Annual summary

nationalgrid

Network Innovation Allowance

2013/14

Contents

01. Introduction

Welcome to the first Annual Summary of National Grid Electricity Transmission's projects under the Network Innovation Allowance (NIA).

The past financial year, 2013/14, has been one of exciting and significant change to our Electricity Transmission business with the implementation of our new RIIO-T1 8 Year Price Control – and in particular the implementation of the new funding mechanisms for Innovation: The Network Innovation Allowance (NIA) and The Network Innovation Competition (NIC).

During the last year we have focussed our innovation investment on activities that will improve the safety, reliability and sustainability of the Electricity Transmission Network and will deliver greatest value to our customers and stakeholders. We have continued to develop our network of collaboration partners, developing closer links with other network licensees, strategic academic partners, industry bodies and supply chain partners.

The NIA has opened up a wide range of opportunities for us to investigate and develop potential solutions to the challenges facing the electricity transmission system in the coming years. We have started work on a number of promising new ideas and projects, particularly in the areas of smarter system operation, maximising what we get from the assets already installed on the transmission network and delivering our network outputs at lower total cost. The NIA has replaced the Innovation Funding Incentive (IFI) of previous years, and we have continued making valuable progress on the many projects aligned to the RIIO framework that started under IFI.

As we start our second year under the RIIO-T1 framework, we will continue with our strategy to embed innovative approaches and ways of working at all levels within the business and work with our collaboration partners. We will also continue investigating and finding ways of reducing the risks and costs of developing and operating the Electricity Transmission Network. We will do this safely as we continue the journey towards a low carbon electricity sector.

J. Pettigrew.

John Pettigrew,
Executive Director

02. Innovation strategy

Strategic themes

Our RIIO innovation strategy identified 7 key themes of focus for our innovation activities which have been demonstrated through the range of innovation projects we have commissioned and continued to work on under each theme:

Strategic theme		
1	**Safety**	We continue to invest in the development of new tools, processes and techniques to protect our staff, contractors and the general public. Our research focuses on ways to more effectively protect our staff and assets where risk of failures exists. This research will help mitigate the impact of risk management hazard zones on system operability and increase access for maintenance.
2	**Reliability**	We have continued working on optimising the way we manage our assets by optimising maintenance times, improving monitoring techniques, extending asset lives and creating a step change in real-time data on asset performance. We are developing new techniques to improve condition information and deepening our understanding of the maintenance requirements of critical high voltage assets.
3	**Environment**	Our portfolio includes a number of projects aimed at minimising the environmental impact of our assets and operations as well as facilitating the connection of lower carbon sources of energy. We are continuing to research and assess the potential impact of climate change on our infrastructure and the way the system is operated so we can make sure we are well prepared for credible future scenarios.
4	**Connections**	System access is a priority for our generation and demand customers so we continue to work on projects that will reduce constraints and increase the speed and flexibility of our maintenance schemes. By creating a smarter transmission philosophy we can make sure our networks are capable of connecting large volumes of renewable generation and operate in harmony with active distribution networks.
5	**Customer Satisfaction / commercials**	The nature of Great Britain's electricity demand has been evolving rapidly and there are a number of ways in which it could be actively managed to reduce the cost of maintaining security of supply. Several projects are focussed on making sure demand side services are technically and commercially viable, through better understanding and modelling of the future demand and reliable means of control and communication. We are also investing in research to ensure the security of connection of renewable generation.
6	**Strategic**	Our strategic research ensures we are collaborating with a diverse range of institutions including universities, other utilities and industry groups to investigate next generation technologies in long term research. We continue to enhance our modelling capabilities, investigate how best to use the emerging technologies and support the development of new materials.
7	**System Operation**	As the GB System Operator we continue to support innovation to facilitate smarter system operation, enabling the efficient and coordinated operation of innovative transmission assets such as HVDC links, series compensation and quadrature boosters. This helps to manage the network challenges posed by intermittent generation. Researching smart platforms will facilitate the commercialisation of innovative storage and demand management techniques as potential alternatives to ancillary services provided by traditional generators.

Innovation helps drive our business forward, helping us to maximise our outputs for the benefit of consumers and stakeholders alike. The need to rise to the challenges that face the energy industry and our customers is driving an innovation culture within our business. Our ambition is to create efficient and sustainable solutions, delivering world class safety and reliability.

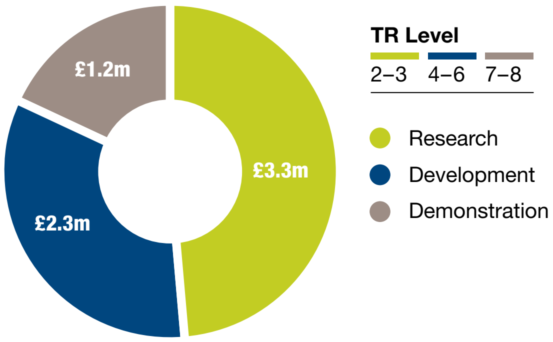
Identifying opportunities and prioritising
During 2013/14 we received proposals for innovative projects from a range of organisations, as well as from within National Grid. All the proposals brought forward are reviewed to assess: alignment with our innovation strategy, potential to deliver value for our stakeholders; requirements for, and implications of, implementation into our day to day business; and eligibility for funding, whether through the NIA or other sources.

The projects sanctioned through this governance process make up a portfolio that is balanced across:

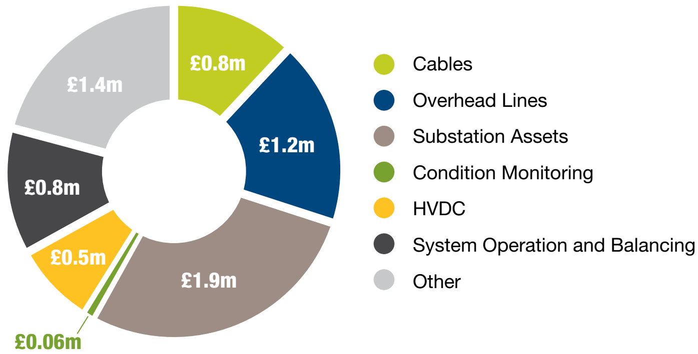
- a wide range of transmission asset types and system operational aspects,
- a range of ways in which we can deliver value, whether reducing costs or understanding and mitigating new or emerging operational challenges, and
- short-, medium- and long-term time horizons.

02. Innovation strategy

TRL Portfolio Value



Subject Area Expenditure Breakdown 2013/14



Our innovation portfolio: Technology Readiness Levels (TRL)

Our portfolio of projects spans the breadth of the technology readiness levels[1] 2 to 8. This diversity and strong mix of projects is a reflection of our staged approach that drives our business forward through the continuous development, trialling and refinement of new technologies and operating procedures.

[1]Technology Readiness Level (TRL) is a scale from 1-9 which provides an indication of how close a technology or new operational practice is to becoming technically and commercially viable and ready to be adopted as a routine option in our day to day business.

For the purposes of the NIA, TRL is defined as:

TRL 2-3:	Research, activity undertaken to investigate the issue based on observable facts;
TRL 4-6:	Development, activity on generating and testing potential solutions to overcome the issue;
TRL 7-8:	Demonstration, activity focussed on generating and testing solutions on the network that takes them to a stage where they can be transferred to business as usual
TRL's 1&9	1 (Blue sky research) and 9 (fully developed and tested and ready to be deployed) are not eligible for NIA funding.

Our innovation portfolio: topics.

The diversity of assets and activities at the heart of National Grid's Electricity Transmission operations is reflected in the nature of the subjects addressed by our NIA projects. Our innovation approach allows us to explore a broad range of areas, all of which have the potential to introduce either lower-cost or lower-risk solutions: often both. A particular area of success during the year was the extension of scope of NIA to include novel operational practices related to the GB System Operator, with a number of projects underway to facilitate the connection of increasing volumes of renewable generation and examining new ways of providing balancing services.

Our organisation

A significant area of progress in 2013/14 has been implementing a change in our organisation so that we can better deliver the benefits for stakeholders introduced by the RIIO framework. Effective innovation will come through our partnerships with several parties: our supply chain, academic partners and SMEs, so our organisation will make it easier for these parties to effectively engage with us. We have specific innovation leaders in each of our four Transmission directorates: Electricity Transmission Asset Management and Construction/Capital Delivery, both representing the England and Wales Transmission Asset Owner; and Market Operations and Transmission Network Services, both representing the GB System Operator.

Each project is assigned a senior sponsor, a project manager and a subject area technical lead. Accountability for the delivery of each project and the implementation of successful outcomes is clearly attributed to one of our four business directorates.

Transmission Owner (TO), England and Wales.

Contact Neil Williams	**Contact** John Zammit-Haber
Capital Delivery is accountable for all construction activities associated with the National Transmission system for both gas and electricity, from development through to delivery with a strong focus on safety, reliability and value.	**Electricity Transmission Asset Management** is accountable for the maintenance of the assets that make up the Transmission Network and deciding on the infrastructure investment necessary to extend and maintain the Electricity Transmission Network in England and Wales.
Email neil.g.williams@nationalgrid.com	**Email** John.Zammit-Haber@nationalgrid.com

Electricity System Operator (SO), Great Britain.

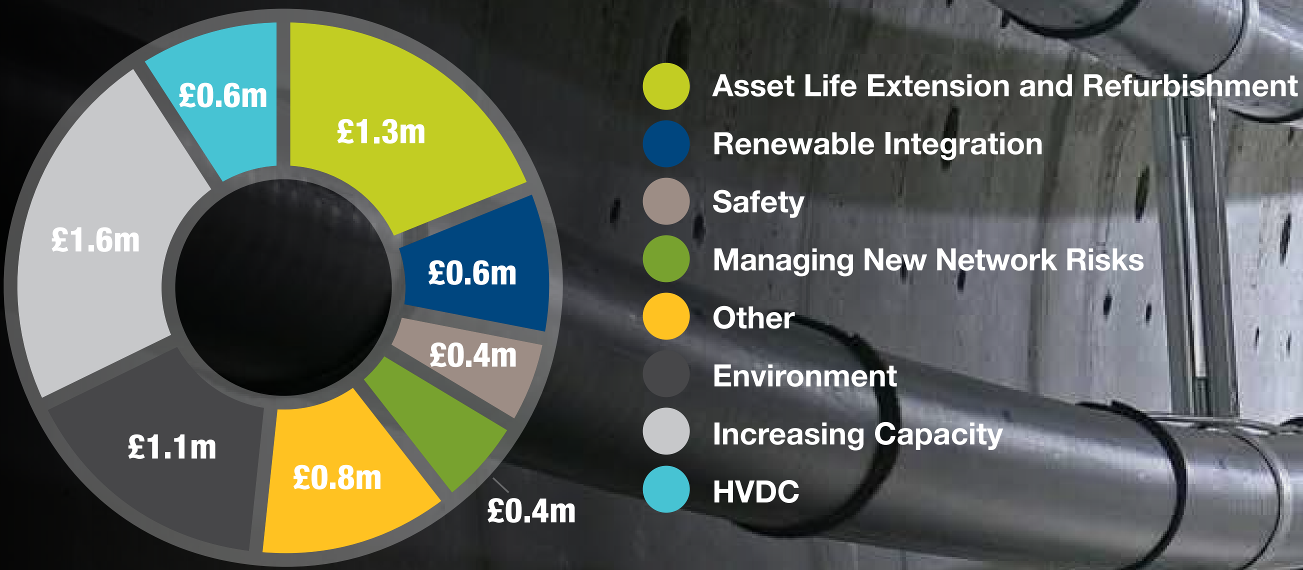
Contact Martin Bradley	**Contact** John West
Market Operations is accountable for the real time planning and operation of Great Britain's Electricity Transmission System. Its role includes market facilitation, production of energy scenarios spanning near and long term horizons together with real time operational data in order to enable and support efficient stakeholder and customer participation in these markets.	**Transmission Network Services** is accountable for network development strategy, customer connections and developing and maintaining electricity market rules.
Email Martin.Bradley@nationalgrid.com	**Email** John.West@nationalgrid.com

If you have a project proposal that doesn't clearly align with these areas of our business, or you are unsure, contact us at:
box.InnovationTransmission@nationalgrid.com

03. NIA portfolio overview

We invested £6.76m in progressing 101 NIA projects in 2013/14. We review our innovation strategy to ensure that it reflects the evolving nature of the GB energy sector, and in particular the role that the Electricity Transmission Network and System Operator play in delivering value to our customers and stakeholders. In addition to relating our 2013/14 activity to our RIIO innovation strategy, we have also grouped our innovation portfolio into seven value driven categories and have summarised our innovation activities under each of these areas.

Value Area Expenditure Breakdown 2013/14



03. NIA portfolio overview

Delivering value for our customers and stakeholders

We are focused on increasing customer value from our transmission network by driving innovation in crucial areas such as the mitigation and management of new network risk, novel ways of managing and using our existing network equipment to defer the need to build new assets and reduce replacement costs. As part of this we ensure we understand the future challenges to the networks as new forms of demand and supply evolve throughout the UK. Most of our innovation projects address more than one of the seven areas we have highlighted: we have grouped our projects according their predominant theme.

Asset life extension

Enabling us safely and reliably to extend the life our existing assets: making the most of the existing grid infrastructure.

Our customers want us to maintain and operate a Transmission system that is fit for purpose. A number of our projects are advancing specific elements of a holistic condition monitoring approach. This helps us continually reduce potentially avoidable cost through better prediction of equipment failures, improved forecasting of remaining usable equipment life and improved and targeted maintenance regimes. The extension of the life and reliability of our assets allows us to provide the same level of service for our customers at a lower cost than if we were to replace them and reduces our consumption of natural resources.

Environment

Strive to reduce our impact on the environment and work closely with our stakeholders to have a positive effect on the environment in which we work.

We continue to investigate and develop new ways to reduce the impact of our network and operations on the environment, at a local, regional and global level. Our stakeholders significantly value the environment we interact with and expect us to take care of it for current and future generations. Our T-pylon project focuses on the reduction of visual impact of transmission towers. In addition, we are working on a number of ways in which we can reduce the cost of undergrounding. Other projects are enabling us to improve the sustainability of our network by facilitating the recovery and reuse of material from our sites and equipment.

Increased capacity

Increase the capacity of our network through the increased utilization of our assets while maintaining at least the same level of safety and reliability.

Projects in this area focus on technologies and solutions to make full use of the potential capacity in the existing electricity grid. In particular we are further developing our existing ratings enhancement capabilities and developing wide area monitoring approaches to network management to establish the exploitable thermal and stability capacity in circuits. This can then be used to reduce significantly the cost of operating the system and potentially avoid or defer reinforcement works that would otherwise be needed to connect new low carbon generation.

Managing new network risks

Improve our ability to address the new complex realities arising from the evolution of low carbon smart gird.

We are progressing a number of projects that aim to make sure our network is able to accommodate the future complexity of demand, while adapting to work with complex new technologies. The characteristics of electricity demand and generation are progressively reducing the intrinsic stability of the transmission system. A number of projects have been investigating these changes, such as reduced system inertia and voltage control issues, to ensure that the transmission network can continue to operate reliably and securely. These projects have provided the foundation for our 2014 Network Innovation Competition proposals, which aim to trial and demonstrate a number of possible solutions that could be used to manage these changes in the future, effectively and economically.

Safety

Managing work safely is our priority by using innovative and creative techniques to improve our employee, contractor and public safety, as well as employee wellbeing.

Safety is the priority consideration on all our projects. The projects we have grouped under this section are those focused on ensuring the safety of our employees such as the Rapid Deployment Ballistic Screens. This looks to deliver a low cost, effective and easily deployed ballistic screening module that is capable of withstanding the debris from an extreme failure of porcelain clad High Voltage transmission assets. Additionally our Enhanced AC and DC Safety Voltage Limits project is developing a software solution to calculate safety voltage limits of ground surface material to provide a better understanding of the most appropriate safety standards for substations.

Renewable integration

We are committed to environmental sustainability, facilitating the transition to a low carbon energy economy by enabling a seamless integration of renewable generation resources, whilst managing our own carbon footprint.

Renewable power generation brings particular challenges for managing the balance of supply and demand. As more generation is subject to weather conditions we are developing increasingly sophisticated approaches to forecasting power output from renewables. We have a particular focus on forecasting extreme weather circumstances, at the scale of a single wind farm, regionally and UK wide. To complement these we are also investigating how we can make most effective use of the increasing complexity of models and amounts of input data. The aim is to quickly and reliably translate it into useful knowledge about renewable generation impacts on system operation in a visually intuitive way.

HVDC

High Voltage Direct Current (HVDC) technology is one of the technical options National Grid is integrating in the future development of the transmission system in Great Britain.

The effective use of HVDC, in particular voltage sourced converter (VSC) technology, is a stand-alone theme in our innovation portfolio: in practice our work in this area overlaps with all the other themes. The dominant emphasis of our HVDC programme is on the safe, reliable and economic integration of new and increasingly complex HVDC connections with the existing HVAC system, both from an asset protection and system operation point of view.

04. Collaboration and dissemination

2013/14 has been a great start for the NIA programme, building on the success of previous years, through successful collaborations and supplier relationships to deliver significant benefits for customers. Our collaboration and dissemination effort is an important factor in the success of our innovation strategy, and vital to helping us overcome future challenges. We recognise that there are significant benefits from partnership and collaboration in innovation. We will deliver the most by working with partners from within the energy sector and academia, as well as those from other sectors who may contribute a different perspective on our activities.

Throughout the year we have strengthened our partnerships with other network operators to provide a greater use of resources and expert knowledge in the industry. The Energy Network Association R&D working group provides the GB electricity networks with a valuable means of sharing knowledge about our innovation projects and identifying challenges that we can most effectively address together, such as the REACT project highlighted in section 5.

Through these connections we are also pleased to be actively working alongside a number of the Distribution Network Operators in support of their Low Carbon Network Fund projects.

Together with Scottish Power Transmission (SPT) and Scottish Hydro Electric Transmission (SHET), we have established a high voltage Transmission Owner/System Operator working group focussed on the technical challenges and collaboration opportunities specifically related to the high voltage networks. These include the collaboration between SPT, National Grid and SHET on the SPT-led VISOR NIC project to increase the usable capacity of existing transmission circuits between Scotland and England.

Looking further afield, many of the challenges facing the GB electricity system are shared by other Transmission networks around the world. We are actively engaged in a number of valuable knowledge exchange networks such the European Network of Transmission System Operators - Electricity (ENTSO-E) Research and Development Committee, the US based Electric Power Research Institute (EPRI) and International Transmission Operations and Maintenance Study (ITOMS). These networks enable us to learn from the experiences of others to bring benefits to the GB network and to maximise the use of our NIA funds through financially leveraged collaborations.

In the autumn of 2013 we co-hosted two major dissemination events to share information about our innovation projects. In September we celebrated 10 years of working in partnership with the University of Manchester with an event highlighting many of the projects that the university has undertaken with us. The event, hosted at the university, was attended by representatives from other GB electricity networks and partners from across our supply chain. In October we co-hosted the annual three day knowledge sharing event organised by EPRI to provide updates to the GB electricity networks on the projects EPRI are undertaking with us and other GB networks.

05. Significant new learning

We have selected a number of key projects from which significant new learning as emerged during 2013/14.

T-Pylon structure and composite insulator testing.

T-pylon is being progressed by National Grid and Bystrup who developed the design as the winning entry of a competition launched in 2011 by RIBA (Royal Institute of British Architects), DECC (Department for Energy and Climate Change) and National Grid. The T-Pylon will make 400kV overhead lines (OHL) more compact and help to address stakeholder concerns to reduce the visual impact of pylons on the landscape and do this at a lower cost than buried cable.

The design uses composite insulators to support the conductor in a unique diamond configuration with phase to phase insulation supporting all 3 phases from one cross-arm. The composite insulation on the T-Pylon also has potential safety advantages over glass or porcelain insulators as they are less likely to fail in service. There are limited international standards for composite phase to phase insulation.

Our NIA funded work on the T-Pylon relates specifically to the certified mechanical testing of the T-Pylon structure itself and the mechanical and electrical testing of the new composite diamond shaped insulators, to demonstrate that they are suitable to be used on the GB network.

Once certified mechanical testing of the T-pylon structures and final testing of the novel insulator arrangements are completed, National Grid will have a validate design that will allow us to be able to consider deploying them on our network to meet stakeholder needs.

Partners: Insulator Suppliers (Allied, Pfisterer and LAPP/Mosdorfer), Structural, Mechanical, Electrical and Wind tunnel test facilities.

For further information on our full project portfolio and to see our project progress reports for the projects listed below, please visit the Energy Networks Association Smarter Networks Portal at www.smarternetworks.org/

400kV synthetic ester filled transformer pilot project.

Since the late 1970's synthetic esters, such as MIDEL 7131, have been marketed as alternatives to mineral oil, and have been in use for around 10 years in power transformers up to 238kV.

Midel 7131 has low flammability and the ability to biodegrade. This reduces environmental risk, and allows a wider range of options to modify fire protection in substation design which, in circumstances where space is constrained, can result in lower costs and maintenance requirements. Together with potential for asset life extension, the use of this synthetic ester based fluid is an attractive proposition for use in higher voltage power transformers.

At higher voltages mineral oil cannot simply be replaced with a synthetic ester as they have different electrical properties and the project was established to give proof of concept of the use of MIDEL 7131, in a 400kV application. A transformer test rig was built, consisting of a full size winding filled with MIDEL 7131 and HV testing was carried out in line with National Grid and IEC specifications (specifically Lightning Impulse Testing).

The successful collaboration with research partners has given National Grid confidence to commission the design and build of a 240MVA 400/132kV synthetic ester filled transformer for use on our network and a contract has been awarded for the supply of three, 400/132kV, 240MVA transformers filled with Midel 7131, for our new build substation site at Highbury, London.

Partners: M&I Materials (Manchester) and Alstom Grid (Stafford).

05. Significant new learning

Cable extraction.
Winner: Chairman's Award, Innovation & Environment.

National Grid has 3,450 km of oil filled cables in service and 294 km of decommissioned oil filled cables in the ground. There are significant costs associated with monitoring these decommissioned circuits, estimated to be £1.4M over the RIIO T1 period.

Since cables are predominately located in built up areas it is very challenging, time consuming, disruptive to our stakeholders and costly to open excavate the ground surface in order to remove these assets.

Fluid filled cable contains oil impregnated paper insulation and a percentage of this fluid remains when the cable is decommissioned. Many trials and experiments have been carried out to remove this residual oil with little success to date.

Therefore rather than focussing on removing the oil we have developed the ability to efficiently remove and recycle decommissioned oil filled cables from the ground. This will provide financial savings, but also reduce potential long term environmental impacts.

Working with JSM, the approach we have taken uses tailored directional drilling technology. This is achieved by using a specially designed drilling head to loosen the backfill material around the cable at selected extraction points. Once a length of cable has been freed from the surrounding backfill, it is pulled out of the ground by a winch, incorporating a unique collet gripper system, and is sent for recycling. The void left by the extracted cable is filled with grout or replaced with a duct for future use.

Approximately 900 km of National Grid cable could be decommissioned by 2030. Using the directional drilling technology has the potential for improved efficiency, reduced disruption and will deliver significant savings over conventional cable extraction methods during the current RIIO period and beyond.

Partners: JSM Construction Group (Power Division).

Trial and performance assessment of Aluminium Composite Core Reinforced conductor (ACCR)

National Grid has been exploring innovative ways of addressing power flow limitations by trialling the use of High Temperature Low Sag (HTLS) overhead line conductors.

These conductors have similar dimensions to conventional conductors but can operate at high temperature with low sag and lower losses with minimal changes in their electrical and mechanical properties. With them, the thermal ratings of existing overhead lines can be increased allowing us to transport more power down an existing overhead line route without rebuilding or replacing the infrastructure.

Each type of HTLS conductor is different as suppliers are developing their own variations of this technology, using different core materials. Therefore we need to fully understand the behaviour, properties and technical requirements such as mechanical capability, installation method and termination arrangements before using them on the Transmission network.

We undertook the assessment and development of 3M's HTLS conductor by installing it on a decommissioned line near Sheffield, where two other HTLS conductors had already been installed. We then carried out an evaluation to compare the mechanical capability, performance, installation methods, and maintenance and repair requirements of these conductors.

Following a favourable performance of the 3M's HTLS conductor, it is now available for use on the Transmission network. In 2013 this new conductor type was installed on a 15km long energised section of our transmission network between High Marnham and West Burton.

Although this trial is part of our ongoing strategy to stimulate increased competition in the HTLS conductor market to reduce the costs of increasing network capacity, during the project our team identified that the 3M HTLS conductor was quieter than expected. This additional benefit may be useful for circumstances where noise may be a particular concern, and is being more rigorously tested as part of a separate NIA project – Noise Assessment of ACCR Conductor (NIA_NGET0137).

Partners: 3M

05. Significant new learning

UK-wide wind power: extreme and variability

To manage generation uncertainty the System Operator holds reserve generators that can ramp up their output quickly to maintain the security of supply. National and regional generation forecasting to support secure and economic system operation is becoming increasingly difficult as the contribution to our total electricity supply from variable and volatile wind power increases. The root issue for wind generation uncertainty is in the uncertainty of the UK weather.

This project is examining historical weather patterns to gain insight into weather uncertainty factors: identifying credible limits of extreme events, and identifying techniques to improve wind power output predictions. Using re-analysis techniques examining historic weather records, Reading University are seeking the answers to important questions such as: what are the longest periods over which there have been very low or very high wind conditions? And, if we'd had a large amount of wind power on the system over the last 30 years, how often would we have had to ramp up or down reserve generation and by how much?

This information will enable us to assess the likelihood of future extreme weather conditions and their impact on GB system operations. This insight will support secure operations and inform optimal investments into system reinforcements, long-term balancing services and information systems. In shorter-term operational timescales it supports a more informed view of reserve requirements necessary for the system operator to maintain system security.

Partners: Reading University.

A combined approach to wind profile prediction

Maintaining the balance between electricity generation and demand becomes increasingly challenging as more of our electricity is generated by inconsistent renewable sources such as wind. The true power output from wind farms with multiple turbines is influenced by many factors; including the effect of turbulent flow of air around one wind turbine before reaching the next. This phenomenon is complex and difficult to represent accurately in wind power output forecasting models.

Current computer modelling techniques using computation fluid dynamics (CFD) are so computationally intensive that it can take many hours to simulate the flow of air around a single wind turbine. We are working with Sheffield University to combine CFD with signal processing techniques to produce a more efficient method that achieves the same result in less time. It will eventually provide the capability to simulate an entire wind farm, building up from a turbine level.

When complete, this project will provide a framework for assessing the necessary model complexity to adequately simulate power production at the scale of a large wind farm. This will enable us to evaluate the potential forecasting improvement we may reach through this technique. We will also be able to develop how we'd then integrate more sophisticated and improved modelling techniques into our wind power forecasting system. Continuing to improve forecasting accuracy will enable us to keep standby power generation costs, and their environmental impacts, as low as possible as more renewable generation is connected to the electricity network.

Partners: Sheffield University

05. Significant new learning

Advanced network control and demand response technologies

The project, started in October 2010, has three main workstreams: identifying how smart control systems can be used as an alternative to transmission reinforcement and constraints; investigating the impact of advanced technologies and control schemes on network resilience and exploring how emerging demand management technologies can be used to benefit system design and operation. This work should ultimately benefit transmission system users and consumers through lower costs and by helping to reduce carbon emissions and meet renewable connection targets.

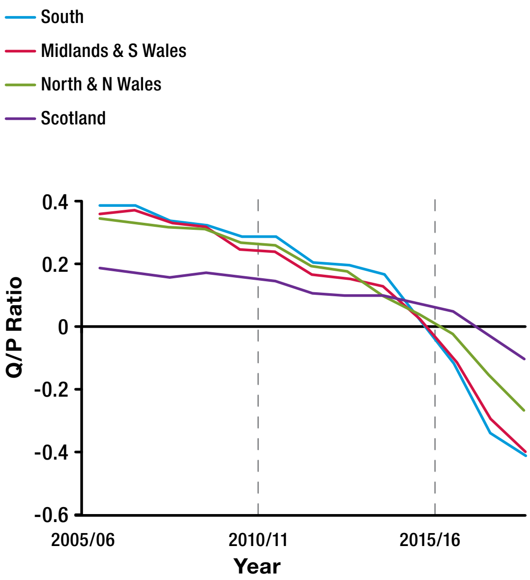
Through the project, innovative approaches are being assessed to make the transmission system "smarter". Work completed to date has demonstrated ways in which the operation of transmission assets can be optimised to real-time system conditions making use of dynamic thermal ratings and quadrature booster optimisation.

The outputs of this research have been important in supporting the development of our 2014 NIC projects : the South East Smart Grid (SESG) and Enhanced Frequency Control Capability (EFCC). For further information please refer to:

www.ofgem.gov.uk/network-regulation-%E2%80%93-riio-model/network-innovation/electricity-network-innovation-competition

Partner: Imperial College.

REACT – Reactive Power Exchange Assessment and Characterisation



This project, co-funded by National Grid and distribution network partners, aims to understand the ongoing decline in reactive power (Q) against active power (P) at the transmission-distribution system interface, by researching changes to demand, distributed generation and distribution network characteristics. The changes in the Q/P ratio have resulted in network operators having to manage higher voltage levels on transmission and distribution networks.

Main aspects of the work so far have included the design and validation of more accurate models capturing distribution network changes. This has shown that factors driving the decline in reactive power include the increased replacement of overhead lines with more capacitive underground cables, greater levels of distributed generation and the connection of much of this generation via underground cable.

When complete, this work will provide greater clarity about what is driving the Q/P changes and more accurate forecasts of demand changes in the future. This will enable better targeting of operational measures and investment to contain high voltages on transmission and distribution systems. The breadth of participation in this work is an important feature in achieving a comprehensive understanding of future voltage regulation challenges.

Partners: University Of Manchester, Electricity North West, Northern Power Grid, Scottish Power, Scottish and Southern, UK Power Networks.

06. Further information

For further information on our full project portfolio and to see our project progress reports for the projects listed below, please visit the Energy Networks Association Smarter Networks Portal at: **www.smarternetworks.org**

Safety

Reference	Title	Partners
NIA_NGET0112	Enhanced ACDC Safety Voltage Limits	Cardiff University
NIA_NGET0116	Combustible Gases in Redundant Oil Filled Cables	Utilise Environmental
NIA_NGET0079	Rapid Deployment Ballistic Screen	Doble, RADNOR, Redman Composites
NIA_NGET0018	Potentials and profiles around earth electrodes and opposite-side injection for large-area earthing systems	Cardiff University
NIA_NGET0012	Induced voltages and currents on transmission overhead lined under NSI 4 working practices	Cardiff University
NIA_NGET0080	400kV Synthetic Ester Filled Transformer Pilot Project	Alstom, M & I Materials
NIA_NGET0108	Incident Investigation Review	Taproot, Sigma

Renewable integration

Reference	Title	Partners
NIA_NGET0138	Frequency sensitive electric vehicle and heat pump power consumption	Competitive selection process underway
NIA_NGET0129	Investigation of subsynchronous interaction between wind turbines and series capacitors	IC Consultants Ltd
NIA_NGET0085	UK Regional Wind: Extreme Behaviour and Predictability	University of Reading
NIA_NGET0139	PV Monitoring Phase 1	Invisible Systems, GMI Energy
NIA_NGET0058	Scalable Computational Tools and Infrastructure for Interoperable and Secure Control of Power System.	Brunel University
NIA_NGET0020	Modelling of Embedded Generation within Distribution Networks and Assessing the Impacts on Load Profile at Transmission Level Grid Supply Points (GSPs)	University of Bath
NIA_NGET0095	Visualisation of Renewable Energy Models	University of Reading
NIA_NGET0128	Clustering Effects of Major Offshore Wind Developments	University of Reading
NIA_NGET0052	Mathematics of Balancing Energy Networks Under Uncertainty	Herriot Watt University
NIA_NGET0023	Quantifying benefits and risks of applying advanced network control and demand response technologies to enhance transmission network performance	Imperial College
NIA_NGET0028	Impact of extreme events on power production at the scale of a single wind-farm	University of Reading
NIA_NGET0016	UK-wide wind power: Extremes & Variability	University of Reading
NIA_NGET0120	Evolution of Energy Storage & Demand Management Services	UK Energy Storage Operators' Forum, Electrical Storage Network, North Sea Power to Gas
NIA_NGET0039	A Combined Approach to Wind Profile Prediction	University of Sheffield
NIA_NGET0142	Assessment of DG behaviour during frequency disturbances as system inertia reduces	Energy Networks Association

06. Further information

Environment

Reference	Title	Partners
NIA_NGET0141	T-Pylon Structure and Composite Testing	LAPP/Mosdorfer, Pfisterer and Allied Insulators, STRI (Sweden) & CEPRI (China), EPL Composites (England), MIRA, University of Southampton, University of Cranfield (England)
NIA_NGET0083	Cable Oil Regeneration	Enervac Corporation, JSM Construction
NIA_NGET0087	Cable Installation Design & Innovation Project (CIDIP)	University of Southampton
NIA_NGET0115	Cable Stripping Truck	Utilise
NIA_NGET0090	Cable Extraction	JSM
NIA_NGET0025	Feasibility Study For Sustainable Substation Design	ARUP
NIA_NGET0013	Tablet interface for a SF6 mass flow top-up device	The University of Hertfordshire, DILO
NIA_NGET0107	Stakeholder Attitudes to Electricity Infrastruture	Collaborative project between 10 European partners, coordinated through ENTSO-E
NIA_NGGT0047	Resource and Asset Reuse Toolkit-Elec Tx	National Grid Gas Transmission, National Grid Gas Distribution, Sinclair Knight Merz
NIA_NGET0099	Thermal Efficiency Trials	Rook Services
NIA_NGET0074	SF_6 Capture and Leakage Repair	The University of Liverpool, Furmanite, Belzona, Siemens

Asset life extension and refurbishment

Reference	Title	Partners
NIA_NGET0102	13kV Shunt Reactor Refurbishment	ABB
NIA_NGET0056	Humber SmartZone pilot project	The University of Manchester, Ampacimon
NIA_NGET0034	Fibre-optic Acoustic Monitoring	Optilan, Optasense, The University of Liverpool
NIA_NGET0093	Online Gas-in-Oil analysis on Existing HV Cables	Doble, ISL and C3 Global
NIA_NGET0103	Modelling the tape corrosion process for oil-filled underground cables	The University of Leicester
NIA_NGET0040	Magnetic Models for Transformers	The University of Manchester, Cardiff University
NIA_NGET0015	Dinorwig Thermal Cycling and Cable Rating	University of Southampton, Doble
NIA_NGET0117	Bulk Oil Circuit Breaker Bushing in situ refurbishment	NAREC Electrical Networks
NIA_NGET0140	OHL Condition Assessment	Brunel University
NIA_NGET0109	Bushing and Instrument Transformer Test tap connection condition assessment tool	Elimpus, Elysis, GE, Invisible Systems, Process Parameters
NIA_NGET0113	Control of Debries and Dust from the treatment of grade 4 steel work (G4T)	CLC Contractors Limited, Fountains Group, PDC Utility Services, Spencer Coatings
NIA_NGET0092	Partial Discharge (PD) on Existing HV Cable	Prysmian, Elimpus, Doble, NDB Tech Inc.
NIA_NGET0044	Transformer Oil Passivation and Impact of Corrosive Sulphur (TOPICS)	University of Southampton, Doble
NIA_NGET0011	Detection and Measurement of ACSR Corrosion	IREQ, Hydro Quebec , BC Hydro
NIA_NGET0104	Proof of concept of IEC 61850 Process Bus technology	ABB
NIA_NGET0088	Transformer consortium research	Consortium led by The University of Manchester
NIA_NGET0010	Optimised location for surge arresters on the transmission network	Cardiff University
NIA_NGET0033	Wireless Condition Monitoring Sensors with Integrated Diagnostics	The University of Strathclyde
NIA_NGET0064	Alternative Bus Bar Protection Solution	Schweitzer Engineering Ltd
NIA_NGET0014	Transformer and System Reliability	The University of Manchester
NIA_NGET0135	Enhanced Sensor development (iCASE)	The University of Manchester
NIA_NGET0118	Understanding and improving condition, Performance and life expectancy of Substation Assets	The Watt Consultancy
NIA_NGET0072	Rogowski coil	Cooper Power System, Prysmian, Metrodata

06. Further information

HVDC

Reference	Title	Partners
NIA_NGET0045	Multi-terminal VSC HVDC operation, control and AC system integration	The University of Manchester
NIA_NGET0060	Application of DC circuit-breakers in DC grids	Cardiff University
NIA_NGET0046	Flexible rating options for DC operation	University of Southampton
NIA_SHET0008	Nanocomposite Elec Insulation Material	University of Southampton, Alstom, Gnosys, Mekufa, Scottish Hydro Transmission
NIA_NGET0057	DC Circuit Breaker Technologies	The University of Manchester
NIA_NGET0089	Impact of HVDC cable operation on telecom lines	Powersure Technology Ltd.
NIA_NGET0084	Optimisation of Node Configuration for Offshore Supergrid	Imperial College, ARUP
NIA_NGET0042	HVDC EngD - Richard Poole	The University of Hertfordshire
NIA_NGET0073	Partial discharge monitoring of DC cable (DCPD)	University of Southampton
NIA_NGET0003	Simulation of multi-terminal VSC HDVC system by means of real time digital simulator (RTDS)	University of Birmingham
NIA_NGET0017	Oil/paper insulation HVDC performance	University of Southampton
NIA_NGET0029	Optimising the operation of an integrated DC link within an AC system	The University of Strathclyde

Increased capacity

Reference	Title	Partners
NIA_NGET0137	Noise Assessment of ACCR Conductor	3M, Bruel & Kjaer
NIA_NGET0036	Thermomechanical Forces in XLPE Cable	Cable Consulting Incorporated (CCI) University of Southampton Mott Macdonald
NIA_NGET0047	Dynamic Ratings for improved Operational Performance (DROP)	University of Southampton
NIA_NGET0043	Live Line Working Equipment	Bond Helicopters Europe
NIA_NGET0111	Facilitating Enhanced Network Capacity Evaluation (FENCE)	University of Southampton, Southampton Dielectric Consultants, Oxford Computing Consultants
NIA_NGET0105	Enhanced Weather Modelling for Dynamic Line Rating	The University of Strathclyde, Scottish Power Energy Networks, Energy Technology Partnership
NIA_NGET0082	Rating Impact of Non-isothermal Ground Surface (RINGS)	Doble, C3, University of Southampton
NIA_NGET0024	Composite Cross Arms study	The University of Manchester, Scottish Hydro Electric Transmission
NIA_NGET0035	Long term performance on Silicon-based composite Insulators	The University of Manchester
NIA_NGET0067	Trial & Performance Assessment of ACCR Conductor (3M)	3M

06. Further information

Managing new network risks

Reference	Title	Partners
NIA_NGET0119	SAMUEL	Reactive Technologies Ltd, Scottish and Southern Energy Power Distribution
NIA_NGET0051	33kV Superconducting Fault Current Limiter	Applied Superconductor
NIA_NGET0110	Electrical Demand Archetype Model (EDAM2)	Energy Saving Trust, University College London
NIA_NGET0134	Granular Voltage Control	Imperial College, PowerPerfector
NIA_NGET0114	Industrial and Commercial Modelling	ARUP, Oxford Economics
NIA_NGET0049	Seconomics Digital Risk and Cyber Security	European Commission
NIA_NGET0097	Development of Generic Dynamic Demand Model in DigSILENT Power Factory	Cardiff University
NIA_NGET0106	Control and protection challenges in future converter dominated power systems	The University of Strathclyde
NIA_NGET0053	RESNET	The University of Manchester
NIA_NGET0100	REACT - Reactive Power Exchange Application Capability Transfer	The University Of Manchester, Electricity North West, Northern Power Grid, Scottish Power, Scottish and Southern, UK Power Networks
NIA_NGET0143	Transient and Clearances in the Future Electrical Transmission Systems (ICASE Award)	The University of Manchester
NIA_NGET0144	Integrated electricity and gas transmission network operating model	The University of Manchester, National Grid Gas Transmission
NIA_NGET0127	EPRI ICT	EPRI
NIA_NGET0019	Reliability assessment of system integrity Protection schemes (SIPS)	The University of Manchester
NIA_NGET0131	iTesla - FP7	International consortium
NIA_NGET0136	Impact of Seabed Properties on Ampacity and Reliability of Cables (ICASE Award)	University of Southampton

Other

Reference	Title	Partners
NIA_NGET0124	EPRI EMF	EPRI
NIA_NGET0123	EPRI Substations	EPRI
NIA_NGET0048	Cables With Long Electrical Sections	University of Southampton
NIA_NGET0091	Impact assessment of Seismic Analysis on Electricity Towers and Substation Equipment / Structures	Mott MacDonald
NIA_NGET0125	EPRI Grid Operations and Control	EPRI
NIA_NGET0098	Computer Vision for Cable Tunnels	ARUP, Costains, University of Cambridge
NIA_NGET0121	Avoiding voltage regulation action conflicts with proposed LCNF project 'CLASS'.	Electricity North West
NIA_NGET0130	Determining a threshold for magnetophosphenes perception at 50Hz	Lawson Health Institute, ENA, Hydro-Quebec, EDF
NIA_NGET0133	Identifying opportunities and developments in EMF research	Multiple Partners
NIA_NGET0038	Design of a smart tool for detecting hidden errors in protection setting files	The University of Strathclyde, Alstom Grid
NIA_NGET0122	Identification and Mitigation of Large Equipment Transport Issues	Wynns LTD
NIA_NGET0126	EPRI Overhead Circuits	EPRI
NIA_NGET0132	Ultrawire - FP7	Consortium led by the University of Cambridge

National Grid Electricity Transmission is also supporting these Low Carbon Network Fund Tier 2 and Network Innovation Competition projects:

- Low Carbon London, led by UK Power Networks
- Smarter Network Storage, led by UK Power Networks
- CLASS, led by Electricity North West
- Capacity to Customers, led by Electricity North West
- Accelerating Renewable Connections (ARC), led by Scottish Power Energy Networks
- Visualisation of Real Time System Dynamics using Enhanced Monitoring (VISOR) led by Scottish Power Transmission
- Multi Terminal (multi vendor) HVDC Test Environment (MTTE) led by Scottish Hydro Electric Transmission

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