

The Annual Network Innovation Allowance Report



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Innovation at the heart of all we do

Innovation might be a core part of our regulatory obligation, but at NGN the desire to truly make a difference goes so much further than ticking boxes.

We are not a company that likes to stand still, which can be evidenced through the huge and ongoing improvements in customer service, safety, engineering best practice, education and sustainability already achieved since the start of RIIO-GD1.

Our Inspire Academy was set up in 2013 with the aim of leveraging the enormous combined knowledge and creativity of everyone in the business. Individuals are actively encouraged to flag up issues and identify potential business improvements, which then results in a challenge being issued to the rest of the business to volunteer their help in developing innovative solutions.

This approach has ignited a renewed passion from employees to get involved because they feel empowered to make a difference. At the present time, 42% of our workforce of 1500 is or has been involved in an Inspire initiative.

Leveraging the skills and talents of the wider internal and external community is very much the approach employed by NGN's innovations team. By keeping the core innovations team lean and drafting in help from specialist colleagues, we ensure more resource is available to fund the projects themselves. We also continue to support the Inspire ethos of giving everyone the chance to develop their skillset and experience through becoming involved with ground-breaking projects.

We are also very grateful for the ongoing support and expertise provided by our expert partners at the Energy Innovation Centre (EIC) whose pioneering work is revolutionising the utilities industry.

At NGN everything we do is focused on innovating to make our industry safer, more customer-focused, more environmentally sound and ensuring value for money for our customers - but if we gain some personal development along the way then it's a bonus.

Within this document, we highlight the key developments, learnings and opportunities presented by six key projects that represent the key focus areas of our innovations strategy, namely safety, environment, asset and network management, customer service, value for money and the future role for gas.



Further information for these and all our other projects can be found at <http://www.smarternetworks.org/>

Mark Forsley

Chief Executive Officer, Northern Gas Networks

Significant New Learning

The first year of the Network Innovation Allowance (NIA) has supported the massive positive shift in NGN's culture and employee engagement. Building on the work done within our Inspire Academy to encourage individual responsibility and ownership, everyone is now actively looking for ways to improve the customer experience by the use of innovation.

Equally valuable are the new partnerships we are developing with innovative suppliers, SMEs and academics, which is introducing NGN to unprecedented levels of new knowledge and expertise.

Our Young Persons' Network came up with the innovative idea that we should use smart technology to make it easier for people to share their own innovative ideas! So, working in collaboration with the Energy Innovation Centre, we have successfully developed and rolled out a 'Suggestion Scheme' app. Now people ideas come straight to the innovations team's inbox for our immediate attention and can be shared with our partners and actioned in an efficient and timely manner. After making a few modifications, it's intended the app will be rolled out to other GDNs later this year.

Despite the notable successes above and those highlighted in the rest of this document, the first year has not been without its challenges. We've come up against a number of hurdles, but finding innovative solutions to these will ensure we do things even better next year:

Implementation – adoption and implementation of successful innovation projects into effective business as usual solutions remains a key challenge. Acceptance of new equipment, techniques, working practices and commercial arrangements needs to address cultural and embedded processes if to deliver their full potential.

Collaboration – we've realised the importance of leveraging the skills of our colleagues at other GDNs and industry associations, but we've also set up a cross utility collaboration forum working with utility companies from across our region including Yorkshire Water, Northern Power Grid and Northumbrian Water, to explore transferable technology and experiences. We're currently looking at how we all respond to emergency situations so we can develop a resilience best practice process, for example.

Competitive Tendering – a key benefit of the NIA is being able to more readily access the innovations being delivered by SME organisations that wouldn't normally be on our radar. Ensuring that our internal processes can respond to requirements of these organisations whilst ensuring full compliance with all legislation is key to ensuring an efficient route to market for these projects. We are exploring ways of making things work, but there are still areas that we need to address as an industry if we're going to be able reap the full rewards from the scheme and support our SME innovations partners.

Impact of standards – with little innovation having taken place in our industry over the past 25 years, it has been challenging to trial new technology on the network when there are no policies in place and even more challenging when we've needed to amend a pre-existing procedure.



"NGN has completely embraced the true ethos of innovation. They understand that to drive innovation, you need to sometimes take a calculated risk and try something completely different, because if you strip out all the risk you also remove the potential for substantial positive change."

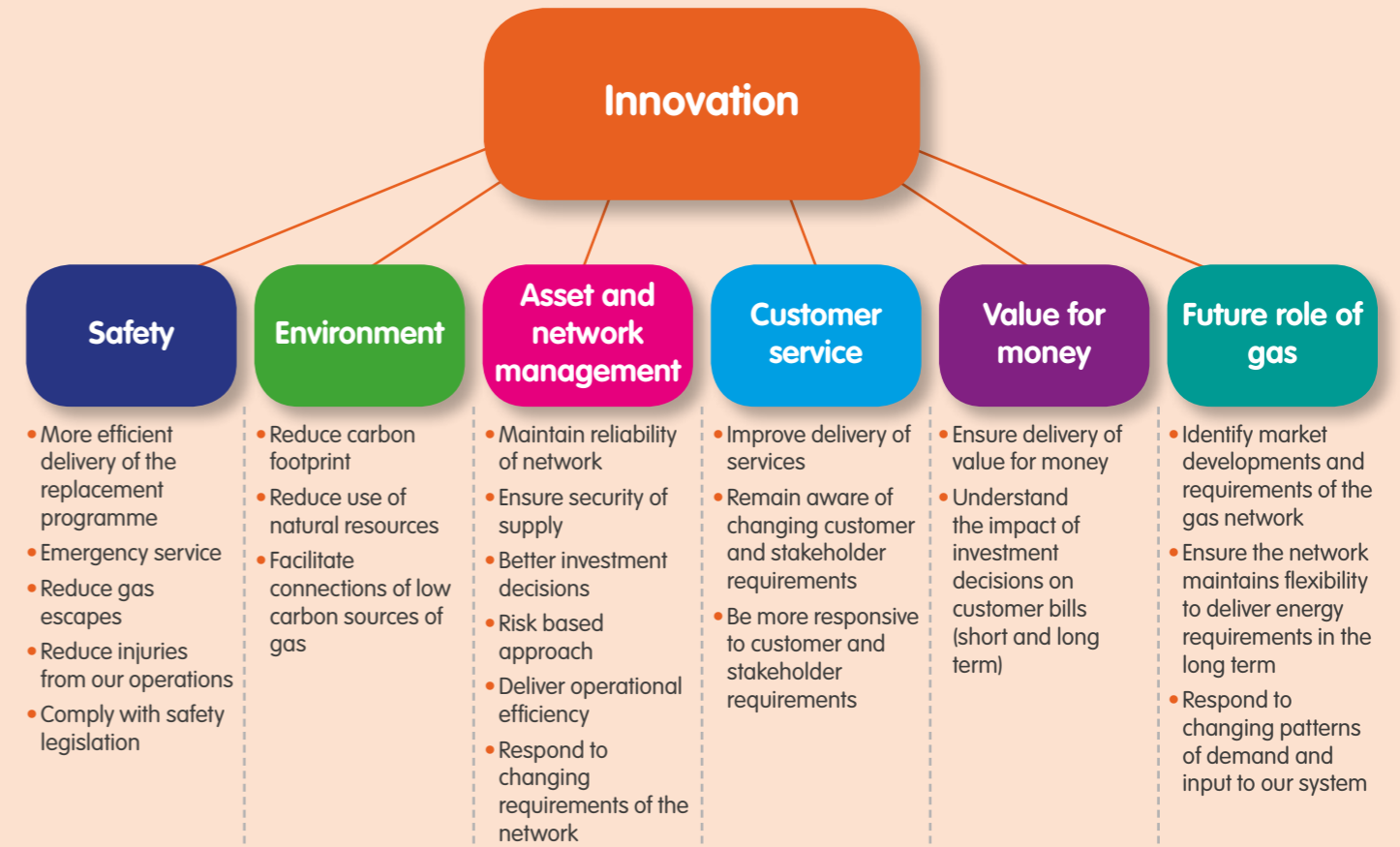
"What's also refreshing is that, at all levels of the business, people are empowered and encouraged to challenge established ways of doing things. As a result, NGN people are passionate, full of energy and enthusiasm and a joy to work with."

"When comes to exploring initiatives that really challenge established mindsets, if anyone will embrace a big idea, it's NGN."

Denise Massey, Managing Director, Energy Innovation Centre



NGN's Innovation Focus Areas



Safety

Remote Water Removal System



Water ingress into gas mains is one of the biggest problems faced by GDNs, resulting in hundreds of supply interruptions every year, compromising the safety of both customers and operatives and tying up significant resource.

Historically, within NGN and many of our co-GDNs, dealing with water ingress has been reactive. Although some work has been done recently to identify and replace our 100 worst offending 'wet mains', not much is known or recorded about the number and spread of incidents, the amount of water typically removed, and the causes of individual incidents.

Although we might like to plan ahead, the dated equipment and techniques available to us have limited our ability to proactively identify problem areas. We usually only know there's a problem when it's affecting supply. Finding the precise location of the ingress is another imprecise art and often results in huge excavations, to the risk and displeasure of customers, the Highways Authority and our operations teams.

Registered with Ofgem in October 2013, this two-stage project seeks to find a solution to these long-standing issues by:

- Identifying the causes of ingress by accessing local weather and flood data, mains replacement data and geographic locations to determine how water is entering the network
- Developing bespoke technology that not only visually locates the source of the leak, but then also extracts the water in one operation, with no need to turn off the gas supply

How?

NGN has contracted Synthotech Ltd, a SME that provides turnkey innovations products and specialises in developing pipework engineering solutions for utility businesses worldwide.

This appointment was made on the back of a revolutionary solution they developed for a gas distribution client in Brazil which combines a CCTV camera with an in built water extraction device. The camera/extraction technology not only separates gas from water, but can also inject the gas back into the main, reducing environmental impact and ensuring that customers are not given cause to worry because they can smell gas.

However, the solution developed for the Brazilian gas network uses a different access system, is designed for different pipes and operates at far higher pressures (5 Barg) than the UK network, so significant modifications are required, such as altering the gas injection system to operate at a lower pressure differential.

In developing a proposed solution, Synthotech is:

Stage 1 - Defining the level of the water ingress problem – Completed

This has seen Synthotech & MACAW working with NGN teams in Middlesbrough and Hull to understand NGN's current water management processes:

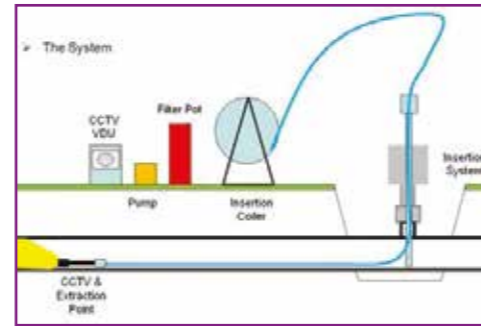
- testing pre-existing and potential new technologies
- compiling a detailed report on the root causes, behaviours and current solutions employed by NGN to tackle water ingress
- preparing a business case around the benefits of developing the CCTV Water Extraction System
- looking at ways to incorporate existing best-practice into the proposed solution
- developing prototype technologies

Stage 2 – Field trials – Autumn/Winter 2014

Synthotech is developing two prototypes, one for mains and one for services. The mains system combines a camera and extraction system and the service system is based on a separate camera (ServiceCam™) and battery powered basic pump device.

These two solutions will be tested side by side when the wetter weather returns, as well as programme of detailed desk research that will review rainfall, flood data and ground conditions across the NGN network to more precisely identify the causes of water ingress.

This will enable Synthotech to put forward a firm, fully researched and costed proposal for the most effective way ahead.



Innovation?

Synthotech's combined camera/extraction technology not only separates gas from water, but can also inject it back into the main, reducing environmental impact and ensuring that customers don't experience anxiety because they can smell gas.

All water will be removed under live gas conditions.

The camera technology Synthotech has specifically developed for services is very new, allowing engineers to identify problems. Using this in combination with an extraction system will ensure that the location, volume and potential cause of the water ingress can be identified.

In conducting its Stage 1 research, Synthotech uncovered some great examples of innovative solutions being deployed by NGN engineers on a local level and they are looking to build these into their final solution.

“NGN has acknowledged that in the 21st Century there needs to be improvements in water management. Water ingress causes major disruption and NGN is taking a very proactive approach to not just removing the water but identifying how and why it is entering the network. In partnership with Synthotech, they are supporting the development of a total network solution for water management,”

Wez Little, Innovations Director, Synthotech.

Environment

Orifice Plate Deformation

Why?

Orifice Plate meters used widely across the National Transmission Systems (NTS), are based on old technology and, within NGN's network there are individual units that require frequent recalibration.

Developed as a general means of monitoring rates of gas flow from the NTS to Local Distribution Zones (LDZs), the significance of the accuracy of the outputs of these meters increased when flow-rated average billing was introduced in 1995. Since then it has become apparent that this type of meter does not always provide the accuracy and consistency of data required to determine what customers should pay; often GDNs have to make assumptions.

In order to comply with the orifice plate metering standard, ISO 5167, the plates need to satisfy numerous criteria such as flatness, edge squareness, surface finish, thickness of size of orifice bore and bevel angle. When used at the pressures for which they were designed (up to 1000 mbar) the meters deflect and deform elastically and remain compliant, but higher pressures may cause permanent deformation, which affects the accuracy of the reading to the point it no longer conforms to the standard.

With the historic equations used to predict orifice plate deformation called into question, this project seeks to clarify the current scope of use of these meters, the degree of permanent deformation and resulting inaccuracies, and to develop a new worldwide standard for testing them.

How?

NGN is collaborating with the project originators, National Grid Gas Distribution (NGGD) which had already implemented Stage 1 of the project, involving a review of existing research, assumptions, literature, software and orifice plates at offtakes from the NTS. This stage also involved selecting a worse case orifice plate for further study.

Stage 2 – In March 2013 NGN joined NGGD, National Grid Gas Transmission (NGUKT) and Scotia Gas Networks to successfully model the deformation of the plate selected in Stage 1 by using a combination of Computation Fluid Dynamics (CFD), Finite Element Analysis (FEA) and manual data handoff.

Standout findings

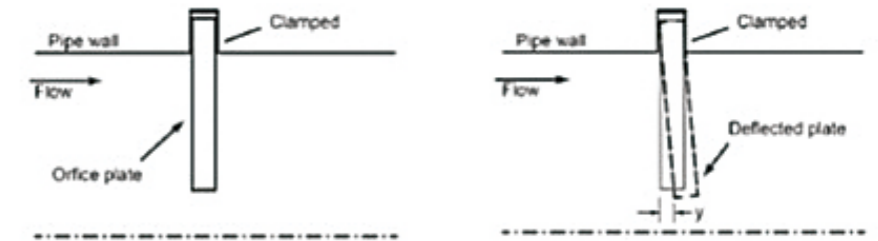
The outputs of Stage 2 have surprised everyone in that they are so far removed from the results anticipated that we are now recalibrating our approach to developing a robust assessment methodology.

Given the high cost of developing and implementing a practical methodology, it has been agreed that Stage 3 will consist of further theoretical analysis of a wider range of plate sizes, beta ratios, mounting types and bevels which it is hoped will lead to the development of a robust methodology for orifice plate deformation assessment.

Future potential

The project partners remain committed and confident that we can develop a more effective standard and we are working towards sharing this with the wider world at the 2015 North Sea Flow Management Workshop.

Ultimately, we hope this will result in renewed credibility for UK gas distribution and an all-round more reliable framework for the entire gas industry.



Asset & Network Management

Biomethane Connections Guidelines

Why?

In 2013, NGN consulted with farmers, local authorities, commercial and industry waste organisations and water companies to generate the first ever regional study into the size of the market.

The study's headline conclusion was that there are hundreds of opportunities for commercially viable biomethane plants in the North of England.

But there are currently no guidelines for GDNs or potential producers outlining how to get a connection and how this should be managed once it's in place.

This initiative is designed to deliver against our asset and network management objectives of ensuring the security of supply and responding to the changing requirements of the network.

How?

NGN and Northumbrian Water (NWL) regularly collaborate on initiatives ranging from safety to customer service. For this project, we have focussed on developing a set of connections guidelines based around best-practice methodologies tried and tested whilst working towards connecting the water company's Howden waste water treatment plant to the network.

A specialist Biomethane consultant was brought in to provide the required technical expertise and help NGN/NWL document the steps producers need to take to get connected, covering everything they need to know from types of connection to gas odourisation and quality control, for example.

A draft user guide has been produced and it is hoped that both the Howden Biomethane project and the guide will go live in November 2014.

Innovation?

The project has identified two potential connections routes:

- **Minimum connection** – this option allows producers to source their own equipment, oversee construction and commission their connection before handing over the management of the connection to NGN
- **Maximum connection** – this option involves NGN managing the whole process

Howden is set to become the one of the UK's first 'dirty water' sites to be connected to the gas network and the learning generated by this exercise will make it far quicker and simpler for not just water companies, but all other producers to get connected in the future.

This project is being run concurrently with a similar initiative being undertaken by sister organisation Wales and West Utilities with Bristol Water and the sharing of expertise between all parties has provided invaluable insight.

Future potential

NGN will use this research to open up the market by making it clear to new entrants what's required and what it will cost.



Cured-In-Place (CIP) Liners

Why?

In the UK, replacement of gas mains is currently only allowed using plastic or steel pipes. But is this always the best and most-cost effective solution?

Twenty years ago, instead of automatically replacing damaged pipes, Cured-In-Place (CIP) liners were sometimes used as an alternative to conventional replacement techniques to prevent leakage from faulty joints. The technique involves lining a host pipe with a flexible tube impregnated with a thermosetting resin, which is then cured to produce a tough pipe lining.

This practice has endured and developed technologically elsewhere in the world and continues to be used within the UK water industry, but has fallen out of favour with the gas industry.

The first CIP liner was installed in 1971 and since then more than 50,000km has been installed worldwide using a variety of different systems and suitable for a wide range of pressure and non-pressure applications.

Under the current RIIO-GD1 framework, there is not as much funding available to replace larger diameter pipes as there is for smaller diameter pipes. This means that GDNs have to find innovative new solutions to overcome these constraints.

It's time for the UK gas industry to reconsider a tried and tested alternative to its PE/steel pipe replacement programme.

How?

NGN is working as part of a group of all of the UK's GDNs on a two-stage project to assess whether re-adopting CIP liners is viable for the UK gas distribution industry.

The project is being managed by WRC, a specialist external consultancy with expertise of the use of CIP liners in the UK water industry and worldwide best practice within CIP liner production and application.



This involves

Stage 1 – Looking at the worldwide market for CIP liner technology and develop a recommendation for which approach/es would best suit the UK

Stage 2 – Conducting in-depth field trials to test suitability of the chosen technologies, with a view to working towards re-introducing the use of CIPs as a refurbishment and replacement alternative

NGN has completed its Stage 1 activities and conducted a Stage 2 trial of different technologies at Stockton on Tees during February and March 2014. A lot of learning was gained during the NGN trial and this had been fed back into the wider project group and supply chain. The results of the other GDN trials are outstanding, but NGN's learnings will help inform next steps.

Future potential

Other Stage 2 activity will see the group undertaking further long-term testing, preparing a list of audited CIP liners that are fit for purpose and producing a final CIP performance specification/best practice guide.

All parties, including WRC, the project steering group and technical advisory group are confident that the delivery of their final project report towards the end of 2014 will support the reintroduction of CIP technology as a less disruptive and potentially much more cost-effective alternative to out and out replacement of faulty pipes.

Beyond the Visual Line of Sight

Why?

Fortnightly helicopter surveys of our entire high pressure network (an area of 25,000km² containing 1200km of pipelines) are time consuming, costly and not environmentally friendly and we are committed to finding a better way of keeping our eye on things.

We have seen other industries making use of unmanned surveillance technologies and we wanted to explore the relevance of this for the utilities sector.



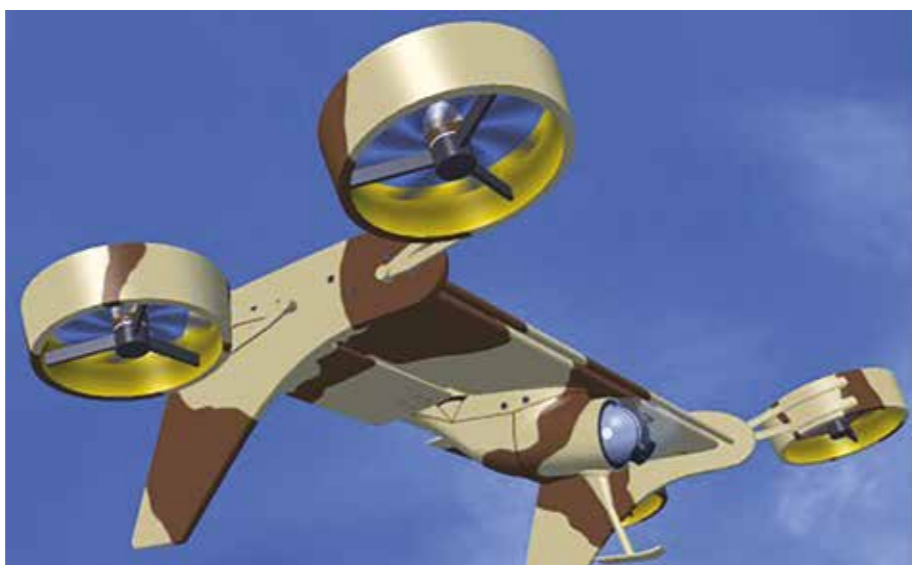
1200km

OF PIPELINES

How?

We were approached by VTOL (Virtual Take Off and Landing) Ltd who had experience in this area, but had not worked within the utilities sector before, so we commissioned them to come up with a business case for NGN adopting a form of Beyond the Visual Line of Sight (BVLOS) unmanned inspection technology.

Stage 1 of this project has been a data gathering exercise that came to an end in July 2014. This will inform the Stage 2 development of a business case for NGN to adopt the technology including the building of a computer generated simulation and undertaking a cost/benefit analysis that will allow us to make an informed decision.



If viable, Stage 3 of the project will see VTOL developing a bespoke specification for NGN that we can handover to the Civil Aviation Authority for sign off in principle. This would, in turn, enable us to make an informed decision about whether or not to move forward with Stage 4 (development of a prototype) and Stage 5 (securing firm CAA approvals and introducing the working technology into service), working towards a potential go-live date of mid 2017.

Further information can be found at:

<http://www.smarternetworks.org/Project.aspx?ProjectID=1470>



Innovation?

NGN is working alongside Scotia Gas Networks and electricity distribution networks, where VTOL is conducting a parallel project and comparing and contrasting our work has provided some invaluable insights.

Customer Service

Predictive Analytics

Why?

Predictive analytics is an advanced forecasting process that, over the past ten to 15 years, has become widely and successfully used within finance, retail and emergency services organisations to optimise output performance, customer experience and resource management. It works by close analysis of large amounts of data to signpost likely future scenarios so that they can be planned for/prevented or influenced as required.

But can it be successfully used to inform decisions and resource within the gas distribution industry?



How?

The project kicked off with a proof of concept trial in 2012/13, which saw NGN building a trial model that was compared against real data. The trial was a huge success, with an accuracy level of 83% in predicting the probability of a reported gas escape and 96% accuracy in predicting the probability that we would be at risk of failing to attend an escape within the required timescales.

NGN identified that it needed to take a structured approach in order to learn about Predictive Analytics and the opportunities it could offer. In June 2013, Predictive Analytics was aligned under Tony Pearson (NGN's Head of Planning & Data Analysis) to delve deeper into how the science could benefit the gas distribution environment.

Six key business areas were selected for further analysis including asset management, operational delivery, investment efficiency and customer impact.

In February 2014 Tony appointed two very different organisations to intensively investigate each of the six areas to determine data availability and suitability for a range of analytical situations. One is an academic-based team who use frontier machine-learning techniques and numerical analysis, whereas the other uses sophisticated commercially available software platforms.

Both seek to test, identify and understand relationships between datasets and use these to develop models that can then be used as an aid to decision-making.

The outputs of this work are anticipated soon. The next stages of the project (2014-2016) will include maximising the learning from developing Analytical models and solutions, delivering these into the business and sharing the learning from this. In parallel, a business case is being developed to permanently adopt Analytics as a "business as usual" approach across the organisation.

83%

accuracy level

Innovation

Based on learnings thus far, NGN is optimistic that Predictive Analytics will deliver real value to our business. Our end goal is to be able to embed the process into our business and prove its effectiveness before sharing this learning with other GDNs and infrastructure businesses.

Value for Money

Acoustic Camera & Core n Vac

Why?

Over 40% of the total cost and by far the most disruptive element of our repair activities is reinstatement and we knew this could be dramatically reduced.

Although coring (Core n Vac) technology is not new to the gas industry as a method of exposing leaking gas mains, it had not been fully proven across all repair techniques. Meanwhile, quickly and accurately locating the leak in the first place remained an issue.

We already knew that a core reinstatement costs around £40, while a traditional reinstatement costs several hundred pounds, so were obviously keen for the business to adopt the technology as business as usual.

However, we also wanted to prepare a business case for adding further value by enhancing Core N Vac with smart leak detection technology.

Specifically, we were looking to prove that:

- combining accurate leakage location with coring could further reduce the time spent pinpointing leaks (by up to 33%)
- this combined approach could reduce the number of long duration jobs on the escape log by 57%
- deploying specialist location skills on difficult to locate leaks would allow repair teams to focus on emergency customers' critical repairs
- there was a noticeable reduction of negative impact on highways
- levels of customer satisfaction would increase

How?

NGN drafted in specialist external expertise to look at the impact combining Minimal Excavation (Core n Vac) techniques with accurate detection.

In line with this, new Visual & Acoustic Leakage Detection technology was trialled alongside Core n Vac for a twelve-week period during early 2014, during which time 100 jobs were completed. As part of the trial, after the core is removed from the vicinity of the leak, a detection device was introduced into the pipe. The device uses a camera to locate joints, while an integrated hydrophone then 'listens' for sounds that might indicate a leak.

Innovation?

The trial has been a resounding success on a number of levels (time spend pinpointing leaks reduced by 50% the number of long duration jobs has reduced by 12% and the percentage of jobs completed first time rose to 30% and we are currently preparing a detailed business case for presentation to the business, other utility businesses and local authority stakeholders.



OVER 40% COST is reinstatement

Future role of gas

Development of Standards for Biogas, Biomethane and Shale Gas

Why?

With NGN and others working towards connecting their first biogas producers later this year, IGEM (Institute of Gas Engineers & Managers) asked GDNs (including NGN) to help develop new standards and guidance documents designed to regulate the quality of gas that will be injected into the system and spell out safe injection practices.

How?

Working together, IGEM, NGN, Wales and West Utilities, Scotia Gas Networks and National Grid Gas Distribution are producing three documents designed to remove barriers by explaining the legislative requirements and required standards surrounding biogas gathering pipelines and biomethane injection into the gas distribution network, as well as developing a separate guidance document relating to the safe and reliable collection of onshore shale gas:

- IGEM/TD/16 – standard for biomethane injection into the gas distribution network
- IGEM/TD/17 – standard for biogas pipelines
- IGEM/G/101 – guidance document

Production of these documents is ongoing with a view to them being signed off for autumn 2014.

Innovation?

The development of the Standards and Guidance documents will provide a common understanding and set of requirements for the gas industry, as well as providing reference material for the waste industry, renewable industry and commercial developers.



Northern Gas Networks

