

nationalgrid

**Network Innovation
Allowance
Annual Summary
2017/2018**

**Gas
Transmission**

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Welcome to our innovation annual summary for 2017/18



“We will continue our focus on the implementation of innovation into business as usual to drive value throughout everything we do.”

Nicola Shaw
Executive Director, UK
National Grid

Throughout this year we've remained focused on innovation that delivers real change, providing a safe, reliable and efficient energy system for the future.

Our portfolio continues to push the boundaries of how we work with projects such as 3D printing of obsolete parts, revolutionising cyber security for our supervisory control and data acquisition (SCADA) systems and unlocking the potential of unmanned drones.

In the last 12 months we have delivered against our ambition for 2017/18, building on our capacity to measure the value delivered from innovation and developing new ways to share this with our stakeholders and customers. We are committed to delivering value from our innovation programmes and expanding our pipeline of projects in our five strategic areas: safety, sustainability, financial, customer and stakeholder, and reliability and availability.

This year our value tracking process has been embedded within the business, delivering several new case studies on recently implemented innovations, while continuing to track the value accruing from innovations delivered to date. Innovation in National Grid Gas Transmission (NGGT) has delivered over £8.6m in value so far, sustaining £4 of value for every £1 invested.

For example, Valve Sealant Line Grouted Tee is helping to repair corroded valves with savings of over £800k and 1,500 tonnes of CO₂ realised to date. Meanwhile, the switch to high efficiency gearboxes is significantly reducing the time and cost of inspecting and repairing non-critical valves on the National Transmission System (NTS). As both solutions are in the early stages of implementation, the savings for the network and our customers will greatly increase in the future.

Following the publication of our first 'Embedding Innovation Value' report last year, we have focused on making this information even more accessible to our stakeholders, with the creation of an online library of case studies which tracks value delivered in real time.

We have continued to build momentum on Project GRAID (Gas Robotic Agile Inspection Device), delivering an important milestone of the offline test programme and now focusing on the upcoming online trials taking place at Bacton and Pannal. As the project comes to a close in 2018/19 the focus for the Project GRAID team will be preparing for adoption into business as usual, delivering the online trials and working with the project partners to build the decision tools that the GRAID data will contribute to.

Throughout 2017/18 we have been focused on working collaboratively with the other network licencees to undertake joint projects, and share learnings and best practice. A major achievement has been the publication of the first ever Gas Network Innovation Strategy, driven by our stakeholder consultation and produced with the Gas Distribution Networks and the Energy Networks Association (ENA). The strategy identifies the most important challenges and opportunities facing our industry, setting out new areas of focus for innovation to ensure we continue providing benefits to customers. We also launched our Network Innovation Competition (NIC) call for proposals, reaching out to small and specialist organisations in order to meet our business challenges and the wider challenges facing the gas industry.

Our ambition for 2018/19 is to continue the development of a dynamic portfolio of projects which deliver real value to our customers, stakeholders and the wider industry and is aligned to the Gas Network Innovation Strategy. We will continue our focus on the implementation of innovation into business as usual to drive value throughout everything we do. We will remain committed to sharing best practice across the industry to deliver a safe, reliable and efficient network that benefits gas consumers across the UK.

Nicola Shaw
Executive Director, UK
National Grid



Sustain world-class levels of safety and seek innovative solutions to reduce the risk on our network

Safety

Keeping people safe is our key priority. Through innovation, we're reducing the risks linked to operating the gas transmission network, while introducing more efficient ways of working. A major focus is on developing new ways to assess the condition of our buried pipelines and manage the risk of ageing assets. All of this work helps us improve safety and efficiency.

We're also addressing the challenges of an ageing workforce by making sure

our senior engineers pass on their invaluable expertise to a new generation of gas engineers.

Other new tools and techniques are solving important safety issues. We're reducing the risk of damage by third parties working on or near our pipelines through projects such as Aerial Imaging Research (AIR). Activities such as this keep the network safe for our colleagues, customers and public.

Title:

Induction Heating

NIA reference:

NIA_NGGT0113

Supplier:

Rapid Heat Systems Ltd.

PEA Cost:

£93.6k

Benefits

£22k

estimated cost saving per weld based on a 42" pipe

Innovative induction wand makes welding safer

Design Assurance Engineer Kirsty McDermott on the benefits of bringing induction heating to in-service welding.

What problem are you trying to solve?

Where a new connection is required to a pipeline we use epoxy or welded tees. The epoxy tee is widely used because of the speed of installation.

However, the epoxy tees do take significant time to manufacture as they must be tailored to the specific dimensions of the pipe. For this reason, it's faster and more effective to use traditional welded tees in emergency situations. When we use these welded fittings, our engineers use a gas flame to heat the pipe to temperature. This requires regular reheating, which means the job can take more than 30 hours.

Using a gas flame near a live line has inherent safety risks, and there's a further risk of overheating the pipe and damaging its structure. Welding the joint between the pipe and the fitting is challenging, too, as they meet at an awkward angle.

How do you propose to solve all these issues?

We're developing an induction heating 'wand', which engineers will simply hold along the joint. It will maintain the right temperature and give equal heating across the area they need to weld. It will allow them to work continuously and safely, saving significant time and cost. We're setting up a test rig at Ambergate Pipeline Maintenance Centre (PMC) and will begin testing the wand in the summer of 2018.

What are the benefits of the induction heating wand?

With no naked flame, the wand will make the job of welding these fittings much safer. It also makes it impossible to overheat the pipes and brings significant cost savings by cutting weld times to 20 hours.



The wand will make the job of welding these fittings much safer.



Aerial 3D laser scanning involves attaching LiDAR technology to an aircraft.



Safety

Title:
LiDAR to Support NTS Pipeline Management

NIA reference:
NIA_NGGT0116

Supplier:
NM Group, Enview

PEA Cost:
£279.5k

“With richer data at our fingertips, we’ll be able to manage our network more safely and efficiently.”

Ian Crompton
Pipeline Technician

Benefits

£140k

estimated reduction in annual line-walking costs if LiDAR is put to use across the network

Sky’s the limit with LiDAR 3D surveys

In a first for the UK gas sector, we’re testing the potential of aerial 3D laser scanning to help us manage the network in a safer, more efficient way.

Managing our pipe network is complex and costly. We employ skilled technicians to use the latest inspection techniques, such as in-line (internal) assessments, aerial surveys and physical walking of our pipelines.

One area where fantastic advances have been made is in aerial 3D laser scanning (LiDAR). This involves attaching LiDAR technology to an aircraft and then scanning the terrain to create a detailed 3D model of the landscape.

In a first for the UK gas sector, we’re using the technique on a section of our network where we know there are issues with depth of soil cover over some of our pipelines.

Scanning from the skies

NM Group has carried out three scans; an initial flight to create a first picture of the land condition, a second three months on to look for short-term changes, then a third and final scan three months later. Enview has completed the first two flights and will complete the final scan in the coming months.

We’ll compare the three highly accurate snapshots of the network to identify potential risks, either from subsidence and earth movements, or due to third-party interference. We believe it will give us a clear picture of the specific locations where we need to take action.

An important part of our innovation is bringing the data collected from LiDAR together with existing data about the pipelines. With the assistance of NM Group’s software (Caydence®) we are creating a 3D virtual world of our pipes and their surroundings. This means that lots of diverse data sets will exist in one platform, giving us a holistic view of the gas network.

Away from harm’s way

Having a clearer view of the network brings benefits on many levels. It will help reduce the number of line-walks our technicians need to do. As these are often in remote, challenging locations, this can bring significant safety benefits. We estimate it will also save the business £140k a year.

We’ll be able to do important safety and logistics planning from our desktops, too. By having a more detailed picture of our pipelines, which show where the nearest roads and access points are, we can make sure anyone visiting the network is fully prepared. This will help keep our staff safe and avoid the cost of unnecessary trips.

Ultimately, with a much richer data set at our fingertips, we’ll have the tools to manage our network more safely and efficiently than before.



Embed sustainability into our network to reduce our environmental impact and make the most of the resources we use

Sustainability

Improving our environmental performance is more important than ever. With gas supplying more than twice as much energy as electricity each year, innovation plays a central role in how we're reducing our emissions and shifting to a low-carbon future.

We're developing new technologies to cut emissions from a range of sources, including vented gas and our compressor fleet. We're committed to using natural resources wisely and exploring sustainable alternatives to carbon-intensive materials, including composites and polyethylene (PE).

Reducing noise from gas equipment, such as above-ground installations and compressors, remains a priority. Through our Noise Mitigation project, we're investigating innovative cladding solutions to reduce the impact of noise on the communities we operate in.

Sustainability is fundamental to the future of the gas network and can reduce both its environmental impact and costs. Innovation will continue to play a key role in identifying the low-carbon solutions that the future of our network will depend on.

Title:

Next Generation Predictive Emission Monitoring Validation (PEMS)

NIA reference:

NIA_NGGT0074

Supplier:

Siemens

PEA Cost:

£151k

Saving customers £490,000 with PEMS

Monitoring emissions across our fleet of compressors is important to us, both as a responsible business and to ensure industry compliance.

“By working closely with gas turbine OEM Siemens, we’re developing the best techniques, innovating all the time and ensuring our emissions measurements are based on the highest quality data.”

Matt Williams

Environmental Assurance Engineer

We make sure our emissions are within the limits laid out in the Industrial Emissions Directive (IED) and Medium Combustion Plant Directive (MCPD).

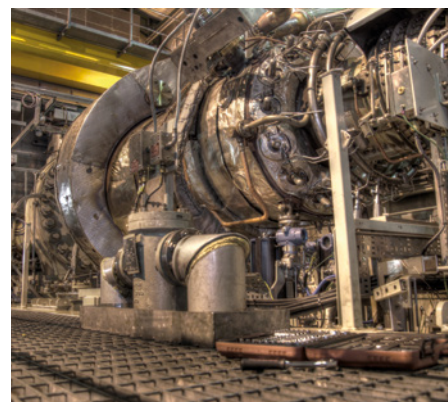
Through our Predictive Emissions Monitoring Systems (PEMS) project, we explored whether we could measure Nitrous Oxide (N₂O) and Carbon (C) emissions in a more novel and less expensive way than conventional methods.

For 12 months, we ran the latest generation of PEMS alongside one that continuously monitors them (CEMS) on a Siemens SGT 400 gas turbine.

High accuracy, lower cost

Results showed that measurements from the less expensive PEMS could reach the high level of accuracy required to meet the performance criteria for both the IED and MCPD.

If rolled out across our full fleet of seven SGT 400 turbines, we estimate a cost saving of £490k compared to installing CEMS systems. This is extremely positive as it means we can meet our emissions requirements at a significant cost saving.



Gas turbine emissions can be reliably predicted using original equipment manufacturer (OEM) expert knowledge.

While the system we originally tested ran from a connected laptop, project partner Siemens has now developed a model which is fully integrated into our turbine's control system, and this is currently being tested. We're also exploring whether we could adapt the system for our older Avon and RB211 gas turbines. If so, a further 50 of our turbines could benefit from PEMS; creating further cost savings.

Benefits

£490k

estimated cost savings across full fleet



Tackling the challenge of noise insulation.

Title:

Noise Mitigation Tool

NIA reference:

NIA_NGGT0112

Supplier:

PESL Consulting

PEA Cost:

£303.3k

“We’re creating a tool that will help NGGT select the right noise abatement technology for current and future projects. It will bring significant benefits to gas consumers as we reduce costs, corrosion risk and noise complaints.”

Owen Ariyo
Project Lead

Benefits

£1.5m

estimated cost
savings over 10 years

Reducing noise sustainably and affordably

We’re making the job of controlling noise on the network more sustainable and cost-effective.

The normal flow of gas through our pipes can cause a significant level of noise emissions. When this exceeds planning limits or becomes a nuisance to local people, we put hard cladding or soft lagging on the pipework to bring noise levels down.

While these methods are effective at controlling noise, there’s a risk that water can get underneath and corrode the pipe. As a result, we need to carry out regular inspections, which involve removing and scrapping the old cladding, repairing any pipe damage we find and putting new cladding in place.

As a business with a commitment to operating sustainably, this level of waste is undesirable. Carrying out so many inspections and repairs is also costly.

Cutting cost, corrosion and maintenance

Through this project, we’re tackling the challenge of noise insulation on two fronts. First, we’re researching existing and new technologies to find which perform better than our current solutions in terms of whole-life cost, maintenance and corrosion protection.

Once that’s complete, we’ll create a comprehensive computer-based tool that will compare all available techniques and recommend the best solution for reducing noise emissions on any given project.

The teams that design our new installations will be able to use the tool to select the most robust, cost-effective and environmentally sound solution on every project.

If successful, we expect this innovation to cut costs by £1.5m over 10 years, due to fewer corrosion repairs needing to be carried out. It will also reduce unnecessary lagging waste and drive good practice and continual improvement for the benefit of the UK’s gas consumers.

Going one step further on noise

In the course of the project, we also studied the noise produced by our compressor machinery. We worked closely with equipment manufacturers to pinpoint the specific sources of noise and identify the best design approaches to reduce it. We’re now in the process of refining our user requirement specifications and evaluation criteria to allow us to procure the most effective compressor machinery noise management solutions.



Deliver value for our stakeholders and seek opportunities to deliver a safe and efficient service across our operations now and into the future

Strategic

Cutting-edge technologies are providing new ways to inspect and manage our assets, and helping us make smarter investment decisions on our network. These innovative techniques can make our business more efficient by getting the best from new and existing sources of data.

We're building strong research partnerships with leading institutions to make sure we're at the forefront of academic research. Through these close relationships, we're developing our

understanding of flow changes on the gas transmission system and building new mathematical models that allow us to effectively manage unaccounted for gas.

Innovation will play an important role in making sure the gas transmission network can support the decarbonisation of heat, transport and energy towards 2050 and beyond. We're exploring how alternative sources and quality of supply will affect the gas network as the nation's energy mix changes.

Title:
Extreme Value Analysis (EVA)

NIA reference:
NIA_NGGT0107

Supplier:
Business Modelling Associates

PEA Cost:
£512.5k

“This complex solution has a clear benefit: it will make our decision-making more robust.”

Aoife McNally
Project Lead



Making better long-term investment decisions for gas consumers

We're using the power of new risk modelling techniques to help us make sounder long-term investment decisions.

As a business that needs to put robust plans in place for the future, it's important we can properly calculate the value of all our potential investments, including those that aim to reduce extreme value risks. These are risks that have a low likelihood of happening, but would have a high impact if they did.

Up to now, we haven't had suitable tools to measure these risks. This could lead us to believe a risk was more or less severe than the reality, which could in turn lead to over- or under-investment. Both scenarios would ultimately result in added cost for consumers.

Innovative techniques

Working with external consultant Business Modelling Associates (BMA), we've used innovative risk-modelling techniques to develop a solution that brings together and

evaluates financial, risk and operational performance.

It's a complex solution with a clear benefit: to help us more accurately quantify the value of investments that aim to reduce extreme value risks and, in turn, make our decision making more robust.

Putting it to the test

We're currently applying the solution to three case studies with promising results. From what we've seen, the solution seems to provide a robust way of assessing extreme value risks and quantify uncertainties in investment decisions in the longer term.

Being able to take these risks into account, without skewing their significance one way or the other, should ensure we make the best long-term investment decisions that are in the best interests of gas consumers.

**Title:**

Advanced Manufacturing
(3D Printing) of NTS Ready
Components

NIA reference:

NIA_NGGT0110

Supplier:

Premtech and The Institute for
Innovation & Sustainable Energy
(IISE)

PEA Cost:

£261k

“This technology has the potential to save us significant amounts of money, and reduce repair costs, disruption to consumers and the safety risk for our engineers.”

Alan Horsburgh
Project Lead

Bringing obsolete components back to life

Across our network, we use a vast array of complex equipment. As assets age, certain parts can become outdated and unavailable.

If one of these parts fails and we can't source a replacement, we're faced with replacing a much larger section at a higher cost.

In this project, we're harnessing the latest 3D printing technology to demonstrate that we can manufacture obsolete parts, and those with long lead times, for ourselves. We're also looking to create tooling moulds for use with 3D manufacturing that would allow us to improve the design and functionality of parts in a way that wouldn't be possible using conventional machining techniques.

The 3D printers we're using, which are supplied by the Institute of Innovation in Sustainable Engineering (IISE), work by welding layers of metallic powder together using a high temperature laser or beam. This produces high density components that are fit for our needs.

Going live with printed parts

So far, we've successfully printed two previously obsolete connectors, which we're now preparing to use on the live network. The project will determine the environmental and safety impacts of using 3D manufactured parts on the network

and the suitability of this technology for deployment in the business.

“This technology has the potential to save us significant amounts of money,” said Project Lead Alan Horsburgh. “Instead of taking pipelines out of service to carry out larger works, we'll be able to print out the faulty part and carry out an easier repair. This will reduce repair costs, disruption to consumers and the safety risk for our engineers.”



We're using the latest 3D printing technology to manufacture obsolete parts.

Title:

Gas Robotic Agile Inspection Device (GRAID)

NIA reference:

NGGTGN02

Supplier:

Synthotech Limited, Premtech Limited, Pipeline Integrity Engineers (PIE)

NIC Cost:

£6.3m

“We’re at the stage where the hard work we’ve put into GRAID is being paid back and we’re seeing the results.”

David Hardman
Project Lead

Benefits

c.£60m

predicted savings over a 20-year period

2,000

tonnes of carbon predicted to be saved annually

Project GRAID gears up for ‘live’ gas debut

Our GRAID robot has completed crucial offline tests this year in preparation for its first operational trial on high-pressure pipework. Here are some project highlights from this standout innovation.

With Project GRAID, we’re transforming the way National Grid Gas Transmission (NGGT) inspects previously unreachable sections of buried pipework at high-pressure gas installations. This world-first pioneering robot goes inside a live high-pressure gas environment to collect data and analyse the condition of the pipelines to help us manage, maintain and replace the assets more efficiently.

Our activities have focused on proving the concept offline as we gear up for the robot’s first live performance on the NTS. The project is now just over six months from completion, and remains on track to meet its goals.

Offline testing

Since October 2017 we have been putting our robot through its paces at our dedicated offline test rig at the DNV GL research site, RAF Spadeadam. We used learnings from an earlier prototype to tweak the designs slightly to make it easier to manufacture in the future.

While the chassis was being rebuilt, we continued testing with the previous model at normal atmospheric pressure. The robot passed its distance test – an important step forward, where we proved it could drive for 100m and back again without failure.

In the event of the robot failing to return, we considered tethering. This has both positives and negatives; one benefit is the pullback facility. We simulated a retrieval of the robot from the pipe to show that if all power failed, the mechanisms in the launch vessel and the Umbilical Management System (a sophisticated trolley and cable that connects us to the robot) would get the robot out.

Pressure testing proved the robot’s ability to withstand extreme pressures (100 bar(g)) and its ability to cope with flow (up to 5 m/s) while still being able to send real time data to the operators.

We are now in the acceptance testing phase. This includes checking the effectiveness of the robot’s inspection arm at collecting high-quality data and introducing natural gas into the test rig to give us a clear understanding of how it will operate in live NTS conditions.

Online trials

GRAID’s first online trial took place at a site called Pannal Offtake, near Harrogate in June 2018. Previously, we had selected Bacton and Cambridge as our trial sites but, due to ongoing Asset Health works, Cambridge was removed from the plan with Bacton still going ahead.

Pannal Offtake gave us a low-risk first connection site for GRAID. A redundant meter stream loop was put in to connect a new pipeline which was never built. So while the pipework is officially on the NTS, there is currently no flow and no impact to the offtake part of the site.

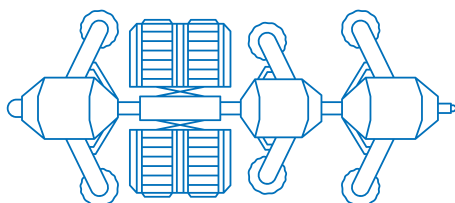
We started the build for two permanent connection points at Pannal in April 2018, which allowed the robot to be driven inside the NTS to perform inspections of the pipeline. Bacton’s build will start in July, with subsequent inspections being carried out in August.

Communications

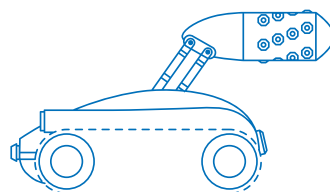
With GRAID taking robotics into new areas, it’s no surprise it’s captured the imagination of the UK media. We hit the

The evolution of GRAID

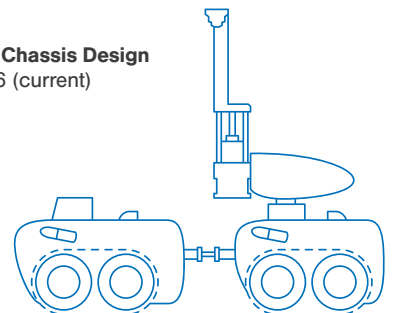
The ‘Crawler’ Concept
November 2014–May 2015



The Dolphin Design
June 2015–May 2016



The Twin Chassis Design
June 2016 (current)



headlines in *The Times* (31 August 2017) as well as a leading industry magazine, *Gas International* (August 2017). We also won the Innovation Project Award at IGEM Gas Industry awards and the Land-based Onshore Pipeline Category at the Pipeline Industry Guild awards.

It's really important to share what we've learned, and along with our partners we've been promoting GRAID at a number of industry and worldwide events.

Challenges we're facing

As we near the end of this NIC project, one challenge is getting approval from within our organisation to use the GRAID robot and associated equipment on the network. So we're working hard to make sure the correct processes are followed and any concerns are put to rest, to make the use of robots business as usual.

We're also making sure people across the company are aware of the data that GRAID can gather, to ensure the business can use it to inform its investment decisions heading into the next regulatory period.

Looking ahead

Our online trials in summer 2018 will involve two weeks of the robot inspecting the live pipelines and taking wall thickness measurements.

From November 2018 we'll be carrying further learning on the robot's sensors to better understand how they identify and profile pipeline defects. We'll also be doing more work on the data model – which will use the latest 3D software to bring our assets to life by providing a colour-coded status of pipeline condition. This will aid the asset health decision-making process.

The final stage of GRAID will be training our staff in how to drive the robot.

We've also left room in the schedule for any potential adaptations resulting from the live trials. We can perform any small changes without affecting the project deadline.



**Find out more
about our
revolutionary robot
at the dedicated
[GRAID website](#)**



Life after the project

The end of the project (November 2018) is really just the start for GRAID. Our first job will be to establish the way NGGT continues to invest in this technology and maximise its benefits in future. Looking at the longer term, there are many opportunities, such as including different inspection technologies, investigating whether new connection sites are viable, reducing the size of the robot to operate in smaller pipework and introducing new modules that could measure stress or even clean or retrieve items from a pipe.





Understand the needs and priorities of our customers to provide exceptional service

Customer and Commercial

We're part of an energy ecosystem that is changing at an extraordinary pace through decarbonisation, globalisation and technology. As it evolves, so do the needs of our customers, stakeholders and communities. We aim to satisfy their needs, while preparing for future demands from new sources of gas and their impact on the gas transmission network.

Through innovation, we're exploring how a wider range of gas quality in the future could affect industrial and commercial energy users. We're challenging current ways of doing things and developing new methods in areas such as network constraint modelling so we can continue to meet the demands of all our customers.

Title:

Epoxy Grout Investigation and Analysis

NIA reference:

NIA_NGGT0109

Supplier:

DNV GL, Namco Solutions

PEA Cost:

£298k

Simplifying epoxy grout

Project Engineer Gordon Platts explains how an innovative epoxy grout is set to simplify high-temperature pipe repairs.

What problem is this project aiming to solve?

We use epoxy grout, an extremely durable material, for pipe repairs such as corrosion damage, cracked welds and laminations. However, it does have limitations. Winter grade has a maximum working temperature of 50°C and summer grade has a maximum working temperature of 60°C which can delay repairs. In windy or extreme conditions we need to mix the three elements – resin, powder and hardener – on site and this can be difficult.

What was your solution?

We assessed and proved the effectiveness of a new grade of epoxy grout. We explored its short-term strength and adhesiveness as well as its long-term performance through exposing it to extreme temperatures. Tests proved that it can keep its strength up to 70°C for the winter grout and 100°C for the summer grout. Another benefit is that

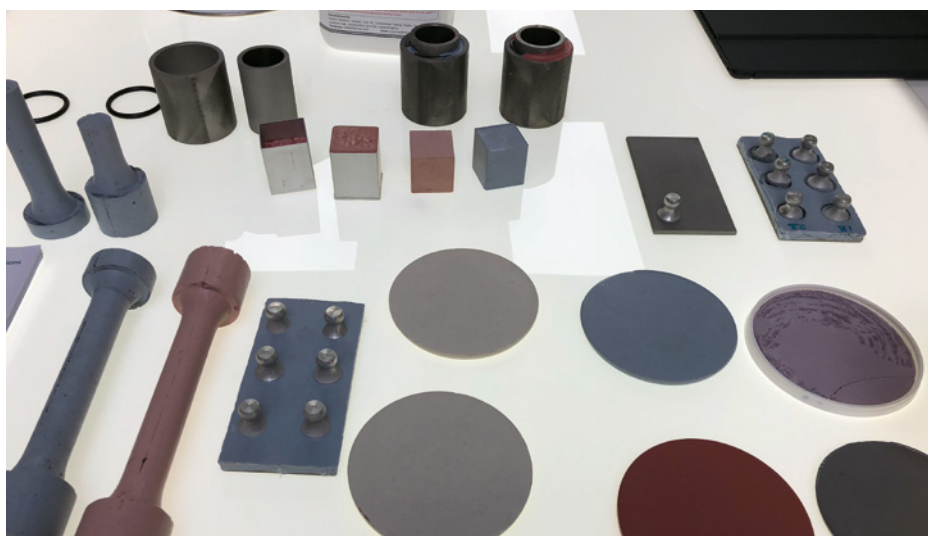
it comes ready mixed, so technicians only add separate bottles of hardener.

What are the main benefits of this new grout?

Because it stays strong at higher temperatures, we can use it on high-pressure pipelines, where the working temperature is more than 60°C i.e. oil lines. Previously, more complex and expensive repairs would have been needed. Currently we have a single source of the existing grout, so this will reduce potential supply risks by using a second grout supplier.

Where are you now – and what's next?

The new solution has been tested in different installation conditions and has proven to be suitable for pipeline repairs. We're hoping to have it on the network by midsummer, where we'll use it to support our existing grout, particularly on jobs where pipes run at higher temperatures.



We assessed and proved the effectiveness of a new grade of epoxy grout.





Title:
Compressor Data Analytics

NIA reference:
NIA_NGGT0118

Supplier:
DNV GL

PEA Cost:
£306.5k

“By having better data about potential issues and asset health, we’ll be able to manage our network operations better and plan investments more effectively.”

Edward Wamala
Asset Performance Analyst

Predicting compressor failures before they occur

We’re using the latest machine learning and data analysis to forecast failures on our compressors, so we can run the network more efficiently for our customers.

We need our compressor fleet to be robust and reliable, so it can deliver gas to our customers across the NTS.

If a compressor trips while it’s starting or when it’s running, it can cause disruption on the network and result in significant supply and demand management charges for our business.

Through this project, we’re creating a tool to predict trips and failures, as well as estimating the remaining useful life of the asset. This will help us take the right action to prevent them from failing.

Making it happen

We already collect important information about the condition of our machines through a monitoring system called ALERT. We’re aiming to optimise use of this data by applying the latest techniques in data analytics and machine learning to find trends that warn us of potential issues. We’ll then use a technique called prognosis modelling to work out which of these trends are the most reliable indicators of when a compressor might fail.

We’ve already made good progress, having gathered the machine condition data we

need, as well as developing software to analyse it. A machine learning model has been tested and we’ll compare its results with other machine learning methods to find the best option.

Once we’ve worked out the most accurate system for predicting failures, we’ll install it onto a site’s ALERT system and test it with live data. If the live test is a success, the system will then be tuned and improved, before being rolled out to other sites with similar compressor types (LM2500).

How will this benefit the network and consumers?

Staff alerted to the likelihood of a trip or failure can react before the issues occur. This will reduce the amount of time our compressors are out of action and result in lower maintenance costs and penalties, fewer safety issues, and more flexibility to meet our customers’ demands in future.

By having better data about potential issues and asset health, we’ll be able to manage our network operations better and plan investments more effectively, ensuring the continuous and reliable delivery of gas for our customers.



We presented CLoCC at the Low Carbon Networks & Innovation conference.

Title:

Customer Low Cost Connections (CLoCC)

NIA reference:

NGGTGN03

Supplier:

Premtech, Aqua Consultants, PROTECH

NIC Cost:

£5.4m

Benefits

12 months

estimated connection time for standard design lower-flow customers

80%

minimum reduction expected in application fees for lower-flow customers utilising standardised designs

CLoCC heralds a new era for gas customers

The NTS will soon be ready to support a new generation of gas customers after an incredible 12 months on project CLoCC (Customer Low Cost Connections).

Progress on project CLoCC has been in full flow as we move towards the end of a project designed to open up the gas network to a new generation of gas customers, including newer forms of indigenous gas.

Three years ago, we began our journey to reduce connection costs to the NTS by half, to less than £1m, and cut the time involved from three years to less than one year.

Achieving this has meant fundamentally challenging every aspect of our gas connection process. The result is a new online gas customer connections portal, a range of standardised physical connection designs, and new commercial processes that reduce barriers to connecting for gas customers.

From the end of October, when the project closes, our network will be a more viable option for lower flow emerging gas producers to consider, such as biomethane and shale. Additionally, exit connections for applications such as natural gas fuel

stations will also become more simple and affordable.

Let's take a closer look at our key achievements from the past 12 months.

Gas customer connections portal

One of the project's main aims was to create an online connections portal where customers can find information about connecting to the NTS, and follow the journey of their application in a simple and convenient way. We have made excellent progress and are ahead of schedule, with the portal now in its final stages of development and testing.

Its most significant feature, which we hope will transform the customers' experience, is that it gives an indicative real-time quote for connecting to the NTS in a matter of seconds.

Commercial arrangements

When we began the project, we identified some commercial processes that were an obstacle to some lower flow gas



customers looking for entry and exit connections. A significant part of our work has been looking at current commercial arrangements and removing these barriers to offer improved flexibility to our customers.

For example, we've removed the absolute requirement for an exit connection to have a Remotely Operable Valve (ROV), which came into force in January 2017. By doing so, we've simplified the connection process and significantly reduced the costs involved, with an ROV typically costing between £100k-£200k (the savings depend on connection size chosen).

We also updated the National Grid Gas Ten Year Statement (GTYS) after feedback from customers. The GTYS is published every year to give customers and stakeholders a better understanding of how we intend to operate and plan for the NTS over the next 10 years.

Previously, the GTYS specification for oxygen content in gas was 10 parts per million (ppm), which biomethane customers told us was an absolute barrier for them considering connecting to the NTS. As a result, we updated the document to make it clear we will consider requests for oxygen content up to the Gas Safety Management Regulations (GSMR) specification of 2,000 ppm on a case by case basis. This update went live on 30 November 2017.

Another achievement has been the work we've done to reduce the connection application fees for lower-flow gas customers. The new application fee for standard design customers will be reduced by at least 80% due to the suite of designs and online connections portal developed as part of Project CLoCC.

Standardised connection designs

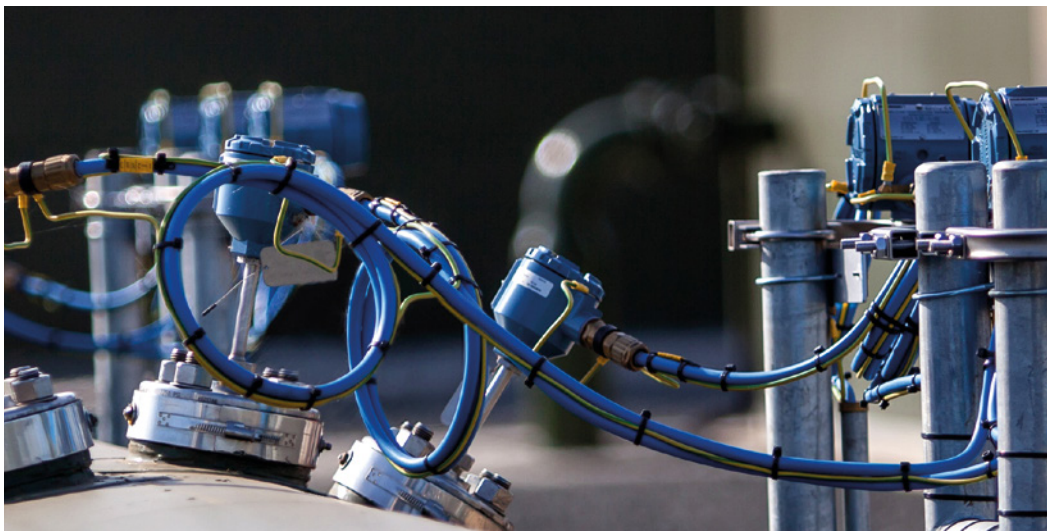
A key element of cutting the time and cost of connecting has been the development of 'plug and play' connection units.

Customers will be able to select from our suite of standardised connection designs covering pipework sizes of 80mm, 200mm and 300mm. These sizes can accommodate a broad range of customers with a wide range of gas types and flows.

This work has been critical to making quicker and cheaper connections possible and will potentially save new customers months of bespoke designing.



Find out more about this innovation at our dedicated [Project CLoCC website](#)



Pilot customer opportunity

Part of the project's final stage is robust testing of all aspects of the new connection solution. Originally, we'd planned to do this at a National Grid testing facility. However, as the project developed, it became clear there was an appetite from gas customers to benefit from CLoCC outputs at the earliest opportunity.

We issued an invitation to industry looking for a pilot customer who could bring CLoCC to life in a live environment. Nine applications were received across a range of industries, including biomethane, shale, gas for transport and gas projects to support electricity generation.

The project appointed Somerset Farm in Cambridgeshire, an anaerobic digestion plant, owned by Biocow Ltd as the pilot customer. The site is positioned in a large area of agricultural land north of Peterborough and expects to be injecting biogas into the NTS within 12 months.

Somerset Farm will provide valuable learning and 'proof of concept' information for both parties and will be invaluable in helping the project handover developments after Project CLoCC closes.





Drive improvements in asset health across our network to ensure it can operate reliably and flexibly to deliver the best possible service

Reliability and Operability

Innovation is integral to finding better ways to operate and manage our network. We're investigating new technologies that will help us meet the challenges we face around reliability and maintenance from our ageing network. We're exploring how new materials could transform the way we operate, too.

In particular, we're looking at how digital solutions can help us inspect pipelines more accurately and efficiently and extend the reliable life of the gas

network. One example, our Compressor Data Analytics project, is seeing how we can optimise the operation of our compressors to make them as reliable and cost efficient as possible.

Advances in software development have also unlocked opportunities. We're exploring the potential of modelling software to produce data-rich drawings of our sites and assets. Through innovation we can continue to build a more reliable network for the future.

Title:
Seam Weld Identification

NIA reference:
NIA_NGGT0096

Supplier:
ROSEN

PEA Cost:
£109k

Benefits

£17k

estimated amount saved every time we avoid an unnecessary repair

Reducing unnecessary and costly pipe repair

When there's corrosion or damage on a pipeline, our inspectors must assess how it is impacting the integrity of the pipe.

An important step in the process is pin pointing the seam welds. If the damage affects the weld, we need to take appropriate action to repair the pipework.

Finding seam welds on many types of pipe is straightforward. However, on High Frequency Resistance Welded (HFRW) and Electrical Resistance Welded (ERW) pipework, it's more challenging as excess metal around the weld is removed during manufacturing.

If we can't identify a weld we have to assume that there is damage affecting the seam weld that must be repaired, even if it may not be necessary. This can be expensive and time consuming.

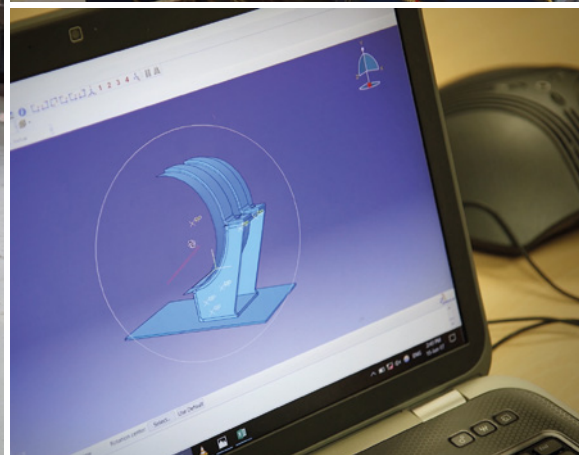
Finding solutions to find the welds

We explored whether there were new inspection techniques that could help our engineers identify welds. We put a range of new solutions to the test, including detailed visual analysis, ultrasonic wall thickness

surveys and handheld laser scanning, and proved they could all be successful at spotting seam welds. Of course, some techniques are more expensive to carry out than others, so to make sure engineers don't use more expensive solutions where they're not needed, we've developed a staged inspection approach. This sees engineers starting off by using the least expensive solution, a detailed visual inspection. If that isn't sufficient to find the weld, they'll move up a staggered list of techniques, which steadily increase in cost, until they've found the seam weld.

We've produced written guidelines for all the different methods, which will now become part of our T/PM/P/11 procedure for carrying out damage assessments on in-service pipelines. For every weld we identify that we couldn't before, we save at least £17k by avoiding unnecessary repairs. We predict three repairs will be avoided each year, resulting in an annual saving of more than £50k.





Earlier this year we performed a crush test. We're now finalising the design specification.



Title:
Composite Pipe Supports Phase 2

NIA reference:
NIA_NGGT0098

Supplier:
Premtech

PEA Cost:
£177.5k

Benefits

25%

estimated cost saving
per pipe support

£400k

estimated cost
savings

Simplifying inspections with composite materials

Current steel pipeline supports risk corrosion so we looked to composite for a practical and cost-effective alternative.

All the supports that hold our pipelines in place at Above Ground Installations are currently made of steel. While they are fit for purpose, they're at risk of corrosion and are challenging to inspect and maintain. For example, when we inspect a pipe, the supports have to be removed. This involves a lot of manpower and expensive lifting equipment, and requires us to break the support's concrete base.

We set out to improve the design of the supports and investigate whether composite materials – those made from a combination of plastic and other reinforcing materials – could be used in place of steel to give us a more practical solution.

Smarter sliding design

We focused on a composite called Glass-Reinforced Plastic (GRP) which is made up of plastic resin and glass fibres and has been proven to be robust across many industries, including aircraft and marine use.

In addition to being more lightweight, GRP also eliminates the corrosion risks

with existing steel pipe supports, reducing maintenance costs significantly.

We developed a new design, which splits the base of the support into two halves. This means that once the pipe has been strapped in place, the sections can easily be slid apart, without breaking any concrete, which significantly reduces cost and time.

The new lightweight design and material means the need for using lifting equipment close to the pipework is avoided; reducing the risk of damage to the pipe.

After rigorous testing, including a crush test earlier this year, we demonstrated that our new composite solution met all our requirements; performing well under heavy loads. We're now finalising the design specification that will allow us to manufacture and purchase GRP supports. We have identified a suitable location and have approved the design to install the first supports on the network.

**Title:**Investigation into the use of
Constrained Layer Damping**NIA reference:**

NIA_NGGT0049

Supplier:

DNV GL

PEA Cost:

£290.8k

Benefits**£90k**estimated savings per
installation**60**total number of pipe
work connections
at risk**£5.4m**estimated total
savings

Tackling the problem of vibrations

Pipeline Officer Paul Connolly on how we're improving our approach to pipeline vibrations.

What are you trying to achieve with this project?

Some pipework at our compressor facilities is susceptible to high levels of noise and pulsations caused by the flow of gas through the compressor itself. Internal acoustic energy is transmitted downstream in the pipework, which leads to severe levels of vibration, known as high frequency acoustic excitation. Over time, this can cause cracking at welded points, and failures of other small bore connections on the pipe. In this project, we put two innovative solutions to the test: constrained layer damping (CLD) and grouted rings.

How do these techniques work?

CLD works by wrapping three layers of material around a pipe location where we know there's a risk of failure. A viscoelastic layer (materials with both viscous and elastic properties) is sandwiched between two stiff layers made of materials such as steel

or aluminium. This combination is ideal for dampening vibration levels. Grouted rings, which are steel rings that are welded to the pipework, can be combined with CLD to stiffen the structure further.

Where are you now?

We recently completed field trials in a live compressor environment. Our results proved that both CLD and grouted rings significantly reduce vibration and are viable techniques. We're now putting together an implementation plan, so we can fully introduce their benefits to the business.

What's the win here for our business and consumers?

These techniques will reduce the risk of vibration-related issues to acceptably low levels. It will bring improved safety and security of supply, and significantly reduce repair and maintenance costs for the business, and ultimately gas consumers.

Title:

Permanent PE Slab Protection

NIA reference:

NIA_NGGT0097

Supplier:

Rosen

PEA Cost:

£199,000

Benefits**£400k**estimated savings by
installing on 30 sites

Effective protection from farm machinery

Senior Engineer Paul Ogden explains how shaped Polyethylene (PE) slabs could safeguard pipes on farmland – and increase reliability.

What problem are you trying to solve?

Farming practices, such as ploughing, can erode soil levels above our pipelines and we've seen a number of occasions where our pipes are shallower than specifications allow. This puts them at a greater risk of damage. If this is significant, we may need to close a pipeline to carry out repairs, which can be costly and disruptive to our customers and to the landowner. We're looking to build on a previous innovation project to find a solution.

How are you planning to do that?

We've already developed flat, lightweight PE slabs, which are being successfully used to protect pipes that cross below shallow ditches. We're now developing a shaped version of the slab, a bit like an upside-down 'U' shape, that could be installed over longer sections of pipeline that run across fields.

Where is the project now?

We're producing early designs of the new, shaped slab and will be doing field tests of these so we can evaluate the benefits and the practicality of installation. Ultimately, we want to find a solution that will be capable of protecting pipes of various sizes, and at various pipe depths.

What are the benefits of this innovation?

Protecting our pipelines brings a clear safety benefit to our engineers and the public. The slabs also minimise disruption to landowners as they're easy, quick and lightweight to install. We predict we'll make savings of £400k by installing them on known locations with shallow depth of cover. These cost savings are due to a reduction in the likelihood of pipe damage requiring excavation and repair, and the affordability of the slabs themselves compared to existing solutions.



The first stage of the project has seen the new system successfully installed and commissioned.

Title:

Open Source SCADA Platform

NIA reference:

NIA_NGGT0114

Supplier:

Lagoni Engineering Ltd.

PEA Cost:

£800k

Benefits

£1.63m

estimated annual savings by running an open source SCADA platform across our entire compressor fleet of 26 sites

Strengthening security with SCADA systems

SCADA systems provide our engineers with central control over individual machines, system status and access to data analysis or archiving.

Over the years, a variety of different supervisory control and data acquisition (SCADA) systems have been engineered and installed across our fleet of gas compressor stations. All these have been designed and installed by either the SCADA system Original Equipment Manufacturer (OEM) or a system integrator with the Intellectual Property (IP) remaining with the OEM.

Because we're not the IP owner for these systems, we face significant costs every time we need to modify or upgrade. What's more, running a number of different systems from different suppliers makes it challenging to manage the threat of cyber attacks and any cyber security risks.

Reducing the cyber threat

In this project, we set out to develop a standard SCADA system based on an open source operating system and SCADA software package. The new system also brings reduced costs. As we will own the IP,

we'll be in control of making any changes to the system. With consistent SCADA platforms across all compressor stations, our design, training and support costs will be substantially reduced. The system also offers lower hardware and software licensing costs.

The first stage of the project has seen the new system successfully installed and commissioned on site in under four days. Initial indications are that the system is performing well. We anticipate future benefits will be to centrally manage our security and operating system updates.

In the next phase, the operating system will be trialled on three further units at the same compressor station. We will also develop a fully modular SCADA package along with type-approval for the system packages that will allow rapid rollout across our compressor fleet. If this phase is successful we'll then look to put in place and maintain a consistent platform across the whole fleet.

Collaborating across the industry

“By embracing collaboration we can find radically new ideas to transform our industry.”

Quentin Mabbutt
Innovation Delivery Manager

We’ve been working with colleagues, stakeholders and the wider gas industry to make the most of our projects and benefit everyone involved.

Collaboration is at the heart of Gas Transmission innovation. It allows us to branch out into wide-ranging innovation areas and develop a safe, reliable and efficient gas network for the future. We’re always on the lookout for new ways to

engage with colleagues, stakeholders and the wider gas industry. In the past 12 months, we’ve worked with new and existing partners to identify important opportunities for our Gas Network Innovation Strategy and to get the best from major projects, including:

Memberships

We continue to play an active role in several industry groups. We have a representative on the Pipeline Research Council International (PRCI), a community of global pipeline companies that collaborate on research that aligns with our industry’s priorities. Our membership means we can ensure energy is transported to consumers worldwide in a safe, reliable, cost-effective and greener way.

We’re members of the European Pipeline Research Group (EPRG), which carries

out and publishes research alongside other European pipe manufacturers and gas companies. By sharing results and recommendations with the wider gas industry, we can maximise benefits.

Another joint venture, called Risk Assessment Methodologies, gives us access to the latest best practice for managing safety risks on gas pipelines and Above Ground Installations (AGIs). Working with industry partners, we’re developing new ways to reduce risks for colleagues, customers and the public.



Two back-to-back bends with composite repairs applied over simulated corrosion patches, in preparation for fatigue testing.

Accelerating repairs on complex pipe features

Composite wrap repair systems – where a carbon-fibre fabric and resin are wrapped around a pipe and then cured and hardened – are effective as semi-permanent repairs on straight and bend sections of high-pressure steel pipework. We’ve teamed up with gas distribution networks SGN, Northern Gas Networks, Wales & West Utilities and Cadent, to explore whether we can extend the use of composite systems to more complex pipe geometries, such as branches or tees, and see whether they’re capable of being classed as permanent repairs.

We’re putting the systems through their paces across a range of areas, including pressure testing, long-term fatigue testing

for 150,000 cycles, material testing under accelerated conditions, and stiffness and flexibility studies on branches to see how these bonds stand up. If everything goes as we hope, we’ll be able to specify the areas where composite systems can be safely extended and make a decision on whether they can become a permanent repair.

By extending the use of these systems, we’ll be able to repair complex shapes much faster. For example, where a traditional epoxy repair on a tee could take up to four weeks, a composite repair could take as little as two days. This would significantly lower costs for the business and consumers.



Supplier Callen-Lenz with the Energy Innovation Centre and several of the partner networks.

Industrial and commercial gas quality

We're working with several gas distribution networks and the Institute of Gas Engineers and Managers (IGEM) to investigate the impact of changes to the Gas Safety (Management) Regulations (GS(M)R), particularly on industrial and commercial gas users.

One of the main activities over the past 12 months has been engagement with stakeholders through an industry-wide survey. We also held an Industrial and Commercial Stakeholder workshop, where people from the industry shared their concerns, challenges and priorities. Everything we've learned will be used to produce a roadmap for the roll-out of these changes to the GS(M)R.



Eye in the Sky

One of the latest collaboration projects, Eye in the Sky, has the potential to improve how drones are used in UK airspace. The project brings together the Department for Transport (DfT), through the Transport Systems Catapult (TSC) and the Civil Aviation Authority (CAA), alongside the gas and electricity networks to explore the use of drones to inspect network equipment, such as pipes and overhead lines.

This project will explore whether drone inspections can be carried out safely beyond the line of sight of the operator. Benefits for customers include lower costs and better safety and flexibility during inspections.



We exhibited our work at the 2017 LCNI conference.

AI for Pipeline Coating

We're using machine learning technology to classify corrosion on the NTS. This will transform pipeline inspections, improve the consistency of our results and help the business make smarter investment decisions.

We reached out to the gas distribution networks, through the Gas Innovation Governance Group (GIGG). As a result, Northern Gas Networks (NGN) and Wales & West Utilities (WWU) have come on board to provide the images we need to train the system's algorithm.

Working together to find a better way

“In the last 12 months we have pushed the boundaries, finding new ways to engage our colleagues, peers and the wider industry.”

Tom Neal
Innovation Governance Manager

Sharing knowledge, experience and lessons learned is vital to successful innovation.

Throughout the past year, we've been connecting with network licensees and the wider industry in a number of ways. These include exhibiting and presenting at the Low Carbon Networks and Innovation Conference (LCNI) 2017 and publishing key project updates through the Annual Summary. We've been making ourselves more visible and accessible in order to

get the most from knowledge sharing. For example, we hosted and took part in site visits and technology demonstrations with suppliers and colleagues. We've also broadened our reach by getting involved with cross-sector events such as Utility Week Live. This allows us to share ideas and capture new and innovative ideas across the wider industry.

Innovation Roundtable

We share our insights and experience with innovation professionals through the Innovation Roundtable. This series of events brings multinational businesses together to discuss innovation. Each event is hosted by a different business, sharing their approach to innovation. Highlights this year include building a collaborative innovation culture at Deutsche Telecom, supporting a fresh approach to disruptive innovation at 3M and embracing digital innovation at Volkswagen.

Engaging beyond our industry is vital to unlocking new opportunities for innovation that support our customers and the transition to a low-carbon energy future. The Roundtable provides unique insights into how other sectors and countries approach these challenges.



Sharing best practice beyond the gas industry

Valuable lessons we learned during two major innovation projects are helping improve safety across a range of industries.

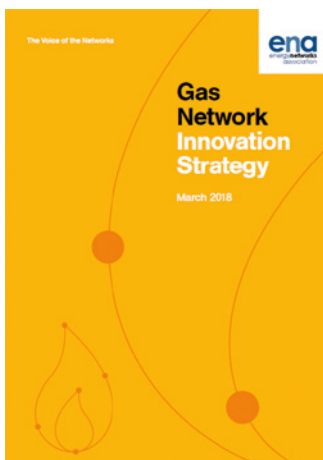
NIA_NGGT0024 and NIA_NGGT0057, which investigated the use of Building Information Modelling (BIM) techniques on the NTS, contributed to a new Publicly Available Specification (PAS1192:6) from the British Standards Institute (BSI). It's called *Specification for Collaborative Sharing and use of Structured Health and Safety Information using Building Information Modelling*. The technical authors of the PAS drew on NGGT experience and examples of innovation in writing the specification. These projects have already achieved around £4.5m

in cost savings for our business. It's rewarding to see that this new specification will allow the benefits of BIM to extend far beyond the gas industry.

We also made a significant contribution to a white paper published by the HSE. Improving Health and Safety Outcomes in Construction brings to life the real-world benefits of BIM through examples from across industry. Case studies from NGGT feature strongly in the report.

The HSE believes these case studies will encourage more construction businesses to consider the benefits of using BIM. This could help improve how assets are built and managed, and boost health and safety across the construction industry.





Gas Innovation Governance Group (GIGG)

The GIGG is coordinated by the Energy Networks Association (ENA) and gives us an important platform to collaborate with gas distribution networks Cadent, Wales & West Utilities, Northern Gas Networks and SGN. The group reached a significant milestone this year with the publication of the first Gas Network Innovation Strategy. Following a consultation with the wider industry, the document

highlights the most significant challenges and opportunities facing the GB gas transmission and distribution networks in terms of improving our efficiency and supporting the UK in decarbonising its energy system. It also sets out our joint strategic aims and the areas in which we're particularly keen to make progress over the next two years.

“The publication of the first joint Gas Network Innovation Strategies will ensure our network infrastructure, our wider energy system and our customers benefit from innovation.”

Matt Hindle
Head of Gas, Energy
Networks Association

Implementing innovation across the industry

We know that embedding innovation into our everyday business is key to maximising benefits for our customers. We believe we can create even more value by looking outside NGGT innovation to the successful projects carried out by the gas distribution networks.

By joining forces with them, we've created an Innovation Implementation Log. This is a concise record of innovations that are under way and can be easily shared in each network to promote and encourage the implementation of successful solutions. This is in the final stages of development and will be rolled out over the next year, extending the reach of innovation across each network and increasing the value for customers.



Value tracking

We've been tracking and measuring our innovations and projects for our customers.

4:1

return on innovation investment

£8.6m













value delivered to date

We're committed to creating the maximum value for our customers through innovation. To make that happen, we're continuing to embed successful innovations into our day-to-day business. Since publishing our first Embedding Innovation Value report last year, we've continued to improve how we track this value. We've honed our processes, expanded our library of project case studies and made it easier for people to find our latest value figures.

Several of the projects featured in our value case studies have been bringing more benefits to customers this year, and they'll

continue to do so in the years ahead. We've added new case studies to the collection, too, which you can read about on the opposite page. In addition, we've created an online library of case studies, which makes them more accessible for our stakeholders and shows the value each project has achieved in real time.

In the past year, we've also introduced a new category of case study which is focused on the lessons learnt and best practice, rather than financial saving. These case studies highlight the importance of driving value to our customers.

Project title	PEA cost	PEA benefits	Benefits realised	Benefit progress
 Impact protection slabs	£32k	Safety – cost avoidance	£483k	<div> <div>PEA</div> <div>Safety</div> <div>Realised</div> <div>£483k</div> </div>
 Vent stack design	£180k	£250k	£84k	<div> <div>PEA</div> <div>£250k</div> <div>Realised</div> <div>84k</div> </div>
 Safety in pig trap seals	£42k	£90k	£40k	<div> <div>PEA</div> <div>£90k</div> <div>Realised</div> <div>£40k</div> </div>
 A greener generation of air compressors	£175k	£50k	£434k	<div> <div>PEA</div> <div>£50k</div> <div>Realised</div> <div>£434k</div> </div>
 Customer ramp rate studies	£58k	£142k	£80k	<div> <div>PEA</div> <div>£142k</div> <div>Realised</div> <div>£80k</div> </div>
 BIM at Feeder 9	£202k	£1m	£885k	<div> <div>PEA</div> <div>£1m</div> <div>Realised</div> <div>£885k</div> </div>
 BIM at Bacton BIM at Peterborough and Huntingdon	£490k	£28m	£3.7m	<div> <div>PEA</div> <div>£28m</div> <div>Realised</div> <div>£3.7m</div> </div>
 Hot tap buried sample probe	£610k	£310k	£1.3m	<div> <div>PEA</div> <div>£310k</div> <div>Realised</div> <div>£1.3m</div> </div>
 Improving CP data with MiniLog	£20k	£186k	£144k	<div> <div>PEA</div> <div>£186k</div> <div>Realised</div> <div>£144k</div> </div>
 Portable Valve Actuation	£97k	£340k	£640k	<div> <div>PEA</div> <div>£340k</div> <div>Realised</div> <div>£640k</div> </div>
 Mini-Grouted Tee	£147k	£15m	£817k	<div> <div>PEA</div> <div>£15m</div> <div>Realised</div> <div>£817k</div> </div>
 CP for pipelines in a tunnel	£32k	£265k	Safety	<div> <div>PEA</div> <div>£265k</div> <div>Realised</div> <div>Safety</div> </div>
Value case studies total	£2.1m	£45.6m	£8.6m	

All PEA costs and PEA benefits are nominal and for NGGT only and have been taken from the Project Eligibility Assessment (PEA). The documents can be found [here](#).

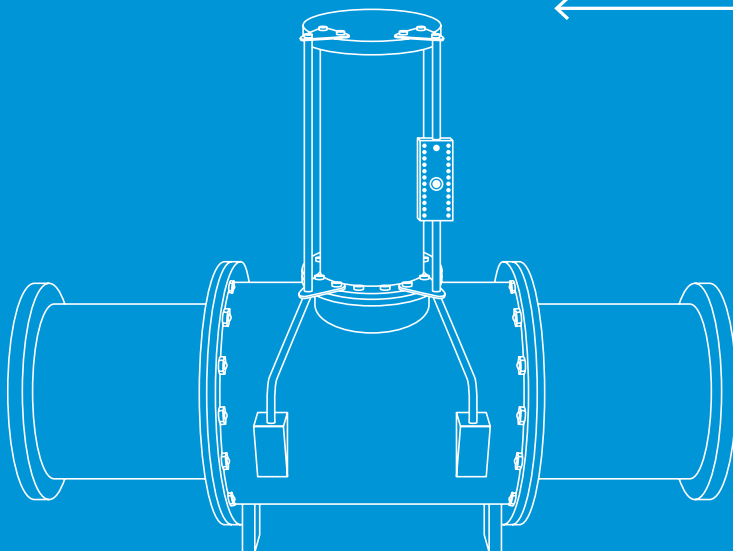
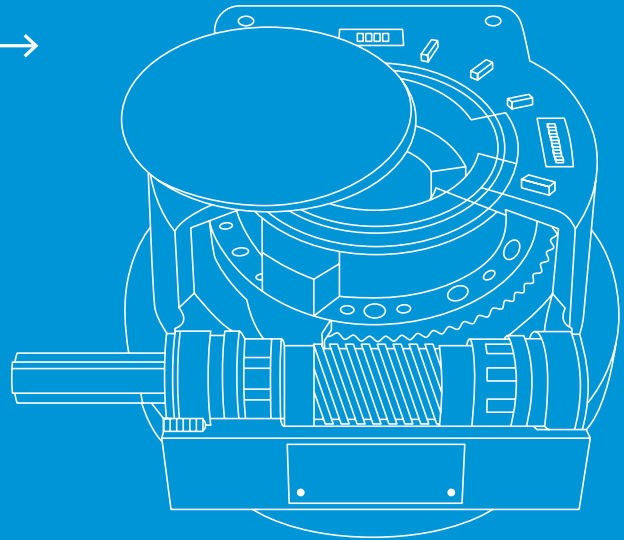
Value in action: case studies

Valve Actuation

A recent NIA project showed that switching to high-efficiency gearboxes could significantly reduce the time and cost of inspecting and repairing non-critical valves on the NTS.

High-efficiency gearboxes allow valves to be operated manually, so the flow of gas can be controlled within the pipeline. These gearboxes significantly reduce the turns required to operate the valve, making them faster and easier to use than traditional gearboxes.

They're also considerably cheaper to buy and install; 16 high-efficiency gearboxes have been installed so far on the NTS, saving a total of £640k. With more gearboxes planned to be installed in the future, these cost savings will continue to grow.



Mini Grouted Tee

Corrosion can occur on valves for a number of reasons, such as their location, age and environmental factors. In the past, when no viable repair solution existed, the valve would need to be removed and replaced. This is expensive, takes several months and has an environmental and safety impact.

The Valve Sealant Line Grouted Tee (Mini Grouted Tee) was developed to allow corroded valves to be repaired while the gas in the pipeline stayed live. This innovative technique was used for the first time on three valves at Kings Lynn Tee, resulting in savings of more than £800k and 1,500 tonnes of CO₂.

The solution also avoids disruption for customers, as repairs can be carried out without taking the pipe out of service.

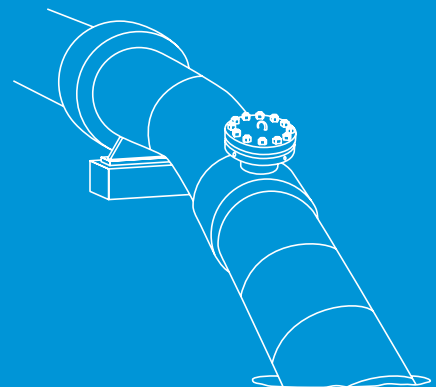
CP for Pipelines within a tunnel

Cathodic Protection (CP) is used on the NTS to protect pipelines from corrosion. This technique allows an electrical current to flow through the pipeline – and to and from the ground bed or sacrificial nodes (easily eroded sacrificial metal) – which prevents the pipe from corroding.

Most tunnels on the NTS are filled with grout or another solid material, but some are water-filled. Making sure that CP is effective on pipes in these tunnels can be

complex and challenging.

An NIA project identified a number of design solutions for pipelines in flooded tunnels that would cut the cost of procurement and construction, provide better protection for the pipeline during its lifecycle, and potentially reduce design requirements. What we've learned will be central to future tunnel projects and ensure that the best solutions are used at a lower cost to the consumer.



To read the full list of case studies, [click here](#).

List of projects: NGGT Lead

We had 39 innovation projects running in 2017/18. To learn more about the projects, click the title to be taken to the ENA smarter networks portal.

Project Reference	Registered Title
NIA_NGGT0035	Investigation of Flow Physics in Gas Pipe Network
NIA_NGGT0049	Investigation into the use of Constrained-Layer Damping
NIA_NGGT0051	Wireless Gas Detection Assessment
NIA_NGGT0063	Investigation into Novel Robotics Locomotion Techniques
NIA_NGGT0067	Sensitivity and Specificity of Stress Concentration Tomography – I CASE award
NIA_NGGT0074	Next Generation Predictive Emission Monitoring Validation (PEMS)
NIA_NGGT0084	Valve Sealant Line Grouted Tee
NIA_NGGT0086	Mathematical Baseline and Error Detection Techniques for the Analysis of Unaccounted for Gas (UAG)
NIA_NGGT0091	Installation Risk and Technology Assessment Model
NIA_NGGT0094	Gas Quality 2020
NIA_NGGT0096	Seam Weld Identification
NIA_NGGT0097	Permanent PE Slab Protection
NIA_NGGT0098	Composite Pipe Supports Phase 2
NIA_NGGT0099	Gas Transmission Network Output Methodology Analytics
NIA_NGGT0102	Acoustic Resonance Technology (ART)
NIA_NGGT0103	Artificial Intelligence for Pipe Coating Inspection
NIA_NGGT0104	Cognitive Technology for Technical Standards
NIA_NGGT0107	Extreme Value Analysis
NIA_NGGT0108	Combined CP and P Remote Monitoring
NIA_NGGT0109	Epoxy Grout Investigation and Analysis
NIA_NGGT0110	Advanced Manufacturing (3D Printing) of NTS Ready Components
NIA_NGGT0111	Aerial Imaging Research
NIA_NGGT0112	Noise Mitigation Tool
NIA_NGGT0113	Induction Heating
NIA_NGGT0114	Open Source SCADA Platform
NIA_NGGT0115	Valve Care Toolbox
NIA_NGGT0116	LiDAR to Support NTS Pipeline Management
NIA_NGGT0117	NDT of Welds by Ultrasonic Techniques
NIA_NGGT0118	Compressor Data Analytics
NIA_NGGT0119	PRCI Pipeline Research Council International 2017
NIA_NGGT0120	European Pipeline Research Group 2017
NIA_NGGT0121	Risk Assessment Methodologies for Pipelines and AGIs 2017
NIA_NGGT0122	EMAT – In-Line Coating Disbondment Detection Assessment
NIA_NGGT0123	RUL Determination for Compressors 2
NIA_NGGT0125	Intelligent P&IDs from 3D Models

List of projects: NGGT Participation

Project Reference	Registered Title
NIA_SGN0092	Pit Protect
NIA_SGN0113	Gas Quality Impacts on Industrial and Commercial Applications
NIA_NGGD0094	Composite Repairs to Complex Shapes
NIA_WWU_045	Eye in the Sky



Get in touch



If you'd like to be added to our mailing list, or have a question or idea you'd like to discuss, get in touch by emailing box.GT.innovation@nationalgrid.com



Or find us on social media: [LinkedIn](#), [Twitter](#) and [Facebook](#)

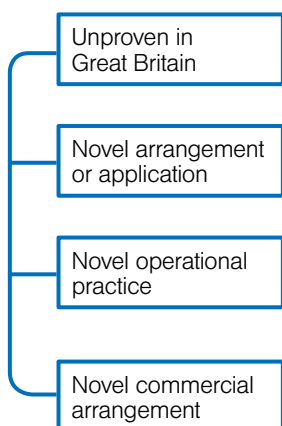


www.nationalgrid.com/gasinnovation

How to get involved in NGGT innovation

There are two types of funding available, which are designed to stimulate innovation across the gas industry as part of the RII0-T1 price control. The Network Innovation Allowance (NIA) provides an agreed annual amount to fund smaller-scale projects. The Network Innovation Competition (NIC), meanwhile, sees network companies compete for funding for large-scale projects that support a lower carbon future for the UK.

Projects funded under NIA and NIC should be at least one of the following:



Network Innovation Allowance (NIA)

NIA funding is accessible throughout the year, providing opportunities to develop innovation programmes across the gas industry. Drivers for the NIA are:

- **Research and Development** – Encouraging operational and technological innovation.
- **Collaboration and Dissemination** – Working with external partners to solve problems and sharing new learning.
- **Customers and Strategy** – Focusing on solutions that deliver direct financial value to our customers.

Projects under the NIA are required to satisfy the following criteria:

- £ Demonstrate customer value.
- Directly impact the gas network.
- Share learning and intellectual property.
- Avoid duplication.

Network Innovation Competition (NIC)

NIC is an annual competition to fund flagship innovative projects that can deliver financial and environmental benefits for gas customers. There is a fund of £20m available each year to Gas Transmission and Distribution networks.

To secure funding, projects should:

- Accelerate the development of a low-carbon energy sector and/or deliver environmental benefits.
- £ Deliver value for money for gas customers.
- Create knowledge that can be shared across energy networks in Great Britain (GB) or create opportunities for roll-out across a significant proportion of GB networks.
- Be innovative (i.e. not business as usual) and have an unproven business case where the risk surrounding the innovation warrants a project to demonstrate its effectiveness.

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