NEW DOCUMENT

RIIO T1 Business Plan

Innovation Strategy

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Innovation Strategy

Summary

The overall strategic goal for SP EnergyNetworks is to become the leading energy networks business in the UK and Iberdrola group by 2014. A key part of this requires innovation and **we have a strategy for innovation to identify new systems and solutions to help develop an economic and sustainable network for existing and future customers.**

Scotland has the richest source of renewable wind energy in Europe with huge untapped resources from wave and tidal sources. Within the price control period SPT will continue to play a major role facilitating Government renewable energy targets and delivering a low carbon economy. We recognise the importance of innovation as we strive to provide economic new windfarm connections and enhance the main infrastructure required to transmit energy south.

Existing assets continue to form a major focus for innovation as we seek to maximise the performance and utilisation of these assets, and extend their useful life wherever possible.

This section will detail our objectives for out innovation strategy and explain how these objectives create a coherent and comprehensive approach to innovation on the transmission network. SPT have a robust management process to manage the innovation process and ensure successful projects are adopted by the business. A number of example projects are outlined along with a mapping of how these align with our innovation development process. Within our business plan we have embedded the application of a variety of unique and innovative concepts and technology, this document summarises some of the most notable projects within the business plan as well as our intentions for realising our innovation strategy through the Innovation Allowance and Network Innovation Competition.

The five key objectives of our innovation strategy are:

1. Identify the needs and expectations of stakeholders for the future network;
2. Identify and develop innovation opportunities to meet stakeholders needs and the future challenges facing the network;
3. Efficiently manage our innovation portfolio to balance the need for innovation with risk;
4. Pursue a balanced portfolio of innovation initiatives which includes technology, commercial and process innovation; and
5. Ensure that learning from innovation activity is adopted by the business.

Contents

1. Introduction – The Requirement to Innovate

In the UK, the energy sector faces significant challenges. The demands of moving to a low carbon economy and meeting our renewable targets whilst maintaining safe, secure and reliable energy supplies will lead to profound changes in its design and operation. Network companies will need to invest an estimated £32bn by 2020. This is a doubling of the average rate of investment over the next 10 years compared with that for the last 20 years. This is only part of the £200bn or more which has to be spent on energy infrastructure.

As the Energy Minister has publicly stated, "£200bn represents the biggest energy challenge of our lifetime." These targets include:

- The UK Climate Change Act (2008) to reduce CO2 by at least 26% by 2020 and greenhouse gas emissions by 80% by 2050
- The Scottish Government has recently increased its national target from 50% to 80% of Scottish electricity consumption to come from renewables by 2020
- Legally-binding UK targets to deliver cuts in greenhouse gas emissions, with 15% of our energy to come from renewable sources by 2020 which equates to 30% of electricity from renewable sources.

In order to meet the challenges of developing the transmission network in a sustainable and economic manner, a range of existing and innovative solutions will be required. To date SP Transmission along with the other transmission owners and DNOs have made good progress in developing new solutions through normal business as well as through more formal means such as the Innovation Funding Incentive. The challenges that transmission owners and operators are now facing are unparalleled and will continue to require new techniques, technologies and processes to address them.

The significant developments in our transmission network over recent years have fundamentally been driven by an ongoing process of stakeholder engagement. SP Transmission has identified a number of key themes as a result of our ongoing stakeholder engagement which are the principal drivers behind why we need to be innovative in our approach to managing the transmission network. The key outputs from stakeholder engagement to date have been:

- Communicating with stakeholders to understand their needs and expectations more effectively;
- The connection of customers (demand and generation) onto the network to deliver sustainable low carbon energy through fair, clear and accessible processes;
- Maintain security of supplies and maximise long term value for end-users through improved network availability and reliability processes and;
- Minimise the environmental impact of our operations.

With these challenges, we recognise that consideration needs to be given to not only the RIIO-T1 period and stakeholder's immediate needs, but also how we address the longer term issues which the transmission network may face. This is being addressed through a balanced portfolio of innovation projects where SPT are looking at some of the longer term issues which may involve technology and techniques at a lower technology readiness level as well as immediate challenges which we will face over the next decade.

It is recognised that the electricity network we have today has an extremely high level of reliability and has been built in a highly economic manner; however the challenges that are anticipated will require a different approach in many areas. A failure to innovate could result in a reduction in this high level of reliability, being able to facilitate an increasingly diverse range of generation on the network, meeting customers' requirements and prove to be more expensive as we address these challenges. Further consequences could also be experienced such as an increase in network constraints without alternative network solutions being developed, increased losses and asset failures all of which have environmental as well as financial consequences.

As an example of the financial savings that are possible by providing innovative solutions:

- The deployment of a novel operational intertrip scheme across the Anglo-Scottish Interconnector has been estimated to make a saving of c.£1m per week in constraint costs to the system operator, with the scheme itself costing £700k.
- The proposed Series Compensation scheme with a cost of £85m would have been in the range of £250m-£500m for an equivalent solution using traditional reinforcement.
- The embedded HVDC project which is the highlight of our innovation activity with a cost of around £380m for SPT is between 50%-75% of the cost of the onshore equivalent reinforcement (as highlighted in the analysis undertaken by SKM).

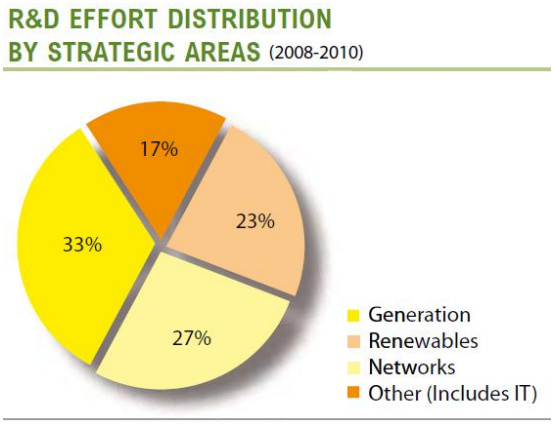
The scale of these savings highlights the importance of innovation and for the business and customers.

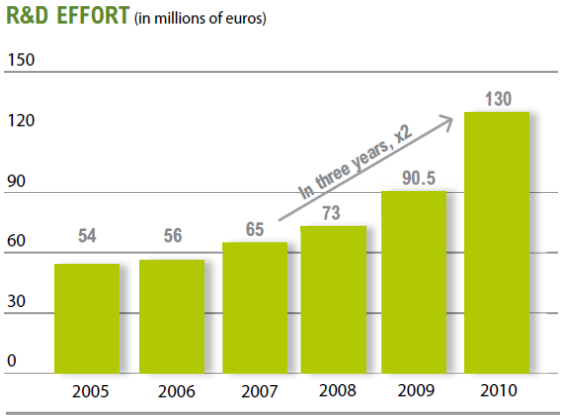
Our overall business plan presents solutions to the challenges we anticipate over the next decade, and many of these solutions are in themselves innovative. However, without considering innovation, future solutions are likely to involve building significant amount of network assets rather than using smarter techniques which are lower cost and more efficient, albeit not yet proven.

We welcome the inclusion of the Network Innovation Competition (NIC) and Innovation Allowance (IA) for funding of research, development and demonstration of new technologies and techniques which will help us to respond effectively to these drivers.

2. Innovation within ScottishPower and the Iberdrola Group

SP Energy Networks are part of the Iberdrola Group, one of the largest energy companies in the world. The group prides itself in its commitment to innovation, which has made it a world leader in renewable generation. Across the group, in excess of €130million was invested on R&D, of which over €35million was associated with networks as shown in the figure below. This involves a variety of R&D across both distribution and transmission, and includes leveraging funds from a variety of sources including European Framework programmes, government funding as well as investment by our shareholders. This investment demonstrates the commitment by Iberdrola and Scottish Power to innovation.





Source: Iberdrola 2010 Innovation Report

From the experiences across the group, ScottishPower will be deploying this learning to ensure we are maximising the outcomes to avoid duplication across countries. We have ongoing knowledge exchange between the other networks organisations within Iberdrola based in Spain, US and Brazil, led by an international steering group for Smart Grids with executive representation and touches on all elements of networks.

SP Energy Networks have a strong commitment to investing in innovation as demonstrated in our annual IFI report. We are also proactive in a number of forums which influences our innovation activity such as the Smart Grid Great Britain forum, Strategic technology Programme (STP) run by EA Technology and European InnoEnergy Knowledge Innovation Centres (KIC) where we are involved with two work streams relating to energy storage and smart grids.

Our innovation strategy, presented below, is representative of our overall approach for both distribution and transmission. The same strategic goal, objectives and processes are used across all of our networks activities to provide an integrated solution which allows the learning to benefit the whole business. Particular areas of focus for

transmission have been highlighted below to provide examples of particular projects, for example our stakeholders for transmission are slightly different from distribution. The overarching management of the innovation process is aligned across SP Energy Networks.

3. Objective 1: Identify the Needs & Expectations of stakeholders

Our first objective is to identify the needs and expectations of stakeholders for the future network

As part of our stakeholder engagement activity to date, we have shared our detailed plans for RIIO-T1 which includes a number of innovative activities, particularly the West Coast HVDC project and other projects which are outlined later in this document. Through this process we have also tried to get a better understanding of our stakeholders' needs and expectations from the transmission network. It is recognised that stakeholder engagement is a key driver of our innovation activity as it is the needs and expectations of customers that will help to steer our innovation plans.

As part of our long term innovation strategy, stakeholder engagement will be central to ensuring that our innovation plans are meeting customer's expectations. The involvement of stakeholders is also a vital source of ideas for innovation – particularly the academic community, equipment suppliers and other network operators (DNOs and TOs). Outwith our formal stakeholder engagement, we have developed strong relationships in this area as demonstrated by the success of SPT's IFI portfolio to date and the range of collaborations that this has involved.

Key Stakeholder Involvement to date–

- National Grid as the GB system operator;
- National Grid and SHETL as TOs for collaboration and sharing learning;
- Academia; to ensure that the transmission network is taking advantage of R&D activity and steering this where necessary for the benefit of the network;
- ENSG, and its member organisations including DECC and Ofgem
- Other research and policy making bodies including EPRI, CIGRE, ENTSOE and Eurelectric in order to inform and keep abreast of developments in transmission technology and policies;
- Technology providers to assist with the development of new products; and
- Transmission network users to ensure the network meets their changing needs.

We are also active in embracing ideas developed in-house using our experience and knowledge within the organisation.

As part of our ongoing stakeholder engagement activity, we will be organising a dedicated innovation workshop to bring these various parties together to better understand the requirements and ideas of our stakeholders to ensure that we are

maximising the potential opportunities. We may also look at how we can undertake this collaboratively with the other TOs given the cooperative nature of innovation activity so that we are sharing ideas which will mutually benefit each other.

As an example of some of this work to date, ScottishPower has a long standing and strong relationship with University of Strathclyde and other institutes through our IFI programme and Distribution activity.

Stakeholder Case Study –

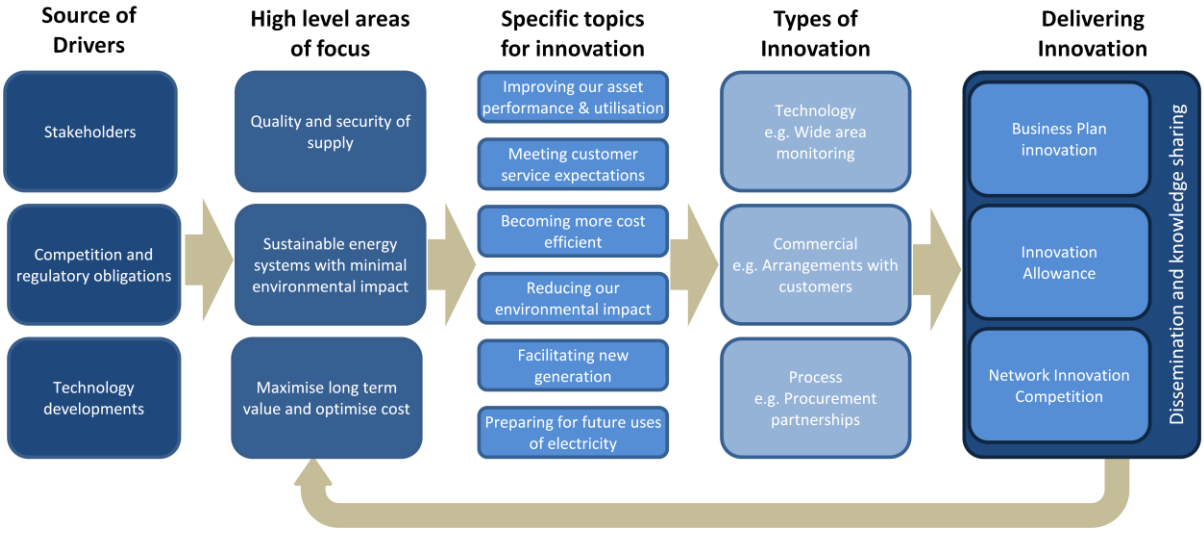
Scottish Power Active Research Centre (SPARC). This initiative between SP Energy Networks and the University of Strathclyde has been running since 2006. In this programme we sponsor research that is relevant to the power sector with particular emphasis on how ScottishPower can improve the network in the short to medium term. The programme has delivered new techniques for cable health monitoring and software tools for the analysis of alarms among many other developments. The collaboration also presents ScottishPower with new R&D opportunities and oversight of new technologies, whilst allowing University of Strathclyde to disseminate learning through the appropriate channels.

4. Objective 2: Identify Innovation Opportunities

Our second objective is to identify innovation opportunities which can provide efficient network solutions. This is based primarily on the needs and expectations of our stakeholders. We also recognise that technology developments are a potential source of innovation as a result of ongoing developments which can help in the delivery of our business plan and longer term objectives. The process to understand and evaluate these will be ongoing over the duration of RIIO-T1through our programme of stakeholder engagement as well as responding to ongoing feedback through the usual business channels.

Our strategy for innovation is to identify new systems and solutions to help develop and economic and sustainable network for existing and future customers.

Our approach to innovation development is summarised in the figure below which contains five steps:



The innovation development process is driven by stakeholders and through technology developments which can improve the networks, reflecting a mix of market pull and technology push. From this work, we have translated these into three key areas of focus around which we will initially be concentrating our innovation:

- Quality and security of supply, which includes the customer service as well as electricity supply;
- Sustainable energy systems with minimal environmental impact, which includes the facilitation of greater volumes of renewable generation onto the network;
- Maximising value and optimising cost.

From these high level areas, we have divided this into six specific topics which innovation will focus on. These specific topics are:

- Improving our asset performance and utilisation. This area covers initiatives such as increasing capacity of the network, or life extending assets through new techniques to assess risk.
- Meeting customer service expectations; including responding to customer enquiries as well as new approaches for connecting customers
- Becoming more cost efficient; looking at alternative systems and technologies which will allow the overall unit cost of delivery to be reduced, this may include new procurement approaches as well as alternative technology.
- Reducing our environmental impact; this will include areas such as visual mitigation and alternative materials for insulation amongst others.
- Facilitating new generation; to allow for the transmission system to accommodate larger volumes of different types of generation as well as some of the challenges this will present like greater intermittency, variation in power flows and fault level, and quality of supply.
- Preparing for future uses of electricity; understanding the impact on the network of new measures such as demand side management, the impact of electric vehicles and greater volumes of distributed generation on the transmission network.

These topics are not prioritised as it is likely that initiatives may fulfil more than one at a time. Individual projects are assessed on the relative merits of how they align with the topics in terms of the overall cost, effort, risk and benefit to the network. It is also important that initiatives are covering a variety of the topics rather than solely focussing on one or two which are regarded as being the most important. The objectives will be subject to review on an annual basis to ensure that they are still appropriate.

To respond to these areas, a number of different types of innovation will be required such as technology, commercial and process innovation. SPT have experience in delivering innovation in all three of these areas and view some of this as ongoing business improvement opposed to stand alone innovation.

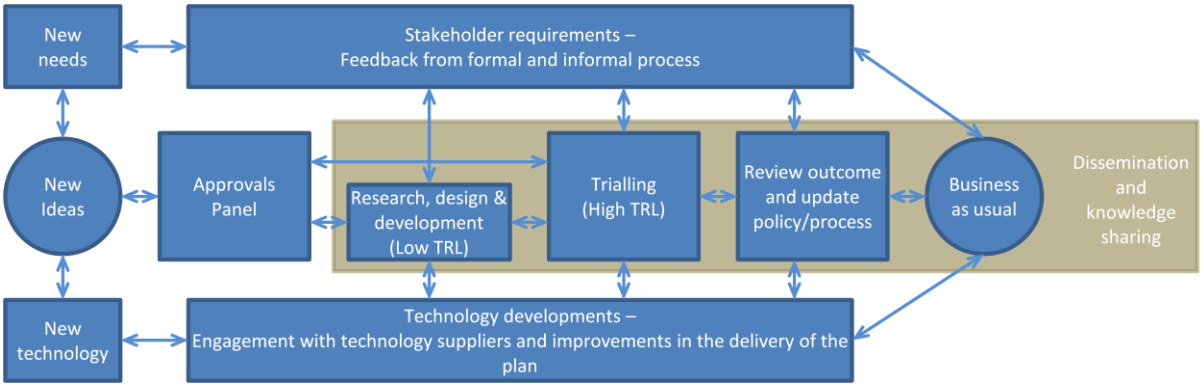
The output of innovation projects will also be an important input to the overall strategy. The learning from the various innovation initiatives is likely to have an impact on the overall innovation drivers, in some instances where it has addressed a problem, the driver may be less relevant, of if the initiative is unsuccessful, it may become a higher priority.

An important stage will also be disseminating the knowledge gained from the innovation to ensure that we adopt it into business as usual, and that other parties including other TOs can learn from this process.

5. Objective 3: Efficient Innovation Management

Our third key objective is to manage a balanced portfolio of innovation initiatives which meet both short and long term needs of the network.

Innovation cannot be a prescribed and rigid process given that it should stimulate creativity and new ideas. However, to ensure good governance, SP Energy Networks have applied an over arching framework to ensure that it is managed efficiently and delivers the benefits without constraining creativity.



Our innovation framework has formal control and is subject to an internal governance procedure. This ensures that regulatory rules and reporting requirements are met. We also use the framework to ensure that all parts of the business can influence the innovation agenda according to the pressures they are facing. In this way we achieve a balanced portfolio of innovation projects with strong engagement from the operational parts of the business. We use the widely recognised Technology Readiness Level (TRL) approach to classifying innovation projects. Our focus tends to be on higher TRL projects which are closer to deployment and our progress is documented in our annual IFI report. We do also have involvement with a number of lower TRL projects to help in the development of these products which is vital to many of our technology providers.

The Approvals panel also acts as a forum to track the progress of projects and address any risks or issues which arise so that they can be escalate as required. As well as considering the technical elements of the project, the Approvals Panel also considers a number of financial and commercial elements to ensure that it is delivering value for money to the business and customers including:

- A qualitative analysis of expected benefits,
- Expenditure including the leverage of external funding to ensure that this is commensurate with the benefit to partners of undertaking the project,
- The expected timescale to adoption of the technology,
- The net present value of the project based on current knowledge, and

- Viable alternatives have been considered and that the innovation will deliver benefits over a traditional solution.

Across IFI, LCNF and future incentives such as the NIA and NIC; SPT are making an investment in this technology as part of our compulsory contribution therefore value for money is paramount and a key consideration for the approvals panel in the decision making process.

It is also vital that R&D/Innovation projects are adopted by the business to become business as usual processes. SPT have a proven record of being successful at this as demonstrated by our pioneering approach to the use of IEC61850 communications for inter trips and increasingly using this for new schemes.

Each of these types of innovation are managed and delivered in slightly different ways within the business but we aim to track these through our Business Transformation team to capture the benefits and how the initiatives are adopted by the business. The Network Development business unit is largely responsible for technology innovation and is assisted by the wider engineering business, our commercial team are responsible for tracking and monitoring commercial innovation, and Business Transformation business unit are responsible for process innovation. A monthly business transformation meeting is held which tracks the progress and benefits of individual projects across a number of different areas in the business. This process is also used to identify risks associated with the project and how these are mitigated and managed. Significant risks which arise as a result of any project are identified on our business risk register which is reviewed by our executive team monthly.

The actual delivery of these initiatives will use the various formal funding initiatives available including the Innovation Allowance and Network Innovation Competition. We will also be seeking access to other sources of funding such as European Union Framework Programmes, and other UK based sources such as the Technology Strategy Board. A large proportion of our innovation activity will also be undertaken as part of the business plan as we look to improve the business, and a large number of our business plan for RIIO T1 are already highly innovative.

Following the deployment of an innovation trial, a cost benefit analysis is undertaken to understand the impact of rolling out the initiative as part of normal business. Some innovations will not require such a process and be adopted normally where it is of clear benefit.

We place significant focus on disseminating this learning across the business to ensure that the relevant staff are aware of new technology as it is developed. Our current organisational structure has a dedicated member of the executive team leading network development, and we undertake dissemination through events such as our annual technology conference which makes staff from across the company aware of developments and gives them the opportunity to become more involved.

Where successful initiatives are to be adopted by the business into business as usual, the relevant areas of the business will be involved to ensure not only staff buy-in, but also that the relevant policies and procedures are updated to reflect the new learning. The primary teams for this are Asset Management, Design, Health & Safety, Environmental and Regulation who are the owners of most of the existing policies and procedures.

6. Objective 4: Pursue a Balanced Portfolio of Innovation Initiatives

Our fourth objective is to pursue a variety of innovation initiatives which includes technology, commercial and process innovation.

Our initial plans for innovation in RIIO-T1 are summarised in the table below.

Business Plan Innovation	**Indicative cost**
Series Compensation	Within business plan
Embedded HVDC – West Coast Interconnector	Within business plan
Integrated Offshore Transmission – East Coast Interconnection	Within business plan
New protection and control techniques	Within business plan
Innovation Allowance	
Wide Area Monitoring	£0.5m
Smart Transmission Zones	£2.5m
Dynamic Rating of Overhead Lines	£1.0m
New conductor corrosion testing techniques	£0.3m
Non intrusive health monitoring of transformers	£0.5m
Protection assets management tools	£0.15m
Circuit breakers diagnosis tools	£0.25m
Risk assessment of substation earthing systems	£0.1m
Alternative low cost tower foundations	TBC
Various other projects, continuing from TPCR4 IFI	TBC
Network Innovation Competition	
Energy Storage	TBC
DC Technology	TBC
Understanding the impact of demand side management and embedded generation	TBC
Other alternative technology demonstrations and initiatives	TBC

i. Innovation within the business plan

Throughout our business plan, we have embedded a variety of innovative technologies and techniques in order to deliver a very efficient and extensive investment plan. The innovation associated with the investment we are making to increase the Scotland England transfer capacity is of particular importance at this time. In addition, the integration of 30GW of wind generation to the GB transmission system requires extensive innovation within our capital programme to accommodate the new generator connections. Some examples of the innovation which is built into our business plan include:

Series Compensation

The planned introduction of Series Compensation on the Interconnector circuits (circa £85m) will substantially remove previous limitations and will achieve a 4.4GW boundary transfer capacity. Series compensation has not previously been widely used in the UK on the transmission network and this project will genuinely break new ground in the deployment of this technique. The end result will be a cost effective solution to reduce constraint costs faced by the system operator. For and equivalent solution to be deployed using traditional reinforcement, we estimate the costs would have been in the range of £250m-£500m, thus demonstrating the potential savings which can be achieved from innovation.

Embedded HVDC

The joint venture with NGET for an embedded HVDC interconnector is already out to tender to develop and construct an HVDC subsea link between Hunterston in Scotland and Deeside in North Wales. SPT will take responsibility for the 90km of subsea cable from Hunterston to the Scottish Territorial waters boundary and 4km onshore at Hunterston as well as a convertor station at Hunterston.

Out of the forecast £380m SPTL project costs, over £300m investment will be required in RIIO-T1. This is a highly complex and unique project in that it is embedding HVDC into a heavily meshed network along with series compensation to a level that has never before been achieved. This solution is a saving of 25-50% of the equivalent upgrade using the traditional solution of onshore reinforcement (as highlighted in the analysis undertaken by SKM for the HVDC project) representing a significant financial benefit as well as the environmental benefit of avoiding additional overhead lines to be constructed or excavation.

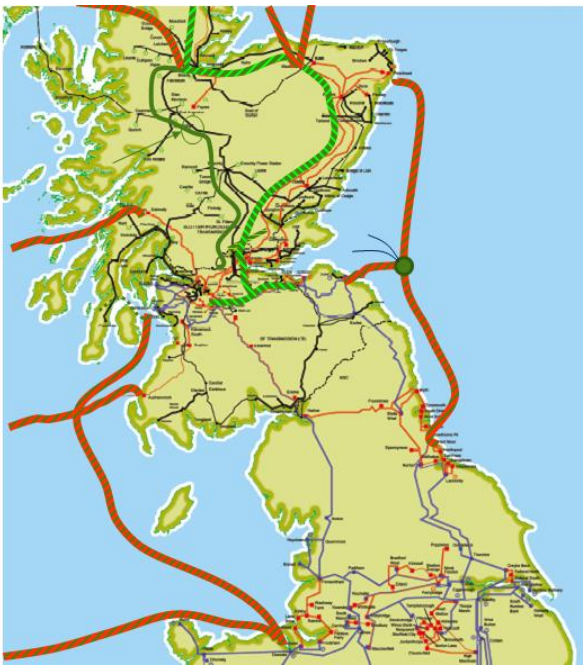
New Protection and Control Techniques

Within many of our projects for Wider Works & Boundary Reinforcement, SPT will be utilising unique control and protection techniques to enhance the performance of the system. This includes SPTs use of IEC 61850 technology which has been developed as part of an IFI project and replaces conventional wiring with an optical Ethernet system. We have made substantial progress in implementing this technology and will continue to lead the way in demonstrating this technology within our investment plans.

Integrated Offshore Transmission

SPT are actively engaged with NGET in the development of the integrated approach to offshore transmission, which seeks to accelerate the delivery of offshore transmission connections with significant overall lifetime and capex savings. This will be achieved by

the use of larger capacity offshore assets, the co-ordination of onshore infrastructure and connection assets and the coordination of offshore and onshore environmental planning activities.

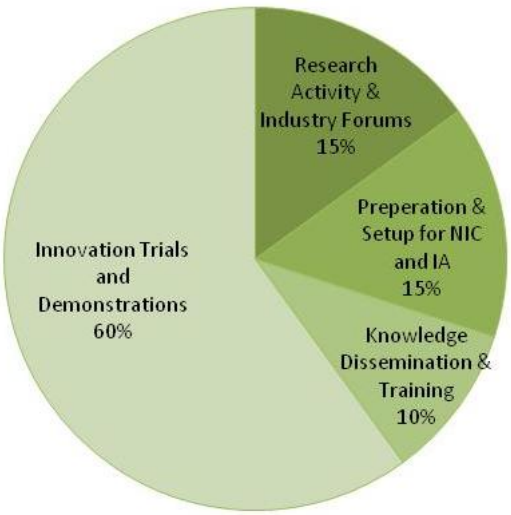


SPT have provided construction offers for the connection of circa 3GW of renewable generation in the Forth estuary. These offers cite the need for an east coast HVDC link from Torness to the north east of England as enabling works. In line with the development of the Integrated approach, SPT are liaising with NGET and SHETL for the design of a multi-terminal HVDC link Peterhead – Torness – Lackenby with a possible offshore hub collector substation. More detail on this proposal is presented in Section 4 of the Business Plan.

Throughout the delivery of our business plan, we will continue to look for new and innovative technology which will allow us to deliver these plans at the lowest cost and most by the most efficient means. This will include not only new assets, but also new methodologies and techniques for constructing our assets and minimising the impact on their surroundings as we deliver our plan.

ii. Innovation Allowance

SPT believes that the Innovation Allowance (IA) will create an environment whereby innovation which may have a slightly higher risk than business plan activities can be progressed. Further, it has been identified that the Innovation Allowance will allow SPT the opportunity to pursue developments as and when they arise throughout the RIIO T1 period, as many of these cannot yet be anticipated. We believe it is vital that the Innovation Allowance can be used for a range of purposes including the preparation for the Network Innovation Competition (NIC) as has been permitted in Tier 1 of the Low Carbon Network Fund, as well as training and dissemination of staff for the adoption of new technology and techniques into business as usual processes. We see this approximate split as set out below.



Based on current plans, we anticipate a cost profile for research activity, preparation and setup for NIC, and knowledge dissemination to be in the order of £600k per annum in the early years of RIIO T1. This will include SPTs membership of various industry working groups such as EPRI, The Strategic Technology Platform and the Scottish Power Active Research Centre (SPARC) at University of Strathclyde. Membership and participation in these forums at an international level is a high priority to ensure we keep abreast of transmission developments around the world.

Some areas being developed for funding under the Innovation allowance are listed below.

Wide Area Monitoring

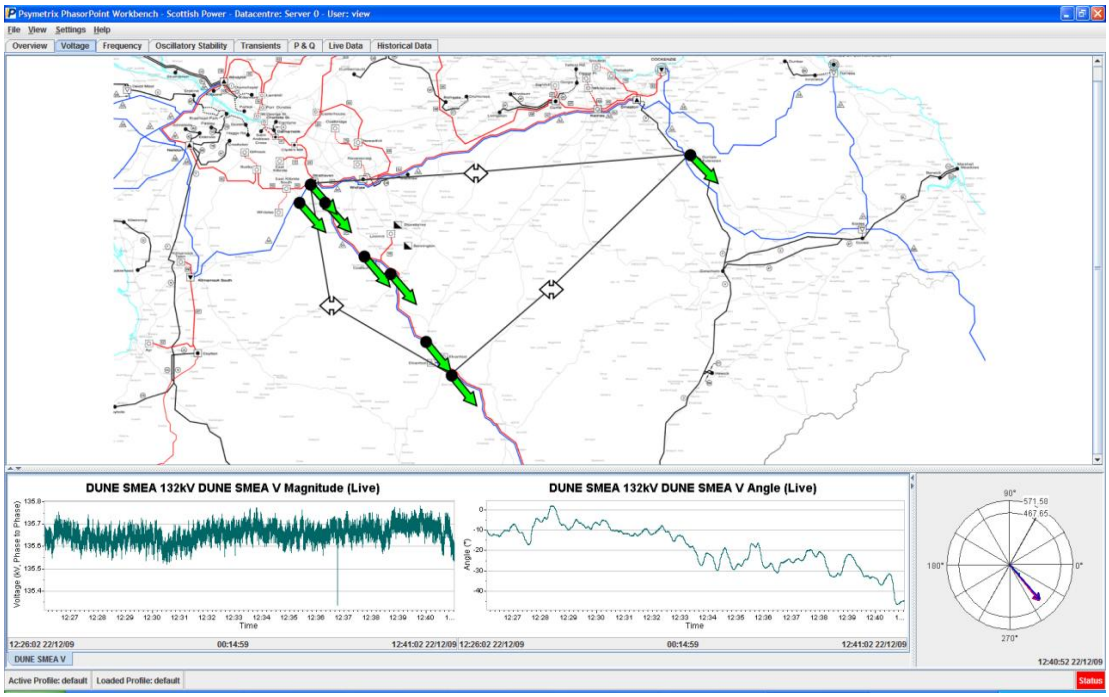
The development of Wide Area Monitoring (WAM) provides a new dimension to system monitoring providing enhanced visibility of system oscillatory modes and real time visibility system stability limits. This enhanced visibility will enable us to push the transmission system harder without compromising system security. We believe this technology is necessary for a future power system with rapidly varying power flows from large volumes of intermittent wind generation. Other benefits of WAM include enhanced visibility of synchronous zones and black start capability, accurate measurement of system impedance and network model validation.

SPT are acknowledged industry leaders in this field and have the skills and aptitude, working with the supplier (Psymetrix) and NGET, to tailor the technology to deliver the system monitoring needs of the future. The developments proposed include but are not limited to the following:-

- The networking of Phasor Measurement Units (PMUs) from the SPT Licence area to be used by the GBSO in real time network security visualisation tools
- The development of the WAM data acquisition systems to capture Sub-Synchronous Resonance (SSR) frequencies that may be produced by the commissioning of Series Compensation and embedded HVDC links across the Anglo-Scottish boundary.
- The integration of WAM with the SMART transmission zone proposal below.
- Joint development of network security visualisation tools with NGET.

The anticipated cost required for engineering, hardware, communication equipment and software development is estimated at £500k.

The figure below shows a display from the Wide Area Monitoring Phasor Point showing instantaneous system vectors based on the technology which we have trialled to date as part of existing innovation projects.



Investment into the development of Wide Area Monitoring will create greater real time visibility of the network which will ultimately allow for greater utilisation of the network, and the facilitation of more renewables onto the network.

Smart Transmission Zone

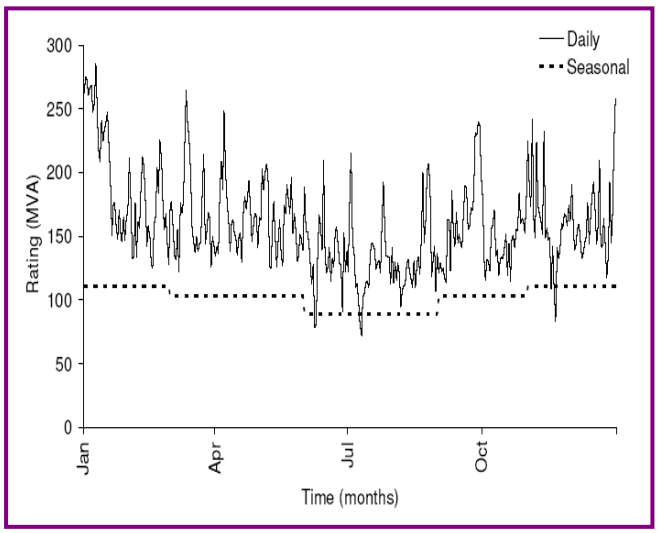
The current manual generation despatch system operated by the GBSO will need to be replaced by a much more sophisticated, automated system more closely integrated with

the transmission system network monitoring and control systems. As a first step towards this radical change, the development of distributed control systems is appropriate and SPT in their role as TO, are to propose and develop with NGET a SMART Transmission Zone across the Anglo-Scottish transmission boundary, to manage the secure transmission of up to 10GW of wind through the SPT transmission system. This system will utilise Wide Area Monitoring technology to provide inputs to a control system that will monitor the integrity of the interconnector circuits and provide automatic post fault control actions to re-secure the system following critical interconnector faults.

These post fault control actions will rapidly reduce the AC power transfer from Scotland to England by automatically tripping conventional/wind generation and also instruct the HVDC link(s) to use their available short term overload capability to unload the AC network. The system may also control the use of Series Compensation to balance interconnector flows across the east and west circuits, pre-fault. The anticipated cost for this SMART zone development is £2.5m spread over a number of years.

This will create the benefit of minimising constraint costs, which are ultimately borne by customers, and will create a development to the operational intertrip which we have already pioneered. The operational intertrip scheme created a saving of millions of pounds in constraint costs at certain times, and we would anticipate that this scheme could make greater levels of savings.

Dynamic Rating of Overhead Lines



Dynamic Rating may be deployed to maximise the thermal capacity of the transmission and distribution overhead line system in a number of ways, e.g. by maximising the connection of windfarms with minimum connection infrastructure, and also by maximising the capacity of the main transmission system in order to minimise Scottish constraints etc. Dynamic rating uses information on wind-speed, temperature and solar gain to increase the overhead line conductor rating, ensuring safe ground clearances are achieved, whilst realising a significant enhancement in capacity. The diagram below provides some indication of potential line ratings compared to current seasonal limits.

SPT wish to develop an overhead line weather enhanced rating system for the main interconnected transmission system for commissioning in 2015 when it is predicted that that there will be a significant increase in thermal constraints. The system will use a network of strategically placed weather stations in conjunction with Met Office area

weather forecasts. The weather information will be input to a database containing composite circuit thermal rating models to provide the GBSO with real time and predictive circuit ratings. The anticipated cost for engineering, weather stations, hardware and software is £1m. This would allow for greater utilisation of existing assets and minimising the investment required in future assets to facilitate more generation and demand on the network.

Some other technology trials and demonstrations that we have identified as of being beneficial include:

- Further embedded HVDC control strategies to optimise dynamic performance, boundary capacity and minimise system losses.
- New techniques for the testing of the condition of Aluminium Core Steel Reinforced (ACSR) conductors.
- Non intrusive health monitoring of transformers and other primary plants.
- Condition based asset monitoring and maintenance.
- New protection technologies and communication standards.
- Improving visual amenity through alternative methods such as alternative tower design.
- Safe clearance policy for wind turbines within the proximity of transmission lines
- Promotion of IEC 61850 protocol for fault recorders and associated equipment
- Solar Geomagnetic Induced Currents (GIC) modelling and system monitoring

Some of these initiatives are developments or a continuation of existing IFI projects while others are completely new. We anticipate other projects will emerge over time that can help to deliver value for customers whilst aiding the transition to a low carbon economy. All of these projects and any other potential projects will be subject to our internal governance and approvals process to ensure that they deliver sufficient benefits and are achievable. With this variety of projects, we believe that 1% of revenue allowed for the Innovation Allowance is appropriate.

Summary

Development in these projects will require a step change in innovation activity from historic IFI initiatives as future projects are of a higher technology readiness level and are at the demonstration phase rather than R&D. As a result, the cost is inherently higher than the historic spending on IFI due to moving from desktop studies and stand alone trials to larger scale demonstration. In order to deliver these projects, SPT would require an annual allowance of approximately **0.75%** of total revenue. An indicative estimated spend profile for the first four years based on the named projects above, and expenditure of c.£600k p.a. to facilitate such work is shown in the table below:

Year	2013/14	2014/15	2015/16	2016/17	2017-21
IA Expenditure	£1.6m	£1.8m	£2.1m	£2.2m	TBC
Total Revenues[1]	£279.5m	£294.7m	£316.2m	£302.3m	-
% Total Revenues	0.57%	0.61%	0.66%	0.73%	c0.75%

This table only shows the predicted spend profile over the first four years based on known projects which align with our innovation strategy. Given the nature of innovation we do not know what other initiatives may arise beyond 2017 but anticipate that 0.75% allowance under the IA will be appropriate for SPT to focus on projects which deliver significant benefits to customers.

This value is higher than the historic IFI allowance, however the scope of work being covered is more substantial and delivers greater benefits than historic IFI activity for customers through the overall strategic approach that SPT is taking, as demonstrated in this document.

Our proposed allowance for the IA is above the current Ofgem policy position but we believe that this is necessary due to the additional elements which are funded through the IA such as the setup an preparation for NIC, and the larger scale of demonstrations that will be undertaken compared to IFI. The additional funding above the current policy position is required in order for SPT to undertake the ambitious projects which we have highlighted in this document. Some of the benefits which will be realised through the higher IA will include greater trialling and demonstration in order to:

- Increase utilisation of assets to reduce system constraints and load related investment,
- Improve the understanding of asset condition to optimise future asset replacement,
- Facilitate more generation onto the network.

Without such an allowance SPT will not be able to participate in some of international forums which provide valuable experience from other countries or undertake the extensive projects which we have highlighted above in the planned timescales. We think that the timing of exploring these initiatives is key as many of the pressures on the network are pressing.

[1] Based on revenue profiles submitted in November 2011.

iii. Network Innovation Competition

In terms of the Network Innovation Competition, we believe this is an opportunity to trial more radical innovation, which could transform the way we operate the network. SPT has already held initial discussions with National Grid to discuss potential projects to progress under the NIC as well as the IA. Given the nature of the transmission system, SPT believes it is key that these are undertaken collaboratively with SHETL and National Grid in its capacity as the system operator as well as TO. Some of the key themes include:

- Energy storage: understanding the opportunities and implications of storage technologies on the network. This may lead to improved usage of renewable generation as well as creating arbitrage opportunities to help the electricity market.
- DC technology; development of technology including voltage source convertors and network configuration strategies. Developments in DC technology will greatly aid the transmission of electricity and reduce costs through research of the equipment.
- Demand side management and visibility of aggregated demand/embedded generation; to understand the implications on network flows and possible reverse power flows, impacting DNOs.
- Other alternative technologies such as superconductors.
- Developing initiatives identified in the IA to be extended to form larger, integrated projects.

SPT will develop these various themes under the Network Innovation Competition, with key partners in order to improve the transmission network, aiding the transition to a low carbon economy and helping to deliver value for money to customers. We believe it is vital that network companies; both transmission and distribution companies, are at the core of any of these projects.

We recognise that the role of innovation extends beyond the activity itself, and only once the technology or technique has been embedded within the business is the project a true success and we will be aiming to achieve this in order to maximise the benefits from all of this work. We have a dedicated team to lead on innovation activities as part of our Network Development Section, and this team will be focussed on embedding these technologies within the business.

iv. Mapping of Innovation Portfolio Against Development Process

The figure shown below provides a mapping of the innovation projects which we have identified to date as areas of immediate priority for RIIO T1 against our innovation development process. This figure demonstrates that the individual innovation projects we are initially focussing on addresses the overarching requirements of stakeholders, and involves a variety of different types of innovation as per our strategy.

	High level area for focus	Quality and security of supply		Sustainable energy systems with minimal environmental impact			Maximise value and optimise cost
Delivery Method	Specific topics / Innovation project	Meeting customer service expectations	Preparing for future uses of electricity	Facilitating new generation	Reducing our environmental impact	Improving our asset performance and utilisation	Becoming more cost efficient
Business Plan Innovation	Series Compensation		Technical/Commercial	Technical/Commercial	Technical	Technical	Commercial
	Embedded HVDC – West Coast Interconnector		Technical	Technical			
	Integrated Offshore Transmission – East Coast Interconnection		Commercial	Commercial			
	New protection and control techniques	Technical/Commercial		Technical			Technical
Innovation Allowance	Wide Area Monitoring		Technical	Technical			
	Smart Transmission Zones					Technical/Commercial	
	Dynamic Rating of Overhead Lines			Technical/Commercial	Technical/Commercial	Technical	
	New conductor corrosion testing techniques				Technical		
	Non intrusive health monitoring of transformers					Technical	
	Protection asset management tools					Process	
	Circuit breakers diagnosis tools					Technical/Process	
	Risk assessment of substation earthing systems						Process
	Alternative low cost tower foundations				Process		Process
NIC	Energy Storage	Technical/Commercial	Technical/Commercial	Technical/Commercial			
	DC Technology		Technical		Technical		
	Impact of demand side management and embedded generation	Commercial/Process	Commercial/Process			Commercial/Process	

This mapping demonstrates how the portfolio of projects identified to date links into the innovation development process. Over the course of RIIO T1, this will develop as new opportunities arise and stakeholder feedback is refreshed, updating the development process.

All of these projects are developed with value for money in mind, be it through

- Greater utilisation of assets,
- Minimising constraints on the network, and the resultant constraint payments which it may generate
- Lower cost innovative alternatives to traditional investments which are not yet proven
- Facilitating a competitive market for generator connections

7. Objective 5: Ensure that Learning from Innovation is Adopted

Our fifth objective is to ensure that learning from innovation activity is adopted by the business and disseminated effectively.

This will also involve undertaking a cost benefit and risk analysis of any trial that is undertaken to ensure that the full implications are understood before making any recommendations or change to policies.

As a result of the above portfolio of innovation projects which have been identified to date, it is vital that the results are understood, and taken forward to be implemented into the business as part of the normal delivery model. Another important stage is that the outcomes are disseminated with other relevant parties so that they can also benefit the wider customer base in Great Britain. These developments will be used to inform future industry forums such as the ENSG which will steer future transmission network developments in the latter years of RIIO T1 and future price reviews, and other policy developments.

8. Summary

We have outlined the approach that is currently adopted by SPT in the development and management of innovation projects to demonstrate the rigorous management process we have in place to ensure we meet our objectives of:

- Innovation meeting the needs of stakeholders,
- Innovation opportunities are identified in a timely manner, which will benefit these stakeholders,
- Innovation is managed in an efficient and proactive manner,
- A balanced portfolio of innovation is pursed which includes commercial, process and technology innovation. Our activity has a relevant focus on developments at different technology and commercial readiness levels to which balances radical with incremental innovation.
- The outcome of innovation activity is adopted by the wider business to ensure that customers benefit at the earliest opportunity whilst minimising the risk to the integrity of the network.

Our plans which we have highlighted in this document and our overall strategic approach to innovation will require an innovation allowance of circa 0.75% of revenue per annum in order to deliver, which we believe will deliver value to customers.