Providers	University of Strathclyde (Lead), Imperial College, Oxford University, Cardiff University, University of Bath

<table>
<tr><td>Project Title</td><td colspan="4"><i>IFI 1003 - Strategic Asset Lifecycle Value Optimisation "SALVO"</i></td></tr>
<tr><td>Description of project</td><td colspan="4">It is estimated that there is £200bn of identified investment requirements in UK core infrastructure during the next 10-20 years and that evidence suggests up to 30% of total asset life cycle costs could be avoided by better decision making. SALVO aims to develop simple, flexible and practical guidance and tools for determining what to spend and when.
A consortium of "Core Participants" is currently being set up to progress the project which will have workstreams in the "start of life", "utilisation and maintenance" and "managing aging assets" phases of the asset life cycle. SP EnergyNetworks is joining the project as an "Associate". This will allow SP EnergyNetworks early sight of the outputs of the project and an opportunity to influence them. The cost of this project membership is £5k.
It is anticipated that the project will provide spin off to SP EnergyNetworks in improving the optimisation of spend and managing the lifecycle of the assets through the tools developed by the project consortium.
The project duration is 3 years.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £9,416
External £186
Total £9,601</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £11,302
External £6,700
Total £18,002</td></tr>
<tr><td>Project Cost (Collaborative + external + SPEN)</td><td>£960,000</td><td>Projected 12/13 costs for SPEN</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="4">The project aims to provide integrated solutions to determining what is worth spending and when according to optimal whole life cycle criteria:-
- asset population health/ criticality definitions and diagnosis
- specific asset's degradation and risk characteristics
- individual intervention justifications (inspection, maintenance, modification, renewal)
- collectively optimised, total system performance and work programme budgets and resources
The project will particularly aim at providing integrated solutions across the asset life cycle and will provide a particular focus in the management of aging assets area.</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>No</td><td>Yes</td><td>No</td><td>No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">• Collate existing best practice processes and available tools
• Identify the realistic range of scenarios, options, decision types, data, information and assumption requirements, cost/risk/benefit evaluations and calculations, results interpretation, decision making and conclusions and implementation processes
• Develop a series of decision templates
• Update and integrate suitable decision support tools for the cost/benefit/risk quantification and optimisation steps, including generic interface design for different data sources and facilities for export of results into work planning and management systems
• Develop and publish a series of worked case studies of the application of these processes and tools</td></tr>
</table>

<table>
<tr><td>Expected Timescale to Adoption</td><td>3 years</td><td colspan="4">Duration of benefit once achieved</td><td colspan="5">7 years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">75%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td colspan="5"></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="4">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="6"></td></tr>
<tr><td>Project Progress March 12</td><td colspan="10">This project is now closed</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="10">Improvement in the management of asset base is likely to lead to a reduction in risks of plant and equipment failure and increase safety for staff and members of the public.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="10">Core Sponsors: National Grid, ScottishWater, London Underground, Cambridge University
Associates: SASOL, Forbo Nairn, Gatwick Airport</td></tr>
<tr><td>R&D Providers</td><td colspan="10">The Woodhouse Partnership and Decision Support Tools</td></tr>
</table>

Project Title	***IFI 1004 - Remote Access to Pole Mounted Auto Reclosers***
Description of project	The Noja pole mounted auto recloser incorporates a protection module, the MPM, which can be accessed to retrieve active and historical data relating to both protection activity and statistical metering. This can only be accessed via an RS232 port within the Noja Control Panel that is mounted below the Main Tank, out with the Safety Distance, and above the Anti-climber. Access to this panel requires a specialist skill. It would a business and safety advantage if additional functions of this equipment could be accessed without having to ascend the pole. The proposal from Nortech suggests that by adding an 'Envoy' module to a Noja, remote access of the data within a Noja would be possible. Nortech has proved that the ENVOY can talk to the NOJA, but this needs to be proved in an operational situation.

Expenditure for financial year	Internal £14,878 External £37,106 **Total £51,984**	Expenditure in previous (IFI) financial years	Internal £0 External £0 **Total £0**
Project Cost (Collaborative + external + SPEN)	**£76,800**	Projected 12/13 costs for SPEN	Internal £10,000 External £25,000 **Total £35,000**

Technological area and / or issue addressed by project	The project aims to address the issue of safe and automated remote access to active and historical data from SPEN's population of Noja PMAR. The project will enable circuits to be ranked accordingly to agreed performance indicators e.g. circuits with most trips which could inform operational and maintenance activities.

Type(s) of innovation involved	Incremental	Significant	Technological substitution	Radical
	Yes	No	No	No

Expected Benefits of Project	• Health and Safety benefit realised by negating the need to climb PMAR poles to access information • Automatic collection of all Noja PMAR event logs, removing the need to drive to site and consequent delays in getting data • Summary analysis of PMAR activity with dashboard showing league table of operations • Central storage of event logs

Expected Timescale to Adoption	3 years	Duration of benefit once achieved	10 years

Probability of Success	50%	TRL Development (Start – Current)								
		1	2	3	4	5	6	7	8	9
							→	→		

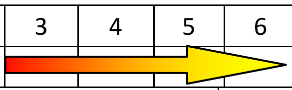
Project NPV	(Present Benefits x Probability of Success) – Present Costs	£343,820

Project Progress March 12	There have been some issues around the communication between the Noja controller and the Nortech envoy. This issue should be resolved in early may and the 30 units should then be able to be installed on the live network.
Potential for achieving expected benefits	By being able to see system events almost real time, this should be able to give operational engineers an enhanced view of any abnormal events without having to go out on site.
Collaborative Partners	None
R&D Providers	Nortech

<table>
<tr><td>Project Title</td><td colspan="10">***IFI 1005 - GIS Impedence Mapping - zMap***</td></tr>
<tr><td>Description of project</td><td colspan="10">Carrying on from the work that was completed in IFI project – IFI 0709 Network Monitor using Web Systems, it is proposed to utilise the voltage and current values obtained from sub.net and PQR during faults and feed them into GeoField, SPEN's GIS mapping software.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="3">Internal £14,075
External £35,043
Total **£49,118**</td><td colspan="4">Expenditure in previous (IFI) financial years</td><td colspan="3">Internal £11,302
External £6,700
Total **£18,002**</td></tr>
<tr><td>Project Cost</td><td colspan="3">**£130,520**</td><td colspan="4">Projected 2012/13 costs for SPEN</td><td colspan="3">Internal £0
External £0
Total **£0**</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="10">The laborious process of tracing a circuit length will be obsolete with the GIS platform that we currently use able to trace via impedance based on a table of impedance values per cable type.
Currently SP have roughly 200 PQR that are able to record faults, but these units are only polled once a day or on an ad hoc basis. This project will enable fault information to be emailed to a user or iHost which can then deduce and impedance value.
As the new ENMAC is currently some time away its imperative that a frontend for new IFI projects and current IFI projects is developed to ease the transition into SPENs SCADA network.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="3">Incremental</td><td colspan="2">Significant</td><td colspan="2">Technological substitution</td><td colspan="3">Radical</td></tr>
<tr><td colspan="3">No</td><td colspan="2">Yes</td><td colspan="2">No</td><td colspan="3">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="10">• The existing GeoField Network Map Viewer tracing engine will be configured to allow tracing from a start point to a specified accumulated impedance value. This will behave in an identical fashion to the existing length-based trace.
• Integration to implement a scheme for SP Power Systems to allow PQRs to trigger autocomms for retrieval of fault records using email. This is required because SP current IT policies do not allow modems to answer incoming calls and the only way to retrieve data from recorders is to use autopoll, automatic or manual.</td></tr>
<tr><td>Expected Timescale to Adoption</td><td>2 years</td><td colspan="4">Duration of benefit once achieved</td><td colspan="5">10 years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">50%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>→</td><td>→</td><td>→</td><td></td></tr>
<tr><td>Project NPV</td><td colspan="4">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="6">£151,554</td></tr>
<tr><td>Project Progress March 2012</td><td colspan="10">This project has now finished, with the impedance mapping software being used within the control rooms.</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="10">Scottish Power own and operate 30 substation disturbance recorders from Embedded Monitoring Systems (EMS) known as a sub.net device. Currently information can be retrieved from the sub.net device either by using an inbuilt web interface, or by receiving e-mails sent by the device in response to events occurring on its monitored inputs.
By using the data from the 30 disturbance monitors we will be able to get a good idea of the potential.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="10">None</td></tr>
<tr><td>R&D Providers</td><td colspan="10">Sigma7</td></tr>
</table>

<table>
<tr><td>Project Title</td><td colspan="10"><i>IFI 1007 – Outram Fault Level Monitor</i></td></tr>
<tr><td>Description of project</td><td colspan="10">The aim of this project is to development of a portable instrument that can successfully measure fault level on a distribution network with repeatability and reliability. The developed instruments will be deployed in at various locations where there is uncertainty in fault level in Low Voltage, 11kV, 33kV and 132kV groups on the network.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="2">Internal
External
Total</td><td colspan="2">£28,720
£4,663
£33,384</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td colspan="2">Internal
External
Total</td><td colspan="2">£1,849
£99,235
£101,084</td></tr>
<tr><td>Project Cost</td><td colspan="4">£121,196</td><td colspan="2">Projected 2012/13 costs for SPEN</td><td colspan="2">Internal
External
Total</td><td colspan="2">£7,500
£0
£7,500</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="10">It is proposed that the instrument could provide a viable alternative for fault level assessment to extensive modelling or at locations where upstream and downstream fault level can vary drastically over a period of time making traditional fault level analysis complex.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="2">Incremental</td><td colspan="3">Significant</td><td colspan="3">Technological substitution</td><td colspan="2">Radical</td></tr>
<tr><td colspan="2">Yes</td><td colspan="3">No</td><td colspan="3">No</td><td colspan="2">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="10">• Accurate fault level profiles for 132kV, 33kV and 11kV distribution sites, showing both downstream and upstream contributions.
• The identification and remedy of fault level conditions previously unidentified.
• The release of network capacity previously unavailable due to perceived the fault level.
• The deferment of investment on healthy equipment / network based on perceived fault level issues.
• Validation and improvement of existing network models.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="3"><2 Years</td><td colspan="3">Duration of benefit once achieved</td><td colspan="4">10 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">75%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="4">→</td><td></td></tr>
<tr><td>Project NPV</td><td colspan="6">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£188,953</td></tr>
<tr><td>Project Progress March 2012</td><td colspan="10">• Outram Researched Ltd has provided SPEN with a test bed demonstration of a single phase fault level monitor (FLM) based on the PM7000 power quality monitor platform.
• Subsequently a 3-phase version has been developed by Outram incorporating additional requirements / features requested by SPEN based on DNO requirements.
• SPEN are currently trialling x6 FLM units on the network to refine the FLM algorithm and firmware and assess the instruments capabilities.
• The preliminary results from site are very encouraging and indicate that the FLM is capable of producing results that are close to those generated by trusted network models.
• As of March thanks to the variety of locations where the FLMs have been deployed the firmware has been significantly updated to take account of new learning and understanding of the observed network phenomenon.</td></tr>
</table>

Potential for achieving expected benefits	As of March the FLM is showing a high degree of promise and SPEN has confidence that the device will deliver accurate measurements. The initial results obtained have consistently been within 10% of the fault level produced from modelling packages.
Collaborative Partners	Outram Research Ltd
R&D Providers	Outram Research Ltd

<table>
<tr><td>Project Title</td><td colspan="9"><i>IFI 1101 – EPRI</i></td></tr>
<tr><td>Description of project</td><td colspan="9">SPEN has taken out membership of the Electrical Power Research Institute (EPRI) in order to gain technical guidance and expertise to support the 2020 Project. This project will employ technologies that have not yet been used in GB and membership of EPRI provides access to a wide range of technical documentation and expertise covering HVDC, Series Compensation and Wide Area Monitoring & Control which feature in the 2020 proposals. EPRI provides a wide range of information in other aspects of power engineering such as smart grids and asset management.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="3">Internal £11,465
External £97,931
Total £109,396</td><td colspan="3">Expenditure in previous (IFI) financial years</td><td colspan="3">Internal £0
External £0
Total £0</td></tr>
<tr><td>Project Cost</td><td colspan="3">£360k for 3 year participation</td><td colspan="3">Projected 2012/13 costs for SPEN</td><td colspan="3">Internal £12,000
External £120,000
Total £132,000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="9">SPEN is one of the principle organisations involved in the Department of Energy and Climate Change (DECC) Electricity Networks Strategy Group (ENSG) work on the 2020 vision for the transmission network. This work has set the footprint for the transmission system in the UK to facilitate the delivery of renewable energy in Scotland in excess of 10GW by 2020. An essential deliverable of this work is the HVDC link between ScottishPower and National Grid. It is proposed for this link to be operational by 2016 to facilitate the flow of the expected renewable energy from Scotland to England. This is the first off many proposed DC links in the UK to deliver the 2020 vision.
Involvement with EPRI will provide information in the technology areas applicable to the HVDC link development.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="2">Incremental</td><td colspan="2">Significant</td><td colspan="3">Technological substitution</td><td colspan="2">Radical</td></tr>
<tr><td colspan="2">Yes</td><td colspan="2">Yes</td><td colspan="3">Yes</td><td colspan="2">Yes</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="9">• EPRI membership will give SPEN immediate benefits in terms of surveying the technologies and application of these technologies in the areas of designing, monitoring, controlling and operating HVDC links.
• SPEN individually or jointly with NationalGrid, can utilise EPRI expertise in the assessment of possible designs and solutions provided internally or by external companies.
• As well as the HVDC module, there are many other modules that can be of considerable benefit to SPEN, such as in areas of wide area monitoring, losses minimisation and smart grids.</td></tr>
<tr><td>Expected Timescale to adoption</td><td><2 Years</td><td colspan="4">Duration of benefit once achieved</td><td colspan="4">10 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">75%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td colspan="4"></td><td></td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="5">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£537,245</td></tr>
<tr><td>Project Progress March 2012</td><td colspan="9">• HVDC Technology Surveillance and Reference Guidelines</td></tr>
</table>

	- Contracts are being placed to work on Reference Book chapters. HVDC Reference Book will be published with all 24 chapters at the end of 2012. • Applications of HVDC Technology and New Developments - Contracts are being placed to work on AC vs DC Wizard software and DC cable technology assessment. • Integrating HVDC in an AC Grid - This project is coordinated with a supplemental project on the same topic in which application studies are conducted for the GB network for National Grid and ScottishPower • HVDC System Performance and Component Testing - Full scale live line work tests have started at the Lenox laboratory - The HVDC insulator dimensioning guide is to be updated for 2012. - A survey is being formulated to determine the performance of utility HVDC insulators - All deliverables are on schedule • Electrical Effects of HVDC - Work on the electrical effects software has begun - Plans are underway for experiments to be performed at the high voltage laboratory in Lenox.
Potential for achieving expected benefits	Work has started on the collaborative project ‘Integrating HVDC in an AC Grid’.
Collaborative Partners	NGC (Integrating HVDC in an AC Grid)
R&D Providers	EPRI

<table>
<tr><td>Project Title</td><td colspan="10">IFI 1102 – Energy Storage Project</td></tr>
<tr><td>Description of project</td><td colspan="10">The aim of this project is to investigate the role of energy storage systems in smart grids.
The need to investigate the role of electrical energy storage has been identified at governmental level. The Parliamentary Renewable and Sustainable Energy Group (PRASEG) inquiry into ‘Renewables and the grid: access and management’ cites storage as a ‘possible solution for addressing variable renewable energy generation’ and highlights the need for ‘Long- term, further research and development’ and ‘clear political and regulatory signals’(PRASEG, 2010). In the UK Low Carbon Transition Plan (HM Government, 2009) storage is included in the list of key elements of a UK smart grid.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="4">Internal £14,272
External £186
Total £14,457</td><td colspan="3">Expenditure in previous (IFI) financial years</td><td colspan="3">Internal £0
External £0
Total £0</td></tr>
<tr><td>Project Cost</td><td colspan="4">£326,000</td><td colspan="3">Projected 2012/13 costs for SPEN</td><td colspan="3">Internal £10,000
External £15,000
Total £25,000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="10">• Economic assessment with respect to traditional reinforcement options
• Identification of appropriate locations for energy storage systems
• Consideration of most appropriate sizes and capacities for energy storage systems.
• Determine appropriate operating strategies for energy storage systems.
• Understand the effects of operating strategies on the ageing of the energy storage systems.
• Evaluate the current and future value of operating an energy storage system to generate revenue through energy market arbitrage.
• Investigate the regulatory issues surrounding the ownership of energy storage systems by DNOs.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="2">Incremental</td><td colspan="3">Significant</td><td colspan="3">Technological substitution</td><td colspan="2">Radical</td></tr>
<tr><td colspan="2">Yes</td><td colspan="3">Yes</td><td colspan="3">Yes</td><td colspan="2">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="10">• Produce learning outcomes and decision support information which can be disseminated within the DNO community which will enable the cost effective and beneficial adoption of energy storage systems.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>3 Years</td><td colspan="4">Duration of benefit once achieved</td><td colspan="5">20 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">50%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td colspan="3">⟶</td><td></td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="6">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">Not known at this stage</td></tr>
</table>

Project Progress March 2012	Good work has been carried out in identifying relevant network models that can be used to mimic the effects of storage. These networks range from rural networks with historical voltage issues to urban networks with high percentage of embedded generation.
Potential for achieving expected benefits	It is hoped that the eventual output of the project will help Scottish Power plan strategically how and where the optimum use of Energy Storage should be.
Collaborative Partners	Electricity North West
R&D Providers	Durham University

<table>
<tr><td>Project Title</td><td colspan="10"><i>IFI 1103 – PD Monitoring in Supergrid Transformers</i></td></tr>
<tr><td>Description of project</td><td colspan="10">The aim of this project is to remotely monitor partial discharge (PD) activity on a 275KV / 33KV transformer using a PD monitoring system supplied and installed by DMS Ltd. After a period of testing the transformer will be inspected to determine the accuracy of the monitoring system in determining PD location.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="2">Internal
External
Total</td><td colspan="2">£8,750
£76,421
£85,170</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td colspan="2">Internal
External
Total</td><td colspan="2">£0
£0
£0</td></tr>
<tr><td>Project Cost</td><td colspan="4">£184,000</td><td colspan="2">Projected 2012/13 costs for SPEN</td><td colspan="2">Internal
External
Total</td><td colspan="2">£7,500
£85,000
£92,500</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="10">The issue addressed by this project is the determination of the long term health of a supergrid transformer by the identification and location of PD activity.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="3">Incremental</td><td colspan="2">Significant</td><td colspan="3">Technological substitution</td><td colspan="2">Radical</td></tr>
<tr><td colspan="3">Yes</td><td colspan="2">No</td><td colspan="3">No</td><td colspan="2">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="10">• Detection and measurement of PD and logging, reporting and alarming for continuous health checks on transformer condition.
• Research and Development in conjunction with Strathclyde University to model the transformer tank and the internal construction and then using triangulation techniques using the data from the PD couplers to determine the location of any PD.</td></tr>
<tr><td>Expected Timescale to adoption</td><td><2 Years</td><td colspan="4">Duration of benefit once achieved</td><td colspan="5">10 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">50%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>→</td><td>→</td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="6">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£28,905</td></tr>
<tr><td>Project Progress March 2012</td><td colspan="10">All partial discharge monitoring equipment has now been installed. Work is now beginning to pull the data into a 3D model</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="10">This project is on target to deliver the benefits.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="10">None</td></tr>
<tr><td>R&D Providers</td><td colspan="10">University of Strathclyde</td></tr>
</table>

<table>
<tr><td>Project Title</td><td colspan="9"><i>IFI 1107 –Cable Identification Devices</i></td></tr>
<tr><td>Description of project</td><td colspan="9">SEBA KMT has produced a device that uses DC pulses to positively identify cables either live or dead circuits. Identification is via a visual display which shows the rise and fall in signal strength along the cable length due to the layup of the cores. As DC is used there is no current induction in adjacent cables thus avoiding incorrect identification which other devices can suffer from. This project will be a trial evaluation of the device through field testing with the device being enhanced as appropriate.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="3">Internal £9,703
External £186
Total £9,889</td><td colspan="3">Expenditure in previous (IFI) financial years</td><td colspan="3">Internal £0
External £0
Total £0</td></tr>
<tr><td>Project Cost</td><td colspan="3">£42,000</td><td colspan="3">Projected 2012/13 costs for SPEN</td><td colspan="3">Internal £7,500
External £25,000
Total £32,500</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="9">Every year there are a number of instances where an incorrect cable is opened in error. This device has the potential to minimise these occurrences.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="2">Incremental</td><td colspan="2">Significant</td><td colspan="2">Technological substitution</td><td colspan="3">Radical</td></tr>
<tr><td colspan="2">Yes</td><td colspan="2">No</td><td colspan="2">Yes</td><td colspan="3">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="9">• The cable detection device can be used on both live and dead HV and LV circuits and no current is induced in adjacent circuits.
• The requirement to excavate an LV cable to the nearest known service location is avoided.
• Unnecessary customer interruptions are avoided.
• The number of open excavations and the associated risk to staff and public is reduced.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2"><2 Years</td><td colspan="3">Duration of benefit once achieved</td><td colspan="4">10 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">90%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>→</td><td></td></tr>
<tr><td>Project NPV</td><td colspan="5">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£1,123,305</td></tr>
<tr><td>Project Progress March 2012</td><td colspan="9">• The order was placed for five SEBA KMT cable identification devices for subsequent trial.</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="9">Assuming that the trials of the cable identification devices and any required upgrade work is successful then the potential for achieving the expected benefits is high.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="9">None</td></tr>
<tr><td>R&D Providers</td><td colspan="9">SEBA KMT</td></tr>
</table>

<table>
<tr><td>Project Title</td><td colspan="10">***IFI 1108 –ESRI Powerfactory***</td></tr>
<tr><td>Description of project</td><td colspan="10">ScottishPower uses an enterprise wide Geographic Information System delivered by Esri UK known as FGIS. This holds electrical plant and circuit data in an ‘ArcFM’ database. The system is used to create and maintain electrical system models on a geographic basis. ScottishPower also use DIgSILENT PowerFactory for electrical network modelling and analysis. This tool enables ScottishPower to model and simulate electrical loading and size plant to meet given business requirements. Currently in the ScottishPower area there are no robust 11kV system models and it will take considerable amount of time to generate such system models to assist in the design and analysis of the 11kV network. The project will attempt to develop an interface between ESRI and PowerFactory to enable the quick and efficient modelling of the 11kV network.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="3">Internal £8,822
External £186
Total £9,007</td><td colspan="3">Expenditure in previous (IFI) financial years</td><td colspan="4">Internal £0
External £0
Total £0</td></tr>
<tr><td>Project Cost</td><td colspan="3">£98,000</td><td colspan="3">Projected 2012/13 costs for SPEN</td><td colspan="4">Internal £11,000
External £78,000
Total **£89,000**</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="10">The aim is to develop a demonstrator project to proof the concept of interfacing the ESRI system with PowerFactory hence enabling the business to quickly develop network models of the 11kV system and possibly LV system. This will provide design engineers with up to date network models that can be utilised and enhance the design process and solutions evaluation. Generating 11kV models is laborious, time consuming and prone to errors. This project will prove the concept of using GIS information to develop up to date electrical models.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="3">Incremental</td><td colspan="2">Significant</td><td colspan="3">Technological substitution</td><td colspan="2">Radical</td></tr>
<tr><td colspan="3">No</td><td colspan="2">No</td><td colspan="3">Yes</td><td colspan="2">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="10">• To provide mechanisms to quickly model the 11kV network in PowerFactory.
• Streamline existing business processes for the design and connection on the 11kV network.
• To quickly run 'what if' scenarios to assist in the design process.</td></tr>
<tr><td>Expected Timescale to adoption</td><td><2 Years</td><td colspan="4">Duration of benefit once achieved</td><td colspan="5">10 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">50%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td>→</td><td>→</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="5">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="5">£1,608</td></tr>
<tr><td>Project Progress March 2012</td><td colspan="10">Project meetings with ESRI and DigSilent are due to take place during March with the project concluding Mid August</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="10">There is hope that this project can build on the back of the distance to fault work carried out previously.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="10">None</td></tr>
<tr><td>R&D Providers</td><td colspan="10">ESRI UK and DIgSILENT</td></tr>
</table>

<table>
<tr><td>Project Title</td><td colspan="9"><i>IFI 1201 –Lynx Kelvatek LV Switch</i></td></tr>
<tr><td>Description of project</td><td colspan="9">The 'Y' type network in Cheshire requires the LV network to be manually managed/switched during 11kV fault isolation and restoration. The LV network has to be disconnected in order that there will be no backfeeds onto the fault while isolationg. It is then reconnected after the 11kV restoration. Care has to be taken so that any stage in the process does not overload the LV network This may involve closing 11kV breakers simultaneously at each end of the fault. Lynx is an electromechanical device that will automatically during the fault conditions.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="3">Internal £8,750
External £186
Total £8,935</td><td colspan="3">Expenditure in previous (IFI) financial years</td><td colspan="3">Internal £0
External £0
Total £0</td></tr>
<tr><td>Project Cost</td><td colspan="3">£303,000</td><td colspan="3">Projected 2012/13 costs for SPEN</td><td colspan="3">Internal £15,000
External £120,000
Total £135,000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="9">This project will develop a system that will allow the 11kV network to be sectionalised as on a radial system with the LV network automatically opening and closing depending on the 11kV status thus allowing engineers to focus solely on isolation/restoration. This in turn will improve CML performance.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="2">Incremental</td><td colspan="2">Significant</td><td colspan="2">Technological substitution</td><td colspan="3">Radical</td></tr>
<tr><td colspan="2">Yes</td><td colspan="2">No</td><td colspan="2">No</td><td colspan="3">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="9">• Improved CML performance.
• Established safeguards to prevent back feeding of HV cables and overloading of LV cables.</td></tr>
<tr><td>Expected Timescale to adoption</td><td><2 Years</td><td colspan="4">Duration of benefit once achieved</td><td colspan="4">15 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">50%</td><td colspan="8">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td></td><td>→</td><td>→</td><td></td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="5">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£107k</td></tr>
<tr><td>Project Progress March 2012</td><td colspan="9">Currently under negotiation</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="9">It is expected that this project will achieve its aim.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="9">None</td></tr>
<tr><td>R&D Providers</td><td colspan="9">Kelvatek</td></tr>
</table>

<table>
<tr><td>Project Title</td><td colspan="9">***IFI 1202 – Nanodielectrics***</td></tr>
<tr><td>Description of project</td><td colspan="9">The aim of this project is to gain an understanding and practical experience of the processing of nanodielectric materials in order to develop a set of materials design and process rules to achieve the reliable production of high performance insulation materials.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="3">Internal £8,750
External £186
Total £8,935</td><td colspan="3">Expenditure in previous (IFI) financial years</td><td colspan="3">Internal £0
External £0
Total £0</td></tr>
<tr><td>Project Cost</td><td colspan="3">£104,980</td><td colspan="3">Projected 2012/13 costs for SPEN</td><td colspan="3">Internal £7,500
External £30,429
Total **£37,929**</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="9">The understanding gained by this project and the materials design rules developed will feed into HV equipment design to achieve new high performance equipment with significantly improved voltage and power ratings and potentially much smaller size for the same rating.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="2">Incremental</td><td colspan="2">Significant</td><td colspan="3">Technological substitution</td><td colspan="2">Radical</td></tr>
<tr><td colspan="2">Yes</td><td colspan="2">Yes</td><td colspan="3">Yes</td><td colspan="2">Yes</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="9">• Increased continuous, switching and emergency current ratings.
• Higher power density equipment or smaller footprint assets.
• Longer insulation lifetime and insulation more tolerant to overloads.
• Enhanced flexibility in network operation.
• Greater resistance to power electronics system harmonics particularly in systems containing HVDC technologies.
• Lower capital costs for civil works.
• Higher retained asset value and operational efficiency.</td></tr>
<tr><td>Expected Timescale to adoption</td><td><3 Years</td><td colspan="4">Duration of benefit once achieved</td><td colspan="4">10 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">35%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td colspan="2">→</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="5">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">Not known at this stage</td></tr>
<tr><td>Project Progress March 2012</td><td colspan="9">Collaboration agreements are awaiting to be signed with kickoff expected on the 1st of June</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="9">Not known at this stage</td></tr>
<tr><td>Collaborative Partners</td><td colspan="9">NGC, SSE</td></tr>
<tr><td>R&D Providers</td><td colspan="9">GnoSys UK, University of Southampton and Areva Research & Technology Centre, National Physical Laboratory</td></tr>
</table>

<table>
<tr><td>Project Title</td><td colspan="10">IFI 1203 – Psymetrix ACAM Phase 1</td></tr>
<tr><td>Description of project</td><td colspan="10">The objective of this project is to prove the concept of an Active Network Management (ANM) approach known as Angle Constraint Active Management (ACAM). Then initiate its development into an operational scheme capable of facilitating the connection and management of additional Distributed Generation (Phase 2).</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="3">Internal £17,327
External £186
Total £17,513</td><td colspan="3">Expenditure in previous (IFI) financial years</td><td colspan="4">Internal £0
External £0
Total £0</td></tr>
<tr><td>Project Cost</td><td colspan="3">£320,655</td><td colspan="3">Projected 2012/13 costs for SPEN</td><td colspan="4">Internal £20,000
External £160,000
Total £180,000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="10">The project will contribute to the UK environmental targets by enabling a greater penetration of renewable generation on to the electrical network.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="3">Incremental</td><td colspan="2">Significant</td><td colspan="2">Technological substitution</td><td colspan="3">Radical</td></tr>
<tr><td colspan="3">Yes</td><td colspan="2">No</td><td colspan="2">No</td><td colspan="3">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="10">• To prove and quantify the additional capacity that an ACAM scheme could introduce
• To prove the correlation of modelled ACAM angles against network PMU measurements
• To identify the operational requirements of an ACAM scheme
• To gain the necessary evidence to justify an operational trial of the ACAM scheme</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="3">2 Years</td><td colspan="3">Duration of benefit once achieved</td><td colspan="4">10 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">35%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="2">→</td><td></td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="6">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="4">£187,974</td></tr>
<tr><td>Project Progress March 2012</td><td colspan="10">• Test site(s) identified and pre-vetted.
• Contract with Psymetrix placed.
• PMU order placed.
• Factory Acceptance Testing scheduled for July 2012.</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="10">As this is a proof of concept trial and yet to start in earnest, at this stage, based on academic feasibility studies this project has good potential to deliver its benefits. Once the equipment is installed later on in the year the ability to realise expected benefits will be better understood.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="10">Psymetrix</td></tr>
<tr><td>R&D Providers</td><td colspan="10">Psymetrix</td></tr>
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<table>
<tr><td>Project Title</td><td colspan="10">IFI 1204 – LV Jumpers with Integral CB</td></tr>
<tr><td>Description of project</td><td colspan="10">The development of a set of a prototype Low Voltage (LV) jumper set to be used in conjunction with a suitably graded portable LV circuit breaker. The full arrangement to be used to energise LV circuits from adjacent live circuits during LV busbar outages, hence reducing customer outages and mobile generator costs. Assuming the prototype proves successful the project will be extended to include evaluation of several units on the network.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £11,008
External £186
Total £11,194</td><td colspan="4">Expenditure in previous (IFI) financial years</td><td colspan="5">Internal £0
External £0
Total £0</td></tr>
<tr><td>Project Cost</td><td>£60k</td><td colspan="4">Projected 2012/13 costs for SPEN</td><td colspan="5">Internal £15,000
External £25,000
Total £40,000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="10">The prototype arrangement would provide a technical solution to reduce customer outages and mobile generator costs / emissions.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="2">Incremental</td><td colspan="3">Significant</td><td colspan="2">Technological substitution</td><td colspan="3">Radical</td></tr>
<tr><td colspan="2">Yes</td><td colspan="3">No</td><td colspan="2">No</td><td colspan="3">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="10">• Improved customer service via the reduction in the CI and CML associated with the LV busbar outages.
• Reduction in the mobile generation emissions and costs associated with LV busbar outages.
• Additional operational applications and benefits derived from field trials and business exposure to the device.</td></tr>
<tr><td>Expected Timescale to adoption</td><td><2 Years</td><td colspan="4">Duration of benefit once achieved</td><td colspan="5">10 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td rowspan="3">75%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td colspan="2">→</td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="5">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="5">TBC</td></tr>
<tr><td>Project Progress March 2012</td><td colspan="10">• The initial prototype arrangement of flexible LV jumpers and portable circuit breaker was manufactured by Ten47 and delivered to SPEN in early March.
• The prototype was installed on a dead LV busbar at the SPEN training complex shortly afterwards.
• The basic installation tests provided confidence that the arrangement was a feasible solution and was of suitable construction for a substation environment.
• Several design improvements were identified during the testing and the prototype has been subsequently taken back by Ten47 to implement them.
• Version 2 to be trialled in May / June 2012.</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="10">As indicated above the initial prototype arrangement has demonstrated it is capable of being used in an operational scenario and is of a suitable design. The construction standards of each of the components have also given SPEN the confidence to implement live testing once Version 2 is delivered.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="10">Ten47</td></tr>
<tr><td>R&D Providers</td><td colspan="10">SPEN</td></tr>
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<table>
<tr><td>Project Title</td><td colspan="4">***IFI 1209 - Substation Earth Integrity Monitoring System***</td></tr>
<tr><td>Description of project</td><td colspan="4">This aim of this project is to develop a system for monitoring the removal/theft of earth straps from Transmission and Distribution substations or other installations</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="2">Internal £7,418
External £186
Total £7,604</td><td>Expenditure in previous (IFI) financial years</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td>Project Cost</td><td colspan="2">£189,347</td><td>Projected 2012/13 costs for SPEN</td><td>Internal £24,697
External £164,650
Total £189,347</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The project will explore three separate work streams
1) Use of RFID technology using RFID tags bonded to earth straps that are monitored (pinged) by a monitoring unit on site to detect their presence.
2) To prove the concept of using SWR (Standing Wave Ratio) as used in radio/antenna optimisation to provide detection of real time “earth tamper” activity.
3) Develop the Cresatech Copper Theft Sensor (CuTS) protype unit for application at ScottishPower substations.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Tech Transfer</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>10</td><td>-1</td><td>11</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">There is no off the shelf product available for permanent installation in a substation which can detect the presence of adequate earthing and real time theft detection.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">1 year</td><td>Duration of benefit once achieved</td><td>15 years</td></tr>
<tr><td>Probability of Success</td><td colspan="2">50%</td><td>Project NPV = (PV Benefits – PV Costs) x Probability of Success</td><td>£71,378</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">Work streams 1 and 2 are at an early stage and, as commented on below, early results are not as good as expected. The potential for success is therefore inconclusive.</td></tr>
<tr><td>Project Progress to March 12</td><td colspan="4">The project only started shortly before the year end, so there is very little progress to report at this time, other than early experience of work streams 1 and 2 has not given encouraging results so far. Work stream 3 has yet to start.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">Scottish Power</td></tr>
<tr><td>R&D Providers</td><td colspan="4">Nortech Online Ltd, Cresatech</td></tr>
</table>

<table>
<tr><td>Project Title</td><td colspan="12"><i>IFI 1210 –Transmission SSR & Harmonics</i></td></tr>
<tr><td>Description of project</td><td colspan="12">SPT is currently undertaking two projects to improve the visibility of the transmission network in readiness for the 2020 reinforcement programme. One project looks to provide essential data on the network harmonics that are required to be Grid Code compliant and is now required to the design of HVDC filters. The second project is the monitoring of several generation sites in England and Scotland that have been identified as being at risk to Sub-Synchronous Resonance (SSR) as a result of the proposed Series Compensation schemes on the Anglo-Scottish border.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal
External
Total</td><td colspan="2">£9,226
£186
£9,412</td><td colspan="3">Expenditure in previous (IFI) financial years</td><td colspan="3">Internal
External
Total</td><td colspan="3">£0
£0
£0</td></tr>
<tr><td>Project Cost</td><td colspan="3">£140,300</td><td colspan="3">Projected 2012/13 costs for SPEN</td><td colspan="3">Internal
External
Total</td><td colspan="3">£12,500
£130,000
£142,500</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="12">The aims of this project are to enhance both projects using advanced hardware / software solutions to: (1) Automatically accumulate process and analyse the harmonic data to create useful system harmonic information. (2) To advance the design of a network fault recorder to accommodate SSR detection as a standard feature in readiness of the Series Compensation being added to the network.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="3">Incremental</td><td colspan="3">Significant</td><td colspan="3">Technological substitution</td><td colspan="3">Radical</td></tr>
<tr><td colspan="3">Yes</td><td colspan="3">No</td><td colspan="3">No</td><td colspan="3">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="12">• Production of automatic harmonic reports that would have otherwise required several man hours of effort each day to recreate.
• Both projects will decrease the risk to external parties connected to the transmission network. In particular SSR detection will prevent the mechanical failure of SSR susceptible turbines connected to the network.
• SPT will have increased awareness of the SSR phenomena and its detection in advance of series compensation. SPT will have greater visibility of the networks harmonic performance and have a greater ability to police it against the Grid Code, with increasing levels of low carbon technology connecting to the network.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="3"><2 Years</td><td colspan="3">Duration of benefit once achieved</td><td colspan="6">15 Years</td></tr>
<tr><td rowspan="3">Probability of Success</td><td colspan="3" rowspan="3">75%</td><td colspan="9">TRL Development (Start – Current)</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="2">→</td><td></td><td></td><td></td></tr>
<tr><td>Project NPV</td><td colspan="6">(Present Benefits x Probability of Success) – Present Costs</td><td colspan="6">To be determined</td></tr>
<tr><td>Project Progress March 2012</td><td colspan="12">This project has just started, with the majority of costs being internal.</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="12">The potential of this project will be realised once equipment is installed in the field and we start to obtain results.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="12">None</td></tr>
<tr><td>R&D Providers</td><td colspan="12">QUALITROL & PI</td></tr>
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