

NIA Project Registration and PEA Document

Date of Submission

May 2020

Project Reference Number

NIA_NGGT0164

Project Registration

Project Title

CH4RGE – Methane Reduction from Gas Equipment

Project Reference Number

NIA_NGGT0164

Project Licensee(s)

National Gas Transmission PLC

Project Start

May 2020

Project Duration

0 years and 11 months

Nominated Project Contact(s)

Steve Johnstone

Project Budget

£177,790.00

Summary

This proposal is to undertake a BAT and FEED study and then pilot a gas compressor seal gas and venting gas recovery system. The solution could then be rolled out as 'business as usual' to help Gas Transmission work towards delivering the Company's Net Zero carbon emissions objective. Three of the major compressor machinery OEMs all currently offer gas recompression, thermal oxidiser or ejector solutions to this issue, which are at varying levels of market readiness.

Third Party Collaborators

Project Environmental Solutions Ltd

Nominated Contact Email Address(es)

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Problem Being Solved

Gas losses occur across the entire UK gas National Transmission System (NTS) through direct gas emissions (principal areas being planned and emergency venting, compressor seal gas losses, valve losses and leaks); these can be classified as fugitive and venting emissions. Such emissions are increasingly becoming a focus; requirements are likely to go beyond current controls (Best Available Technique (BAT) and licence conditions) driving National Grid (NG) to make significant emissions reductions to avoid financial, environmental and reputational harm. These emissions occur as methane leaked directly to the atmosphere – methane has a Global Warming Potential (GWP) 25 times higher than carbon dioxide. Direct and indirect emissions of carbon dioxide also occur from the NTS e.g. turbine fuel usage and electricity consumption, however these are regulated and controlled under existing mechanisms such as the EU emissions trading system (EU ETS).

For NG to achieve the stated corporate goal of Net Zero GHG emissions by 2050, in line with the UK Government's target, significant reductions in methane emissions will be required in the short and medium term. Reducing emissions through innovation and technology are key to achieving these goals. Commitments to reduce greenhouse gases are being made internally, and at sector and

government level. Organisations such as ENTSOG, Marcogaz, GIE and OGCI are initiating programmes to better understand methane emissions across the entire gas value chain and drive their reduction; this may be a precursor to a European methane trading scheme and EU strategic and legislative plans for methane reduction. National Grid Gas (NGG) needs to continue to understand the technical solutions available in order to make the right business investments. Internally NGG is implementing a carbon price, to be applied to investment decisions and used alongside the existing incentive and shrinkage based costs associated with these emissions. Progress is being made in NGG through a number of initiatives e.g. the 1000 tonne reduction challenge (aimed at reducing direct greenhouse gas emissions) and the upgrade of legacy plant and equipment. These have already resulted in reductions in methane emissions and it is recognised that some supporting tools, such as the venting calculator, could be optimised to represent current system arrangements and enable effective decision making. However new technology solutions will be required to achieve the necessary shift and to off-set future financial exposure (which could exceed £30million over 20 years).

Initial approaches to Original Equipment Manufacturers (OEMs) have indicated that a range of technologies are in the latter stages of development which could provide solutions to reduce seal gas losses and planned venting losses to zero. For the first time, these solutions bring the prospect of a ready transition to 'Business As Usual' (BAU) methane capture, from suppliers with proven capability in delivering technologies which will not impact on the availability or security of supply of the compressor network. This project will investigate the viability of these technologies across the current and potential future NTS and set out a clear path to implementation, clearly defining any potential limitations.

Therefore, the proposed funding of an initial £177,790 to invest in research (e.g. need case and pre-feasibility study of available and applicable methane emissions reduction technologies) followed by subsequent phased funding of up to £1.4m (subject to further sanctions) for a pilot study and roll out, could reduce methane losses from CMT by 80% (560,000 tCO₂e over 20 yrs), cutting the 'cost of carbon' business exposure by £24.8m in addition to wider societal and reputational gains.

Method(s)

The scope and deliverables which form this PEA application represent the first stage (4.0 Need Case / 4.1 Pre-feasibility) of what is planned to be a long-term engineering project programme aligned to the ND500 delivery model. The overall programme will assess the feasibility, conceptual and detailed design requirements of prospective BAU emissions capture solutions, leading to a pilot on the NTS, allowing full evaluation of effectiveness/costs and development of a roll out plan. This first stage seeks to affirm the high level technology options and emissions in scope i.e. 'casting a wide net', and will at the same time proceed with initial evaluation of the highly viable technology solutions being proposed by the main OEMs (seal gas and vent recovery mitigation). A review of work done to date, and the potential to link with other NIA projects such as MorFE (Monitoring of real-time fugitive emissions – NIA_NGGT0137) will be considered.

Scope elements (divided into Work Packages)

- Project set up and launch – establishment of a steering group and planning of key stage workshops
- Data review - evaluation of existing and available gas loss data to ensure that the need case is fully understood, the direction of travel appropriate and justified, and to quantify the potential benefits of the project. This will include a review of current gas venting philosophies and conventions, on an individual site and equipment basis, to reaffirm key assumptions on systems and practice across the network. It will also review the outputs from related studies undertaken by NGG and others in order to encapsulate the progress made by other initiatives.
- As a subsidiary output, an optimised venting calculation tool will be produced to allow qualification of the relative benefit of 'vent or hold' at UK compressor sites, enabling interim optimisation of the compression system. The tool can also serve as a 'counterfactual' position to investment in new technology solutions by looking at how far the business could go towards reducing venting losses if a) a theoretical optimal vent-hold strategy could be rolled out; and b) look at constraints and blockers which may prevent this being realised.
- Technology review – desktop evaluation of existing studies and research into available solutions, casting the net wide enough to ensure all potential scenarios are considered, but maintaining the objective to achieve a viable and deployable solution for the short term. Engaging with OEMs to enable initial high level BAT and cost benefit analysis of the identified gas emissions reduction technologies.
- Key stage project review workshop and presentation of Task 2 & 3 findings to secure agreement on the scope and direction of the ongoing study.
- Site and gas turbine review – evaluation of gas compressor sites and equipment to ascertain where potential solutions could be deployed. Identification of locations and equipment for a future pilot study.
- Establishment of performance criteria - identifying key terms of reference which would need to be addressed in detailed safe working design studies.
- Review of operational impacts, control mechanisms, and Emergency Shut-Down (ESD) philosophy - engaging with representatives from Operations, Subject matter Experts (SME's) from NGG Engineering and Asset Management (EAM) and Design Assurance Engineers from Capital Delivery to understand real life considerations and constraints.
- Key stage project review workshop and presentation of Task 2 & 3 findings to secure agreement on the scope and direction of the ongoing study.
- Formal Environmental Assessments (FEA) planning – reviewing FEA scope, and undertaking an initial planning meeting to enable completion of T/PM/ENV/20 FEA Planning Proforma
- Production of a project scope - collating information on the need case, preliminary constraints and assumptions, functional specifications and design philosophies, preliminary site reviews, anticipated project programme and stakeholder engagement schedule, using the NGG Basis of Design Document (BoDD) or Project Scoping Document (PSD) template.
- Key stage project review workshop and presentation of Task 2 & 3 findings to secure agreement on the scope and direction of the

ongoing study.

- Tender for Front End Engineering Design (FEED) support - preparation of technical documents, and evaluation criterion, tender review and determination.
- Preparation of NIA Project Summary Report
- Project close-out and lessons learnt
- Regular engagement and decision workshopping with NGG project teams at key stages to determine the direction of the project and its ongoing viability.
- Learning dissemination – production of presentation material and literature, and attendance at one presentation of the outputs.

N.B. the desk based nature of the work minimises the risk of any Covid-19 delays or programme impact.

Scope

The scope of this study is a need case and pre-feasibility study on innovative technologies designed to reduce methane emissions from principally gas compressor machinery trains but potentially other asset types as the data, technology and site reviews progress.

As the UK progresses towards Net Zero by 2050, NGG will need to seek to minimise methane emissions. The energy sector at a European and international level is also taking the transition to a low carbon energy network seriously and are holding producers and gas transporters to account. Social pressure to demonstrate commitment to contributing to reductions has increased in recent years and as consumer awareness grows, will continue to intensify. There will be a consequential desire for customers and shareholders to see where efforts are being made, and to see greater transparency in the dissemination of any associated financial savings.

There are known gas losses across the NTS and many sources are associated with compressor station operations, including venting, seal losses and other balance of plant emissions. Steps to review venting philosophies and conventions with the aim of reducing losses from routine venting have been taken in recent years (e.g. the '1000 tonne challenge') and as reliance on legacy infrastructure reduces, the NTS is transitioning to technologies which offer lower methane loss e.g. wet seal compressor usage is being superseded by dry seal equipment on modern gas turbines and electric drives. Achieving Net Zero by 2050 will ultimately require a shift to a hydrogen or methane-hydrogen based NTS but in the short and medium term, with continued reliance on methane transmission for the foreseeable future, technological solutions are required which can be installed easily as new or retrofitted to existing equipment. These must be capable of ready integration with existing systems. The end goal of net zero emissions by 2050 may well be achieved by methane alternatives, however every tonne of CO₂e contributes to climate change. The pathway to 2050 is as important as the end goal and that requires reducing emissions as quickly as possible.

Previous Innovation Funding Incentive (IFI) funded studies looking at 'Alternatives to Venting' identified a number of theoretical candidate solutions to these issues, but none which could readily transition to BAU on network critical plant and sites with an acceptable risk profile. Initial approaches to OEMs have indicated that a range of technologies are in the latter stages of development which could provide solutions to seal gas losses and planned venting losses in particular. For the first time, these solutions bring the prospect of BAU methane capture from suppliers with proven capability in delivering technologies which will not impact on the availability or security of supply of the compressor network. In some cases, these technologies are undergoing pilot trials, although none on the UK NTS and none which fully implement integrated combined seal and venting capture. This confirms the market is seeking viable solutions for gas recapture and re-pressurisation for which real life utilisation and success could be demonstrated. It is essential that NGG becomes an early adopter in this field to maintain its global reputational position.

The cost case is explored below. Initial quantification of methane losses indicates that a reduction potential exists across the network of ~700,000 tCO₂e over a nominal 20 year period, even when applying restrictive assumptions on the potential applicability of sites and equipment (e.g. focusing on existing and planned dry low emission compressors and electric drives, only at higher utilisation sites). Overall this project has the potential to deliver financial return, but also key environmental, sustainability, reputational and societal benefits.

Objective(s)

To evaluate the need case associated with methane reduction from gas equipment on UK NTS sites. To conduct a pre-feasibility assessment of methane reduction technologies, and to consider where possible how these technologies may be appropriate to a future NTS.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

1. A clear need case which justifies, or otherwise, the potential use of methane reduction technologies on UK NTS sites.
2. To enhance our understanding of technology options for the reduction of methane losses from all gas equipment and their applicability on UK NTS sites.
3. If viable, to advance potential solutions towards implementation, in readiness to move to a subsequent feasibility study, and
4. As an interim measure, to provide a greater understanding of the relative benefit of 'vent or hold' philosophies and optimisation of the venting calculator tool.

Project Partners and External Funding

Project Environmental Solutions Limited (PESL) Consulting
(Subsequent project stages, outside of the scope of this PEA would look to bring other partners on board, in addition to PESL, e.g. engineering contractors and OEM suppliers.)

Potential for New Learning

- Greater clarity on target areas for methane emission reduction from gas transmission assets, principally gas compressor machinery trains
- Increased understanding of 'vent versus hold' strategies and barriers to 'optimisation'
- Understanding of technology options, their applicability and market readiness
- Identification of potential sites and application of these technologies on the NTS
- Overview of operational and engineering constraints which would need to be overcome for feasibility and design

Scale of Project

Desk based / market engagement / operational engagement

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

UK wide

Revenue Allowed for the RIIO Settlement

£0

Indicative Total NIA Project Expenditure

£177,790.00

Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

n/a

How the Project has potential to benefit consumer in vulnerable situations:

n/a

Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

Whilst the financial cost benefit of this project can be measured it is important to note that this is not the sole rationale for undertaking this work. In order to achieve progress against critical objectives such as Net Zero, investment must be made where there is a real prospect of achieving environmental, sustainability, reputational and societal gain, even if the financial aspects of these metrics cannot be quantified.

A high-level cost benefit model is summarised below:

- Business cost of carbon of £1.56m pa, or approximately £31.1million over a 20 year period. Based on 2019 figures. Excludes NG and societal costs associated with incentive mechanisms and gas shrinkage losses. Considers emissions from modern dry seal gas turbines and electric drives only. Disregards the known widespread problem of passing valves which result in methane losses from the vent lines during operation, which some technologies may assist in recovering. Uses a value of £45 per tonne (internal cost of carbon factored into investment decisions) which is likely to increase over time.
- Initial calculations suggest an investment of £6.5million could deploy a technology solution at 11 key high running sites where modern dry seal gas turbines are already in use or in flight.
- This could result in a reduction of 80%, or 560,000 tCO₂e, over a 20 year period, potentially reducing the business exposure by £24.8million.

Please provide a calculation of the expected benefits the Solution

N/A

Please provide an estimate of how replicable the Method is across GB

Once determined feasible, the emissions reduction methods could be replicated at any NGG compressor station. It is assumed that the technologies likely to be offered by the market will be applicable to new build machines, and could be retrofit to modern generation gas turbine and Variable Speed Drive (VSD) driven gas compressors, such as but not limited to Solar Titan, Siemens SGT400, GE LM2500 and Siemens electric drives.

Please provide an outline of the costs of rolling out the Method across GB.

A preliminary estimate of the roll out cost at 11 key sites would be £6.5million (including the pilot NIA project).

Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

- A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).
- A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)
- A specific novel operational practice directly related to the operation of the Network Licensees system
- A specific novel commercial arrangement

RIIO-2 Projects

- A specific piece of new equipment (including monitoring, control and communications systems and software)
- A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven
- A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)
- A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology
- A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution
- A specific novel commercial arrangement

Specific Requirements 4 / 2a

Please explain how the learning that will be generated could be used by the relevant Network Licensees

The primary learnings will be applicable to NGG as the sole UK gas transmission licence holder, however there are potential wider benefits for European TNOs. It may also benefit other UK market participants and licence holders with gas compression equipment e.g. operators of interconnectors and terminals. Other network licensees, such as the gas distribution networks, could benefit to the extent that they have Above Ground Installation (AGI) sites on which they vent and release methane from gas equipment (e.g. pigging).

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

n/a

- Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

Is the default IPR position being applied?

- Yes

Project Eligibility Assessment Part 2

Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

NG initiated the 'Alternatives to Venting' project with GL Noble Denton through the IFI scheme to assess and demonstrate technologies that could help reduce the amount of natural gas vented. The report (Alternatives to Venting', A. Varma and CY. Law, GL Report 9415, Issue 1.0, September 2009.) identified several emission reduction technologies, including: Recompression, Adsorbed Natural Gas (ANG) and Flaring. However, none of these could readily transition to BAU on network critical plant and sites, with an acceptable risk profile. No investment in these solutions has been carried out in the intervening years.

Initial approaches to OEMs in 2019 indicated that this topic has become very current and that a new range of technical applications are in the latter stages of development which could provide solutions to capture seal gas losses and planned venting losses in particular. For the first time, these solutions bring the prospect of a ready transition to BAU methane capture from suppliers with proven capability in delivering technologies which will not impact on the availability or security of supply of the compressor network.

On this basis the drivers and market readiness have changed materially since the original Alternatives to Venting Project, such that the

proposed work represents no duplication. Previous learnings will provide a key reference for the review phase of the proposed NIA project.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

n/a

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

Project aligns to RII0 T2 innovation objectives. Changing drivers around impact and importance of methane emission control are encouraging development of the market; only since 2019 have compressor OEM supported technologies been progressed, which provides far greater confidence in the potential for integration with existing systems. For the first time, a combined seal and vent capture technology is considered feasible. At present there are no online applications of these technologies on the UK NTS. The candidate technologies are currently at low TRL but could be readily developed by this project and provide the first opportunity to apply the BAT approach (ENV21/22) to such. Development of the venting calculator offers an understanding of the counterfactual position to technology solutions, and current barriers to optimisation.

Relevant Foreground IPR

n/a

Data Access Details

n/a

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

Unproven in the UK context and technology not available for direct purchase without trials and operational viability assessment.

Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

No RII0 T1 or T2 funding available for this programme, considerable commercial and technical risk to adopting a direct roll out.

This project has been approved by a senior member of staff

Yes