

# SIF Alpha Project Registration

## Date of Submission

Dec 2022

## Project Reference Number

NGET/Eye\_in\_the\_Sky/SIFDataDigitalisation/Rd1\_Alpha

## Project Registration

### Project Title

Eye in the Sky – Utilising satellite data to improve grid resilience

### Project Reference Number

NGET/Eye\_in\_the\_Sky/SIFDataDigitalisation/Rd1\_Alpha

### Project Licensee(s)

National Grid Electricity Transmission

### Project Start

Aug 2022

### Project Duration

6 Months

### Nominated Project Contact(s)

Sean Coleman

### Project Budget

£440,000.00

### Funding Mechanism

SIF Alpha - Round 1

### SIF Funding

£396,000.00

### Strategy Theme

Data and digitalisation

### Challenge Area

Data and digitisation

## Project Summary

This project brings forward 3 of 12 asset monitoring use cases studied during the Discovery phase, which at maturity would collectively deliver an estimated 22 million GBP (NPV over 10 years) value to Networks and customers through a combination of cost savings by replacing manual ground and aerial monitoring, and cost avoidance through increased risk awareness. A switch away from manual monitoring will also lower emissions associated with Operation & Maintenance activities. This is closely aligned with the Data and Digitalisation challenge's aims to improve asset visibility and increase monitoring, efficiency, reliability, security, and resiliency of networks.

The project will investigate the development of a remote, automated nationwide land and asset motion solution based on the use of SAR satellite imagery and different InSAR analysis techniques. The project will investigate how the accuracy and concentration of land and asset motion data points can be improved and integrated into NGET's asset monitoring systems. The project will also investigate the development of a remote, automated, nationwide

network monitoring solution based on the use of sub meter resolution optical imagery. The solution will look at risk and change issues in general and specifically unauthorized construction and storage of building materials. The project will advance understanding of the defects/changes experienced by the network, their size, frequency, and risk priority and test EO detection likelihood, with a view to integration into NGET's asset monitoring systems.

## Project Description

This project brings forward 3 asset monitoring use cases studied during the Discovery feasibility phase, which at maturity would deliver an estimated 22 million GBP (NPV over 10 years) value to NGET and customers through a combination of cost savings by replacing manual ground and aerial monitoring, and cost avoidance through increased risk awareness. A switch away from manual monitoring will also lower emissions associated with Operation & Maintenance activities. This is closely aligned with the Data and Digitalisation challenge's aim to improve data monitoring, increase efficiency, reliability, security, and resiliency of networks.

The project meets the scope of the competition in following key areas:

1."How to improve the visibility of infrastructure and assets, for instance new digital infrastructure or novel uses of sensors and communications technologies"

The proposed solution will improve the visibility of the infrastructure and assets as follows:

a.increase the frequency, accuracy and auditability of change and risk monitoring surveys compared to current ground-based methods.

b.provide network operators with detailed historical and near real time information on the movement of the land in and around their assets and of the movement of assets themselves across entire networks compared to current ground-based methods

2."How novel uses of data and digital platforms can significantly improve network planning, modelling and forecasting capabilities." The analytics and outputs of the proposed satellite derived solution can be fed into network operator data lakes and workflows, used alone, or combined with other data streams to better understand changes and risks, to deliver better planning and resource allocation.

Solutions to be developed The project will investigate the development of a remote, automated nationwide land and asset motion solution based on the use of SAR satellite imagery and different InSAR analysis techniques. The project will investigate how the accuracy and concentration of land and asset motion data points can be improved and integrated into NGET's asset monitoring systems. The project will also investigate the development of a remote, automated, nationwide network monitoring solution based on the use of sub meter resolution optical imagery. The solution will look at risk and change issues in general and specifically unauthorized construction and storage of building materials. The project will advance understanding of the defects/changes experienced by the network, their size, frequency, EO detection likelihood and risk priority, with a view to integration into NGET's asset monitoring systems

## Preceding Projects

NIA\_WWU\_045 - Eye In The Sky

## Nominated Contact Email Address(es)

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# Project Approaches And Desired Outcomes

## Innovation Justification

**Problem** - Increasing network reliability requires increased awareness of the encroachments, risks and changes such as subsidence in and around network infrastructure in a digital format that can be mapped to the network and/or combined with other network data. Increased awareness in practice means more frequent monitoring of our networks BUT current manual ground and aerial based monitoring techniques are time consuming, costly, do not always result in digital outputs and have high CO2 footprints.

**Existing applications** - Satellite data technology is widely used for meteorology where it provides essential data to model weather forecast and wider effects of climate change. In military applications satellite data provides essential data to plan operations and support teams on the ground increasing visibility of the battlefield and reduce safety risks. The use of SAR satellite imagery for the smallscale monitoring of land motion is gaining traction in the mining sector, but largescale monitoring applications of the movement of both land and assets remains innovative. Similarly, while there is increasing interest in the use of satellite imagery and data for remote monitoring of risks and changes around critical infrastructure, solutions are not mature and investment in innovation is required to meet user needs. More applications exist for deforestation measurement, greenhouse gas emission detection and other. There are several existing techniques that use the high-resolution multispectral satellite imaging to produce 3D-stereopic image which is used to detect the vegetation growth/height around transmission and distribution lines. This information support vegetation control decision making while reducing a need for manual survey with helicopters or ground teams.

**Existing Research** - Satellite data are widely used by the Oil and Gas industry, past NIA projects Satellite Infrastructure Monitoring (NIA\_SGN0150) and High Altitude Aerial Surveillance (NIA\_NGGT0064) developed by gas networks demonstrated a strong benefit case for using aerial and satellite data analysis. It 8/17/22, 4:54 PM Print application - Innovation Funding Service <https://apply-for-innovation-funding.service.gov.uk/management/competition/1164/application/10037439/print> 6/16 was timely to evaluate opportunities for electrical network monitoring applications created by the availability of exponentially growing volumes of both commercial and open-source satellite data from satellite constellations such as the Sentinels (Copernicus), Planet, Satellogic, Iceye, Capella Space, Airbus, Maxar and others now and in the future. Work done during Discovery highlighted the fast progress that has been made by solution providers with solutions around Wildfire and Vegetation monitoring deemed to be 'business as usual' and therefore not appropriate for further SIF Alpha phase funding.

**Research Gap** - While Wildfire and Vegetation network monitoring are deemed to be business as usual, the use of satellites to monitor a broader range of encroachments, risks and changes around networks and network assets is not freely available nor are the analytics mature. Likewise, there is no remote monitoring system that can provide network operators with network wide data on uplift, subsidence, or landslides in and around assets or of the motion of assets themselves, for example sinking towers.

**Innovative solutions to be developed** - The project will investigate the development of innovative remote, automated, nationwide:

land and asset motion solution based on the use of SAR satellite imagery and different InSAR analysis techniques- network monitoring solution for detection of unauthorized construction and storage of building materials and other risks/changes based on the use of sub meter resolution optical imagery and risk/change detection algorithms

## Benefits

**Networks** will benefit from fast, accurate, auditable, and more frequent monitoring and risk assessment across their entire networks and better infrastructure development planning decisions. The proposed technology applications being developed as part of this Alpha application can be, with minimal adoption efforts, utilised on electrical, gas, water, and other networks in the UK and overseas. In fact, a recent report by the EU Space Agency (EUSPA) value the global EO value added services market for Utilities at 76 million Euro and predict it to double by 2031.

**Government Priorities** - The SIF aims to fund network innovation that will contribute to achieving Net Zero rapidly and at lowest cost to consumers. The specific SIF scope areas defined by Ofgem are aligned to these aims. This project meets the scope of the competition in following key areas:

1."How to improve the visibility of infrastructure and assets, for instance new digital infrastructure or novel uses of sensor and communications technologies"

8/17/22, 4:54 PM Print application - Innovation Funding Service

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The proposed solution will improve the visibility of the infrastructure and assets as follows:

a.increase the frequency, accuracy and auditability of change and risk monitoring surveys compared to current ground-based methods.  
b.provide network operators with detailed historical and near real time information on the movement of the land in and around their assets and of the movement of assets themselves across entire networks compared to current ground-based methods

2."How novel uses of data and digital platforms can significantly improve network planning, modelling and forecasting capabilities." The analytics and outputs of the proposed satellite derived solution can be fed into network operator data lakes and workflows, used alone, or combined with other data streams to better understand changes and risks, to deliver better planning and resource allocation.

**Environmental Impact** - The ground or aerial based inspections have a GHG emissions footprint which would be reduced drastically if network monitoring were fully or partially switched to satellite-based monitoring. The emissions that could be avoided by a switch to satellite monitoring by NGET, NGGT and UK network operators in general will be estimated as part of Alpha phase updated cost benefit analysis. Many consumers will welcome a reduction in the noise pollution caused by aerial monitoring mainly performed by helicopters . End Consumers will benefit from higher grid reliability, lower land and asset motion related O&M and emergency pylon replacement costs. The general cost benefit analysis identified that proposed applications can deliver up to £22m NPV value against business as usual, mainly through reduce cost from emergency asset replacement and reduced cost for manual inspections. How these savings can be shared with end consumers will be investigated in the Alpha phase.

## Risks And Issues

All risks are covered in a separate risk register and managed accordingly throughout the WP's within the project

# Project Plans And Milestones

## Project Plans And Milestones

The project will be delivered by three work packages (WP)

WP1. Solutions R&D investigation (change detection, land and asset motion)

Task 1.1 - Solutions R&D investigation change risk detection. Build change risk register (change type, size, EO detection likelihood and risk priority), and use data from several data provider to test detection accuracy. Monitoring of 400 km of network to identify method accuracy.

8/17/22, 4:54 PM Print application - Innovation Funding Service

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Task 1.2 - Solution R&D investigation of land motion. Across several test sites process APSIS and PSInSAR data analytics to compare methods efficiency. Investigate the effectiveness of corner reflectors at generating points that are persistent scatterers, estimate cost of the optimal solution.

Task 1.3 - Solution R&D investigation asset motion. Across same test sites process APSIS and PSInSAR analytics to compare methods efficiency. Investigate effectiveness of corner reflectors at generating points that are persistent scatterers on assets such as buildings, pipelines and pylons, estimate cost of the optimal solution.

Lead party: Spottitt

Support party: Cranfield University, Terra Motion and Airbus (via Spottitt).

Deliverable 1: Technical analysis report of solutions R&D investigation (change detection, land and asset motion)

WP2. Integration into business as usual

Task 2.1 -- Detailed cost benefit analysis of the technical solutions considering use cases, regulation, technology development and integration costs

Task 2.2 - Review of Networks requirements for integration with existing data systems and processes

Lead party: NGET

Support party: Wipro, DNV

Deliverable 2: Integration into business-as-usual requirements and cost benefit case

WP3. Future development and demonstration requirements

Task 3.1 - Summary of technical requirements for business and usual

Task 3.2 - Summary of integration requirements for business as usual

Task 3.3 - Solution optimization, test plan and process reimagination

Task 3.4 - Roadmap to business as usual

Lead party: DNV

Support party: All parties

Deliverable 3: Report of future development and demonstration requirements

8/17/22, 4:54 PM Print application - Innovation Funding Service

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The project plan Gantt chart can be found in the appendix. It shows 3 key review meetings (Kick-off in Month 1, Mid Term Review in Month 3, and Final Review in Month 6) during which project progress/risks/findings etc versus plan will be reviewed. Between review meetings the core team will meet every two weeks. Changes to the project partners between Discovery and Alpha are as follows. ESA continues to support the project providing access to free and open-source Sentinel-1 data and their involvement as a named project partner was not

considered vital. Airbus (liaising via their official reseller Spottitt) has joined as named data provider as one of the market leaders in commercial satellite imagery. Terra Motion will support the project as subcontractor to Spottitt with their patented APSIS(c) land motion analytics. Wipro will support NGET as an expert in data systems integration to assess how solutions can be integrated with existing data systems. DNV have joined to provide expertise in asset management and quality assurance to assess requirements for future solutions demonstration. The project will be managed by DNV, who have significant experience delivering innovation, research and development projects through network funding mechanisms, including strategic change, technology policy and systems roadmap development. As Lead-Partner, NGET will be responsible for providing regular control and support to the day-to-day project management that DNV will deliver. This will ensure that the WPs remain on track to meet their strategic objectives and that technical challenges are resolved in a manner consistent with the enduser's innovation requirements.

From a project perspective the key success criteria are that the defined tasks should be delivered on time and within budget. In addition, confirmed combined network/customer benefits of services still shown to be >15 million GBP (NPV over 10 years).

### **Regulatory Barriers (Not scored)**

UK power network operators are not limited by the regulators to use any specific technology to monitor the risks and changes around the network, there are therefore no regulatory barriers in the short term (Alpha and Beta Phases) or in the longer-term transition of this project into business as usual.

While each satellite image providers have slightly different rules, the industry norm is that end users like networks do not actually buy satellite imagery, end users infact buy the license to use, store, view, share with 3rd parties, and perform analytics on the raw satellite imagery sold to them. To meet the needs of various internal networks end users who would like the freedom to store and share purchased imagery internally and with 3rd parties, it is important that during Alpha, Beta and business as usual phases the imagery licence sits with networks and not with the service provider. So for example for Alpha phase Spottitt will purchase satellite imagery but the named licensee will be NGET.

This project delivery and the use of high resolution satellite imagery raises no GDPR issues as no personal data is identifiable from the imagery being used and no personal data will be stored as part of the delivery of this project.

### **Business As Usual**

#### **Supply Chain Engagement**

As part of the Discovery phase, we evaluated the Satellite data supply chain, this included a detailed investigation into the type and quality of data available as well as access costs and number of providers. In Alpha phase , the intention is to define the potential business as usual scope for NGET, NGGT and potentially other licensees and work with data providers to develop network focused and the most cost-effective solutions to demonstrate effectiveness in real network operation while de-risking future business as usual (BAU) investments. We are keen to hold a dissemination meeting with the Energy Networks Association both to share the findings from the project but also discuss how they can be embedded in day-to-day operations for TOs and DNOs.

### **Roadmap**

A road map will be created for implementing the innovation into BAU. Part of this roadmap will include trialling of the new equipment in live operation during the Beta phase of the project. The programme implications of offline trials, parallel trials and first deployment trials need to be considered (as stated in the National Grid Transmission Policy Statement defining requirements for a new technology adoption).

**Further factors include:**

- \*Training requirements – the new technology will have operational requirements that operatives will need to become familiar with. Training will be rolled out to the workforce, which incurs costs and time.
- \*Technology impacts on business processes/systems and data - any impacts will be determined and mapped as part of Alpha and tested in Beta, before implementing the new technology as BAU.
- \*Avoidance of long term, single supplier dependency; technical assurance and capability - the supply chain will need to be evaluated and deemed competitive with a range of data and analytics providers.
- \*Cyber security threats will need to be assessed.
- \*Post-delivery support agreements (PDSA) and system/asset recovery will need to be established for the new technology.
- \*The recovery of the costs as part of pricing network reviews will also be investigated.

**Wider networks application**

The proposed technology applications being developed as part of this Alpha application can be, with minimal adoption efforts, utilised on electrical, gas, water, and other networks in the UK and overseas. We anticipate that the tools we develop will be adopted by the GB distribution network operators, subject to the availability of sufficient high-resolution data. We will explore the opportunities to disseminate findings through presenting results at industrial workshops and conferences, like CIGRE or IET. Cross industry learning can be shared to improve the solutions performance. The algorithms developed and IP generated can be licensed to commercial service providers and royalties generated returned to consumers.

## Commercials

### Commercialisation

NGET ensures it is not undermining the development of competitive markets in the short term by involving multiple project partners, testing multiple techniques and satellite data sources during this Alpha phase. In the longer-term post Beta phase standard NGET purchasing protocols require that this work to be announced via public tender, plus the results of all phases will be freely available to other UK Networks to enable them to tender for the same services if of value to them and their end consumers. Currently mainly NGET and NGGT have expressed an interest, however, project organised a workshop with GB DNOs to present project progress and will continue engaging with them to identify development requirements.

The primary customer segment for the proposed services are asset managers and those responsible for construction and network security within power, gas and water utility companies in the UK and internationally.

To commercialise this innovation strong commercial and technical partnerships with data providers and data processors will be important whether Networks chooses to license this technology themselves, or not.

### Intellectual Property Rights (Not scored)



All project partners understand that knowledge transfer is a key aim of the SIF, and that the learning from this project must be made available to other licensees and other interested parties to maximise the benefit to consumers delivered by the funding.

Foreground IPR produced by the project, such as a description of the application of a SEGIL technology to a network and the benefits this can deliver, will be communicated in the Alpha Phase reporting in sufficient detail to enable others to benefit appropriately from the learning delivered by this project. Confidential details of IPR will not be disclosed, however sufficient information will be provided to enable other licensees to understand the technology being developed and its applicability to their own networks. This is in the interests of all project partners as it is hoped that the solutions can be demonstrated to be technically and commercially viable so wider licensee understanding of the new technology could lead to additional network development activity and economic benefits for the supply chain, including our project partners.

Project compliance with the IPR arrangements as defined in Chapter 9 of the SIF governance document will be assured via the contractual arrangements which will be put in place between NGET and each of the project partners.

## Costs and Value for Money

The Discovery Phase costs were £94.8k during which the project team identified up to £22m (NPV over 10 years) of potential benefits against business as usual methods. The project costs below are for the "Alpha" phase only. For further details please see the attached spreadsheet. The project costs are aligned to the project plan as follows:

### Activity Responsible Partner Cost

Deliverable 1: Solutions R&D investigation

Lead: Spottitt (Supported by Cranfield University, Airbus and Terra Motion) £240k

Deliverable 2: Integration into business as usual

Lead: NGET (Supported by Wipro, Spottitt and DNV) £95k

Deliverable 3: Future development and demonstration requirements

8/17/22, 4:54 PM Print application - Innovation Funding Service

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Lead: DNV (Supported by all project partners) £70k

Project Management DNV £35k

Total £440k

Project partners request SIF funding in full to deliver the project, NGET will provide 10% of total project contribution as required by the SIF GD:

NGET (Including £70k Cranfield University and £65k Wipro costs) - £187k

Spottitt (Including £29k TerraMotion and £26.4k data procurement costs) - £150k

DNV - £100k

NGGT - £3k

Total £440k

NGET contribution £44k

SIF funding requested £396k

The Discovery phase has enabled us to investigate technical feasibility and general CBA of 12 satellite-based monitoring use cases. 2 were identified as being mature enough to be considered business as usual, 2 were identified as having too low a technology readiness level to be considered further. Of the 9 remaining, the three selected for progression to Alpha phase had by far the highest monetary value to National Grid and potentially customers yet the team recognise that to achieve a fully ready 'business as usual' Satellite analytics solution a significant scale of innovation funding over several years will be required that is difficult to achieve through the NIA mechanism or business as



usual investment, as the value would be delivered outside of RIIO-2 price control. However, this follow-on Alpha Phase funding is the next step in an innovation journey that will ultimately deliver improved network reliability and thus reducing blackout risk costs whilst delivering significant additional advantages and wider benefits to all GB networks and consumers.

#### Subcontractor Costs

Additional specialist works around maximising the number of asset motion measurement points and how resolution limits measurement/classification have been subcontracted by NGET to Cranfield University as part of this project and following on from their valuable involvement in the Discovery phase.

Additional specialist works around maximising the number of land motion measurement points have been subcontracted by Spottitt to Terra Motion.

The finances of all project partners are included in this summary.

Total costs (£)				
Funding sought (£)				
Funding level (%)				
Other funding (£)				
Contribution to project (£)				
186,980	142,800	76.37%	0	44,180
3,269	3,269	100.00%	0	0
148,250	148,250	100.00%	0	0
101,450	101,450	100.00%	0	0
Total	£439,949	395,769	0	44,180

providers of the patented APSIS(c) (Advanced Pixel System using Intermittent SBAS) land motion analysis technique.

NGET could subcontract certain parts of the WP2 to Wipro or DNV where internal resource or expertise may be limited. This will be addressed over the course of the project and inform Monitoring Officer accordingly.

#### Value for Money

The budget represents value for money for the following reasons:

\*Significant scope is being attempted within the six-month project timeframe, with 1200 km of network being monitored for risks and changes using satellites and up to 400km of network analysed for land and asset motion as part of the service development work.

\*Daily rates are at UK industry norms for similar engineering or consulting services

\*Spottitt's subcontractor and material costs for satellite imagery and cloud storage and processing will be passed through with no margin added, the same is true for Cranfield University costs when passed through NGET

\*The size of the 22million GBP (NPV over 10 years) benefits opportunity to NGET and customers through a combination of cost savings by replacing manual ground and aerial monitoring, and cost avoidance through increased risk awareness.

## Supporting Documents

### Documents Uploaded Where Applicable

Yes

#### Documents:

10037439 - Eye in the Sky - Ofgem Alpha award letter.pdf

10037439 application - Eye in the Sky.pdf

EiTS Risk Register.xlsx

SIF Alpha Project Registration 2022-12-12 2\_18

SIF Alpha Project Registration 2024-02-20 11\_15

**This project has been approved by a senior member of staff**

Yes