Gas Network Innovation Competition 2014
Report and Recommendations

Prepared for
The Gas & Electricity Markets Authority

By

Gas Network Innovation Competition Expert Panel

November 2014

1 Introduction

1.1 This report is prepared by the Gas Network Innovation Competition (NIC) Expert Panel (the Panel) and sets out the Panel's recommendations to the Gas and Electricity Markets Authority on the portfolio of projects to be funded in the 2014 funding round. The members of the Expert Panel are as follows:

- **Ron Chapman**
- **Sharon Darcy**
- **Miriam Greenwood OBE DL (Chair)**
- **Prof. David Newbery**
- **Sean Sutcliffe**

1.2 We received two submissions. Full details of each submission will be available on the Ofgem website. The names of the companies, titles of the submissions and the amount requested from the Gas NIC are as follows (the values in brackets indicate the total cost of the projects).

- **T-Shale - Northern Gas Networks Ltd - £5,617k requested (£6,241k in total)**
- **In Line Robotic Inspection of High Pressure Installations - National Grid Gas Transmission - £5,675k requested (£6,305k in total)**

1.3 The Panel followed the evaluation process set out in the Gas NIC Governance Document version 1 (1st February 2013). Initial submissions were received by Ofgem and were screened by Ofgem staff for compliance with the requirements set out for the

Initial Screening Process. Consultants were appointed by Ofgem to review the submissions (the consultants' reports will be published in full). The Panel met the Network Licensees (NLs) early in the evaluation process to allow the project teams to present their submissions. During the period up to the completion of the consultants' reports and prior to the second NL meeting, the consultants and the Panel sent each of the NLs a number of questions with the purpose of clarifying the submissions and highlighting areas of concern.

Following those meetings, the Panel met to review each of the submissions in the context of the criteria set out in the Governance Document. In evaluating the submissions, the Panel took into account all of the documents which had been made available: the submissions, their appendices, the consultant's reports as well as any additional information which had been submitted via Ofgem or the consultants from the NLs. They also took account of information from meetings which were held with the NLs and any material provided during those meetings. Based on this evaluation, the Panel reviewed the projects against the criteria. This report sets out the Panel's recommendations to the Authority.

1.4 This report should be read together with the consultant's reports, the NLs' submissions and the other information that is published concurrently with it on the Ofgem website. This report sets out the results of the Panel's deliberations and its recommendations to the Authority. As such it is primarily concerned with the views of the Panel. All the details of the projects and the technical evaluations undertaken by the consultants are contained in the other published documents.

2 Evaluation Criteria

2.1 The criteria that the Panel is required to take into account in the evaluation process are set out in the Gas NIC Governance Document.

In this section we list the evaluation criteria and briefly discuss a number of points which arose during the evaluation process and which provide some context to the evaluation of the projects described in the following section. A full description of the criteria is set out in the Governance Document.

2.2 (a) Accelerates the development of a low carbon energy sector and/or delivers environmental benefits whilst having the potential to deliver net financial benefits to future and/or existing customers.

The NL was required to demonstrate that the project has the potential to deliver net financial benefits to existing and/or future customers. In addition, the NL needed to demonstrate that the proposed project solution has the potential to accelerate the development of the low carbon energy sector, or deliver wider environmental benefits to customers, or deliver a combination of both.

Whilst the Panel recognizes that the low carbon criterion may be more difficult to satisfy in gas than in electricity, nevertheless, it is an important criterion and the Panel felt that more consideration of the capacity of projects to deliver low carbon and/or environmental benefits is required.

2.3 (b) Provides value for money to gas customers.

The NIC is focused on projects which can deliver benefits and resultant learning applicable to the gas transportation system, and takes into account the level of funding requested. Projects which minimised the cost of demonstrating this and maximised the value of the learning gained were ranked highly against this criterion.

The Panel noted that the NLs had taken on board more learning from prior Gas NIC, Electricity NIC and Low Carbon Networks Fund (LCNF) funded projects. However, it considered there was still more scope for companies to use Network Innovation Allowance (NIA) funding to develop projects to a point where they would be more suitable for NIC funding.

The Panel did not see much evidence of genuinely competitive tendering within the projects. It is recognised that where there is a consortium of partners, each bringing innovative thinking, this is not always appropriate. However, suppliers' rates should always be compared with the market rates.

The NLs should also demonstrate that the value of any intellectual property (IPR) generated would flow through to gas customers.

2.4 (c) Generates knowledge that can be shared amongst all relevant NLs.

A principal objective of the NIC is the generation and sharing of knowledge from the projects. The Panel paid particular attention to the plans to disseminate learning from each project, both to other NLs and to other interested parties. Credit has been given

to innovative plans, tools and techniques which enable learning (both successes and failures) to be shared openly and accessibly with other NLs and in a timely way.

The Panel was encouraged to see more evidence that the project teams had learned both from previous NIA projects and from the considerable amount of learning from Europe and the rest of the world.

2.5 (d) Is innovative (i.e. not business as usual) and has an unproven business case where the innovation risk warrants a limited development or demonstration project to demonstrate its effectiveness.

The NIC is specifically targeted at innovative projects that a NL would not undertake in its normal course of business where the technical, operational, regulatory or commercial risks associated with the project are so significant that they cannot be funded either by shareholders or through the price control.

The NL is required to demonstrate that the project is innovative, untested at the scale at which it will be deployed and that new learning will result from the project. The Panel was encouraged to see more evidence that the NLs were examining novel ideas from Small and Medium Enterprises (SMEs) and researching globally to provide the assurance that the project was innovative and that the technologies or processes to be developed would be utilised.

2.6 (e) Involvement of other Project Partners and External Funding.

Collaboration between NLs and other parties in the energy supply chain is a central objective of the NIC. The Panel expects the NLs

to both explore and raise additional (or part) funding where this is available. Project partners should where possible be expected to make a contribution particularly if they stand to gain commercially.

The Panel was pleased to see greater clarity in the process by which Project Partners were sought and chosen and by the involvement of more academic institutions and SME's.

None of the projects had access to external funding and in future years this may limit the number of projects being funded. The Panel did note that several partners had offered to discount their costs.

2.7 (f) Relevance and timing.

When evaluating how projects performed against this criterion, consideration was given to the appropriateness of the timing of the proposed project in terms of its readiness for deployment if successful and the timing of the potential market challenge it seeks to meet.

The Panel look to see that there is an operational involvement in the project definition and delivery. This generates confidence that there is a real business need for the innovation and that the implementation will be timely.

2.8 (g) Demonstration of a robust methodology and that the project is ready to implement.

The Panel and the Authority must be confident that the NL can reasonably be expected to deliver the project.

The Panel recognises that it is difficult at the start of a project designed to develop new learning and processes to define fully all of the subsequent stages – particularly where these will be determined by the results of the earlier work. The Panel considers that specific go/no-go stage gates reduce the level of risk of NIC funds being wasted. The Panel found projects which were built on previous NIA funded studies had the clearest and best developed plans.

2.9 Comments on process

The Panel met the NLs twice during the evaluation process. Prior to the second meeting the Panel sent a list of questions they wished to see answered at the second presentation. All of the NLs built their second presentation around answering these questions which was helpful. Clear and agreed answers inevitably give the Panel confidence that the team has fully thought through the proposed work and possible issues and is able to answer and deal with Panel concerns.

The questions that the Panel raises are intended to provide clarification and to highlight areas where the bid may cause concerns. NLs who approached the question sessions with an open mind; who were prepared to admit to areas of uncertainty and sought to address these, were more convincing than those who simply sought to defend their original submission.

The Panel cannot direct project teams to change substantively their projects once submitted. However, the question and answer sessions allow the NLs to ensure that the Panel understands the

project objectives clearly and to highlight how these address the NIC criteria.

The Panel recognized the constraint of numbers able to appear at bilateral meetings but would have liked to meet more of the project management team. The second bilateral is an opportunity to do this. Wider visibility of the project management team would help to build confidence that the project can be successfully delivered.

3 Evaluation of submissions

3.1 T-Shale - Northern Gas Networks - Ltd - £5,617k requested (£6,241k in total)

The opportunity to exploit unconventional gas sources, and in particular shale gas, in the UK is considerable and the subject of significant investment from upstream developers. While there may be a number of environmental, economic and technical challenges to overcome to realise this resource, it is also the case that to minimize costs and maximize benefits there is a requirement, at an early stage, to consider the impact on the natural gas transmission and distribution networks.

The principal challenge identified in techno-economic terms for the gas networks is to optimise connections from unconventional gas sources. Since these sources tend to be from smaller scale, distributed wells, there is potential merit in connecting directly to lower level distribution networks, rather than aggregating supply and connecting to higher tier pressure levels. In reviewing the submission it became clear to the Panel that the key issue for the gas networks is that the low flow characteristics of gas distribution networks are not well understood. The design criterion to date has been peak flow conditions, whereas for direct input into low pressure distribution systems the low load conditions are likely to provide the constraint.

The main element of this project would be the installation of 53 ultrasonic flow meters at a range of sites on the NGN gas distribution network, which would be used to deduce generic low flow distribution models.

This analysis would shed light on the ability to input unconventional gas into the network and would then be integrated into a broader 'S-Gas' model which allows the assessment of a range of development scenarios in terms of capital and operational expenditure, and carbon impact.

In addition, other broader legal, regulatory social and environmental factors would be taken into account in a 'T-Shale' web based decision tool to allow stakeholders to understand the overall impacts of the development of unconventional gas sources.

NGN would be supported in this project by Addleshaw Goddard, Aqua Consultants, Environmental Resources Management (ERM), Enzen Global Ltd and Leeds University.

Low carbon and/or environmental and financial benefits.

The submission did not argue that this project would deliver significant carbon benefits, although the potential to accelerate coal to gas conversion was outlined. In addition it was argued that a project goal is to understand better the environmental impacts of shale gas. The Panel felt there were other arguments that could have been fairly made in terms of the additional carbon cost of transporting shale gas outside the low pressure network or by substituting gas with a higher carbon footprint, whether through liquefaction or compression losses, or facilitating the delivery of biogas, which has a potentially considerable carbon saving compared to conventional gas.

The analysis of financial benefits was limited. The Panel understand that the project would help to identify the costs and benefits of different transportation options. However, it

considered that transportation of shale gas may not currently be on the critical path for a developer. Without the active involvement of potential developers it is hard to form a judgement on the financial issues. It may be that other issues, such as planning consent for drilling, may have a more significant impact.

Value for Money.

The Panel were unconvinced that the approach, when taken together with the timescale for deployment, provided value for money in providing a solution to the core problem being addressed of the understanding of low flow constraints. There was agreement that this was a problem that needed addressing in a timely manner, but while the method outlined was coherent and capable of delivering a solution, the Panel were of the view that the problem could be addressed both more effectively and cost–effectively using smart meter and other sources of data. It was recognized that although the national smart meter roll out is not beginning until 2015, the company did not explore the opportunity of working with suppliers with an earlier smart meter roll out programme. A limited number of smart meters would provide sufficient data to develop a low flow model.

In addition to this fundamental value for money concern, the Panel were concerned that some costs put forward by one consultant were egregious and did not appear to reflect feed-back previously given by the Panel that consultant's time allocation and day rates should be set at a competitive rate. It should be noted that in the final submission the consultant was removed and their role would be tendered competitively during the project. Other consultants had discounted their rates to a competitive market rate.

Generates knowledge for the NLs.

The Panel were persuaded that a low flow distribution model would be of benefit to NLs in assessing the impact of unconventional gas entry. This project would generate that knowledge. During Panel discussions with the team, it was questioned whether an earlier stage piece of work, mining existing customer data and wider data sets, could have been undertaken under the NIA scheme to better inform this project. The Panel were not totally convinced by the arguments put forward that data were not available which could have allowed such a 'first order' set of modelling to be undertaken to strengthen the project case.

Innovation.

It is certainly the case that if some of the projections on the amount of unconventional gas that can be developed are realised, this would have a major impact on the UK gas network and particularly on the distribution networks within regions with potentially significant shale gas reserves such as NGN. Given this, the development of a model, both in terms of low flow models and more broadly, represents an innovation that is not business as usual.

Partners and funding.

The team put together provided strong capabilities in their respective areas. It was not altogether clear to what extent these experts were providing bespoke packages in their areas of expertise, or whether they would be effectively integrated into the

project. As noted earlier some concerns over value for money were addressed during the evaluation process.

The Panel felt a particular gap in the project was in relation to shale gas developers. Whilst UK Onshore Oil and Gas (UKOOG) would play a minor role in the project, it would have been much stronger if prospective commercial developers were directly involved. There may have been practical reasons why this was not possible to achieve but if so these were not clear to the Panel. The involvement of developers would have provided more detailed information on the development profile and enabled a better understanding of, *inter alia*, well volumes and flows.

The project has no external funding.

Relevance and timing.

Given policy support for unconventional gas, and likely development of the sector, this is undoubtedly a very relevant project.

The Panel welcomes the initiative of NGN in addressing this issue in advance of likely need, so as to inform the debate better and to shape developers' plans. Shale gas developers face a choice of connecting to the national transmission system (NTS) or to a lower pressure tier. The price at the injection point should give the efficient signal, and the time variation in that price should indicate the optimal time pattern of development and exploitation. Low flow conditions would potentially limit the scope for injecting gas into the gas distribution networks (GDNs) during the summer. There is thus an important missing element in our understanding of nodal and temporal supply and demand conditions that would

allow for efficient connection to, and operation of, the transmission and distribution networks. There is therefore a strong case for models and validation studies to reduce this information gap.

It was not clear to the Panel how urgent the need was for a solution given the early stage in the shale gas licence award/drilling/evaluation process. This seeming lack of an immediate need perhaps explains developers' reticence to be involved. It is also one factor that the Panel took into account in believing that a solution to low flow modelling based on data from smart meters could be both better and lower cost, since this information will only improve year on year as the roll-out gathers pace. With time, the requirements of specific field characteristics will also become clearer.

Methodology.

The main question that the Panel understands the project will address is to be able to estimate more accurately the volume of gas that can be injected into the low pressure system at periods of low demand, given the inability of the low pressure system to store gas as line pack. In order to be able to determine the maximum acceptable volume that can be accepted into the network, the NL has to be able to determine the minimum demand level, which will depend on the number and type of customers connected to each branch, as well as the characteristics of the branch. Such models exist for calculating the maximum demand that may be placed on the network, which is an essential factor in sizing the network.

Although there are no exactly comparable low-flow models, the Panel felt that an analysis of consumer demand patterns (which would depend on customer type, e.g. those that used gas only for cooking and hot water heating) combined with standard gas flow modelling, would provide an initial estimate and confidence intervals as a function of the number of customers. That might in turn be roughly validated from data on pressures and daily injection volumes on each day, when combined with temperature and other data (week-day, holiday, etc.).

Econometric data mining would seem to be an important first step in postulating hypotheses that could be tested by more granular data (e.g. from a sample of smart meters) before the far more expensive step of installing flow meters as proposed in this project.

A final hypothesis that requires testing is the flexibility with which shale gas fields can be either developed or operated. The Panel were concerned that whilst the methodology was suitable for a low flow measurements project, the bid did not compare this option with alternative commercial arrangements. For example, it was not clear why this chosen option was preferable to constraining off the supply of shale gas, storage or operating wells in a seasonal manner (e.g. opening new wells in the autumn so that they served the winter peak and flows were subsequently reduced once demand fell in the spring).

The Panel were, also, not convinced that the broad ranging operational, legal and social factors to be taken into account in developing a web based decision tool would, in practice, lead to the level of analysis that could guide stakeholders effectively. It was felt that many of these factors would more properly be

addressed in a bespoke environmental impact assessment for each potential development, which would be site specific and so less amenable to the generic modelling approach proposed by NGN.

As stated above, while the Panel welcomed the expertise of the various partners, their integration into the project was not well demonstrated. The somewhat outline project plan appeared to reinforce the perception that the project required more articulation and development.

The Panel were also concerned by the lack of engagement with stakeholders and with the smart meter process.

Panel Conclusions.

The Panel agreed with NGN that it is increasingly important to characterize the low flow characteristics of gas distribution networks and the related commercial arrangements for possible alternative gas sources.

The Panel would welcome proposals that use existing and soon-to-be enhanced data on demand levels in low flow periods, both from more aggregated data mining using econometrics on the off-take volumes and associated pressures, and the development in smart meter data, combined with network modelling of the kind already developed for studying peak flows. Such investigations may highlight the importance of validating these models with additional data, perhaps from flow meters.

One benefit of this prior modelling would be to identify where and on what types of networks the smart meters would yield most additional information. The Panel also thought that a better

characterization of the supply side (from biogas and shale gas) would further clarify the value of such modelling and would in any case be required to develop suitable contractual arrangements. A greater understanding of the needs of potential developers is required. The Panel, therefore, concluded that this project, whilst clearly identifying a problem in need of solution, had not proposed the most appropriate solution, and would therefore not represent value for money.

The Panel strongly encourages NGN to use its NIA funds to build initial low flow models using available data and to commence other innovative elements of the project. This would provide a better basis for another NIC bid should it choose to do so.

Overall the Panel felt that the project failed to satisfy several criteria and offered a very poor likelihood of delivering financial benefits for distribution customers.

3.2 In Line Robotic Inspection of High Pressure Installations - National Grid Gas Transmission - £5,675k requested (£6,305k in total)

National Grid Gas Transmission (NGGT) proposes to develop a new system to inspect underground pipe work at Above Ground Installations (AGIs). Together with two SMEs, Synthotech and Premtech, NGGT proposes to design and develop a new type of inspection device to perform this task. Pipeline Inspection Gauges (PIGs) are routinely used for pipeline inspection. However, the partners propose a new design of device that can operate in pipe work at high pressure (100 barg) and cope with the complex geometry of pipes at AGIs. The stated key benefit of the project is that the development of such a device would allow the adoption of a risk based maintenance and replacement scheme for the pipe work. This should result in environmental, safety and financial benefits, while avoiding disruption caused by unneeded excavations, premature asset replacement and unplanned events.

The project has four key objectives. First, to determine accurately and reliably the condition of high pressure below ground pipe work at AGIs using an internal inspection robot. Secondly, to generate a proactive, rather than reactive, risk based approach to the management and maintenance of aging assets, based on the knowledge of the actual condition of pipe work. Thirdly, to minimise the occurrence of unnecessary excavations and avoid the premature replacement of assets reducing significant carbon emissions and generating cost savings of circa £58m over 20 years. Finally, to minimise the likelihood of asset failure through proactive asset management, thereby significantly reducing the risk of a high pressure gas release into the atmosphere and the

consequential safety, financial, environmental and reputational impact.

Low carbon and/or environmental and financial benefits.

The team identified three areas of carbon and financial benefits: reduced excavation costs (£1.9m p.a.), asset life extension (£20m over a 16-year period)), and reduced risk of major incidents/outages in relation to an AGI failure (£10m over a 20-year period). The Panel were unconvinced that the third element was entirely plausible, in that it was unlikely that an asset management regime would be allowed to develop with an increased risk of an AGI failure. However, the first two elements were felt to be entirely reasonable. The Panel recognised that robotic inspection could be only part of an overall regime that could lead to asset life extension, but this was nevertheless a significant prize that could be won if this project were successful, and which could also be achieved in a less disruptive/more cost effective way. In addition there are likely to be further benefits from the application of the new technology to related problems in other NLs' areas.

Value for Money.

The Panel were concerned that although the merits of the project if successful were clear, it was technically quite a risky project given the novelty of the approach and operating requirements. It was therefore welcome that the team acknowledged this by clarifying that they would set clear acceptance criteria at key milestones (Sections 9.1, 9.2 and 9.3) and would only proceed with further stages of the project if those criteria were met.

In addition, the company agreed to amend the intellectual property approach from that originally outlined, to make it clear that IP developed in this project would be available to other users in the UK gas industry; in particular covering potential application in the gas distribution network.

The revised IPR ownership proposals gave the Panel confidence that application of the new technology by other NLs or internationally would result in financial benefits for UK gas customers.

Generates knowledge for the NLs.

The Panel were pleased to see that NGGT had already engaged with the other NLs and received strong letters of support from them. The proposed dissemination plan was well thought through. The applicability to the AGI installations outside the National Transmission System would also be included within the knowledge sharing approach.

The Panel noted that the testing programme would be open to relevant organisations and this showed a willingness to share learnings from failures as well as successes. As in previous projects with significant technical risk, the Panel were keen to ensure that negative as well as positive learnings were shared across the industry, to guide and inform future developments.

Innovation.

The project is clearly innovative. In the view of the Panel the level of technical risk and the limited initial market means that this work would not be carried out in the normal course of business.

The Panel were reassured that the team had used an NIA project for global technology scanning and to understand the existing approaches to unpiggable sections of the network, in order to develop a more robust project. It was clear from this work that there is not, at present, a suitable tool for the work being proposed, whilst at the same time there are reasonable grounds to suppose that one could be developed to meet the requirement.

Partners and funding.

The process by which NGGT had identified business needs and then invited external contractors to offer solutions to these was exemplary. The innovation introduced through the involvement of Synthotech and Premtech was welcomed. The Panel noted the expertise and enthusiasm shown by all the project partners. The involvement of Leeds University gives access to relevant innovative academic thinking. The use of Pipeline Integrity Engineers Ltd, as an independent reviewer, gives confidence in the robustness of the technology. The partner organisations bring good technical know-how and an innovative culture to the project.

The project would not access any external funding.

Relevance and timing.

There is no doubt that this is a relevant and timely project. Data was supplied as part of the project to show that there are a large number of AGIs reaching the end of their design life (60% of National Grid's AGIs are due to come to the end of their original asset lives by 2020). While the failure rate has been very low to

date, there would nevertheless need to be a much more active asset integrity programme in order to justify asset life extension. In addition, data provided by robotic inspection would allow for more informed replacement programmes where that is necessary. The solution is likely to be relevant to GDNs.

Methodology.

The Panel was convinced that the project was well designed following the question sessions where the go/no-go stage gates were explained in more detail. The fact that the project builds on continuing technology watch work funded under the NIA added confidence.

The project team seemed to be well integrated with each party clear and confident in their roles. The support of operations for the project gave assurance that the work would be well directed and quickly utilised if successful. The project plan was well thought through and the team were enthusiastic and ready to start work.

Panel Conclusions.

Overall the Panel considered the project was exciting and offered the potential to deliver significant financial benefits to gas customers by avoiding the unnecessary replacement of AGI assets by extending their design lives.

4 Recommendations to the Authority

4.1 We set out below our recommendations to the Authority on the funding of the 2014 projects.

4.2 The Panel recommends that the following project is funded but that verified evidence that each go/no-go criteria (Sections 9.1, 9.2 and 9.3) has been met should be sent to Ofgem to agree whether the project should continue:

- **In Line Robotic Inspection of High Pressure Installations - National Grid Gas Transmission - £5,675k requested (£6,305k in total)**

4.3 The Panel recommends that the Authority does not fund the following project.

- **T-Shale - Northern Gas Networks Ltd - £5,617k requested (£6,241k in total)**

4.4 In Section 2, we have set out a number of concerns and issues that arose during the evaluation. Overall the Panel were disappointed with the number of the bids that were submitted for this, the second, Gas NIC. Whilst there are no proposals for a full review of the scheme during the next year the Panel welcomes feedback on how the process can be improved. The Authority and the NLs should consider the following points:

- Consideration should be given to clarifying the process of releasing the funding in stages and, where appropriate, the NLs encouraged to identify a limited number of specific

points in the trials where decisions to proceed would be required.

- The NLs should regard the rejection of a proposal as an important learning step. Bidders may learn a considerable amount from rejections and may subsequently return with successful bids.

- The NLs should continue to develop their innovation processes so that key business development opportunities can be shared with a wide range of potential SME and academic partners. Promising concepts should be tested using NIA funds which would lead to the development of a stream of well grounded NIC bids.

4.5 The Panel would like to thank the project teams for their hard work and for their engagement during the evaluation process; we would also like to thank the external consultants and the Ofgem team for all of the support and assistance that was provided.

4.6 The Panel is aware that some stakeholders may have concerns regarding the criteria applying to the Gas NIC projects. In particular, some stakeholders believe that the focus on carbon and environmental benefits could prevent some projects which might deliver significant financial benefits alone from being funded. This is because there may not be the same scope in gas as in electricity projects to deliver carbon or environmental benefits. The Panel understands that Ofgem is currently consulting on views so it can consider this issue further.[1]

[1] https://www.ofgem.gov.uk/ofgem-publications/91323/nicniaconsultation141114.pdf