Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.

NIA Project Registration and PEA Document

Date of Submission

Oct 2026

Project Reference Number

NIA3_NGET0046

Project Registration

Project Title

AIMS: Air System Integrity through Metal Sealing

Project Reference Number

NIA3_NGET0046

Project Licensee(s)

National Grid Electricity Transmission

Project Start

November 2026

Project Duration

1 year and 7 months

Nominated Project Contact(s)

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Project Budget

£997,500.00

Summary

AIMS will develop and demonstrate a method for sealing leaks in high-pressure compressed-air systems while they remain operational. Pneumatic equipment is essential to safe, reliable electricity transmission substations, but leaks increase compressor running, energy use, maintenance and asset wear. Conventional repairs can require difficult-to-arrange outages and scarce specialist resources. RW Seals' M3 technology uses bismuth alloy applied by spray or a purpose-designed mould to seal a flowing leak. The 18-month project will develop solutions for atmospheric and operational pressure, test safety and performance across the intended pressure range, undertake field pilots where safe and practical, validate key cost-benefit assumptions, and define a route to business-as-usual deployment. Benefits include lower operating costs and energy use, longer compressor life, reduced outage demand, improved reliability and transferable learning for other networks and industries.

Preceding Projects

NIA2_NGET0016 - Novel methods for sealing SF6 leaks

NIA2_NGET0049 - Sprayed Metal for Effecting Leaking Transformer Repairs (SMELTeR)

Third Party Collaborators

Rawwater Applied Technology Limited

Nominated Contact Email Address(es)

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Problem Being Solved

High-pressure compressed-air systems support safety-critical and operational equipment in transmission substations, including pneumatically operated assets and air-insulated switchgear. When these systems leak, compressors must run more frequently to maintain pressure. This increases electricity consumption, operating cost, maintenance demand and mechanical wear, shortening compressor life. It also uses experienced engineering resources that could be directed to higher-priority work. The current efficient repair options are constrained because many leaks cannot be addressed without depressurising equipment or arranging an outage. Outages are difficult to plan, may reduce network availability and require staff to remain ready to restore equipment rapidly if system conditions change. A conventional repair or replacement may therefore be delayed while the leak and its consequences continue. Initial investigations found 15 of 22 compressors across seven sites operating beyond expected runtime, and wider operational data indicates that leakage is a material contributor. The challenge is to establish a safe, validated and scalable way to repair accessible leaks without compromising pressure-system integrity or electricity system reliability.

Method(s)

The project will use staged development, demonstration and field validation. RW Seals will develop M3Spray and M3Cast application methods using low-temperature bismuth alloy to stem and reinforce flowing leaks. Phase 1 will develop and test an atmospheric-pressure solution and prepare the high-pressure work. Phase 2 will develop and pressure-test the live leak solution, starting at 20 bar and targeting the operational range up to 65 bar. Testing will address pressure holding, failure modes, alloy ingress, vibration, reversibility, removal for emergency return to service and the practical time needed to seal multiple leaks. Safety and performance evidence will gate field pilots. Phase 3 will assess use by TO personnel or contractors, training, surveys, deployment priorities, value tracking and the potential appropriate business-as-usual operating models.
This method has been selected based on experience with suppliers looking at different issues not directly related, but relevant to this topic. Investigation of this technology within ordinary business activities was attempted several times. The barriers to doing so were too great, leading to the establishment of the AIMS project as the most suitable method to progress these investigations. The BAU attempts also highlighted the high potential impact of such a solution being validated and deployed, allowing the refinement of the project to meet business needs and demonstrate the value of the opportunity.

Data Quality Statement (DQS):
The project will be delivered under the NIA framework in line with OFGEM, ENA and NGGT / NGET internal policy. Data produced as part of this project will be subject to quality assurance to ensure that the information produced with each deliverable is accurate to the best of our knowledge and sources of information are appropriately documented. All deliverables and project outputs will be stored on our internal sharepoint platform ensuring access control, backup and version management. Relevant project documentation and reports will also be made available on the ENA Smarter Networks Portal and dissemination material will be shared with the relevant stakeholders.

Measurement Quality Statement (MQS):
The methodology used in this project will be subject to our supplier’s own quality assurance regime. Quality assurance processes and the source of data, measurement processes and equipment as well as data processing will be clearly documented and verifiable. The measurements, designs and economic assessments will also be clearly documented in the relevant deliverables and final project report and will be made available for review.

Scope

The project covers development and validation of bismuth-alloy sealing methods for accessible leaks on NGET high-pressure compressed-air pipework and relevant pneumatic assets.
Work includes: requirements and leak-type review; development of spray, cast and mould solutions; representative laboratory and workshop testing; safety and performance assessment; validation across 20-65 bar where achievable; evidence on alloy ingress, vibration, seal stability and failure behaviour; timed emergency-return-to-service and multi-seal demonstrations; atmospheric-pressure and high-pressure pilots where safety gates and site access permit; updated cost-benefit analysis; dissemination; and a business-as-usual transition plan.
The current programme is 18 months, front-loading development and allowing later activity for pilots and deployment planning. The project does not authorise uncontrolled live application. Any field use remains subject to approved risk assessment, pressure-system governance, site controls and the agreed technical acceptance route.

Phase 1: Atmospheric pressure common solution, technical underpinning testing and high pressure preparation work
Phase 1 targets a low pressure solution (under 1-day outage conditions where the pressure is reduced to atmospheric and the mould solution is applied) with an Emergency Return to Service (ERTS) of 1 hour and preparation work for a high pressure solution, alongside underpinning the solution technically. Performance requirements and safety requirements will be gathered and documented to inform testing to underpin transition to BAU however the key requirements are currently understood to be:
· Alloy seal performance under pressures of 20 – 65 bar

· Alloy seals performance due to vibrations from air flow (flow-induced vibrations)
· Alloy ingress during seal application at atmospheric pressure
· Failure mode analysis – if the seal fails, how will it fail – up to 1.5 times the operating pressure
· Alloy control – ensuring alloy is not deposited in unwanted areas

The phase 1 solution will consider flexible or standardised moulds for air ring mains which are considered viable options due to repeatability of design of air ring mains, and deployment at atmospheric pressure. To support test work, a dedicated pressure rig, capable of achieving 20 – 65 bar of gaseous pressure will be designed, risk assessed, built and commissioned. In addition, rigs for failure mode testing at 1.5 x operating pressure (water), and vibration testing due to air flow will be built. Development of the alloy solution will be carried out to the performance requirements, working from 20 bar pressure holding upwards. This will consider alloy reinforcement to meet performance requirements if needed, while maintaining the benefit of reversibility if practicable. A set of tests will also be carried out towards the end of Phase 1 on alloy ingress, vibration and failure mode to provide a body of evidence to underpin the risk assessment to safely apply the seal for the operational envelope tested, and understand how the seal will perform in the operational environment it will be exposed to. The test plan and results will be discussed with NGET and if required, additional development and testing will be planned into Phase 2 to support transition to BAU. The final atmospheric solution will then be tested for alignment with the original CBA, including alignment with the ERTS testing. Surveys and information gathering will also be carried out to identify common leaks beyond ring mains and already surveyed leak sites. A pilot site will be identified for air ring mains and other air leaks. If safety testing has passed, a pilot will be carried out, however the pilot has been removed from the critical path to mitigate risk of site access. In parallel, preparation will be done for phase 2 in the form of M3 handheld spray development for gaseous leaks, starting at low pressures and working upwards towards the operational pressure range. Research will be carried out into the theoretical factors which have to be true to get a good seal against a high-pressure leak, and whether the introduction of the combined solution indicates that the pressures required in placing M3Cast can be minimised. Research and analysis will also be done into high pressure holding mould solutions for viability to ensure the highest chance of success in Phase 2. A report and interim learning dissemination (specific channel to be identified) will share phase 1 outcomes.

Objective(s)

1. Develop a repeatable method for sealing accessible compressed-air leaks at atmospheric pressure and at operational pressure without creating unacceptable safety or asset risk.

2. Demonstrate pressure-holding capability from 20 bar towards 65 bar against defined acceptance criteria.

3. Establish failure modes, reversibility, alloy-ingress risk, vibration response, seal stability and emergency removal requirements.

4. Demonstrate whether an emergency return-to-service time of one hour and installation of three seals within one working day are achievable.

5. Complete field pilots where safety, site access and operational conditions allow.

6. Validate the cost-benefit assumptions using measured test and operational evidence.

7. Define training, competence, deployment, assurance, monitoring and ownership arrangements for a scalable business-as-usual model.

8. Share learning so other GB network licensees can assess applicability to their compressed-air assets, and rapidly deploy if the solution is suitable.

Consumer Vulnerability Impact Assessment

An assessment of distributional impacts (technical, financial and wellbeing related) for this project has been carried out using a bespoke assessment tool, which assesses the project as having a neutral effect on consumers in vulnerable situations. To help inform the assessment, this tool considers the categories of consumers identified in the Priority Services Register. This project has been assessed as having a neutral impact on customers in vulnerable situations. This is because it is a transmission project. Potential indirect benefits are positive: reducing avoidable operating cost can support efficient network charges, while avoiding or shortening outages can support continuity of supply.

Success Criteria

The project will be successful if it:
(1) defines controlled application methods and acceptance criteria for target leak types;
(2) demonstrates pressure holding from 20 bar towards 65 bar, with the achieved envelope clearly evidenced;
(3) characterises failure modes, alloy ingress, vibration, stability and reversibility sufficiently to support a safety decision;

(4) demonstrates removal or make-safe activity compatible with a target one-hour emergency return to service;
(5) demonstrates whether three representative seals can be completed within one working day;
(6) completes at least one atmospheric pilot and, subject to safety approval and site availability, a high-pressure pilot;
(7) produces traceable data and an updated CBA that tests the principal assumptions;
(8) delivers training requirements and a practical BAU transition plan; and
(9) publishes appropriate learning and de-sensitised outputs. Partial technical success will still be reported, including confirmed limitations and no-go applications.

Project Partners and External Funding

Nil – project is not co-funded and utilises only the supplier.

Potential for New Learning

The project will establish whether a bismuth-alloy seal can be safely applied against flowing compressed air at pressures substantially above previous applications. New learning will include the usable pressure and leak envelope; suitable leak geometries, materials and mould arrangements; surface preparation; seal strength and durability; failure behaviour; risk of alloy ingress; vibration response; reversibility; emergency removal; application time; training and competence needs; field practicality; inspection and monitoring requirements; and costs and benefits at scale. The work will also compare atmospheric-pressure and live-pressure repair routes and identify when each is appropriate.
Learning will be captured in test plans, results, pilot reports, CBA updates and a BAU transition plan, with appropriate de-sensitised outputs shared through NIA reporting and industry engagement. NGET will openly communicate with other networks around the project progress throughout, with a view to enabling fast follow for others. This will not be restricted to the project close but is open to provide regular updates where they can provide value to others. Where other networks engage with the project with specific requests, tailored outputs will be provided depending on their requirements as much as reasonably practicable, to enable and encourage assessment and progress. Suitable high-value dissemination opportunities will be determined as the project progresses, depending on results.

Scale of Project

The scale is proportionate to the technical and safety challenge and the potential network benefit. The project progresses from TRL 4 to TRL 8 and must address laboratory development, performance and safety testing, representative scenarios, field pilots, operational training and deployment planning. A smaller project would be unlikely to cover both atmospheric and live-pressure solutions, the 20-65 bar target envelope, multiple leak geometries, failure-mode evidence and operational demonstrations needed for a credible decision. The opportunity is scalable: NGET operates hundreds of compressor systems, and compressed-air systems are also used by other electricity, gas, nuclear and industrial operators. The project is structured to fail fast where necessary, with pilots kept off the critical path, so expenditure can be controlled if the solution cannot safely meet the required envelope.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

Development and controlled testing will take place at RW Seals facilities and other approved test locations. NGET asset surveys and pilots will use selected GB transmission substations subject to safety approval, operational need, outage conditions and site access – a key dependency is where the operational teams using the equipment will be based for their BAU activity at the time testing is required, which cannot be determined in advance due to the nature of their work. Sites already surveyed include 4 operational locations, but the final pilot sites have not been confirmed. The learning and potential deployment apply across the NGET transmission estate and may be relevant to other GB network licensees with high-pressure compressed-air systems.

Revenue Allowed for the RIIO Settlement

No specific surplus revenue has been identified. Any avoided expenditure or efficiency benefit will be quantified through project benefit tracking.

Indicative Total NIA Project Expenditure

997,500 total including contingency.
NIA expenditure 897,750

Internal costs 200,000 to cover personnel time supporting RW Seals milestones as below, plus consumables.

M - 1
Phase 1 Kick Off
Phase 1 - Atmospheric pressure solution, technical underpinning testing and high pressure preparation work
Start Date + 0 months
£150,000

M - 2
Performance & Safety Requirements
Key requirement workshops and documenting
Start Date + 3 months
£100,000

M - 3
Phase 2 Kick Off
Phase 2 - High pressure leak sealing solution
Start Date + 6 months
£100,000

M - 4
Handheld equipment manual provision & Phase 3 Kick Off
Phase 3 - M3Spray use by NGET and Progression to BAU
Start Date + 7 months
£15,000

M - 5
Safety Test – Scoping and Planning

Scope and plan for future testing
Start Date + 7 months
£150,000

M - 6
Phase 2 Performance Testing start
Testing of high pressure leak sealing solution
Start Date + 10 months
£100,000

M - 7
Phase 1 Report
Report on phase 1 results, plus CBA
Start Date + 14 months
£50,000

M– 8
Atmospheric Solution Pilot
First pilot on systems at atmospheric pressure (not live systems)
Start Date + 15 months
£10,000

M- 9
Phase 2 Report
Report on phase 2 results
Start Date + 16 months
£25,000

M- 11

High Pressure Solution Pilot
Pilot on systems at high pressure (live systems)
Start Date + 17 months
£25,000

M- 12
Project Summary Report
Reporting on project, administrative closure activities
Start Date + 18 months
£10,000

Project Eligibility Assessment Part 1

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations

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:

The project is not designed specifically for consumers in vulnerable situations and a formal impact-tool assessment remains required. Its potential benefit is indirect. Improved network reliability and fewer or shorter outage requirements support continuity of electricity supply, which can be particularly valuable to consumers who are medically dependent on electricity or have limited ability to respond to an interruption. Lower avoidable operating and maintenance costs can also support an efficient network cost base. No direct customer-facing intervention, differential access condition or adverse distributional impact has been identified

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

n/a

Please provide a calculation and/or description of the expected benefits of the solution

Baseline options are do nothing, conventional part replacement requiring an assumed two-day outage and four-hour emergency return to service, and atmospheric repair requiring an assumed one-day outage and one-hour emergency return to service. The innovation case targets live repair with no outage. Operational data from 20 systems across seven sites was extrapolated to known systems. Sensitivity analysis assumes 10%, 25% or 75% of leaks can be accessed and sealed. The worst case estimates about £0.3 million annual savings, a three-year payback and 30-50 outage days avoided. The central case estimates £1.3-£1.6 million annual savings, a 0.7-year payback and 70-140 outage days avoided. Recipients are electricity consumers through efficient network costs and reliability, and NGET through reduced energy, maintenance, outage and specialist-resource demand. These are estimates to be validated during the project.

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

NGET has hundreds of compressor systems. The method may be applicable to accessible leaks in compressed-air ring mains, unions, bulkheads and pneumatically operated assets, subject to leak geometry, material, pressure, condition and safe access. The project will define the application envelope rather than assume universal suitability. The learning may also be relevant to other GB electricity transmission and distribution licensees, gas networks and industrial users with compressed-air systems. Replication will depend on survey results, competent-person requirements, approved procedures, training, assurance and economic prioritisation.

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

A complete GB rollout cost is not yet available because the project must determine which leak types can be sealed, the delivery model, training requirements and the per-repair service cost. The CBA compares conventional replacement, atmospheric repair, live repair and do nothing, but the source material does not provide a validated network-wide rollout budget. Phase 3 will establish the preferred model, including supplier-led deployment versus trained NGET or contractor personnel, equipment, consumables, competence, assurance, surveys, inspection and value tracking. As this methodology is to replace existing costly and time-consuming methods reliant on outages, operational colleagues indicate that any success in this methodology is likely to represent cost savings against the

current process.

Requirement 3 / 1

Involve Research, Development or Demonstration

Projects 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

Involve Research, Development or Demonstration - Please select all that apply

☑ 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

Other Network Licensees can use the outputs to decide whether bismuth-alloy leak sealing is applicable to their compressed-air assets, how to survey and prioritise leaks, what pressure and geometry limits apply, what controls and competencies are required, and whether supplier-led or in-house deployment is economic. Test methods, acceptance criteria, failure-mode findings, operational evidence, CBA assumptions, training considerations and the BAU model will support informed replication while avoiding unsafe or unsuitable applications. De-sensitised learning will be shared through the required dissemination platform and appropriate industry forums.

n/a

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. Networks must explicitly mention similar projects that they have considered and how these differ.

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

The review identified different leak projects and no duplicate. NIA2_NGET0049 SMELTeR investigated transformer oil leak sealing, NIA2_NGET0016 developed methods for SF6 leaks. These projects demonstrated some transferable application knowledge but do not validate live sealing of high-pressure compressed-air system, which have very different considerations. AIMS is distinct because it targets compressed air, pressures up to 65 bar, different leak behaviour and operational hazards, and a BAU model for atmospheric and live-pressure repair.

Gas properties, operating pressure, leak geometries, asset consequences and safe systems of work differ. Previous applications do not provide evidence that a seal can be safely applied, remain stable or be removed against NGET compressed-air pressures. Reusing proven elements reduces risk and cost, while the new testing addresses a separate operational problem and creates learning transferable to other networks.
The proposed innovation is the live application of low-temperature bismuth alloy to stem and reinforce leaks in high-pressure substation compressed-air systems. This operational pressure is materially higher than previous investigations and a deployable high-pressure solution without a maintenance outage has not been achieved.
BAU methods using depressurised repair are constrained by cost, outage unpredictability and operational impact. The project combines new application equipment and moulds, pressure and safety validation, representative emergency scenarios, live pilots and an evidence-led BAU model. It will also test whether trained NGET or contractor personnel can deploy the solution, improving scalability beyond a small specialist workforce.

Attempts were made to undertake similar work within BAU environments, but this failed multiple times. The learnings from these failed attempts highlighted the need for this distinct innovation project, and also highlighted how valuable the solution could be.

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

Not applicable.

Additional Governance And Document Upload

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

The proposed innovation is the live application of low-temperature bismuth alloy to stem and reinforce leaks in high-pressure substation compressed-air systems. The source material states that this operational pressure is materially higher than previous investigations and that a deployable high-pressure solution without a maintenance outage has not been achieved. Earlier BAU attempts using depressurised repair were constrained by cost, outage unpredictability and operational impact. The project combines new application equipment and moulds, pressure and safety validation, representative emergency scenarios, live pilots and an evidence-led BAU model. It will also test whether trained NGET or contractor personnel can deploy the solution, improving scalability beyond a small specialist workforce.

Relevant Foreground IPR

Expected foreground includes project-specific spray, cast and mould developments; application procedures; pressure-test methods and results; safety and failure-mode evidence; leak-type and deployment guidance; training requirements; CBA updates; and the BAU transition model. RW Seals brings background IPR in M3 alloy technology, equipment, know-how and existing patents. Access to that background is required to use some foreground outputs.

Data Access Details

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:
A request for information via the Smarter Networks Portal at https://smarter.energynetworks.org, to contact select a project and click ‘Contact Lead Network’. National Grid already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
Via our Innovation website at https://www.nationalgrid.com/uk/electricity-transmission/innovation
Via our managed mailbox box.NG.ETInnovation@nationalgrid.com

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

BAU repair methods have not provided a safe and practical way to seal these leaks at operational pressure. Conventional repair can require depressurisation, outage planning, specialist attendance, component replacement and uncertain access. The proposed method is at TRL 4, is unproven at the required pressure and introduces technical, safety and operational uncertainties that BAU teams cannot accept without structured development and demonstration.
Previous failed attempts at undertaking air leak sealing within BAU highlighted that a dedicated innovation project is needed to establish the application envelope, failure modes, safe controls and operating model before the solution can be adopted. The previous attempts highlighted not only the need for this project, but also the high value of it being undertaken.

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

NIA support is required because the project carries technical risk that seals may not hold across the 20-65 bar target range or across relevant geometries; safety risk from working on live pressure systems and possible alloy ingress or uncontrolled failure; operational risk from pilots on critical assets and the need for rapid emergency return to service; commercial risk from developing specialist equipment, moulds, training and a scalable delivery model before demand is proven; and regulatory and assurance risk because the method changes how pressure-system leaks are managed. The benefits could extend across GB networks and wider industry, but a single BAU repair budget would not normally fund transferable R&D, controlled failure testing, dissemination and cross-network learning. The staged, fail-fast plan limits exposure while generating evidence for a deployment decision.

This project has been approved by a senior member of staff

☑ Yes