

NIA Project Registration and PEA Document

Date of Submission

Mar 2014

Project Reference Number

NIA_SGN0037

Project Registration

Project Title

Oscillating Energy Harvester (Phase 2)

Project Reference Number

NIA_SGN0037

Project Licensee(s)

SGN

Project Start

February 2014

Project Duration

2 years and 1 month

Nominated Project Contact(s)

Martin Chorley, Innovatino Project Manager

Project Budget

£60,394.00

Summary

The scope of the project is to:

- Design a prototype harvester to meet physical constraints
- Design a mechanical housing
- Build a prototype harvester
- Construct a mechanical housing and flow test rig
- Laboratory test an energy harvester system
- Optimise the design of harvester
- Design and assemble the electronic circuits to regulate power to the external battery power pack
- Laboratory test a complete energy harvester with associated data logger equipment
- Review the project outcomes and make recommendations for further development and field trials
- Prepare project report.

Nominated Contact Email Address(es)

sgn.innovation@sgn.co.uk

Problem Being Solved

Scotia Gas Networks have a large number of low energy battery powered pressure data loggers and profile systems used for the

monitoring and control of the low pressure networks, across both our Scotland and Southern licence areas. These systems allow network pressures to be constrained at the safest minimum low pressure to ensure security of gas supply to the customer, whilst minimising gas leakage.

The battery life of this equipment is limited and involves regular replacement. Occasionally premature battery failure causes additional unscheduled visits and the loss of this essential equipment, resulting in elevated network pressures.

Battery replacement is expensive and involves operatives visiting many sites. The majority of the data logger and profile control equipment use bespoke battery packs on which equipment manufacturers impose premium costs. Cheaper alternatives are not acceptable because the battery pack must comply with the intrinsically safety certification of the equipment for its use in gaseous atmospheres.

To extend battery life alternative power sources such as solar power have been tried, but these tend to suffer from maintenance and vandalism issues.

Method(s)

This project is concerned with developing a solution to extend battery life by providing a local low energy source to power data logger and profile equipment. The technique to be investigated is the Oscillating Energy Harvester, which generates electrical energy by recovering the kinetic energy in the gas flow. The electrical energy generated is stored in batteries. Charging the batteries is expected to extend battery life from 1 to around 5 years, depending on operating conditions.

This project builds on a previous SGN IFI project (Oscillating Energy Harvester Phase 1) which investigated the feasibility of the technique through mathematical modelling, which concluded that it was theoretically possible to generate sufficient energy reliably within the gas flow and pressure parameters available.

This project therefore seeks to develop and laboratory test a prototype Oscillating Energy Harvester, which will generate sufficient electrical energy to power a range of equipment and understand the further potential benefits.

Scope

The scope of the project is to:

- Design a prototype harvester to meet physical constraints.
- Design a mechanical housing
- Build a prototype harvester
- Construct a mechanical housing and flow test rig
- Laboratory test an energy harvester system
- Optimise the design of harvester
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Additional time has been required by the project partner, The University of Southampton, for the initial technical testing. Therefore, a further 8 months has been added to the project, resulting in completion February 2016. This is an important process and the unit is required to be substantially tested at this stage to allow a full set of results to be gathered and allow the project partner to establish how the technology and results will affect the GDN requirements in relation to the original problem definition. Refinement of the proposed test criteria has now been completed and the remaining stages will continue as planned.

There is no change to the expected benefits or cost of the project. The change is needed to allow the project to progress to a successful conclusion and the benefits to be realised.

Objective(s)

The objectives of this project are to:

- Develop proof of concept of a solution which is capable of powering pressure data loggers and profile control equipment. Develop working prototype and carry out off site laboratory testing.

- Evaluate performance and explore the potential for further development and field trials in a live gas environment.
- Provide relevant information to the other Network Licensees.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The success criteria for the project are to:

- Identify the ability of the prototype energy harvester to produce sufficient reliable electrical power within a range of simulated operational gas pressure and flow conditions
- Highlight the capabilities of the electronic interfacing circuits to regulate, control and store sufficient electrical energy to power data logger and profile control equipment.
- Produce and disseminate learning to the other Network Licensees.

In order to determine whether this project has been successful or not at various stages, the project must progress through a number of stage gate milestones. SGN's Project Manager will evaluate the performance against the requirements before approving progress to the next stage.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

This phase of the project is limited to the development and laboratory testing of a fully functional prototype oscillating energy harvester to ensure the technique is consistent with previous mathematical modelling, to gain practical experience in creating the ideal gas conditions for the energy harvester operation, and to demonstrate the energy generated can be efficiently regulated, controlled and interfaced with a range of typical data logger and profile control equipment used within the gas distribution networks. It is envisaged at this stage a further phase of refinement, manufacture and extensive field trials on live gas installations would need to follow, however we have limited the scale of the current project to ensure unnecessary expenditure is not committed before proof of concept is established.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

This project will be undertaken at the University of Southampton. It is expected the technique would be applicable throughout GB.

Revenue Allowed for the RIIO Settlement

During the RIIO-GD1 it is estimated SGN will spend approximately £1.28m on the purchase of replacement batteries for data logger and profile control applications, plus staff time to visit site for replacement and faults. As this technique is at a low TRL it is not yet possible to determine whether revenue saving will be likely during the RIIO-GD1 period. However it is believed that if it can be progressed successfully through to a reliable working system this method has the potential to enable cost savings in the replacement of batteries.

Indicative Total NIA Project Expenditure

The total allowable NIA expenditure to be claimed for this project is £54,354 (90% of the eligible project costs to be incurred during NIA period).

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)

As this project focuses on an early prototype device using new technology it is difficult to quantify the potential financial benefits at this stage.

It is envisaged that a fully developed and tested oscillating energy harvester would lead to the following financial benefits:

- Reduction in battery replacement costs by extending battery life (SGN annual budget for data logger batteries £162,500)
- Reduction in maintenance activities

Please provide a calculation of the expected benefits the Solution

N.A. This is a research project.

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

SGN have approximately 3,000 installations which could potentially be affected by the successful outcome of this project. It can be assumed that the other networks also have a large collective number of installations across Great Britain (GB) that this method could ultimately apply to if future stages are progressed following the success of phase 2.

Similar to SGN, the other Network Licensees have not specifically identified an allowance for battery replacement in their RIIO-GD1 proposals; however it is likely that the other networks have a proportion of low energy data loggers, profile control and electronic equipment that require battery power. Therefore, this project does have the potential to be rolled out across GB and provide future savings in the capital and operational costs associated with battery replacement, while improving asset integrity.

It must be noted that these figures are estimates rather than real network data and the nature of battery replacement across all Network Licensees and installations will vary, which could affect the potential to apply the method and the benefits of applying it. The main focus of this project is to develop and laboratory test a prototype Oscillating Energy Harvester, which will generate sufficient electrical energy to power a range of equipment and also understand further the potential benefits.

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

There are minimal costs associated with sharing the conclusions and recommendations of this feasibility study with other Network Licensees, which will be the first step towards rollout across GB. As stated above, the very early TRL means that it is not possible to

estimate the costs of deployment at this stage.

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

All Network Licensees will be able to use the learning generated as the outcome of design, development and testing of the oscillating energy harvester will be presented in a clearly defined report that will focus on the suitability of the technique to power electronic equipment and the gas conditions required for ideal operation. The conclusions and recommendations could be used by relevant Network Licensees to determine whether future development of this technology could provide benefits in cost and reliability of data logger and control systems, as well as potentially enabling other electronic innovations to be considered.

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.

n/a

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

n/a

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

n/a

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

n/a

This project has been approved by a senior member of staff

Yes