Innovation Funding Incentive Annual Report 2014-15

July 2015

Version Control	
Version 1.0 Final	16th July 2015
Author	Chris Goodhand

Contents

2014/15 IFI annual report

July 2015

Executive Summary

1. This report has been prepared by Northern Powergrid to inform interested parties of the innovation activities of its electricity distribution licensees, Northern Powergrid (Yorkshire) Electricity Distribution plc, and Northern Powergrid (Northeast) Ltd. It covers the period from 1 April 2014 to 31 March 2015. It has been prepared in accordance with standard condition 46 of the electricity distribution licence, the associated regulatory instructions and guidance (published by Ofgem) and the Energy Networks Association (ENA) Engineering Recommendation (ER) G85, issue 2, 2007 (the Good Practice Guide). It also informs our returns under standard licence condition 47.
2. This report is the last under the DPCR5 Incentive for Innovation stimulus.
3. The key projects in Northern Powergrid during the reporting period are:
    - Collaborative projects, including:
        - Cable Core Temperature Sensor;
        - Cable Paper Moisture Meter;
        - Oil-filled Cable Additive;
        - Sustainable Multi-storey Communities;
        - UAV/VTOL – Unmanned Aerial Vehicle;
        - Ultrapole – Ultrasonic wood pole inspection; and
        - Live Alert;
        - ENA R&D programme; and
        - EA Technology Strategic Technology Programme (STP).
    - Internal innovation projects dedicated to local Northern Powergrid needs:
        - Network Inference Study;
        - ANM – Beverley-Driffield;
        - Distribution Load Estimate Methodology
        - Decision modelling;
        - Smart Data;
        - Triangle Data analysis;
        - Integrated Substation Condition Monitoring
        - Failure on Demand; and
        - Condition Based Risk Management (CBRM)
4. Qualifying spend for the period has been £576,378 (2014 : £435,958) and £711,417 (2014 : £569,615) for the Northeast and Yorkshire licence areas respectively, giving a total of £1,215,520 (2014 : £1,005,574) across the combined geographic area. This is an increase of around 20% compared with the previous reporting period.

Revision Record

Version	Date	Revision Details	Author
0.9	6/7/2015	Final draft	Chris Goodhand
1.0	16/7/2015	Final	Chris Goodhand

Introduction

5. This report has been prepared by Northern Powergrid to inform interested parties of the innovation activities of its electricity distribution licensees, Northern Powergrid (Yorkshire) Electricity Distribution plc, and Northern Powergrid (Northeast) Ltd. It covers the period from 1 April 2014 to 31 March 2015.

6. A single report has been prepared because the two licensees are operated under common management, sharing best practice between them. Our approach to research and development is no exception, and we draw no arbitrary distinction in the innovation carried out for the two licensees. Projects and programmes are therefore set up and progressed jointly for both licensees. Finally, the report breaks out the relevant expenditure by licensee to support regulatory reporting requirements.

7. The report focuses upon research and development work eligible for Ofgem's innovation funding incentive (IFI). The IFI, now superseded in ED1 by the Network Innovation Allowance, was intended to provide funding for projects focused on the technical development of distribution networks, up to and including 132 kV, to deliver value (i.e. financial, supply-quality, environmental, safety) to end-consumers. IFI projects could embrace any aspect of distribution system asset management from design through to construction, commissioning, operation, maintenance and decommissioning.

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

9. The report has been prepared in accordance with standard condition 46 of the electricity distribution licence, the associated regulatory instructions and guidance (RIGs) and the Energy Networks Association (ENA) Engineering Recommendation (ER) G85 (the Good Practice Guide (GPG)), which states:

3.4 Annual Regulatory Reporting Requirements for IFI Projects

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

- *IFI budget carry-forward*
- *eligible IFI expenditure*
- *eligible IFI internal expenditure*
- *combined distribution network revenue*
- *the IFI annual report.*

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

- *IFI carry- forward nearest £1k*
- *eligible IFI expenditure nearest £1k*

• eligible IFI internal expenditure nearest £1k

• combined distribution network revenue nearest £0.1m

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

10. The programmes and major projects that will be discussed in this report are:

- Collaborative projects led by the Energy Networks Association (ENA) R&D working group, including:
  - ENA R&D programme (including work undertaken for the Ofgem/DECC Smart Grid Forum);
- The EA Technology Limited (EATL) Strategic Technology Programme (STP), including:
  - Module 2 (Overhead Networks);
  - Module 3 (Cables);
  - Module 4 (Substations);
  - Module 5 (Distributed Energy);
  - Various engineering knowledge-sharing technical forums to develop STP proposals;
  - Energy Storage Operators' Forum;
  - Protective Coatings Forum; and
  - Partial Discharge User Group.
- Collaborative projects, including:
  - Cable Core Temperature Sensor;
  - Cable Paper Moisture Meter;
  - Oil-filled Cable Additive;
  - UAV/VTOL – Unmanned Aerial Vehicle;
  - Ultrapole – Ultrasonic wood pole inspection; and
  - Live Alert.
- Internal innovation projects dedicated to local Northern Powergrid needs:
  - Network Inference Study;
  - ANM – Beverley-Driffield;
  - Distribution Load Estimate Methodology
  - Decision modelling;
  - Smart Data;
  - Triangle Data analysis;
  - Integrated Substation Condition Monitoring
  - Failure on Demand; and

- Condition Based Risk Management (CBRM)

11. As permitted by the GPG, this report aggregates portfolios of projects under collaborative umbrellas such as the ENA, EATL's STP, and internal costs in developing and managing projects.

Project Reporting

Externally-driven activities

12. In this section we consider those projects driven by bodies outside the distribution sector where, although we have the choice as to whether or not we become involved, they fall outside our direct governance. For such projects we therefore effectively take the role of unpaid sub-contractors, often making considerable contributions in kind, as well as financially supporting these, often, nationally important initiatives.

13. Electricity Networks Futures Group (ENFG) remains active although the range and volume of projects from this source has reduced compared with the lead in to the ED1 well justified business planning.

14. We have continued to develop ideas submitted as part of an unsuccessful tier two project bid to Ofgem's Low Carbon Network Fund (LCNF) during the 2013 bidding round. The Activating Community Engagement (ACE) project has now been initiated, as an LCNF tier one project and then transitioning into an NIA project. The project was successful in gaining additional funding from Innovate UK.

15. We continue to investigate opportunities for cross-utility projects based on the common requirements of our societal stakeholders and have now commenced the Sustainable Multi-storey Communities project alongside Northern Gas Networks.

ENA

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

17. A range of other activities have also been delivered through the ENA although some of these, which are innovation by any broad definition, are not IFI eligible. These are not reported here.

18. The remaining active projects are reported below:

ENA Collaborative Programme

Project Title	**ENA R&D Programme**		
Description of project	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.		
Expenditure for financial year	Internal £5,250 External £-144 Total £5,106	Expenditure in previous (IFI) financial years	Internal £38,895 External £262,362 Total £301,258
Total Project Costs (Collaborative + external + Northern Powergrid)	£149,874+	Projected 2015/16 costs for Northern Powergrid	Internal £10,000 External £50,000 Total £60,000
Technological area and / or issue addressed by project	The projects listed below address issues which have been identified by the ENA Working Groups as significant issues requiring technical investigation and development: Reactive Power (REACT): In the last 2 years, there have been significant difficulties in managing voltage levels during minimum demand periods. Analysis of this issue has shown that the root cause is related to the significant decline in reactive power relative to active power. Whilst minimum active power demands have fallen by around 15% in the last 5 years, reactive power has declined by 50% in this time. Current trends for 2012 show that this reduction is continuing, broadly, across the country. In order to better understand the challenge of manage voltage levels within licence standards and to plan for additional future reactive compensation requirements, a thorough understanding of the reactive power trend needs to be developed. Smart Grid Forum Workstream 7 (WS7): The WS7 study is intended to carry out the technical analysis necessary to confirm how the network described by the Transform outputs will be realised. This will both confirm its technical viability and provide an understanding of its characteristics, for example to identify what control co-ordination may be required to ensure reliable and robust whole-system operation. Most importantly, it will highlight any new roles and responsibilities that a DNO will be required to accept from a largely technical perspective. This forms part of a wider ENA activity entitled DS2030.		

Type(s) of innovation involved	Incremental to radical	Project Benefits Rating	Project Residual Risk	**Overall Project Score**

Expected benefits of project	These projects. In the context of the extended portfolio of activities, have the potential to provide a wide range of benefits. In some cases, they will help to understand key asset-related issues and allow designs to be altered to address them. The current projects are addressing a long term detrimental trend in total electricity network behaviour and an issue relating to improved understanding and development of the future network.		
Expected timescale to adoption	Year 2016	Duration of benefit once achieved	10-20 Years

Probability of success	75%	Project NPV (Present Benefits – Present Costs) x Probability of success	£100,000
Potential for achieving expected benefits	Reactive Power (REACT): The objectives corresponding to the First Year Report Stage 1 and the Second Year Six-month Report have been met within the last 12 months (May 2014 to May 2015) and the corresponding reports delivered. Two additional brief project status reports have also been delivered. The progress on the project includes: • The methodology to improve original DNO network models in order to mimic in time-series simulations the GSP behavior during periods of minimum load. • The identification of historic changes and trends using DNO network and monitoring data. • The quantification of effects on reactive power from PV penetrations, network changes and demand trends in primary substations. • The assessment of future reactive demand at GSPs of 4 DNOs for different trend-based scenarios. Smart Grid Forum Workstream 7: This project is expected to achieve its intended benefits. It will provide a set of generic nodal distribution network models that have been demonstrated to be technically viable to meet the needs of 2030 users. These models have now been developed and their viability will be demonstrated in the coming months. The models will be used to show how specific methods/solutions can be used to ensure technical viability of the networks and when particular methods/solutions may need to be applied. This analysis will be provided in the Stage 4 &5 results report. The final Stage 6 report for the project will use the outcomes of the studies to address the questions posed by the Smart Grid Forum about future distribution system operation, including a discussion of the roles and responsibilities of a DNO in 2030 in terms of supporting whole system optimisation, contrasted with the position today. Where appropriate this will highlight further specific development work that could be carried out		
Project progress to March 2015	Reactive Power (REACT): The objectives corresponding to the First Year Report Stage 1 and the Second Year Six-month Report have been met within the last 12 months (May 2014 to May 2015) and the corresponding reports delivered. Two additional brief project status reports have also been delivered. It is important to highlight that the project was initially planned to start in May 2013 but it actually did in August 2013. The Second Year Final Report Stage 2 is on track and will be completed by August 2015. The outcomes of the project are in accordance with the initial objectives of the project proposal. More specifically, the following tasks have been accomplished: Identification of historic network and demand changes and trends. Quantification of effects on reactive demand during minimum load from different distribution-based factors (i.e., demand trends in primary substations, network changes, penetration of photovoltaics).		

	Assessment of future reactive demand at transmission-distribution interfaces of different DNOs. Production of improved network models, which unlike original DNO models mimic transmission-distribution interfaces during periods of minimum load, to be used for further studies Smart Grid Forum Workstream 7: Works during the second half of 2014 focussed on defining the four representative networks that will be used for the study and the future scenarios that will be applied. The base networks were finalised and agreed in November 2014 and, following additional development work, the scenarios were finalised in early 2015. In addition, an international review was conducted to capture learning from work in other countries and this was concluded in September 2014. An updated version will be produced towards the end of the study to ensure any more recent work is identified. Towards the end of 2014, the key questions that the overall DS2030 project aims to answer were reviewed. Minor revisions were agreed with the project Steering Group and WS7 in February 2015. Since the start of 2015, efforts have focussed on defining the detailed methodologies to be used in the network analysis studies. These were presented as a series of discussion papers which were reviewed and agreed by the Steering group and WS7. This stage was largely concluded by May 2015 and studies are now commencing. Both projects have been transitioned to the NIA scheme. Further information is available at the Smarter Networks Portal, please see links below The costs for the Smart Grid Forum Workstream 7. A reduction of £26,000 to the overall IFI claim for this year has been made on account of this.
Collaborative partners	ENA member companies
R&D provider	Various

EA Technology Strategic Technology Programmes

<table>
<tr><td>Project Title</td><td colspan="3">Strategic Technology Programme Overhead Network Module 2</td></tr>
<tr><td>Description of project</td><td colspan="3">A DNO research & development collaboration hosted by EA Technology</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £2,275
External £70,000
Total £72,275</td><td>Expenditure in previous (IFI) financial years</td><td>Internal £24,645
External £412,680
Total £437,325</td></tr>
<tr><td>Total Project Costs
(Collaborative + external + Northern Powergrid)</td><td>Rolling programme across all DNOs</td><td></td><td></td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="3">The Module 2 programme for budget year 2013/15 aimed to optimise overhead network design, improve operational performance, maximise potential benefits, improve financial performance and minimise risk associated with overhead networks, whilst having due regard for the environment and energy efficiency. The programme also aimed to deliver continuous improvement in terms of the safety and environmental performance of the overhead network to meet the individual business requirements of member companies. Several of the projects contribute to the industry's knowledge of variation in climate change.

<u>Projects Funded in 2014/15: Completed at the end of March 2015:-</u>

- S2151_3 Alternatives to wood poles – Stage 3: Composite poles tests
- S2162_3 Residual strength of wood poles - Stage 3: Last 20 poles plus analysis/writing up
- S2164_4 Probabilistic wind and ice map for UK - Stage 4: weather maps
- S2183_1 Relationship between measured ice loads and conductor size
- S2185_1 Performance of CPI wedge taps with shear-off bolts
- S2186_1 In-situ Megger testing of wood poles on de-energised HV OH lines
- S2174_3 Participation in Cigré WG B2.43 (OHL rating calculations) Stage 3: 2013/14
- S2174 CIGRE WG43 work funded by EATL

Updated information can be found at :- https://www.stp.uk.net</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental, to Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

<table>
<tr><td>Expected benefits of project</td><td colspan="3">Projects in this module will significantly increase the performance and reliability of the network. In certain cases the asset life may also be extended.

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

• Improvements in network reliability by identifying root causes of faults and developing solutions;
• Safe early detection of potential defects that can then be repaired in a planned and timely fashion;
• Cost-effective and early identification of damaged insulators and discharging components, which if not addressed would result in faults;
• Development of tools, technology and techniques to reduce risk or cost, or to increase speed of capital deployment of member-company programme delivery;
• A better understanding of how overhead line assets perform in service, which can be used to determine the overall asset management policy;
• Reduction in levels of premature failure of assets;
• Avoidance of redesign, reconstruction or refurbishment of overhead lines, where this is driven by a perceived need to increase ratings or strengthen lines and is required to conform with existing standards, but may actually be unnecessary;
• Co-operation between European countries in the development of forecasting methods of atmospheric icing and for the exchange of forecasting tools;
• Comparison of new covered conductor with known performance of older types;
• Increasing scientific understanding of processes and climatic conditions leading to icing;
• Extension of the service life of poles and reduction in potential levels of failures;
• Reduction in lifetime costs by the appropriate use of alternative materials;
• Improved methodology for determining conductor ratings, to provide greater confidence;
• Positive impact on environmental performance and, in many cases, positive impacts on safety;
• Improved understanding for members of novel conductors for new-build or re-conductoring lines that gives lower capital cost, minimum visual impact and environmental acceptance.</td></tr>
<tr><td>Expected timescale to adoption</td><td>Range 1-5 years - dependent on project</td><td>Duration of benefit once achieved</td><td>Range 3-5 years - dependent on project</td></tr>
<tr><td>Probability of success</td><td>Typically >50%</td><td></td><td></td></tr>
</table>

Potential for achieving expected benefits	The project cost may not always reflect the likely full costs of implementation. These will be identified provided that the outcome of the early stage is positive. However, STP has delivered a number of notable innovations since its inception.
Project progress to March 2015	All projects are now complete.
Collaborative Partners	Other DNOs
R&D providers	EA Technology

Project Title	**Strategic Technology Programme: Cables Module 3**		
Description of project	A DNO research & development collaboration hosted by EA Technology		
Expenditure for financial year	Internal £2,100 External £15,543 Total £17,643	Expenditure in previous (IFI) financial years	Internal £12,664 External £476,195 Total £488,859
Total Project Costs (Collaborative + external + Northern Powergrid)	Rolling programme across all DNOs		
Technological area and / or issue addressed by project	The STP Cable Networks programme for budget year 2014/15 aimed to optimise underground cable network design, improve operational performance, maximise potential benefits, improve financial performance and minimise risk associated with underground cable networks, whilst having due regard for the environment and energy efficiency. The programme also aimed to prevent cable failure modes and to deliver continuous improvement in terms of safety and environmental performance of all aspects of the underground cable network to meet the individual business requirements of member companies. Several of the projects contribute to the industry's knowledge of variation in climate change. **Projects Funded in 2014/15: Completed at the end of March 2015** - S3168_4 Comparing future designs of HV (≥100V to 66kV) and EHV (>66kV up to and including 400kV) polymeric cables (13/14) - S3174_1 (REVISED) Evaluating the Performance of Service Termination Equipment (13/14) - S3187_4 Development of an ENA engineering recommendation for the use of sealant systems for cable ducts and transits (13/14) - S3204_1 Design tool for bonding arrangements of cable circuits (11/12) - S3214_3 Research and evaluation of the effectiveness of Tan-Delta testing and polarisation index for condition assessment of ageing cables: Trial and evaluation for paper cables (13/14) - S3216_1 Cross-bonding and segregation of cable systems in tunnels and shared resources by utilities: Researching the issues (11/12) **Projects Funded in 2013/14: In Progress at the end of March 2015:-** - S3174_2 Delivering Improvements to the Performance and Management of Service Termination Equipment (14/15) - S3245_1 Development of CRATER 'Lite' (13/14) Updated information can be found at :- https://www.stp.uk.net		

<table>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental to Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected benefits of project</td><td colspan="4">Projects in this module will positively contribute to an increase in the performance and reliability of the cable network. In many cases the cable asset life may also be extended.

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

- Successful and practical methods for sealing ducts;
- Alternatives to current design and installation practices that offer benefits in lower lifetime cost and higher performance (e.g. increased ratings);
- Reduced risk in environmentally sensitive areas;
- A reduction in the number of accidents / incidents, so increasing safety of staff and the public;
- Increased understanding of potential failure modes and performance of service terminations to support effective management and replacement strategies;
- A reduction in digging, causing less disruption to the public, reducing impact on the environment and avoiding disposal of soil to landfill;
- Offset future increases in CAPEX and OPEX;
- CI/CML savings per connected customer;
- Reduced cable purchase costs;
- Enforced network resilience;
- Implementation of strategies for reducing cable failures, resulting from excessive forces;
- Reduction in number of cable faults;
- Reduced design costs.</td></tr>
<tr><td>Expected timescale to adoption</td><td>Range 1-2 years - dependent on project</td><td>Duration of benefit once achieved</td><td colspan="2">Range 3-5 years - dependent on project</td></tr>
<tr><td>Probability of success</td><td>Typically >50%</td><td>Project NPV = (PV Benefits – PV Costs) x Probability of success</td><td colspan="2">Not calculated</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">A number of STP projects are at an early stage and the project cost may not always reflect the likely full costs of implementation. These will be identified provided that the outcome of the early stage is positive. However, STP has delivered a number of notable innovations since its inception.</td></tr>
<tr><td>Project progress to March 2014</td><td colspan="4">All projects are now complete.</td></tr>
</table>

Collaborative Partners	Other DNOs
R&D providers	EA Technology

Project Title	**Strategic Technology Programme: Substations Module 4**		
Description of project	A DNO research & development collaboration hosted by EA Technology		
Expenditure for financial year	Internal £3,500 External £116,143 Total £119,643	Expenditure in previous (IFI) financial years	Internal £56,088 External £419,505 Total £475,593
Total Project Costs (Collaborative + external + Northern Powergrid)	Rolling programme across all DNOs	Projected 2014/15 costs for Northern Powergrid	Internal £5,000 External £47,000 Total £53,00
Technological area and / or issue addressed by project	The STP Substations programme for the budget year 2014/15 aimed to improve operational performance, maximise potential benefits; improve financial performance and minimise risk associated with substation assets, whilst having due regard for the environment and energy efficiency. The projects aimed to provide cost-effective solutions to increase reliability and deliver continuous improvement in terms of safety and environmental performance of existing and future substation assets, to meet the individual business requirements of member companies. **Projects Funded in 2014/15: Completed at the end of March 2015:-** - S4181_9 On-going Programme of Transformer Post Mortems (13/14) - S4185_10 Developing Strategic Asset Management Processes Through Technical Liaisons with European Utilities (13/14) - S4255_2 Mechanical Strength of Transformer Paper Insulation: Verification of Tear Index Procedure (11/12) - S4265_2 Literature Review of Remedial Treatment of Degraded Polymeric Materials (13/14) - S4307_1 Considerations for LV Supplies in Secondary Substations Classified as 'Hot' Sites in Accordance with ENA ER G60 (13/14) - S4303_1 Evaluating the Effectiveness of VRLA Battery Monitoring Techniques used in Primary and Grid Substations (13/14) - S4310_1 Understanding the dielectric performance capability of HV Insulation of selected 11kV circuit breakers under "normal" service conditions against the environmental performance criterion of IEC 62271-1 (13/14) - S4221_2 Out of Phase Modelling (08/09) - S4221_3 Out of Phase Modelling: Additional Research (10/11) - S4247_1 Identifying tests to determine the Continuous Rating of CT's in Service (10/11) - S4247_2 Identifying Tests to determine the Continuous Rating of CT's: Additional Research (12/13) **Projects Funded in 2014/15: In Progress at the end of March 2015:-** - S4181_10 132kV Transformer Post Mortems (14/15)		

<table>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental to Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected benefits of project</td><td colspan="4">Projects within this module have been cost effective and help improve reliability and safety of substations in distribution networks in line with government policy.

If the projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain the following benefits, including:
- Increased reliability and continuous improvement in terms of safety and environmental performance of existing and future substation assets;
- Collaborative evaluation of battery installations and operational practice to ensure a safer and more reliable network;
- CI/CML savings per connected customer;
- Optimised safety and environmental requirements for management of insulating oils and SF6;
- Technical liaison with International Utilities to share new technology and failure modes;
- Offsetting of future increases in CAPEX and OPEX;
- Development of condition-based assessments, or tests, to determine asset condition;
- Prevention of failures of oil-filled equipment, tap changers, earth switches, which will improve safety and avoid unnecessary scrapping of serviceable components, thereby alleviating environmental impact;
- Extension of serviceable life of switchgear and transformers;
- Further development of technical understanding of protection-system maintenance requirements;
- Understanding of the degradation and failure processes of substation plant and equipment, and quantification of the risks associated with those processes;
- Further development of technical understanding of operational staff in complex electrical issues;
- Mitigation of risk to environment;
- Increased safety of staff and public from reducing risk of fire and the number of accidents / incidents;
- Reduced lifetime costs and improved functionality from the appropriate use of new technology.</td></tr>
<tr><td>Expected timescale to adoption</td><td colspan="2">Range 1-4 years - dependent on project</td><td>Duration of benefit once achieved</td><td>Range 1-6 years - dependent on project</td></tr>
<tr><td>Probability of success</td><td colspan="2">Typically >50%</td><td>Project NPV = (PV Benefits – PV Costs) x Probability of success</td><td>Not calculated</td></tr>
</table>

Potential for achieving expected benefits	A number of STP projects are at an early stage and the project cost may not always reflect the likely full costs of implementation. These will be identified, providing the outcome of the early stage is positive. However, STP has delivered a number of notable innovations since its inception.
Project progress to March 2014	All projects or project stages started in the module during 2014/15 have been completed with the exception of S4181_10 132kV Transformer Post Mortems which has been transitioned into ED1 NIA. The STP program run by EA Technology has been wound down and no new projects are being generated for ED1.
Collaborative Partners	Other DNOs
R&D providers	EA Technology

<table>
<tr><td>Project Title</td><td colspan="4">Strategic Technology Programme Networks for Distributed Energy Resources Module 5</td></tr>
<tr><td>Description of project</td><td colspan="4">A DNO research & development collaboration hosted by EA Technology</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £1,400
External £0
Total £1,400</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £50,088
External £415,017
Total £465,105</td></tr>
<tr><td>Total Project Costs
(Collaborative + external + Northern Powergrid)</td><td>Rolling programme across all DNOs</td><td colspan="2"></td><td></td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The STP Networks for Distributed Energy Resources programme for budget year 2014/15 aimed to maximise potential benefits and reduce costs and risks associated with facilitating the design, development and operation of networks for the integration of low-carbon technologies into future network designs, whilst having due regard for the environment and energy efficiency.

The programme was aimed to cost-effectively improve the operational efficiency and business performance of member companies within prevailing regulatory constraints. We have included the costs for the new Energy Storage Operators Forum within this activity

The program of works is being wound down and the projects below completed in the 2014 / 15 period.

S5243_1 : AC cable connections - Practical and Electrical Limits to Their Length
S5267_3 : Generation Diversity: Assessment and visualization of wind and hydro
S5241_2 : Managing the Risks of Multiple Points of Supply

Updated information can be found at :- https://www.stp.uk.net</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental to Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Expected benefits of project</td><td colspan="4">Projects within this module have been cost effective and help improve reliability and safety of generation connection in distribution networks in line with government policy.

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

• Investigation of distributed generation connection methods without undue reinforcement, while at the same time improving supply quality by reducing CMLs and voltage unbalance;</td></tr>
</table>

	• Increased understanding amongst all member companies of technical, commercial and regulatory issues and development of effective solutions to these issues; • Development of understanding of the implications of connecting low-carbon technologies to the distribution network in terms of safety, design, reliability, security and power quality; • Optimised implementation, wherever possible, of the government's low-carbon strategy and accommodation of the likely growth of DG; • Improved management of the implications of connecting distributed resources to the distribution network in terms of the statutory, regulatory and commercial frameworks; • Investigation of low-carbon network designs and plan transition from passive to active networks; • Improved power quality issues due to dynamic load change; • Enabling of the development of strategies to manage power quality levels and customer expectations; • Highlighting of the issues and benefits of smart grids, smart meters and active network management systems, ultimately improving CMLs; • Significant benefits in terms of enhanced knowledge and awareness of overseas best practice in DG system integration, which can be applied as appropriate in the UK; • Optimisation by all participants of network design and financial and operational performance as the levels of storage, managed demand and distributed generation increase on the distribution networks; • Development and emergence of distributed generation, demand-side management, storage technologies.		
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	Typically >50%-	Project NPV = (PV Benefits – PV Costs) x Probability of success	Not calculated
Potential for achieving expected benefits	A number of STP projects are at an early stage and the project cost may not always reflect the likely full costs of implementation. However, STP has delivered a number of notable innovations since its inception.		
Project progress to March 2015	In this module all projects have now been completed. This STP program, run by EA Technology, has been wound down and no new projects are being generated for ED1.		
Collaborative Partners	Other DNOs		
R&D providers	EA Technology		

Project Title	**Protective Coatings Forum**		
Description of project	Protective Coatings for Plant and Overhead Line Towers: Quality Control and Consultancy Services		
Expenditure for financial year	Internal £2,100 External £7,295 Total £9,395	Expenditure in previous (IFI) financial years	Internal £14,881 External £55,501 Total £70,382
Total Project Costs (Collaborative + external + Northern Powergrid)		Projected 2015/16 costs for Northern Powergrid	Internal £2,500 External £7,000 Total £9,500
Technological area and / or issue addressed by project	Issues relating to protective coatings for lattice towers and substation plant are explored at this user group forum with speakers from the member companies, academia and various global suppliers. The main tasks of the project, as agreed with the sponsoring companies, were as follows:- • To provide quality control services to supporting electricity companies on tower and plant painting. • To maintain and monitor the batch certification scheme. • To carry out laboratory tests on paint samples from field contracts to ensure compliance with EA Technology specifications. • To liaise with manufacturers on quality control procedures and on their development work on improved paint systems. • To carry out quality assessment checks / troubleshooting in individual electricity companies as required. The project budget includes the provision for one visit to each supporting electricity company. • To produce updated specifications for tower and plant paint systems as required, and to maintain a list of EA Technology Assessed manufacturers. • To attempt to increase the number of EA Technology Assessed suppliers by testing samples and monitoring field trials where appropriate. • To monitor the trials with the water based paint system with a view to ensuring a smooth transition to environmentally friendly paint systems as demanded by legislation. • To keep abreast of environmental legislation relating to VOC limitations to assess when restrictions on solvent-based paints are likely to be enforced. • To continue to assess other VOC compliant paint systems which may be suitable alternatives to the water-based paint system for painting towers. • To carry out additional tasks as required and agreed by the supporting electricity companies, within the scope of the project e.g. the assessment of new paint systems, laboratory tests etc. • To provide general guidance to the supporting electricity companies on all aspects of surface coatings. • Analysis of paint flakes (for lead content) using Scanning Electron Microscope (SEM) recovered from sites surrounding towers • Trials of a variety of concrete muff coat paints and anti-vandal paints at a NGC site, Bushbury, near Wolverhampton.		

<table>
<tr><td></td><td colspan="3">• Quality Assurance (QA) inspection of One Coat Alkyd paint on a number of structures in the ENW, Manchester area.</td></tr>
<tr><td>Type(s) of innovation involved</td><td colspan="3">Primarily incremental improvement</td></tr>
<tr><td>Expected benefits of project</td><td colspan="3">The expected benefits of the agenda items addressed during 2014-15 are:
• An industry standard specification for paint systems
• An industry maintained assessed manufacturers list
• An industry list of assessed testing instruments
• Monitoring of production batch samples and samples recovered from site
• Quality assurance inspections of installations
• Development of specialist coatings with anti-vandal properties
• Development of specialist coatings for concrete muff tower foundations
• Innovative approaches to review alternatives to standard paint systems
• To have manufacturers develop systems to overcome technical issues
• To be informed of changes to associated European legislation
• To be a knowledgeable forum able to inform and influence national and international technical bodies and associations.
These benefits will enhance the way in which lattice towers and substation plant are protected from the effects of the environment.
Further work will be conducted during 2015/16 outside of regulatory innovation stimulus.</td></tr>
<tr><td>Expected timescale to adoption</td><td>Range 1-3 years - dependent on legislation</td><td>Duration of benefit once achieved</td><td>On-going</td></tr>
<tr><td>Probability of success</td><td>Range 50-100%
dependent on project</td><td>Project NPV</td><td>Not calculated</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="3">A number of specific sub-projects have led onto various new systems and installation techniques being either introduced or rejected, thus improving asset life, system reliability and impact on the environment.</td></tr>
<tr><td>Project progress to March 2015</td><td colspan="3">The minutes from meetings, presentations and a file index of projects are available to members. This may have a positive impact on one or more of the asset management policies.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="3">DNO members</td></tr>
<tr><td>R&D provider</td><td colspan="3">EA Technology Limited and suppliers technical engineers</td></tr>
</table>

Project Title	**Partial Discharge User Group**		
Description of project	The Partial Discharge User Group is a technical forum where information on partial discharge-related failures can be discussed.		
Expenditure for financial year	Internal £6,650 External £7,350 Total £14,000	Expenditure in previous (IFI) financial years	Internal £29,980 External £51,774 Total £81,754
Total Project Costs (Collaborative + external + Northern Powergrid)	£359,523	Projected 2015/16 costs for Northern Powergrid	Internal £2,500 External £6,500 Total £9,000
Technological area and / or issue addressed by project	Partial discharge is the primary cause of disruptive failure of HV switchgear. The Partial Discharge User Group is a technical forum where information on partial discharge-related failures can be disseminated and the understanding of the impact of partial discharge on switchgear can be enhanced through targeted investigative research and development work. This will in turn enhance the way in which HV assets are managed and maintained and will make a positive impact on the safety of operators working in substations.		
Type(s) of innovation involved	Primarily incremental improvement		
Expected benefits of project	Due to the ageing profile of switchgear and the introduction of air-insulated switchgear designs using cast resin, there is less tolerance of the effects of partial-discharge activity. Unless the condition of the switchgear is actively assessed and managed there will be an increase in failure rates. The expected benefits of the projects taken in the financial year 2014-15 remain: • Understanding of the potential partial discharge-related failure points for all types of switchgear. • Determination of the mechanism of failure related to surface discharge. • Ascertaining of the end of life of switchgear found to be experiencing surface-related partial discharge. • Understanding of the typical sound signatures of surface-related discharge by use of analysis in the time and frequency domain. • Enhanced interpretation of routine partial-discharge surveys. • Better targeting of maintenance. • Preservation or reduction of the low failure rate for HV distribution switchgear. • Understanding of the effect of the environment on the levels of partial discharge activity and the condition of switchgear. • Access to advice and support. • On site assistance.		

	• Use of a substation wiki. • Members discount on instrument purchases. Further work will be conducted during 2015/16 outside of regulatory innovation stimulus.		
Expected timescale to adoption	Range 2 - 5 years dependent on project.	Duration of benefit once achieved	On-going
Probability of success	50-100% dependent on project.	Project NPV (Present Benefits – Present Costs) x Probability of success	Not calculated
Potential for achieving expected benefits	During 2014-15 the PD User Group continued to invest in database of results that enables significant and key information to be quickly drawn from the large population of historical results. This has been built on over several years and the database now incorporates pictures, drawings, failure records and sound files (for the analysis of heterodyned ultrasonic activity). This greatly enhances the incident-reporting facilities, which helps engineers to better interpret the results of partial-discharge surveys and make an assessment of whether switchgear is in need of immediate attention. The database is web enabled to allow members direct access from their computers for reference or to upload information from their computers. Continuing the investigation previously referred to, different types of switchgear and components commonly used by the DNOs are sited at EA Technology and investigated for discharge activity, in some cases creating a discharge source to be monitored. The aim of this work is to try to determine the mechanism of failure associated with surface discharge to try to determine the end-of-life period once a discharge source has been found.		
Project progress to March 2015	A number of new instruments and monitors have been developed, and existing instruments improved and tested by members. The database has been updated, and there is now a better understanding of acceptable levels of partial discharge in the more modern types of switchgear. This has developed a greater understanding of potential failure mechanisms of the new types of switchgear being introduced to the networks. Progress has been made on how best to optimise the environment for switchgear prone to partial discharge in terms of temperature and humidity. Plant-specific partial-discharge issues have progressed.		
Collaborative Partners	DNOs		
R&D provider	EA Technology Ltd		

Project Title	**Engineers' Forums – Cable, OHL, Plant and Protection**		
Description of project	These are biannual forums attended by engineers from the UK distribution network operators. Each area of technical interest (Cables, OHL, Plant and Protection) holds its own separate series of meetings. The aim of the forums is to allow engineers to share knowledge and raise awareness of issues that affect the industry as a whole, including plant failures / safety and new developments in the specific technology areas, allowing fast take-up of innovation and best practice		
Expenditure for financial year	Internal £3,675 External £9,002 Total £12,677	Expenditure in previous (IFI) financial years	Internal £53,919 External £41,240 Total £95,159
Total Project Costs (Collaborative + external + Northern Powergrid)	£410,984		
Technological area and / or issue addressed by project	Issues are explored with speakers from the Member Companies, academia and various suppliers both in the UK and overseas. The scope of the forum covers manufacturing, installation, operation and maintenance issues along with implications on safety. Failure modes are reviewed to improve cable reliability along with analysis of asset management tools, techniques and technologies.		
Type(s) of innovation involved	Primarily incremental improvement and dissemination of new knowledge		
Expected benefits of project	The expected benefits of the agenda items undertaken during 2014-15 are: • To consider common problems and seek to identify common solutions (e.g. equipment performance, failures etc) • To be informed of new technologies and innovation (e.g. what is new from the manufacturers, technical bodies etc.) • To consider the impact of technical changes in the design and operation of power networks from the specific technological perspectives • To consider cost-effective management solutions for networks (e.g. safety, reliability, environment, maintenance, testing, commissioning etc.) • To be a knowledgeable forum able to inform and influence national and international technical bodies and associations. This in turn will enhance the way in which technological aspects of networks and assets are managed and maintained and safely operated. Northern Powergrid will no longer participate in these forums after March 2015.		
Expected timescale to adoption	Range 1-3 years dependent on project.	Duration of benefit once achieved	Ongoing

Probability of success	50-100% dependent on project.	Project NPV (Present Benefits – Present Costs) x Probability of success	Not calculated
Potential for achieving expected benefits	A number of specific forum topics lead onto various successful preventative projects, thus improving safety and system reliability.		
Project progress to March 2015	The minutes from meetings, presentations and a file index of cable issues have been sent to members. This may have a positive impact on one or more of the asset management policies at individual DNOs.		
Collaborative Partners	DNOs		
R&D provider	EA Technology Ltd		

Project Title	**Energy Storage Operators' Forum (ESOF)**		
Description of project	Continuing Tri-annual Forum established in 2013. The aim of the forum is to allow network operators and others to share knowledge and raise awareness of issues as they arise with this new class of network assets.		
Expenditure for financial year	Internal £4,550 External £4,460 Total £9,010	Expenditure in previous (IFI) financial years	Internal £8,400 External £8,890 Total £17,290
Total Project Costs (Collaborative + external + Northern Powergrid)	£262,066	Projected 2015/16 costs for Northern Powergrid	Internal £8,000 External £8,000 Total £16,000
Technological area and / or issue addressed by project	All aspects of the ownership and operation of storage devices are within the scope of this activity.		
Type(s) of innovation involved	Primarily incremental improvement and dissemination of new knowledge.		
Expected benefits of project	The expected benefits are: • The delivery and update of a good practise guide to overcome the lack of industry standards in this developing field. • To consider alternative ancillary commercial operating regimes to optimise operational costs • To consider common problems and seek to identify common solutions (e.g. equipment performance, failures etc). • To be informed of new technologies and innovation (e.g. what is new from the manufacturers, technical bodies etc.) • To consider the impact of technical changes in the design and operation of power networks from the specific technological perspectives. • To consider cost-effective management solutions for networks (e.g. safety, reliability, environment, maintenance, testing, commissioning etc.). • To be a knowledgeable forum able to inform and influence national and international technical bodies and associations. • To influence the direction of new innovative work, required by the industry as a whole, to allow the safe and successful implementation of this important technology. Further work will be conducted during 2015/16. A decision on whether this will be inside or outside of regulatory innovation stimulus mechanisms still needs to be made alongside our collaborative partners.		
Expected timescale to adoption	Range 1-3 years dependent on project.	Duration of benefit once achieved	Ongoing

Probability of success	75-100% dependent on project.	Project NPV (Present Benefits – Present Costs) x Probability of success	Not calculated
Potential for achieving expected benefits	A number of specific forum topics lead onto various successful preventative projects, thus improving safety and system reliability.		
Project progress to March 2015	Outcomes delivered by the ESOF during the year include: • Created, co-authored, reviewed and published the second revision of the good practice guide for energy storage; • Re-Published 2nd edition white paper entitled the 'State of charge of GB'; • Attended 3 hosted visits to Shetland, Leighton Buzzard and Buxton, viewing the SSE Lerwick, UKPN SNS storage facility along with destructive testing at HSE laboratories; • Created, co-authored and reviewed the LCNF conference presentation material; • Attended and presented at the good practice guide public launch event at the iMechE in Westminster.		
Collaborative Partners	Electricity North West, National Grid, Scottish Power, SSE, UKPN, Western Power Distribution,		
R&D provider	EA Technology Ltd		

Other Collaborative Projects

Project Title	**Cable Paper Moisture Meter**		
Description of project	Most of the HV cables in service in the UK and Worldwide use paper as an insulation medium. In many cases Fault energy in these cables will create a break in external shielding of the cable. This quite often exposes the paper to moisture present in surrounding air, soil or even water in ducts. Despite being soaked in oil the paper maintains its hygroscopic properties (which means it will rapidly absorb water). The level of absorption will depend on the water availability in the environment, oil availability in the cable, time, temperature etc. In such cases jointers need to make sure the remaining moisture level in the cable is minimal and to ensure that the paper will provide appropriate HV insulation. If the level of moisture in the paper is too high faults are likely to occur in the same place. There are two main problems that jointers face. The first is to establish the level of moisture content in the cable at the point of the joint as this is undefined currently. The second is to decide how much of the cable needs to be replaced as a result of moisture ingress. This decision is very important as any further cuts in the cable significantly increase the price of repair due to the cost of excavation and customer minutes lost (CML). Currently a 'hot oil bath' method is utilised to determine the moisture content, and although this method is time consuming in the field and potentially hazardous is not objective, and with no clear standard. The project will establish if and at alternative method can be developed using a multi frequency capacitance approach.		
Expenditure for financial year	Internal £1,225 External £41,115 Total £42,340	Expenditure in previous (IFI) financial years	Internal £600 External £38,598 Total £39,198
Total Project Costs (Collaborative + external + Northern Powergrid)	£233,275	Projected 2015/16 costs for Northern Powergrid	Internal £ 0 External £ 0 Total £ 0
Technological area and / or issue addressed by project	The current moisture assessment method, which has been in existence for several decades, is difficult to use and requires a naked flame. This project set out to: • Develop a multi-frequency instrument that can be used to analyse the moisture content of paper insulated cables; • Produce results with a high level of confidence and consistency. The more accurate measurement should alleviate the potential for cables being re-commissioned when unsuitable and the potential future failure; and • Remove the safety risk associated with the use of a gas burner to heat wax to a temperature of 120°C.		

Type(s) of innovation involved	Significant	Project Benefits Rating	Project Residual Risk	**Overall Project Score**
		18	-2	**20**
Expected benefits of project	Benefits are staff safety, improved customer service through reliability and financial. Jointing team safety is improved, increased network performance results from the decreased failure rate on jointed cables and repair costs are decreased due to both increased accuracy in the assessment required cable lengths to be replaced and by reduced excavation.			
Expected timescale to adoption	2016	Duration of benefit once achieved	10 Years	
Probability of success	10%	Project NPV (Present Benefits – Present Costs) x Probability of success	£ 505,000	
Potential for achieving expected benefits	The initial results from the project indicated that the approaches tested could potentially deliver the required functionality. Further development will not now be forthcoming and the potential benefits of this project will not now be delivered.			
Project progress to March 2015	The project did not continue to stage 2 due to a disagreement with the commercial terms of the project which had been signed up to in the original contract. The R&D provider therefore decided to cease the project at the end of stage 1.			
Collaborative Partners	Electricity North West, SPEN, UKPN, Energy Innovation Centre.			
R&D provider	EA Technology Ltd.			

<table>
<tr><td>Project Title</td><td colspan="4">Cable Temperature Sensor</td></tr>
<tr><td>Description of project</td><td colspan="4">This project is to validate a concept for an easily retro-fitted sensor for measuring and/or deducing the temperature of the core of a 3-phase electricity network power cable. Using cable temperature to infer the current in a cable offers the possibility to use this approach to provide a lower cost, more easily installed alternative to current transformers. It also provides a retro-fit alternative to fibre-optic cable temperature sensing. Additionally the measurement of the core temperature can be used to gauge when a cable reaches its temperature tolerance levels independent to the power being transferred.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £1,575
External £21,850
Total £23,425</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td>Total Project Costs
(Collaborative + external +
Northern Powergrid)</td><td>£207, 575</td><td colspan="2">Projected 2015/16 costs for
Northern Powergrid</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 problem being addressed by this project is to measure the cable core temperature at regular intervals using a sensor attached to the outer sheath of a cable. The sensor ideally is to be small, easily retro-fitted and will be of relatively low cost to manufacture. Two potential methods of temperature measurement were to be under consideration as follows:
Direct temperature measurement of the cable sheath with a computational model inferring a virtual temperature sensor at the cable core. The computation would be based on a cross-sectional thermal model of the cable components and materials.
Direct heat flux measurement to quantify the amount of heat exiting the cable, using the thermoelectric effect - also known as the Peltier and Seebeck effects depending on the direction of conversion between heat and electricity.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>18</td><td>-3</td><td>21</td></tr>
<tr><td>Expected benefits of project</td><td colspan="4">It is expected that the development of such a sensor would give the networks the increased ability to manage peak currents. The sensors would
improve the understanding of the network condition to help with network utilisation and deferral of capital expenditure (by extending the life of cables through peak temperature management), potentially also reducing the costs of outages.</td></tr>
<tr><td>Expected timescale to adoption</td><td>2018</td><td colspan="2">Duration of benefit once achieved</td><td>10 Years</td></tr>
</table>

Probability of success	10%	Project NPV (Present Benefits – Present Costs) x Probability of success	£ 194,000
Potential for achieving expected benefits	Stage 1 (Analytical and experimental proof of principle work) has shown that cable core temperature can be predicted with reasonable accuracy from easily accessed measurements of the cable exterior, and there may be techniques to improve the impacts of thermal lag so that a temperature sensing method can provide a range of useful measurements to assist with network management.		
Project progress to March 2015	Stage 2 (Proof of Concept Laboratory Prototype) was successfully completed in July 14. Stage 3 (Proof of Concept & Live Trial) began in Sept 14 with a Site trial in March 15. Project is now complete and a review is being held to decide whether development work should be carried out.		
Collaborative Partners	SPEN, SSEPD, ENWL, UKPN, Energy Innovation Centre		
R&D provider	The Technology Partnership Ltd		

<table>
<tr><td>Project Title</td><td colspan="4">Live 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:
• extend the voltage sensing range downwards from 2000 Volts;
• undertake a full market appraisal; and
• undertake full evaluation of the technology whilst in operation.
This project aims to take the Energised Alert device from TRL 4 to 8.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £0
External £0
Total £0</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £1,250
External £23,261
Total £24,511</td></tr>
<tr><td>Total Project Costs
(Collaborative + external +
Northern Powergrid)</td><td>£71,356</td><td colspan="2">Projected 2015/16 costs for
Northern Powergrid</td><td>Internal £ 2,500
External £ 2,500
Total £ 5,000</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">Significant</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>Year 2016</td><td colspan="2">Duration of benefit once achieved</td><td>25 Years</td></tr>
<tr><td>Probability of success</td><td>25%</td><td colspan="2">Project NPV (Present Benefits – Present 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 technical benefits although there have been several delays due to external factors. The project outcome is now in field trials and the potential to deliver a device into the marketplace remains high, although the precise schedule is difficult to predict.</td></tr>
</table>

Project progress to March 2015	• 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 complete • Stage Four was completed and issues surrounding over sensitivity were identified. • The project was stalled pending legal authorisation to the extension of the project to solve the issues identified in Stage 4. • Stage Four extension was agreed and has now been completed, there are 10 prototype units ready for live trials. Stage Five was added to the project during the stage 4 extension, however this has now been cancelled due to the IFI funding closing.. No claim against IFI allowances has been made this year and further funding will not come from regulatory innovation stimulus.
Collaborative Partners	Electricity North West, SPEN, SSE, UKPN, Energy Innovation Centre,
R&D provider	Live Alert

Project Title	**Gendrive Phase Balancer/Voltage Regulator**			
Description of project	The distribution network controlled using transformers and tap-changing has proven reliable, however controllability of voltage is limited at best and faces the greatest challenge in remote and rural areas. An active series voltage regulator is proposed to provide a more stable and smarter local supply. The unit proposed will in effect prevent or at worst delay the cost of reinforcing problematic distribution circuits.			
Expenditure for financial year	Internal £350 External £0 Total £350	Expenditure in previous (IFI) financial years	Internal £600 External £48,627 Total £49,227	
Total Project Costs (Collaborative + external + Northern Powergrid)	£146,204	Projected 2015/16 costs for Northern Powergrid	Internal £0 External £0 Total £0	
Technological area and / or issue addressed by project	Voltage control on the LV network where voltage control through primary transformer tap changers is no longer sufficient. I.e locations where there are high levels of load or distributed generation			
Type(s) of innovation involved	Significant	Project Benefits Rating	Project Residual Risk	**Overall Project Score**
		12	-3	**15**
Expected benefits of project	Successful development of the Gendrive device would: • Allow the Creation of a system that can control the voltage on an LV feeder • Will be able to balance voltage across the phases • Will be able to correct power factor on each phase • Will reduce Total Harmonic Distortion • Neutral currents will be regulated and controlled			
Expected timescale to adoption	None	Duration of benefit once achieved	-- Years	
Probability of success	0%	Project NPV (Present Benefits – Present Costs) x Probability of success	£ 0	
Potential for achieving expected benefits	The first stage of the project identified the limitations of the initial GenDrive approach which would have had limited ability to achieve the benefits sought. However a second design has been created that exceeds these. There is a good level of optimism that this project will deliver the technical benefits sought.			
Project progress to March 2015	The company was placed in Administration in March 2014. As a result the project was cancelled in September 2014 and the project closed out. No company has bought the technology.			
Collaborative Partners	Electricity North West, SPEN, SSE, UKPN, Energy Innovation Centre,			

R&D provider	GenDrive Ltd.

Project Title	**Oil-filled Cable Additive**		
Description of project	The project seeks to identify, develop and assess self-repairing systems for oil and fluid filled cable sheaths such that damage to the sheath will self-heal, to avoid oil leakage losses and the resulting environmental clean-up, as well as preventing contamination of the cable that could compromise its performance and lead to premature cable failure.		
Expenditure for financial year	Internal £2,100 External £42,650 Total £44,750	Expenditure in previous (IFI) financial years	Internal £2,550 External £103,218 Total £105,768
Total Project Costs (Collaborative + external + Northern Powergrid)	£313,050	Projected 2015/16 costs for Northern Powergrid	Internal £ 2,500 External £80,000 Total £82,500
Technological area and / or issue addressed by project	The project is investigating chemical and material additives which change their nature on contact with their environment under leakage conditions. The project consists of three stages: • Stage 1 - critical review and selection of potential repair technologies and the sourcing of the component compounds and design of test rigs; • Stage 2 - first level scoping assessment of prospective repair technologies to assess their ability to function in cables subjected to damage; and • Stage 3 - second level evaluation of the best candidate repair technologies from Stage 2 with recommendations on which technologies to commercialise and the best route for commercialisation.		

Type(s) of innovation involved	Significant	Project Benefits Rating	Project Residual Risk	**Overall Project Score**
		10	-1	**11**

Expected benefits of project	Across the whole of the GB distribution network the current cost of this problem is of the order of several £M per annum. Implementation of cable with self-heal properties would improve resilience to these issues. Specifically; • .Financial savings from reduced frequency of cable repair as a result of leakage; • Reduced necessity to repair damaged underground cables and the consequential environmental impact.; • Reduced ground contamination issues; and • Reduced customer disruption from premature cable failure		
Expected timescale to adoption	Year 2018	Duration of benefit once achieved	10 Years
Probability of success	30%	Project NPV (Present Benefits – Present Costs) x Probability of success	£ 133,000

Potential for achieving expected benefits	The contractor has has identified a number of chemistries that have the potential to create the desired blocking effect when a fluid leak is present. These chemistries will be advanced through further stages and experimentation. There has been a good level of engagement with the ENA Fluid Filled Cables working group and their experience has been valuable. There is confidence that the chemistries identified will be able to provide the benefits identified at the start of the project. Further project phases to test and develop the options further are now required and will be the subject of a separate NIA funded project.
Project progress to March 2015	An interim report was produced in February 2014 which showed good progress on identifying healing additives and mechanisms. Aged oils from DNOs and lab oils from other parties is allowing these mechanisms to be tested out in the laboratory. Stage 2 was competed in Sept 14, moving the project onto Stage 3 (Evaluation) which was project completed in March 15, all deliverables have been met with the final report issued in March 15, identifying the best candidate technologies.
Collaborative Partners	Electricity North West, UKPN, Energy Innovation Centre.
R&D provider	Gnosys Global Ltd.

<table>
<tr><td>Project Title</td><td colspan="4">Sustainable Multi-Storey Communities (Towerblocks)</td></tr>
<tr><td>Description of project</td><td colspan="4">Through initiatives such as the low carbon network fund many new low carbon technology options and possible network design approaches are now available. These options sit across the entire energy and utility system.

The inhabitants of multi-storey buildings provide a self-contained community of energy users. The nature of these dwellings and their locations also means such communities often coincide with areas of social deprivation and the fuel poor.

This project seeks to assess, from multiple stakeholder perspectives, but with societal considerations at its heart, those system options which are most feasible and desirable. A feasibility study and recommendations as to which options might be further studied or pursued will be produced.

In order to fully understand the new energy system options available to ourselves and to Northern Gas Distribution it is important to understand the social impact and community appetite for adoption.

The project meets our strategies and needs for technical innovation, customer energy, low carbon energy and corporate social responsibility.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £20,000
External £1,500
Total £21, 500</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td>Total Project Costs
(Collaborative + external + Northern Powergrid)</td><td>£155, 000</td><td colspan="2">Projected 2015/16 costs</td><td>Internal £6, 000
External £44, 000
Total £50, 000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The project addresses the broad systems aspects of the application of the full range of technologies, both individually and in combination, available to energy network operators.</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>10</td><td>-5</td><td>15</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">This project allows the further development of whole system approaches to network development, increasing efficiency and effectiveness in investment, whilst ensuring maximum customer, and other stakeholder, acceptance. The project will provide a feasibility assessment of the available options which can then be used to guide and inform future implementation or follow-up trials.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>2017</td><td colspan="2">Duration of benefit once achieved</td><td>10 Years+</td></tr>
<tr><td>Probability of Success</td><td>50%</td><td colspan="2">Project NPV (Present Benefits – Present Costs) x Probability of success</td><td>£36,000</td></tr>
</table>

Potential for achieving expected benefits	The project is a low technology readiness activity which will provide a platform for further work although the precise nature of that work will not become clear until completion. Given whole system approaches have not been investigated for the GB network it is anticipated that this project has a high likelihood of identifying previously untried options for energy networks that have a high degree of acceptability to customers.
Project Progress to March 2015	The project is in its early stages. Assessment of the current state of the art, detailed scoping and planning is underway. Candidate communities and buildings have been identified. Field work should commence during summer 2015. This project will be completed as an NIA project, registered by Northern Gas Networks
Collaborative Partners	Northern Gas Networks, Newcastle City Council, Your Homes Newcastle.
R&D Provider	Newcastle University.

<table>
<tr><td>Project Title</td><td colspan="4">UAV/VTOL – Unmanned Aerial Vehicle</td></tr>
<tr><td>Description of project</td><td colspan="4">The use of helicopters to inspect overhead line assets, whilst necessary and cost effective, is an expensive exercise and significant cost savings could be realised by the deployment of unmanned aerial systems. One or two of the UK DNOs are already successfully using unmanned aerial systems (UAS) for inspection tasks. However these systems are not suited to Beyond Visual Line Of Sight [BVLOS] operations.

To achieve this demanding goal of BVLOS, requires an expert approach to addressing the following three critical issues for electricity overhead-lines:
• Clearly defining BVLOS operations for which Civil Aviation Authority [CAA] approval can be sought and secured;
• A financial analysis that can provide a clear indication as to where categorized BVLOS operations will provide the best Return On Investment [ROI] for network operators and be viable for current and/or as yet undefined future operations; and
• Specifying a Remotely Piloted Aerial System [RPAS] that can provide a long endurance capability and fly BVLOS as well as meeting CAA regulatory requirements.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £5,950
External £21,850
Total £27,800</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £6,550
External £118,951
Total £125,501</td></tr>
<tr><td>Total Project Costs
(Collaborative + external +
Northern Powergrid)</td><td>£550,506</td><td>Projected 2015/16 costs</td><td colspan="2">Internal £10, 000
External £ 0
Total £10, 000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The project seeks to address both issues of technical capability of UAS based inspection and the regulatory and economic issues that act as barriers to implementation and must be overcome to allow successful deployment of this class of vehicle.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>18</td><td>-2</td><td>20</td></tr>
<tr><td>Expected benefits of project</td><td colspan="4">A UAS offers significant cost savings when compared to helicopter deployment. Being able to operate beyond the visual line of sight will result in significant efficiency improvements through higher productivity more circuit being surveyed during inspection periods.

Other benefits that unmanned aerial systems will bring include:
• Reduced environmental impact with greatly reduced fuel consumption.
• Reduced disruption to land owners, livestock and local residents during inspection.
• Reduced safety risk by using un-manned apparatus to retrieve data.
• Reduced Civil Aviation restrictions in the vicinity of airports, chemical plants, MOD land etc.</td></tr>
</table>

	• Reduction in stand down time due to bad weather or strong winds. • Reduced numbers of "missed towers" by not having to avoid motorways, railways or housing estates etc.		
Expected timescale to adoption	2017	Duration of benefit once achieved	30 Years
Probability of success	30%	Project NPV (Present Benefits – Present Costs) x Probability of success	£ 624,442
Potential for achieving expected benefits	The approach of this project is designed to address the CAA requirements, seen as the main barrier to implementation, at every stage in order increase the potential for achieving expected benefits. This allows a sensible stage-gate approach to achieve the best chance of successful delivery.		
Project progress to March 2015	The project commenced in March 2014. Our current assessment of the technology to date is that overall it would seem that regulation and technical knowledge is in place to allow the development of a BVLOS RPAS for electrical assets and hopefully gas too (though without the inherently safer flight paths to follow along the overhead lines that we have it seems like the gas industry have further to travel to make this work). There are still lots of things to do to move the technology on from VLOS to BVLOS primarily around proving the safety case to the CAA, (e.g. collision avoidance). The next and final task (Stage 4) is to get a specification produced.		
Collaborative Partners	Scottish Power, SSE, UKPN, Northern Gas Networks, Scotland Gas Network, Southern Gas Networks, Energy Innovation Centre.		
R&D provider	VTOL Ltd.		

<table>
<tr><td>Project Title</td><td colspan="4">Ultrapole – Ultrasonic Woodpole Inspection</td></tr>
<tr><td>Description of project</td><td colspan="4">There are currently several invasive instruments on the market for detecting wood rot in wooden poles used by the distribution network operators (DNOs) which are based on both acoustic (hammer in nail, tap and listen) and ultrasonic (slice shadow) technologies. Current products on the market adopt a variety of techniques but all are restricted to detecting rot in very close proximity to the point at which the measurements are being taken.

To satisfy the objective of assessing pole condition there is a need for an instrument that is easy to use in the field, takes non- intrusive measurements, and has the ability to operate at ground level over the entire length of the pole. Such an instrument would prevent the need for digging around the base of the pole disturbing previously good ground conditions, or climbing the pole to make measurements at height.

This project is to conduct a study into the feasibility for such a device.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £ 0
External £ 0
Total £ 0</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £600
External £36,218
Total £36,818</td></tr>
<tr><td>Total Project Costs
(Collaborative + external +
Northern Powergrid)</td><td>£147,272</td><td colspan="2">Projected 2015/16 costs for
Northern Powergrid</td><td>Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">Wooden poles are affected by their environment and can lose their physical integrity. This leads to issues of both network reliability and staff and public safety. Ultrasound can be used to detect changes in wood density due to rot or other deterioration. Current techniques use ultrasound to analyse cross sections of the pole, ‘slices’, which are normally at ground level. This project aims to develop a technique to use ultrasound longitudinally and thus from one point access the top and bottom of the pole.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>10</td><td>-1</td><td>11</td></tr>
<tr><td>Expected benefits of project</td><td colspan="4">This project will determine whether ultrasonics can be used to assess the condition of the complete wooden pole. If achievable this will provide a tool to assess overhead line poles without having to climb the pole or dig below ground level. This will be a safer and more cost effective method than those currently available.</td></tr>
<tr><td>Expected timescale to adoption</td><td></td><td colspan="2">Duration of benefit once achieved</td><td>20 Years</td></tr>
<tr><td>Probability of success</td><td>10%</td><td colspan="2">Project NPV (Present Benefits – Present Costs) x Probability of success</td><td>£ 76,055</td></tr>
</table>

Potential for achieving expected benefits	Withdrawn from project.
Project progress to March 2015	Stage 1 Exploration, Science Review/Technology Assessment was completed in Sept 14. Northern Powergrid was not satisfied that the results of the analysis indicated a value-for-money delivery of the technology could be achieved. Northern Powergrid, along with ENW, withdrew from trhe project.
Collaborative Partners	Electricity North West, Scottish Power, SSE, UKPN, Energy Innovation Centre.
R&D provider	Acuity Products Ltd.

Northern Powergrid's internal innovation programme

Project Title	**ANM Beverley - Driffield**		
Description of project	Northern Powergrid is facing growing pressure in the connection of new generation to its networks. The existing approach to network operation limits the utilisation of the installed infrastructure. Connection offers to generators often mandate significant reinforcement, imposing costs and timescales that make many projects unfeasible. Northern Powergrid would like to extend their existing range of innovative projects to develop its knowledge of Active Network Management (ANM). This approach to network operation will manage constraints through curtailment of new generators, and thereby utilise the existing infrastructure more fully. This should make possible connection offers with lower cost and shorter timescales, and support the connection of more generation. Northern Powergrid has identified an area of network suited to an initial ANM deployment, Driffield in Yorkshire. In using Driffield as case study Northern Powergrid will develop its capabilities and resources so that ANM can be deployed elsewhere in future. This project will help Northern Powergrid to achieve its goals in both learning and implementation. It is anticipated that this project will provide Northern Powergrid with the experience, tools and documentation to enable us to apply active network management schemes at Driffield and elsewhere on the Northern Powergrid networks as business as usual.		
Expenditure for financial year	Internal £34, 475 External £155, 894 Total £188, 369	Expenditure in previous (IFI) financial years	Internal £0 External £0 Total £0
Total Project Costs (Collaborative + external + Northern Powergrid)	£188, 369	Projected 2015/16 costs	Internal £0 External £0 Total £0
Technological area and / or issue addressed by project	The project has used generator connections and network constraints in the Driffield area as a case study to help achieve the organisational change required for implementation of ANM across Northern Powergrid's networks. Phase 1 of this project went through a process of analysis, addressing technical and commercial issues across the business, and design, laying the foundation for implementation in Phase 2 but also producing guidance documents and decision making required for ANM to be used in future. The key technical objectives of the project were to: • Develop our understanding of curtailment and constraint analysis, • Outline the Driffield ANM scheme design and functional requirements, • Produce interface, communications and HMI requirements, • Discuss and develop our stance on protection as a backup to ANM.		

Type(s) of innovation involved	Incremental	Project Benefits Rating	Project Residual Risk	**Overall Project Score**
		12	-5	**17**
Expected Benefits of Project	Northern Powergrid will benefit from having developed the guidance necessary to deliver active network management schemes as business as usual. Through positive and constructive engagement with multiple business departments across Northern Powergrid, on the technical, commercial and customer service aspects of ANM it is expected that appropriate guidance will be developed to enable Northern Powergrid to deploy ANM as a business as usual offering to generation connections customers that make economically efficient use of network headroom.			
Expected Timescale to adoption	2015	Duration of benefit once achieved	10 Years+	
Probability of Success	90%	Project NPV (Present Benefits – Present Costs) x Probability of success	£276,000	
Potential for achieving expected benefits	The successful outcome of the project indicates a very high potential for delivering the anticipated benefits. Maximum potential will be realised through engagement of the appropriate staff within Northern Powergrid to tackle the issues that ANM raises.			
Project Progress to March 2015	This project is now complete. The project has used generator connections and network constraints in the Driffield area as a case study to help achieve the organisational change required for implementation of ANM across Northern Powergrid's networks. This project went through a process of analysis, addressing technical and commercial issues across the business, and design, laying the foundation for implementation in the next phase as business as usual but also producing guidance documents and decision making required for ANM to be used in future. The key technical objectives of the project were to: • Develop our understanding of curtailment and constraint analysis, • Outline the Driffield ANM scheme design and functional requirements, • Produce interface, communications and HMI requirements, • Discuss and develop our stance on protection as a backup to ANM. This project has satisfactorily developed our understanding and knowledge in all these areas through the use of interactive workshops engaging all relevant business units effectively. Not only have we produced a technical implementation to support these objectives, we have developed key staff understanding of ANM, ensuring that appropriate knowledge is in place to support customers utilising this approach.			
Collaborative Partners	None			

R&D Provider	Smarter Grid Solutions

<table>
<tr><td>Project Title</td><td colspan="3">CBRM Extension – Health Indices – Stage 5: Direct data upload to cloud-based CBRM tool</td></tr>
<tr><td>Description of project</td><td colspan="3">EA Technology previously completed work on producing condition based risk management (CBRM) models for Distributed Substations (DSS) and Wood Pole Overhead Line (OHL). This applies health index analysis and CBRM on all of Northern Powergrid's wood pole overhead lines and distribution substations. However IT hosting issues have provided a barrier to seeing the project through to deployment by making testing, bug-fixing and updating extremely difficult to do. Therefore a stage 4 of the project was implemented in 2012/13 which ensured that the software tool could also run on an internet cloud. Our final step for fully evaluating whether CBRM can become a usable tool within the business is to prove that we are able to update the databases via direct data upload to the cloud based application. This final functionality will provide the means to recalculate health indices with fresh data whenever we wish to do so, during the cloud-based tool's one year evaluation period.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £4,200
External £32,566
Total £36,766</td><td>Expenditure in previous (IFI) financial years</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td>Total Project Costs
(Collaborative + external +
Northern Powergrid)</td><td>£42,766</td><td>Projected 2015/16 costs for
Northern Powergrid</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="3">EA Technology has recently completed work on producing CBRM models for Distributed Substations (DSS) and Wood Pole Overhead Line (OHL). Northern Powergrid now need seamless access to the technology to test how it works in an operational environment with regular data updates and without bugs. This project will enable this testing environment to be set up.</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>16</td><td>-3</td><td>19</td></tr>
<tr><td>Expected benefits of project</td><td colspan="3">Financial
A robust and defensible investment plan based on a sound understanding of the assets, their current and future condition, and an assessment of future condition, performance and risk. This will enable the optimum replacement/refurbishment programme based on minimising cost and maintaining a defined level of performance. There is also an added benefit that this work can be used as a basis for the new tier 2 output measures for ED1.

Knowledge Transfer
"The principal outputs of this project will be CBRM models, all of which will provide health indices, POF values and criticality ratings for individual and combined assets in year 0 and future years with and without interventions. The engineering parameters and the methodologies provide knowledge that can be retained within the business for continuity into future years."

Environmental
Assets for which condition degradation has environmental impacts, such as</td></tr>
</table>

	oils leaks from distribution plant, are identified during the processing of condition data into health indices. Network Performance Assets for which condition degradation affects network performance, such as unreliable overhead lines, are identified during the processing of condition data into health indices.		
Expected timescale to adoption	1 year	Duration of benefit once achieved	4 Years
Probability of success	75%	Project NPV (Present Benefits – Present Costs) x Probability of success	£55,007
Potential for achieving expected benefits	We are confident that we have a functional CBRM software tool and a set of Health Indices that we can already access on an internet cloud as well as on our servers. Direct data uploading functionality into cloud based implementations of CBRM is proven in other DNO's so we have no reason to believe it cannot work here. A small amount of risk lies with the level of resource / complexity required for preparing the data interface.		
Project progress to March 2015	The project has now completed successfully. CBRM data update capability has been tested on the cloud. This is helping us to assess whether the tool is suitable for adoption by the business. The next project stage in any CBRM project, should we decide to adopt the tool, will be to extend CBRM to other asset classes, and to tailor all of the models to suit Ofgem's common framework as well as to cater for our own asset management purposes. None of this will happen until the new Oracle Spatial asset management system has been installed and the common framework has been agreed. A further stage is unlikely to commence therefore until late in 2015/16 and even 2016/17.		
Collaborative Partners			
R&D provider	EA Technology Ltd		

<table>
<tr><td>Project Title</td><td colspan="3">Decision Modelling - Asset Risk</td></tr>
<tr><td>Description of project</td><td colspan="3">decisionLab is a consultancy which specialises in developing bespoke and customised Operational Research and statistical models. Northern Powergrid entered a project in May 2014 to evaluate the decisionLab modelling approach.

The overall objective of this project was to provide a suitable alternative and enhanced modelling platform for carrying our optimised intervention modelling. As a strong supplement to the existing health index processes embedded within Northern Powergrid, the outputs from this project would informs future business plan submissions.

The focus was on the use of a sophisticated modelling software platform (AIMMS) initially for a single asset category with a view to employing it for multiple asset categories.

Further development of the model was then carried out to enable it to prescribe optimal interventions within and across asset categories.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £27,125
External £151,299
Total £178,424</td><td>Expenditure in previous (IFI) financial years</td><td>Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Total Project Costs
(Collaborative + external +
Northern Powergrid)</td><td>£178,423</td><td>Projected 2015/16 costs for
Northern Powergrid</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="3">Over the last decade Northern Powergrid has developed a suite of condition based risk models. The parameters that drive these decision support tools are now relatively stable and the functionality well embedded into key business processes such as the asset replacement pipeline.

They contain high levels of inherent complexity and uncertainty, in particular associated with the subjectivity of input data (condition bands and weightings) and forecasting model error. Further, the overall volume of data per asset, and the number of assets now covered in the suite of models, presents its own challenges in terms of the robustness of the models and the processes by which these models are updated, manipulated and interrogated.

The objective of this project is to provide a suitable alternative and enhanced modelling platform for carrying our optimised intervention modelling. As a strong supplement to the existing health index processes embedded within Northern Powergrid, the outputs from this project would inform the basis of our future business plans.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Significant</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>8</td><td>-3</td><td>11</td></tr>
</table>

Expected benefits of project	In terms of benefits realised, it was anticipated that the enhanced modelling capabilities would: - Reduce the internal resource associated with carrying out intervention plan modelling and optimisation. - Further benefit would be realised from optimising the investment pipeline over and above the work already carried out in this area, as a result of the enhanced modelling capabilities and intervention strategies that could be evaluated.		
Expected timescale to adoption	2015	Duration of benefit once achieved	16 Years
Probability of success	60%	Project NPV (Present Benefits – Present Costs) x Probability of success	£ 86,755
Potential for achieving expected benefits	Optimised intervention modelling is already undertaken and established within the business as a key infeed into key business processes. This project will initially be based on enhancing the existing processes through enhanced modelling techniques, further realising recognised benefits from this type of work.		
Project progress to March 2015	The project was completed on 31/03/2015 with Northern Powergrid taking delivery of the populated and customized Asset Risk Model. Overall the project is considered to have met these objectives by delivering: - **Amalgamation:** Multiple asset categories within a single model - **Consistency:** Decision-making is standardised across asset categories, plan comparisons are easier - **Simplicity**: Easier to use than existing spreadsheet models - **Flexibility**: Each asset category has a configurable list of multiple thresholds (MTC) to produce candidates for three intervention scenarios (Essential, Unconstrained, Budget-constrained) A further iterative stage (consisting of multiple phases) of this project is currently being developed.		
Collaborative Partners	None		
R&D provider	decisionLab.		

<table>
<tr><td>Project Title</td><td colspan="3">Failure on Demand</td></tr>
<tr><td>Description of project</td><td colspan="3">This project has two key elements:

The forensic investigation of two AEI/GEC BRVP17 and two South Wales C4X switchgear mechanisms will enable understanding of the degradation processes and the cause of the slow opening of the switchgear. The information obtained will assist in developing an appropriate strategy to ensure the reliability of the remaining population of assets, with the objective of reducing the rate of Failure on Demand (FoD) incidents. Learning on asset degradation will also feed into our decision support tools developed on the CBRM platform.

The production of an approved new product specification, supported by field trials, for retrofit AEI/GEC BRVP17 and South Wales C4X circuit breakers will provide a cost-effective alternative solution to replacing a whole switchboard where one or two individual units are identified to have unacceptable performance that cannot be rectified through maintenance.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £ 0
External £ 0
Total £ 0</td><td>Expenditure in previous (IFI) financial years</td><td>Internal £15,850
External £64,840
Total £91,690</td></tr>
<tr><td>Total Project Costs
(Collaborative + external +
Northern Powergrid)</td><td>£91,690</td><td>Projected 2015/16 costs for
Northern Powergrid</td><td>Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="3">To carry out forensic analysis of the moving portion of a total of four sample circuit breakers (two South Wales Switchgear type C4X and two AEI/GEC type BVRP17), to include intrusive examination of the mechanism and analysis of the lubricants applied. The work will be carried out by a third party and will comprise the following key activities:

- Analysis of background information, including previous trip-timing profiles and maintenance procedures
- Completion of three consecutive trip-timing profiles on each circuit breaker
- Visual examination and photography in the ‘as received’ condition
- Detailed examination of the mechanism to determine the general condition and identify any degradation, condition of lubricants, corrosion, wear, alignment etc.
- Removal of lubricant from mechanisms to assess condition with regard to the ability to lubricate adequately
- Dismantling of mechanism as required
- Optical and electron microscopy of components as required
- Compilation and issue of report

To facilitate the removal of switchgear moving portions for analysis and to provide Northern Powergrid with approved retrofit moving portions as an alternative option to replacing a whole switchboard where failures</td></tr>
</table>

<table>
<tr><td></td><td colspan="4">are confined to one or two specific units, it is proposed to specify, assess, purchase, retrofit install and trial two AEI/GEC BVRP17 moving portions and two South Wales Switchgear C4X units.</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>10</td><td>-5</td><td>15</td></tr>
<tr><td>Expected benefits of project</td><td colspan="4">The successful implementation of any intervention strategies including maintenance activities in light of forensic findings and the use of retrofit units will reduce financial penalties due to FoD interruptions by 20%, achieved over a 15-year period (in line with the 11kV CB maintenance frequency) following completion of the project.</td></tr>
<tr><td>Expected timescale to adoption</td><td>2015</td><td>Duration of benefit once achieved</td><td colspan="2">15 Years</td></tr>
<tr><td>Probability of success</td><td>90%</td><td>Project NPV (Present Benefits – Present Costs) x Probability of success</td><td colspan="2">£258,029</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="4">The project has been successfully completed.</td></tr>
<tr><td>Project progress to March 2015</td><td colspan="4">Partial discharge measurements were taken in April 2015 from the retrofit circuit breaker replaced in April 2014 and levels are satisfactory.

The findings of the forensic analysis work have been used to inform Northern Powergrid maintenance policy and the annual Asset Serviceability Review.

The performance of the retrofit units has informed Northern Powergrid's code of practice for circuit breaker refurbishment.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="4">None</td></tr>
<tr><td>R&D provider</td><td colspan="4">EA Technology Ltd</td></tr>
</table>

<table>
<tr><td>Project Title</td><td colspan="4">Lubrication Project</td></tr>
<tr><td>Description of project</td><td colspan="4">The project is a research project between Northern Powergrid and Imperial College, London to review legacy lubrication materials and techniques, analyse the main degradation mechanisms and utilise laboratory tests to determine optimised lubrication requirements in different environments and applications across the Northern Powergrid distribution networks.

The project is split into three stages :

Stage 1: Northern Powergrid to Identify equipment types and legacy lubricants used within Northern Powergrid. Imperial College, London to develop a test protocol to mimic the conditions that grease will be expected to operate in and thus determine a method of artificially aging grease samples to allow a series of tests to be used to determine the static friction of the degraded grease.

Stage 2: Site visits to observe typical maintenance operations and collect samples of lubricants used in the various interfaces

Stage 3: Develop a report to confirm the suitability, and expected lifetime of lubrication materials used within Northern Powergrid together with recommendations for any improved lubrication materials currently available and or frequencies of application.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £13,125
External £40,000
Total £53,125</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £9,900
External £80,000
Total £89,900</td></tr>
<tr><td>Total Project Costs
(Collaborative + external + Northern Powergrid)</td><td>£95,000</td><td>Projected 2014/15 costs for
Northern Powergrid</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">• To determine the relative performance and likely lifetime of legacy lubricants used on different switchgear types.
• To specifically review the performance of current lubricant especially where it may be applied to existing switchgear without the complete removal of other previous Original Equipment Manufacturer (OEM) or legacy lubricants
• To obtain a better understanding of a series of Failure on Demand (FOD) events occurring on a small population of Primary Circuit Breakers within Northern Powergrid which have resulted in unacceptably high CML's and CI's</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>13</td><td>1</td><td>12</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">• Improvements in our switchgear maintenance policy through the identification or confirmation of appropriate lubrication materials and frequencies of application.
• Increased network performance by a reduction in FOD events</td></tr>
</table>

Expected Timescale to adoption	2016	Duration of benefit once achieved	20 years
Probability of Success	25%	Project NPV (Present Benefits – Present Costs) x Probability of success	£81,815
Potential for achieving expected benefits	A comprehensive study is underway which, if a solution can be identified, should be successful. The complex and probably interactive nature of the problems under examination contributes to a relatively large risk that the project is not successful and that the expected benefits are not delivered.		
Project Progress to March 2015	The project study is now complete. A sequential series of studies have now been completed. It is evident that the combination of legacy lubricants and maintenances practices has led to the formation of a highly viscous material which coats and then impedes movement of the switchgear mechanism. This accretion is not easily removed using current cleaning and re-lubricating methods. This is contributing to the failure of switchgear on demand. Changes to operational practice and to the range of products used for switchgear cleaning are now being made.		
Collaborative Partners			
R&D Provider	Imperial College of Science, London, Technology and Medicine. Tribology Group, Department of Mechanical Engineering		

<table>
<tr><td>Project Title</td><td colspan="4">Smart Data</td></tr>
<tr><td>Description of project</td><td colspan="4">Low carbon energy networks are being developed at Northern Powergrid which utilise distributed energy resources (DERs) and smart home technologies. This project is in the form of part-sponsorship of a university PhD being carried out under the auspices of Sheffield University's EFutures programme. It aims to understand what information will become available with the introduction of new smart meter and low carbon technologies into the market place, and to establish how we can derive business benefit from it by either changing existing processes or introducing new processes.

The relevance of this project to the business then is that it aims to make a significant contribution to the next generation of network management systems through understanding and showing the capabilities of geospatial diagrams and data representation with regards to low carbon and smart data, in terms of the impact they can have on network management. The project contributes to our preparedness for the future by enhancing our understanding of the data management implications of low carbon technologies.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £4550
External £10,000
Total £14,550</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £ 7,000
External £20,000
Total £27,000</td></tr>
<tr><td>Total Project Costs
(Collaborative + external + Northern Powergrid)</td><td>£41550</td><td>Projected 2015/16 costs for
Northern Powergrid</td><td colspan="2">Internal £3,500
External £0
Total £</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The project will develop a geospatial information system (GIS) demonstrator showing how smart data can be uploaded and applied to improve key business decision making.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Technological Substitution from outside industry</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>13</td><td>-5</td><td>18</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Financial
There may be some financial benefit provided from improved decision making. Such preparedness and good planning also minimises potential financial waste and optimises how we use the new technology.

Knowledge Transfer
The principal output of this project is a comprehensive overview of what kinds of data and representation solutions might be expected in managing our network in a low carbon future. It will also implement a practical demonstrator. This knowledge will be valuable to the business in understanding and planning how we use the new data in future decision support. The demonstrator may well form the basis for specifying design requirements for future network management systems.

Environmental
This project is part of the E-Futures doctoral training centre that is training a new generation of scientists and engineers to address the challenges inherent in making the transition to a sustainable energy</td></tr>
</table>

	future. Network Performance Improvement in network performance is a probable project outcome due to intelligent use of data about faults, customers and repair teams in a geo-spatial representation.		
Expected timescale to adoption	4 years	Duration of benefit once achieved	6 Years
Probability of success	25%	Project NPV (Present Benefits – Present Costs) x Probability of success	£8,976
Potential for achieving expected benefits	The project potential rests on the criteria "basic technology sub-system validation in laboratory environment". That is because GIS systems are already well established but the challenge here is to integrate these with new types of smart data. However there is also some risk in that there is uncertainty about how far our own systems will have developed to be able to provide meaningful parameters. There are also new innovative elements to smart grids which might present unforeseen problems.		
Project progress to March 2015	The following milestones have been met:- • The prototype of a GIS demonstrator has developed further in terms of more thought being put into smart data representation. • A statistical method has been developed to predict the usage pattern of houses where smart meter load data is missing, by having the figures for the total customer import at the substation based on the figures for the same day in previous weeks or years. • All the data and information required for the fieldwork has been collected. The key now is to do the analysis. • Papers have been accepted for the CIRED conference (statistical method) and the PowerTech conference (visualisation). This is the final year of a 3 year project. The key outputs will now be delivered after project completion. A copy of the thesis is now expected in December 2015. Delivery of the GIS demonstrator and statistical methods is expected in October 2015. A dissemination workshop is expected in November 2015.		
Collaborative Partners			
R&D Provider	Sheffield University Schools of Management and of Information Systems		

<table>
<tr><td>Project Title</td><td colspan="4">Distribution Load Estimates (DLE) Methodology</td></tr>
<tr><td>Description of project</td><td colspan="4">This project is to apply computational/statistical analysis tools and techniques to the available demand data with a view to identifying the presence or otherwise of underlying trends within the data itself or linked to other parameters. The details of the analysis required are left intentionally vague in order to permit a high degree of flexibility and interpretation.

This project is aimed at using a computational approach to undertake a forensic analysis of the available data to identify and analyse underlying demand trends. The key deliverable from this project is a fully documented new tool/model and process for forecasting demand which is materially more accurate/more robust to internal and external challenge than the present process.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £7,000
External 46,272
Total £53,272</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £5,320
External £20,000
Total £25,320</td></tr>
<tr><td>Total Project Costs
(Collaborative + external + Northern Powergrid)</td><td>£132,378</td><td colspan="2">Projected 2015/16 costs for
Northern Powergrid</td><td>Internal £3,500
External £20,000
Total £23,500</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The project scope associated with this piece of work is to gain a deeper understanding of underlying historic demand trends of customers supplied by the Northern Powergrid distribution networks so that their future needs can be better understood and forecast. The study will include assessment of historic data for the entire primary substation, supply point and grid supply point populations across both Northern Powergrid licences, thus covering the EHV-HV, EHV-EHV, 400kV/275kV/132kV-EHV and 132kV-HV substations; where EHV levels are typically 33kV and 66kV and HV levels are 11kV and 20kV. LV distribution substation loading is out of scope.</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>10</td><td>-2</td><td>12</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">• The development and delivery of a revised DLE methodology that materially increases the accuracy and robustness of the demand forecasts, compared with the current Northern Powergrid method, will facilitate enhanced robustness of future investment planning decisions, both internally and externally.
• Should the project successfully identify a number of high correlating factors and incorporate these factors into an improved methodology for forecasting maximum demands across the planning horizon, it is anticipated that the reinforcement plan will become more stable, and potential schemes will have an improved robustness and investment driver case.
• It is anticipated that due to the improved process, the resulting investment plan will be more robust.</td></tr>
</table>

Expected Timescale to adoption	2016	Duration of benefit once achieved	10 Years+
Probability of Success	60%	Project NPV (Present Benefits – Present Costs) x Probability of success	£2,092
Potential for achieving expected benefits	The learning elements of this project will be judged to be successful if, for the new load forecasting process delivered, the material differences between the proposed and current approaches can be described and explain the difference and which approach better meets the project objectives and why A number of industry-wide studies into load forecasting have been carried out, focusing mainly on economic drivers to future changes in loading. The learning from historical changes in loading represents a change to the development approach as does the use of mathematical and statistical modelling to determine those historical trends. The output will be readily taken up if successful as there is a specific business need for a more robust process for determining future demand levels.		

Project Progress to March 2015	Since initiation of the project in 2012, research the following is representative of the key elements of progress on the literature search to date: • Literature search into machine learning as a potentially methodology for time series trend analysis and future profile prediction. NGET data has been used to demonstrate ANFIS (Adaptive Network based approach to Fuzzy Interference System) as a potential methodology for time series future trend prediction. A paper was produced on the methodology and further expansion of the work carried out following review with Northern Powergrid. • Detailed review of the Northern Powergrid load forecasting process and access/familiarity with Northern Powergrid systems and data. Historic data shared and MD algorithm and error calculations completed to increase dataset and process knowledge. • Wider literature review covering retail, financial and energy sectors progressed resulting in documentation of key approaches. • Varied trend analysis via a range of mathematical methods, including principal component analysis and k-means clustering as a means to carry out load categorisation and to enable historic trends to be used in developing algorithms to apply by substation to determine future load profiles. • Continued assessment using k-means and principal component analysis to identify historic trends by customer type and presentation of conference paper to UPEC 2014 (Cluj-Napoca, Romania). • Continued development of various clustering techniques which can be considered on substations as part of a larger forecasting method. Presented a conference paper to Powercon 2014 (Chengdu, China) and drafted paper for submission to UPEC 2015 (Staffordshire University, UK) • Developed an overall forecasting algorithm using a combination of the customer clustering method and ANFIS. • Started consideration of method for the long-term forecast for comparison to forecast in DLEs. The process will generate an 8 year ahead MD forecast which will then be compared to Northern Powergrid current method for submission to a conference or journal paper. Will work with Northern Powergrid for this validation process. • Creating short summary reports of the project to date to assist with the final thesis.
Collaborative Partners	None
R&D Provider	Durham Energy Institute (Durham University)

<table>
<tr><td>Project Title</td><td colspan="4">Network Inference Study</td></tr>
<tr><td>Description of project</td><td colspan="4">There is an increasing weight of expectation on GB electric distributors to deploy active network management (ANM), to permit more connections with less reinforcement. This is illustrated by a raft of LCNF projects, including our own Customer-Led Network Revolution (CLNR).

Experience with CLNR GUS confirms the need for solutions which are simple to deploy and maintain. This project seeks to build upon the SGS rule-based approach (which is already simpler to deploy than GUS CLNR) to eliminate the need for accurate and timely updates on network topology (switch state), which is proving difficult to secure.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £3,300
External £25,851
Total £29,115</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td>Total Project Costs
(Collaborative + external + Northern Powergrid)</td><td>£29,115</td><td colspan="2">Projected 2015/16 costs</td><td>Internal £0
External £0
Total £0</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">This project will explore whether a simplified rule/case-based topology processing technique based on existing circuit analogue measurements could infer network topologies without the need for switch status inputs, and thereby leverage existing measurements and contain costs associated with other, more complicated approaches. This project tests the feasibility of the concept through desktop evaluation, including prototype implementations in modelling software. It is important to determine when and how such techniques may respond incorrectly to dynamic network topologies and hence how to ensure results are used safely. The proposed technique will be compared with other approaches including full state estimation.

Distribution network issues to be addressed in this project include both thermal and voltage management for an intact network as well as a network in n-1 outage conditions. The rule base would identify the network topology and hence facilitate a response to it such as instructing set-points for control equipment such as tap changers, capacitor banks and even generation set points through the SGS power flow and SGS voltage applications. This will determine what level of simplicity of rules can be obtained for inferences that would guide the configuration of the deployed ANM system. Identifying the correct network topology is key because distribution network problems, and their resolution, depend on the network configuration and the nature of demand and generation</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>12</td><td>-1</td><td>11</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The set-up, maintenance and testing of complex ANM solutions could easily tie up a chartered engineer full-time, giving £75k/yr that could be saved by simpler solutions</td></tr>
</table>

Expected Timescale to adoption	2015	Duration of benefit once achieved	10 Years+
Probability of Success	50%	Project NPV (Present Benefits – Present Costs) x Probability of success	£61,308
Potential for achieving expected benefits	This is a feasibility study, so we will certainly find out if this kind of approach is feasible.		
Project Progress to March 2015	This project is now complete. Candidate solutions have been identified, setting us up for a follow-on development/deployment project once a suitable opportunity arises. In the short term, simplifying the network problem to a simple set of rules can often be done without knowledge of network state. That is, a circuit generally becomes overloaded after a given outage, so switch state becomes superfluous.		
Collaborative Partners	None		
R&D Provider	Smarter Grids Solutions		

<table>
<tr><td>Project Title</td><td colspan="4">Integrated Substation Condition Monitoring</td></tr>
<tr><td>Description of project</td><td colspan="4">The reliable operation of circuit breakers is crucial to the dependability and safety of the distribution network, where failure of a circuit breaker to function causes the next zone of protection to operate, resulting in a greater number of customers off supply and consequently a greater financial impact on the business through IIS penalties.

Northern Powergrid is committed to making greater use of asset condition and performance data to inform asset management decisions. To facilitate more accurate intervention strategies and better supported investment decisions, greater and wider use of real time monitoring and diagnostics on the distribution system is needed.

This project aims to gather circuit breaker performance and operating environment data through the use of a real time monitoring system applied to several common types of switchgear.</td></tr>
<tr><td>Expenditure for financial year</td><td>Internal £224,926
External £7,700
Total £232,626</td><td colspan="2">Expenditure in previous (IFI) financial years</td><td>Internal £ 0
External £ 0
Total £ 0</td></tr>
<tr><td>Total Project Costs
(Collaborative + external + Northern Powergrid)</td><td>£749,754</td><td colspan="2">Projected 2015/16 costs</td><td>Internal £10, 000
External £299,902
Total £309,902</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">The method proposed is an Integrated Substation Condition Monitoring system (ISCM) comprising:
– Monitoring of partial discharge activity
– DC trip coil profiling including battery voltage monitoring
– Operating/breaking currents & times (I^2t)
– Operating environment - temperature & humidity

The majority of sensors proposed are already used by Northern Powergrid; the key area of development is the integration of all the sensors into one system, allowing the correlation between variables to be explored and trends in circuit breaker performance to be identified.</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>15</td><td>-2</td><td>17</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The benefit of safely deferring asset replacement by 5 years over the nominal life of 60 years is assessed to be 0.7m p.a. to Northern Powergrid alone. If confidence in the data was such that life could be extended by 10 years, the saving would be 1.4m p.a.</td></tr>
<tr><td>Expected Timescale to adoption</td><td>3 years</td><td colspan="2">Duration of benefit once achieved</td><td>20 years</td></tr>
<tr><td>Probability of Success</td><td>75%</td><td colspan="2">Project NPV (Present Benefits – Present Costs) x Probability of success</td><td>>£1,000,000</td></tr>
</table>

Potential for achieving expected benefits	It is likely that with accurate data relating to circuit breaker performance asset management decisions can be optimised to maximise the serviceability of the asset safely, delivering efficient and secure supplies to customers.
Project Progress to March 2015	The Post Design Brief was produced in December 2014 and the factory build commenced in January 2015. Successful factory acceptance testing was undertaken in March 2015.
Collaborative Partners	None
R&D Provider	Siemens

Benefits Realised

19. An essential part of any R&D programme is that the outcome of completed projects is rolled out into 'business as usual' products and processes. We see this as an increasingly accelerating process as IFI is now increasingly mature and the pipeline of projects producing tangible results is beginning to have an impact on day-to-day operations and decision making.

20. Where possible we are now bringing innovation projects to bear on real and immediate business-as-usual problems. Our ANM project was an example of this approach from this year. As a result this produced a quickly delivered project that is proving easy to integrate into our day to day operations.

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

- **Future network development**. Our ANM trial in the Beverley-Driffield area has proved to be highly successful. The very fast development of this technology has built on our own experience of flexible generation connections and work undertaken as part of the LCNF activities. This has allowed us to provide offers of additional capacity for generation connections in an area that, by older, more conservative metrics, was effectively full.

- **Risk Management** We have devoted a considerable amount of resource to risk management over the last several years. Our approach has become increasingly sophisticated but increasingly complex. We are now looking to integrate learning across several different areas so that we are selecting the optimal options from those available. Our decision modelling activity contributes to this by improving our understanding of the interaction of many different variables and helping us to exploit the most economically efficient of those options.

  Our risk management also extends beyond modelling to understanding the mechanics and chemistry of potential equipment failure modes. Our lubrication study project has delivered results which will allow us to mitigate a serious failure-on demand issue for high voltage switchgear, an issue that we have been working on to fully understand the underlying problem for some time.

- **Managing the assets.** As in previous years the longstanding, programme of projects to improve condition monitoring through the development of health indices continues to have a beneficial impact on our ability to manage both the installed and future asset base effectively and efficiently. To enhance our ability to exploit this more broadly we have completed a cloud-based implementation allowing us to access his from across the business.

  We have also commenced a new project using real-time, integrated substation condition monitoring to improve the operational management of our asset base. This work is initially investigating the use of this for switchgear but further options may be available later.

- **Strategic development**. The STP activities fall into this category, as they add to the body of knowledge without necessarily having an immediate impact. During the year we have shared this extensive understanding with the HSE, demonstrating the need to continue this evolutionary programme of activity. As a result of the move into RIIO ED1 we have reviewed the STP process and associated costs and made the decision to move the management of this activity to the ENA. This has meant that the current programme of activities, with the exception of a small number of legacy items, has been completed and closed down. The successor process, the collaborative energy programme (CEP), is currently in the design phase and should be in place, alongside its new NIA complaint governance process in the final quarter of 2015.

A further development has been the start of our first cross-utility network project, the Sustainable Multi-story Communities project. We are collaborating in a project with Northern Gas Networks to fully understand the options we have across our combined energy delivery system and how selection of those options are likely to be received by a key customer group.

22. We have continued to support the Energy Innovation Centre (EIC). This is an activity undertaken in collaboration with all but one of the other DNOs. It is designed to both identify and encourage innovations from new sources, such as other industries or SMEs with no previous experience of working with the electricity distribution network operators. Several new projects from this source have been identified and initiated this year. The costs of running the EIC have been distributed across the running projects identified from this activity.

The EIC membership now also includes gas network operators and we actively are seeking opportunities to collaborate across utilities.

Programme Planning and Co-ordination

23. To co-ordinate and, as importantly, disseminate innovative activity across the business, we have previously established improved internal systems. The resource expended on running the innovation process as a whole within Northern Powergrid is not a project within its own right: however, without this commitment no R&D would be possible within the company. This cost includes project administration, project management, reporting, internal group meetings and preparatory work on future projects, where such costs cannot be directly associated with a project.

24. An innovation strategy was developed during 2013 as a part of the well justified business planning activity. As part of the process of ensuring that this strategy continues to reflect the needs of both the business and our stakeholder it is anticipated that a major revision will take place during the 2015/16 regulatory year.

25. The transition from the IFI regime to the RIIO ED1 Network Innovation Allowance (NIA) appears to have been a relatively easy process. Our deliberate policy of running down the number of project we had as the change approached has been helpful. Only a handful of projects needed to be transitioned from IFI to NIA. The portfolio of activities now needs to be ramped back up in line with the innovation strategy.

NPV Methodology

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

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

Summary of Current Portfolio

28. The following summarises the full portfolio and the expenditure incurred during 2014–15.

		Expenditure		
	No. of Projects	Internal	External	Total
ANM Beverley- Driffield (SGS)	1	£34,475	£153,894	£188,369
Cable paper moisture meter (EIC)	1	£1,225	£41,115	£42,340
Cable temperature sensor (EIC)	1	£1,575	£21,850	£23,425
CBRM Extension Work	1	£4,200	£32,566	£36,766
Decision modelling	1	£27,125	£151,299	£178,424
Distribution Load Estimates Methoodology (Durham)	1	£7,000	£46,272	£53,272
EATL Cable Engineer's Forum	1	£875	£2,300	£3,175
EATL Energy Storage Operators Forum	1	£4,550	£4,460	£9,010
EATL OHL Engineer's Forum	1	£1,400	£2,332	£3,732
EATL Partial Discharge Users Group	1	£6,650	£7,350	£14,000
EATL Plant Engineer's Forum	1	£0	£2,285	£2,285
EATL Protection Engineer's Forum	1	£1,400	£2,085	£3,485
EATL Protective Coatings (Painting Forum)	1	£2,100	£7,295	£9,395
Gendrive phase balancer/voltage regulator (EIC)	1	£350	£0	£350
Lubrication study - Imperial College	1	£13,125	£40,000	£53,125
Sustainable Multistorey Communities (Towerblocks)	1	£5,250	£20,000	£25,250
Network Inference Study	1	£1,050	£19,565	£20,615
Oil-filled Cable Additive (EIC)	1	£2,100	£42,650	£44,750
Other	1	£0	£4,285	£4,285
Reactive Power Project (ENA)	1	£3,850	-£26,000	-£22,150
SG Forum Workstream 7 (ENA)	1	£1,400	£25,856	£27,256
Smart Data	1	£4,900	£10,000	£14,900
Strategic Technology Programme module2 Overhead Lines	8	£2,275	£70,000	£72,275
Strategic Technology Programme module3 Underground Cables	8	£2,100	£15,543	£17,643
Strategic Technology Programme module4 Substations & Plant	13	£3,500	£116,143	£119,643
Strategic Technology Programme module5 Embedded Generation	3	£1,400	£0	£1,400
Substation monitoring	1	£7,700	£224,975	£232,675
Tree Growth Regulators	1	£1,050	£0	£1,050
Triangle data analysis	1	£5,950	£25,000	£30,950
UAV/VTOL (EIC)	1	£5,950	£21,850	£27,800
Programme Management		£48,300		£48,300
	58	£202,825	£1,084,970	£1,287,795

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

Number of active IFI projects	58
NPV of current project portfolio	£12,215,538
Summary of other benefits anticipated from active IFI projects	Marginal improvement in reliability
Total expenditure in reporting period.	£1,287,795
Total expenditure to date	£8,768,558
Benefits actually achieved from IFI projects to date	see text

Summary of 2014/15 IFI investment

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

IFI Summary 2014-2015 Final

Eligible Project Spending (external)	£1,084,970
Eligible Project Spending (internal)	£202,825
IFIEt, Grand Total	£1,287,795
Revenue Yorks, RDt	£404,600,000
Revenue North East, RDt	£327,800,000
Total 2014-15 (CBR)	£732,400,000
ptrit, Pass Through Rate 14-15	80%
IFI Maximum (0.5% of CBR)	3,662,000
KIFIt, Notional carry forward to 2015-2016	1,831,000
Incentive revenue adjustment, IFIt	£1,030,236

31. In proportion to the revenue split between the two licensees, eligible project spending is;

	Eligible Spending	Carry Forward
Yorks	£711,417	£1,011,500
North East	£576,378	£819,500
Total	£1,287,795	£1,831,000

Outlook for 2015/16

32. We envisage that the portfolio of NIA projects to be worked on in 2015/16 will largely be made up from:

- Continuing to support the 'in progress' projects listed in this report, notably:
  - Initiation of the first projects in the new ENA Collaborative Energy Portfolio;
  - Oil-filled Cable Additive;

- Sustainable Multi-storey Communities;
- UAV/VTOL – Unmanned Aerial Vehicle;
- Decision modelling follow up;
- Smart Data;
- Distribution Load Estimate Methodology; and
- Energy Innovation Centre, Ellesmere Port.

o Developing new projects, collaboratively, such as through the ENA, where possible, but otherwise alone, including:

- Trialling of an alternative material and construction to replace wooden poles;
- Understanding and eradication of potentially catastrophic link box failure modes;
- Automated equipment for wood pole inspection;
- Work aimed at improved monitoring and control of our LV network;
- Improvements in understanding the local conditions which impact asset health and condition, initially focussing on cables;
- Development of approaches for fault anticipation;
- Support of and development of projects for the Strathclyde/Imperial College Centre for Doctoral Training;
- Further exploitation and development of CLNR outcomes such as the NPADDs;
- Customer energy projects which support both our network development and corporate social responsibility needs.