Scottish & Southern Electricity Networks
TRANSMISSION

SIF Round 4 Project Registration

Date of Submission

Jun 2025

Project Reference Number

SHET/ANZEN/ODIN/ Rd4_Discovery

Initial Project Details

Project Title

ODIN – Optimisation and Diagnostics for Innovative Networks

Project Contact

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Challenge Area

Accelerating towards net zero energy networks

Strategy Theme

Optimised assets and practices

Lead Sector

Electricity Transmission

Project Start Date

01/05/2025

Project Duration (Months)

3

Lead Funding Licensee

SSEN - Scottish Hydro Electric Transmission

Funding Mechanism

SIF Discovery - Round 4

Collaborating Networks

Scottish and Southern Electricity Networks Transmission

Technology Areas

Asset Management

HVDC

Maintenance & Inspections

Condition Monitoring

Electricity Transmission Networks

Project Summary

SSEN-T previously delivered the NIA AIM High Project which introduced an autonomous robot within an inaccessible HVDC valve hall to perform monitoring tasks. Currently, data gathered from the robot and the related operational data is managed manually and is labour-intensive with no trend analysis or data management package available.

This SIF Discovery ODIN Project will investigate automated interpretation and diagnostics of data collected from continuous monitoring from robots operating in these halls. This will use modern analytic techniques including machine learning and artificial intelligence (AI). The use of modern condition-monitoring techniques will allow us to improve on the system availability and manage outage periods more efficiently with informed asset management decisions. This will become important moving forward as we benchmark the current performance of the system before expected load increases. ODIN will prove a novel solution that can be adopted in existing and future asset designs reducing the need for unplanned maintenance and cost to customers.

Add Preceding Project(s)

NIA_SHET_0041 - Autonomous Inspection & Monitoring of High Voltage Assets (AIM High)

Add Third Party Collaborator(s)

Ross Robotics

Project Budget

£168,447.00

SIF Funding

£149,612.00

Project Approaches and Desired Outcomes

Animal testing

- ○ Yes
- ◉ No

Problem statement

High-voltage direct current (HVDC) converter station valve halls generate strong and hazardous electromagnetic fields (EMF), making them inaccessible to personnel while in operation. Therefore, live inspections of these assets are not possible. Instead, halls are accessible once per year during a scheduled maintenance outage, limiting the ability to diagnose issues in real-time, leaving a significant gap in monitoring and increasing the risk of undetected faults, unplanned outages, and inefficiencies in network operation.

Addressing this challenge, SSEN-T launched the NIA AIM High Project, introducing an autonomous robot to perform monitoring tasks within the HVDC valve hall. Following the Project's success, a further 7 robots will be deployed as part of SSEN-T's business-as-usual (BAU) HVDC operations in RIIO-3.

Currently, data collected from the robots' sensors and cameras, along with related operational data, is managed manually. This process is labour-intensive, requiring new data management and analytical solutions to efficiently handle large volumes of real-time data.

Video Description

www.youtube.com/watch?v=KternMZyHsE

Innovation justification

Challenge

The Project addresses Challenge 4 – Accelerating Towards Net Zero Energy Networks.

Innovation

SSEN-T is the first UK Network to integrate robotics into live fully operational HVDC converter stations to conduct autonomous inspections. The Ross Robotics' robot is currently the only robotic solution suitable for harsh HVDC environments. This Project can maximise the use of the gathered data to reduce operational expenditure and prevent unexpected outages. This will apply advanced analytical techniques to CBM and data insight techniques, such as AI, to detect incipient fault conditions, predict potential failures and provide insights to prevent equipment failure. Since SSEN-T have implemented the UK's first monitoring robot, analytical techniques maximising the use of the data are yet to be developed.

Developing these techniques now will enable benchmarking of the system's current performance before anticipated load increases add further thermal stress to the equipment.

Readiness

Please see attached Table 1 document.

Size & Scale

An agile approach is taken over 3 months to gain an understanding of how current processes could be improved to support the integration, management and operation of data analytics with existing data. At the end of Discovery Phase understanding will be sufficient to decide whether an Alpha Phase offers value for money and is feasible. Alpha will include further development of the solution enabling automated interpretation of data to facilitate operational decision making.

Funding

This new solution is innovative but unproven, requiring development and validation before it can be introduced as BAU. There are risks associated with implementation, including the effectiveness of the proposed technology and techniques within the Project scope. These must be tested to determine their viability. Additionally, there is a risk that the trialled solution may not be adopted into BAU therefore is best suited to be funded via SIF Discovery funding.

Counterfactual Solutions

If no action is taken, SSEN-T will continue to operate under the current status quo, unable to gain a complete picture of the condition of critical assets inside HVDC halls. The counterfactual solution is to manually interpret data to identify faults, without the advantages of data analytics. This approach increases the risk of missing faults, makes hall inspections inefficient, and limits data integration, making it difficult to develop new fault diagnosis methods. Ultimately, it restricts opportunities for a more intelligent and effective approach to operational maintenance.

Impacts and benefits selection (not scored)

Financial - future reductions in the cost of operating the network

New to market - services

Others that are not SIF specific

Impacts and benefits description

Financial - future reductions in cost of operating network

Currently, the maintenance of HVDC assets relies heavily on scheduled inspections and reactive repairs, leading to higher operational costs, increased risk of forced outages, and constraints on renewable generation integration. The existing approach lacks predictive analytics, resulting in inefficient resource allocation and potential asset failures. Key baseline metrics include system availability, frequency of forced outages, maintenance costs, and renewable generation curtailment due to asset constraints.

This innovation introduces condition-based maintenance (CBM) techniques enabled by advanced data analytics. By implementing CBM, we expect to significantly reduce forced outages, lower maintenance costs, and enhance system availability. Initial forecasts suggest that, at a network partner level, these improvements could result in cumulative net benefits through reduced downtime, extended asset lifespan, and optimised operational efficiency. These benefits will be measured using key indicators: outage frequency, maintenance expenditures, and asset performance over time.

Additionally, if commercialised, robotic inspection technologies would generate vast amounts of data, posing a challenge for operations teams. A dedicated data platform will be essential for collecting, storing, processing, and analysing this data efficiently. By streamlining data management, Partners anticipate cost savings in manpower hours, improved fault detection accuracy, and more targeted maintenance interventions.

New to market – services

Developing an industry-wide standardised methodology for assessing performance and operational behaviour in HVDC applications is essential. Using robotics as a sensor platform, will enable CBM in HVDC halls, including those that are otherwise inaccessible. Since HVDC halls are widely used, there is a significant opportunity for a UK company (Ross Robotics), to lead the market. By scaling up and commercialising this technology, they can position themselves as a first mover and serve a growing global market. The Project will enable efficient collation, analysis and visualisation of asset conditions within the halls supporting an effective asset management strategy.

Others that are not SIF specific

ODIN offers qualitative benefits including an enhanced reliability, efficiency, safety, and sustainability while reducing costs and improving overall operation and maintenance of HVDC systems. The use of modern condition-monitoring techniques will enable improvement of system availability and manage outage periods more efficiently with informed asset management strategies. Ultimately this supports acceleration towards a net zero energy network.

Completion of the Discovery Phase is likely to discover additional benefits and opportunities to address wider development and adoption within the industry. One of the outputs of Discovery is a quantitative cost benefit analysis (CBA).

Teams and resources

SSEN-T have successfully collaborated with Ross Robotics, building positive and productive working relationships from previous NIA funded Project (AIM High).

Lead

SSEN-T will lead WP1 & WP5, and support all other WPs, providing strategic oversight over the whole Project, while providing a dedicated Project Manager and Innovation Manager with expertise to deliver all Project Management activities. SSEN-T is best placed to lead this Project as the first & only TO in the UK to carry out inspections within inaccessible HVDC halls using autonomous robots.

Project Partner

Ross Robotics is a cutting-edge technology company focused on automated robotic monitoring and condition analysis in HVDC environments. Based in the UK with a team of highly experienced and qualified engineers, Ross Robotics has a portfolio of more than 40 international patents and has successfully completed both commercial and Government-funded projects in HVDC, Nuclear Decommissioning, Defence, Agriculture, Oil & Gas and Transportation. The platforms are designed to operate in challenging and harsh conditions where human intervention is too dangerous, costly or impractical. In HVDC the platforms have been deployed with SSEN-T, RTE, Elia, 50 Hertz, National Grid, and Amprion. In other industries, the platforms have been deployed at CERN's Large Hadron Collider, Chernobyl Nuclear Facility and a number of other uniquely challenging environments.

Ross Robotics' cloud data platform, AIDA, provides customers with an advanced cloud-based fleet management, data visualisation, and AI-powered data analysis and insights capability.

Ross Robotics will lead WP2-Data Ingestion, WP3-User Interface and WP4-Automatic Issue Identification, utilising their extensive experience in deploying and maintaining autonomous systems in HVDC environments and demonstratable track record of delivering reliable secure enterprise-class software in compressed timeframes.

Resources

The robot platform system is preinstalled into the HVDC hall at Blackhillock converter station from the NIA Project, therefore, in a state of readiness to commence the Project. The information gathered by the robot will support the development of the cloud data platform, AIDA.

Other External Parties

SSEN-T is engaging Hitachi Energy as a potential Project Partner for Alpha as the HVDC original equipment manufacturer (OEM) of Blackhillock HVDC converter station. Information gathered is of interest to HVDC transmission operators and manufacturers, which will be disseminated to other TOs throughout the SIF Project. SSEN-T are early adopters of this process within our HVDC valve halls, which other TOs may find high risk.

Project Plans and Milestones

Project management and delivery

Project Management Approach

SSEN-T will follow its well-established robust Project Management processes successfully applied to all previous SIF Projects and other Innovation Projects. Discovery Phase Projects will be run by applying an agile, flexible and adaptable approach throughout which is audited and compliant with the SIF Governance document. We have a dedicated SSEN-T SIF process document (Internal: PR-NET-GOV-532) that has been refined by the results of a recent internal audit conducted by the SSE Group Audit and will be followed throughout SIF Projects.

The Project is divided into 5 work packages as detailed in the Project Management Template uploaded to the application portal.

WP1: Project Management (Lead – SSEN-T)

(SIF funding request: £12,421)

WP2: Data Ingestion (Lead – Ross Robotics)

(SIF funding request: £41,623)

WP3: User Interface (Lead – Ross Robotics)

(SIF funding request: £41,623)

WP4: Automatic Issues Identification (Lead – Ross Robotics)

(SIF funding request: £41,623)

WP5: Data & Benefit Analysis Development (Lead – SSEN-T)

(SIF funding request: £12,321)

Links and Dependencies between WPs and Milestones are in the *Project Plan* within the *Project Management Template*.

Risk Management

A list of technical, management and commercial risks has been compiled by the Project Partners *(Project Management Template)*. Regular reviews will be held to track and update the Risk Register. The main risks and associated mitigations are:

- Failure of robot - limits viability of Project as the robot must remain in the hall until the next scheduled outage or scheduling an unplanned outage to rectify. To mitigate this the robot has been deployed at Blackhillock converter station for several months with suitable performance. It also has a redundant communications system for failover communications protection.
- Delivery delays - Discovery Phase is a very compressed timeline with a lot of work to cover. To mitigate this, all Partners will ensure they are ready to start work immediately, and they are clear on what tasks need to be conducted.

Planned or unplanned supply interruptions

The Project will not lead to any planned or unplanned supply interruptions for consumers and therefore will not have a detrimental effect on the consumer and will not require access to the electricity or gas network.

Energy Consumer Interactions

Whilst there is no direct Consumer contact anticipated, preventative and predictive maintenance can be carried out before the HVDC links are forced out of service, saving us money and time that would be spent on replacing damaged assets, and limiting constraints of renewable generation.

Key outputs and dissemination

Key Outputs

Implementation of this Project will allow us to better understand the performance and operating condition of the Caithness Moray Shetland (CMS) HVDC System. The use of modern condition-monitoring techniques will allow us to improve on the system availability and manage outage periods more efficiently with informed asset management decisions. This will become important moving forward as we benchmark the current performance of the system before expected network load increases. Ultimately the end of this Project will determine the Alpha plan and a CBA.

The outputs per work package are:

- WP1: A Discovery Phase that is completed as defined in the submission documentation and that meets the Project Direction (SSEN-T).
- WP2: Transfer and secure storage of raw inspection data from the on-site operator control unit (OCU) to the AIDA platform (Ross Robotics).
- WP3: A basic model-view-presenter (MVP) user interface once SSEN-T data is in the system (Ross Robotics).
- WP4: Finding and identifying conditions for further review in the incoming data (Ross Robotics).
- WP5: Identifying, prioritising, managing, and monitoring risks to information systems within our SSEN-T business, along with a further developed CBA (SSEN-T).

Dissemination

The methods for dissemination of the key outputs and lessons learned, shared as summary versions that respect commercial sensitivities, are:

- Each organisation has its own corporate website which is a platform for sharing the outputs of the Project.
- SSEN-T and the Project Partner will publish reports and data compliant with SIF Governance Clauses 9.1 to 9.33 that sets out SIF Governance for IPR. Data and reports will be available according to the treatment of IPR within the SIF Governance document.
- In addition, SSEN-T will signpost all reports and data generated that can be requested subject to appropriate confidentiality and commercial agreements being in place with the requesting party consistent with IPR set out in the Project funding application and subsequent collaboration agreements.
- Energy Networks Association Portal.
- Energy Innovation Summit Autumn 2025: to potentially present the findings of ODIN.
- Attendance at industry and research conferences including IET and CIGRE conferences.
- Discovery ‘Show and Tell’ Webinar, expected to take place July 2025.
- Hitachi HVDC Global User Conference in May 2025.

The Project team will work collaboratively to ensure the key targeted outputs are delivered and the knowledge learned is disseminated via suitable routes and platforms.

Competitive Markets

There are no activities or outputs in the Discovery Phase that will prevent other networks from procuring similar services from other parties.

Commercials

Intellectual Property Rights (IPR), procurement and contracting (not scored)

To ensure transparency is provided to the Project Partners, regarding the IP landscape, the Project will employ an IP register to capture the Project Background IP and any Foreground IP that is generated during the Discovery Phase of the Project, however, it is not anticipated that IP will be generated during this phase of the Project.

The default position for the governance of the Project (Collaboration Agreement) in terms of IP will be that described in the latest SIF Governance Document (currently Version 2.1) as part of Chapter 9.

Investment Needs

The Project Partners previously worked together on an NIA Funded Project, NIA_SHET_0041, Autonomous Inspection & Monitoring of High Voltage Assets (AIM High), funded £454,556. An autonomous robot was installed within the confined space of a HVDC valve hall to monitor equipment status and need for maintenance. This innovation would allow for any faults or need for maintenance to be identified without causing unplanned downtime of the system and allowing for engineers to perform condition-based maintenance. This Project provided a reliable alternative to current asset monitoring design within HVDC halls. SSEN-T are looking to include robotics in specifications for future HVDC converter stations. This innovation Project has successfully assisted with learning and defining specification of robotics and hall interfaces. The SIF ODIN funding opportunity is required for the next step of development in implementing robots into substations, to develop multiple data type analysis for adoption of CBM and enhanced predictive maintenance.

Value for money

Costs

The total cost for Discovery Phase is £168,447, with £149,612 (89%) requested in funding and £18,835 (11%) provided as internal contributions, meeting the 10% minimum requirement and ensuring value for money. Project costs are proportionate to the work delivered. SSEN-T and Ross Robotics offer competitive, non-profit rates aligned with previous SIF Innovation Projects and UKRI cost guidance, ensuring better value than standard industry rates.

SSEN-T costs: £43,435 to lead Project and manage the delivery of work. SSEN-T requests £39,092 (90%) of funding, contributing £4,343 (10%). SSEN-T will lead (WP1) Project Management & (WP5) Data & Benefit Analysis Development.

Ross Robotics costs: £125,012 with a funding request of £110,520 (88%), contributing £14,492 (12%). Ross Robotics will lead (WP2) Data Ingestion, (WP3) User Interface & (WP4) Automatic Issue Identification. This is the highest cost as it involves significant and complex data development across the 3 work packages.

Subcontractors

Jase Keeber (£19,968) Enterprise Architect - responsible for architecture, security and network of data solution.

Nidal Prasovic (£19,968) Solutions Architect - responsible for functionality and User Interface of data solution.

Dave Cooper (£3,200) IT & Networking.

Subcontractors are individuals with a long history of working with Ross Robotics, extensive knowledge of their products and working practices and highly specialist knowledge and expertise unique and critical to the success of the Project.

The Project will leverage the existing Ross Robotics platform, already installed at Blackhillock HVDC converter station.

Commercialisation

SSEN-T aims to integrate robotics into business-as-usual HVDC operations, expanding deployment to seven robots across its CMS multi-terminal HVDC system (subject to RIIO-T3 funding approval). Successful development of the AIDA platform in Discovery Phase will enable the technology package to be developed through Alpha & Beta stages, accelerating dissemination,

adoption and facilitating wider industry uptake among other TOs.

Robotics is expected to be adopted into SSEN-Ts Eastern Green Link joint ventures with National Grid and Accelerated Strategic Transmission Investment (ASTI) HVDC projects. The Project will support the specification and strategies for wider robotics deployment, condition monitoring and data management.

SIF funding provides major growth opportunities for Ross Robotics in both domestic and international markets. This cutting-edge AI-based technology has real cost and network availability impact for users and is key to the widespread deployment of robotics within the TSO sector. Ross Robotics expect the technology to generate significant revenue and employment growth as well as establishing them as a technology leader within this market.

Supporting documents

File Upload

ODIN Discovery Show And Tell - 1.4 MB
ODIN End Of Phase - 4.5 MB
SIF Round 4 Project Registration 2025-06-19 3_24 - 82.5 KB
Table 1.pdf - 8.2 KB

Documents uploaded where applicable?

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