SIF Alpha Round 3 Project Registration

Date of Submission

Feb 2025

Project Reference Number

10129395

Initial Project Details

Project Title

SYSMET – SYstem Strength Measurement and EvaluaTion

Project Contact

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Challenge Area

Novel technical, process and market approaches to deliver an equitable and secure net zero power system

Strategy Theme

Net zero and the energy system transition

Lead Sector

Electricity Transmission

Other Related Sectors

Electricity Distribution

Project Start Date

01/10/2024

Project Duration (Months)

6

Lead Funding Licensee

SSEN - Scottish Hydro Electric Transmission

Funding Licensee(s)

SSEN - Scottish Hydro Electric Transmission

Funding Mechanism

SIF Alpha - Round 3

Collaborating Networks

UK Power Networks

National Grid Electricity Transmission

Technology Areas

High Voltage Technology

Condition Monitoring

Measurement

Network Monitoring

Electricity Transmission Networks

Fault Current

Fault Level

Project Summary

As the share of inverter-based resources, including renewable generation, increases, lower system strength can lead to uncontrolled voltage changes which can escalate to instability and risk widescale customer disconnections. To secure the Net Zero grid, Network Owners urgently need to monitor system strength conditions to implement the most effective and economic mitigations. At present, neither the requirements for system strength monitoring nor the possible hardware and digital solutions are well defined. The SYSMET Project brings together leading experts to create the pathway for confident implementation of measurement-based tools that provide comprehensive visibility of system strength status for operational decision making.

Add Preceding Project(s)

SIF_SHET_024_SYSMET (1) - SYSMET - SYstem Strength Measurement and EvaluaTion

Add Third Party Collaborator(s)

National Grid Electricity Transmission

National Physical Laboratory

UK Power Networks

SSE Renewables

Imperial College London

Project Budget

£532,701.00

SIF Funding

£478,612.00

Project Approaches and Desired Outcomes

Animal testing (not scored)

- ○ Yes
- ⊙ No

Problem statement

Problem Summary

Electronic power convertors enable variable Inverter Based Resources (IBR) including wind, solar and battery storage to interface with the grid, but do not provide the same inherent stability as traditional fossil-fuelled rotating generators. Consequently, responses to disturbances are changing, and lower system strength is becoming an increasing concern moving towards Net Zero. A weak system may not recover from faults, resulting in uncontrolled voltage changes which can escalate to network instability. Without reliable visibility of system strength, Network Owners need to take conservative, non-targeted mitigating actions such as curtailment of IBRs.

To secure the Net Zero grid, Network Owners urgently need capabilities to monitor low system strength conditions to implement the most effective and economic mitigations. Traditionally, calculated fault levels were an indicator of system strength. However, there is growing evidence that fault levels do not fully reflect the response to disturbances in IBR-dominated power grids.

Project Evolution

The Discovery Phase has identified new definitions and metrics of system strength, in particular categorisation into small- and large-signal system strength. Small-signal system strength metrics indicate susceptibility to inverter-induced oscillations triggered by small disturbances while large-signal system strength metrics indicate ability to recover from major faults. It was established that small-signal system strength metrics can be monitored in real-time by measuring grid impedance at a range of frequencies to identify damping ratios that vary with inverter control settings and operating points.

However, at present, there is no existing capability in the GB grid to measure frequency-dependent impedance, thus preventing the online monitoring of new system strength metrics. Discovery Phase has identified innovative candidate solutions including active frequency scanning and AI/ML techniques. However, proven field demonstrations at transmission voltage levels are limited. There is no existing guidance or standard on performance expectations for a system to monitor frequency-dependent impedance and derived system strength metrics.

SYSMET plans to address this gap to enable industry-ready solutions. The Alpha Phase will:

- Develop standardised specifications for equipment required for system strength monitoring including injection sources and measurement systems.
- Develop standardised specifications for system strength monitoring software that transforms voltage and current measurements into three-phase impedance parameters and displays system strength metrics.
- Test and validate candidate solutions in simulation and laboratory testbeds.
- Engage with potential technology providers, estimate solution implementation costs, map governance processes for trial implementation in Beta Phase.
- Complete a Cost-Benefit Analysis of system strength monitoring.

Innovation justification

Challenge Theme

The Project addresses Innovation Theme 2 “Leveraging disruptive computing technologies for improving system visibility, performance, and cyber-security.”.

Innovation

GB grid operators are increasingly concerned with power system strength because of the rapid growth of renewable resources connected to the grid by inverters, but at present have only limited or no capability for real-time system strength monitoring. The state-of-the-art of system strength assessment is summarised by a lack of standardisation. Various versions of the Short Circuit Ratio (SCR), defined fundamentally as the fault level divided by nominal active power, have been proposed. However, the results do not necessarily provide consistent conclusions for network operation.

Two UK distribution system operators (SPEN and UKPN) are trialling real-time fault level monitoring, but this has not yet been demonstrated at transmission voltage levels. Fault level monitoring is based on measurement of the impedance at the fundamental frequency which characterises the responsiveness between changes in voltage and current. Inverters have more complex responses that span across frequencies other than the fundamental, which can induce e.g., sub-synchronous oscillations. Therefore, new system strength metrics require as input the impedance across a range of frequencies.

The SYSMET Discovery Phase has engaged directly with network contacts from five relevant previous innovation Projects, including the Strength-to-Connect and DOME Projects. Building on their outputs, a clear user requirement for real-time frequency-dependent impedance determination was identified. The Alpha Phase will directly utilise the SYSMET Discovery Phase outputs including a list of potential vendors, report on candidate measurement and machine learning techniques as well as preliminary measurement specifications and data accessibility requirements.

The core innovation of the SYSMET Project is a pathway to verified implementation of frequency-dependent impedance measurement to enable real-time monitoring of system strength metrics in the GB Net Zero grid dominated by Inverter Based Resources (IBRs). The target approach is an active frequency scanning method, which requires suitable injection equipment to create small perturbations in the required frequency range and measurement systems capable of extracting the response under normal grid operation conditions. The measured voltage and current signals will be processed with advanced digital signal processing algorithms robust to noise effects to obtain impedance values and transform these into system strength metrics. The use of machine learning techniques will be explored to extend spatial coverage.

Three technical work packages will develop specifications for solutions that leverage novel computational algorithms to achieve system strength visibility which will improve the performance of an IBR-dominated Net Zero power system, thus aligning with the SIF innovation challenge and with the SIF Alpha Phase both in scale and technical risk. The Project will expand to integrated demonstration with grid operation and control systems in the Beta Phase.

System strength monitoring via frequency-dependent impedance identification is a novel capability that goes beyond incremental extension of existing monitoring infrastructure. There is no blueprint implementation in the UK to provide guidance. New equipment and software may need to be procured and installed, tested and integrated, requiring dedicated resources and expertise that cannot be met within business-as-usual activities.

We are aware of high CRL system strength tools available, but these have not been adapted/proven in the UK. These and other novel SYSMET solutions for different system strength indicators are at low CRL for the UK market. TRL progression planned:

Current: TRL2/3 relevant processes understood in other applications.

Alpha: TRL4 is targeted through proof-of-concept validation in a commercial simulation environment.

Beta: TRL7 achieved through prototype demonstration in the field.

Impact and benefits (not scored)

Financial - future reductions in the cost of operating the network

Financial - cost savings per annum on energy bills for consumers

Environmental - carbon reduction – direct CO_2 savings per annum

New to market – products

Impacts and benefits description

Current Position

As the power system evolves to integrating more Renewable Energy Sources (RES), fossil-fuelled Synchronous Generators (SGs) are being displaced by Power-Electronics-Interfaced Devices (PEIDs) such as Inverter Based Resources (IBRs), which do not generally have the same inherent electromechanical properties as SGs such as large inertia capability.

The fundamental-frequency short-circuit level (SCL) and short-circuit ratio (SCR) have been traditionally used to define system strength in the SG-dominated power system. With the advent of RES and IBRs, one of the main assumptions that supported the use of SCL and SCR as system strength metrics, i.e. the dominance of SG-based electrical generation, no longer holds. Hence, a new way of measuring power system robustness for the electrical grid of the future is required.

Currently, there is no standardised approach to measuring system strength for the electrical grid of the future, where RES and IBRs will start to dominate electrical power generation and transmission. Furthermore, whilst there are monitoring tools and digital solutions available in the UK and internationally, they are immature and inadequate for IBRs.

Adopting a standardised approach to measuring system strength based on frequency-dependent impedance of grid-connected devices such as IBRs will ensure a stable transition to the RES-based electrical power grid of the future. This standard system strength measurement approach will enable manufacturers of grid monitoring systems to develop new and innovative devices that are fit-for-purpose and industrially relevant. It will also provide Network Owners with a set of requirements that can be issued to prospective monitoring tool providers who must demonstrate compliance with functionality and measurement accuracy requirements.

Reliable, widespread, and consistent monitoring of system strength indicators will enable Network Owners to address problems arising from lower system strength to ensure the availability of the power system. Furthermore, greater knowledge of real-time system stability will allow better decision-making when disturbances occur so mitigating actions minimise the overall cost and impact on customers.

Qualitative Benefits

High-level net benefits:

a) reducing constraints and costs for renewable generation customers.
b) increasing system resilience due to improved system stability, thereby reducing the risk of severe disruption.
c) optimising network operating costs and reducing consumer bills.

Quantitative Benefits

Benefits include reduced cost to the network’s balancing mechanism, Pathfinder 3 (addresses stability issues) plus a lower risk of outages; major or minor. The estimated cumulative discounted net benefits to consumers up to 2050, including SYSMET technology investment, is £220 million.

Financial - cost savings per annum on energy bills for consumers

Accurate quantification and measurement of the strength of the network allows efficient and targeted real-time deployment of stability services. Low system strength can cause issues with network stability and the default countermeasure is constraining generation and implementing stability services to increase the fault level or inertia of the system. These reactive actions can have high operational costs (£7 million per annum).

Environmental- carbon reduction - direct CO2 savings/annum against a business-as-usual counterfactual

Improvements in the management of grid stability build operational confidence in the stability of the network, allowing increased system capacity for renewable generation, and reducing CO2 emissions if it avoids the need to use of synchronous fossil fuel generation for system strength.

New to market– products

SYSMET defines a new way to measure system strength, measurement requirements, and test methods. Standardised requirements will enable focussed development and procurement of adequate hardware (injection equipment, instrument transformers and digital measurement devices) as well as software for evaluation and visualisation of system strength indices. Potential technology developers include Reactive Technologies and Outram Research Limited who have existing fault level monitoring products, as well companies that offer wide area monitoring solutions such as GE Digital.

Teams and resources

SSEN-T has established an exceptional team for this innovative SYSMET Project. We have previously collaborated with all Partners and built positive and productive working relationships through collaboration in previous SIF and other large-scale projects, including Discovery Phase of this Project. Imperial College London and SSE Renewables join the consortium in Alpha, bringing a wealth of expertise and valuable insight. The Partners, each expert within their fields, are best placed and committed to working together to progress through Alpha Phase.

Lead

SSEN-T is the owner of the electricity transmission network in the north of Scotland, maintaining and investing in high voltage 132kV, 220kV, 275kV, and 400kV electricity transmission, encompassing both AC and DC networks. SSEN-T is well placed to adapt SYSMET into BaU.

Project Partners

National Physical Laboratory (NPL) is a world-leading research organisation with excellence in measurement, data, computing, and digital science disciplines and is ideal to lead the development of standardised specifications for system strength measurement in SYSMET. NPL will lead WP2 to identify and investigate the requirements and availability of equipment for system strength measurement including injection sources and measurement systems whilst contributing to WP3 by developing specifications for impedance measurement algorithms. Additionally, they will complete laboratory test measurements in WP4 to assess the accuracy of candidate system strength measurement methods.

UK Power Networks owns and maintains electricity cables and lines across London, the Southeast and East of England, and makes sure power flows reliably, safely, and securely. UKPN's priorities are to tackle the climate crisis by connecting renewable energy, electric car chargers and low carbon heating, meet their customer's evolving needs by improving their services, support their customers in vulnerable circumstances and go above and beyond for the communities they serve.

National Grid Electricity Transmission (NGET) owns the transmission network in England and Wales, approximately 4,500 miles of overhead lines, and 900 miles of underground cables, all connecting 350 substations. NGET has extensive experience in leading innovation projects within areas of digitalisation, asset management and network condition monitoring.

Imperial College London is a world top-ranked university. The team, led by Prof. Tim Green, has rich experience and impactful publications in power system stability analysis and system strength definition, highly relevant to SYSMET The Imperial College Team also undertakes two National Innovation Allowance (NIA) projects with National Grid ESO: Strength to Connect, and Data-Driven Online Monitoring and Early Warning for GB System Stability (DOME), which were identified as closely related to this Project. Imperial College is newly involved in this Project due to their relevant experience, and their existing studies on new system strength metrics.

SSE Renewables (SSER)

SSER is a leading developer and operator of renewable energy, headquartered in the UK and Ireland, with a growing presence internationally. The Company has an operational portfolio of around 4GW of onshore wind, offshore wind and hydro generation, which produce 10TWh of renewable power each year with a further 15GW+ construction and development pipeline, with a team of around 1,500 renewable energy professionals based across the UK, Ireland, Spain, France, Italy, Greece, the Netherlands, Japan, and the USA. SSER have honed their skills through over 15 years of delivering world-leading projects with expertise in project design and optimisation, consenting and stakeholder engagement, financing, procurement, construction, and operations.

Resources and equipment

NPL will be using its facilities as a national laboratory to undertake measurements. Existing equipment in the form of multifunction calibrators, digital multi-meters, power amplifiers, transconductance amplifiers, transducers and current shunts will be used for measurement test setups. The provision of calibration for any equipment used will be undertaken from secondary reference standards maintained by NPL.

Project Plans and Milestones

Project management and delivery

The Alpha Phase is divided into six work packages. The total SIF funding request is £478,612, and the Partners are contributing a total of £54,089.

Project Management Approach

SSEN-T will follow its well-established robust and proven project management processes successfully applied to SIF Round 1 and 2 Alpha Phase projects (5 projects in total) by applying an agile, flexible, and adaptable approach throughout the Project. A dedicated SSEN-T SIF process document will be followed in the execution of SIF projects to ensure quality and consistency. Tools will include MS Office and interactive whiteboards.

WP1: Project Management [Lead: SSEN-T]

- Agreement and execution of Collaboration Agreement.
- Weekly Project Partner meetings, monthly risk and opportunity meetings and quarterly UKRI reviews.
- Regular project tracking and reporting against the plan including determining corrective steps should progress deviate significantly against the baseline schedule.

WP2: Specifications for System Strength Monitoring Hardware [Lead: NPL]

- Identify the requirements and availability of equipment to inject signals into the grid for impedance identification.
- Technical assessment of a system suitable for measuring the grid response to injected signals.

WP3: Specifications for System Strength Monitoring Software [Lead: ICL]

- Development of a software method (including an algorithm) to measure the impedance generated by an injection source.
- Determination of system strength metrics using the impedance information derived by software.
- Specify a methodology for communicating system strength metrics to network operations (considering BaU).

WP4: Simulation, Testing and Validation [Lead: SSEN-T]

- Determine how and where on the network a signal should be injected using systems models and simulations.
- Build an understanding of measurement error sensitivities using models and optimise injection specifics.
- Undertake trial measurement in a test bed as a means of validation.

WP5: Commercial Options and Governance Processes [Lead: NGET]

- Engagement with key projects (began in Discovery) and six key technology providers, including Reactive Technologies, Outram and GE Digital (began in Discovery) to explore collaboration opportunities for Beta.
- A techno-economic analysis of potential SYSMET solution and running trial on the network.

WP6: Development of CBA and Beta Application [Lead: SSEN-T]

- Establish a network working group to discuss and develop the CBA.
- Maturing of the CBA through Alpha based on the working group's activities.
- Initial Project Partner discussions held to begin the scoping of a potential Beta Phase.

Risk Management Strategy

SSEN-T has compiled a list of risks building upon the Discovery Risk Register and will conduct regular reviews (monthly) with all Partners to update the register. The top risks include (i) Collaboration Agreement sign-off. Mitigation: Use the Discovery version as the base and issue in advance of the start date (SSEN-T) and (ii) Not being able to secure suitable researcher for the work. Mitigation: The Imperial College team has multiple researchers in relevant areas and with certain flexibility, so a successor can be found if the major researcher leaves the team. The Project plan is based on existing NPL scientists, resources will be re-confirmed before Project start, and back-up staff identified.

Planned or unplanned supply interruptions

The Project has no detrimental effect on the consumer and will not require access to the electricity or gas network.

Consumer Interactions

Whilst there is no direct consumer contact anticipated, the Project aims to deliver equipment to reliably and accurately measure system strength in a network now dominated by IBRs, helping to drive better system operation decisions, thereby, improving network efficiency.

Key outputs and dissemination

Key Outputs

The top-level technical output of the Alpha Phase will be a validated model that produces a perturbation (injected signal) in a virtual electrical system from which the impedance may be calculated in real-time.

The overall objective of the Alpha Phase is to enable the implementation of online system strength monitoring based on frequency-dependent impedance measurement in the GB power system by:

- Developing detailed standardised specifications for high-voltage injection equipment and measurement systems. Assess the suitability of existing network assets against specifications. Identify candidate implementation locations.
- Developing detailed standardised specifications for algorithms to evaluate impedance and system strength metrics from measurement data. Determine the required injection level considering real grid characteristics. Assess integration with existing monitoring and modelling systems in terms of data flows, communications, and visualisation.
- Identifying technology partners for implementation of hardware and software requirements.
- Developing validation methods to verify the accuracy of new system strength monitoring solutions.
- Understand governance processes for field implementation including network approvals, and compliance with grid codes and standards.

The outputs per work package are:

WP1: An Alpha Phase that is completed as defined in the submission documentation and that meets the Project Direction (SSEN-T).

WP2: The requirements and specification for the injection source and the subsequent identification of suitable equipment (NPL, SSEN-T, NGET).

WP3: Software requirements for frequency-dependent impedance measurement and suitable algorithms able to measure this matrix. Methodology for transforming this measurement into a quantification of system strength (NPL, SSEN-T, ICL, UKPN).

WP4: Simulation data to refine the quality of the injection source and determine the accuracy of the impedance measurement. A laboratory test rig is used to validate measurement hardware using simulated inputs (SSEN-T, ICL, SSER, NPL).

WP5: Identification of technology providers as possible collaboration partners in a Beta Phase. A framework for how the system could be trialled on the network (All networks).

WP6: Cost estimate for SYSMET solution plus a further developed CBA, compared to the version submitted as part of the Alpha application (SSEN-T).

Dissemination Opportunities

- A Project poster will be created early in the Alpha Phase as a vehicle to disseminate SYSMET externally and to encourage involvement moving forward.
- All Project Partners have websites; a platform for sharing updates on the Project and providing contact details to encourage participation.
- Project Partners will inform all stakeholders about the Alpha Phase ‘Show and Tell’ in advance to afford them the opportunity to attend.
- A poster will be available to promote the Project at the Energy Innovation Summit (October 2024), a widely attended event by networks and innovators alike.
- Publication of Project documents on the publicly available ENA Smarter Networks Portal.

- NPL and ICL plan to disseminate Project results through professional networks such as CIGRE UK and the European Metrology Network on Smart Electricity Grids.
- ICL will explore the possibility of publishing results in a technical journal subject to agreement by all Project Partners.

Commercials

Intellectual property rights, procurement and contracting (not scored)

The Intellectual Property Rights (IPR) arrangements will be defined in the Alpha Phase Collaboration Agreement (CA) with the starting position being the terms agreed in the Discovery Phase. The latter is based upon those recommended in Chapter 9 of the latest SIF Governance document (v2.1). Given the Alpha Phase includes two new Project Partners (Imperial College London and SSE Renewables) the contract negotiations will need to include their feedback. The CA includes a schedule where Background Intellectual Property is to be declared to help ensure there is transparency across the partnership.

Any IP generated within the Alpha Phase will follow the terms laid out in the executed Collaboration Agreement. To reach a consensus on the Collaboration Agreement early in the Project, it will be issued before a funding decision has been announced to allow the new Partners, in particular, time to review the document and provide feedback. The plan is to share the Discovery Phase CA with the new Partners before the end of Q2 2024, after the application has been submitted, to allow plenty of time for reviewing and providing feedback before the Project starts, should the application be successful.

Commercialisation, route to market and business as usual

SYSMET aims to define a standard system strength measurement method based on frequency-dependent impedance measurements, which will enable a smooth energy transition to the renewable-energy-powered electrical grid. The ultimate objective of SYSMET is to ensure a safe and secure supply of electricity for the consumer. The standard method to identify frequency-dependent impedance resulting from SYSMET's Alpha Phase will be used for stability analysis in a large-scale offline electromagnetic transient simulation as well as in real-time. This method will inform the Transmission Owners (TOs) and the System Operator of potential sources of instabilities in the electrical grid. Corrective measures will be actioned based on this newly defined method to assess system strength and voltage stability. The Network Partners will identify real-world installations where the new, standard impedance measurement method will be deployed in the UK's electrical network.

Six potential technology providers, including three UK-based SMEs (Reactive Technologies, Outram, GE Digital) were contacted during the Discovery. The Alpha Phase will build relationships with the providers and develop a strategy for assessing options in the Beta Phase. SYSMET builds on several interrelated activities already underway in the TOs and ESO, which provide the basis for a route to deployment. This includes the synergies between SYSMET and other current efforts such as the Strength to Connect and DOME projects. In the Alpha Phase, modelling and analysis of GB's electrical network will be undertaken in a commercially relevant simulation environment based on representative models issued by the Partners.

SYSMET will deliver a significant contribution to the understanding and management of the sources of oscillatory instability in a converter-dominated network, with a route to industry-wide standardisation and future commercial roll-out of this Project's outcome. Setting out the details of that roll-out requires effort and collaboration across multiple parties. The route to a commercial system is expected to occur in several Phases, depending on the outputs of Alpha.

The Beta Phase aims to create both an offline and real-time frequency-dependent impedance measurement system that serves the purpose of TOs and ESO, as well as DNOs and Renewable Generators, to ensure the stability of the electrical grid. Beta will include at least one solution provider whose product offering will be aligned and developed based on the outcomes of Alpha. The deployment will follow, which may include additional offline testing before the system is installed on the live network. We may first see a 'TO only' system with the development of new solutions that can be installed within the operational technology network(s) of the relevant TO, to control TO-owned and operated assets. This could be delivered as part of the normal RIIO regulatory framework process if the Project establishes that it is beneficial for the GB consumer for it to be installed and developed. This may be followed by an ESO-managed system that can also control and recommend actions using User assets as well as TO-owned assets. This would require the development of the relevant market frameworks and industry practices.

SSEN-T is investing massively in the transmission network in Northern Scotland and can deliver these massive programmes of work. While the development and implementation of new solutions as envisaged by SYSMET will come at a cost and involve significant complexity, this will be relatively small in comparison to the wider programme of SSEN-T work. The Project Partners have consistently demonstrated their ability to trial and introduce novel approaches to system operation and the use of new technologies. The roll-out of SYSMET will build on this experience and be aligned with other change programmes as required to ensure the best value for GB consumers.

Policy, standards and regulations (not scored)

It is considered that there are no barriers to the delivery of this Project from present regulations, policies and standards. It is anticipated that Project learning will inform future Grid Code and STCP modifications to fully harness the opportunities and this will follow the normal code management processes. It is not anticipated that there will be a need for any changes to government policy or to standards outside of Ofgem's remit.

The system monitoring roadmap being developed in Alpha (WP5) will consider more fully any impacts on and possible changes to industry codes and standards. This will include looking at improving clarity of obligations, specificity of requirements and general improvements of the standards to cover for oscillatory events and onset of instability. NGET, NG ESO, NPL and SSEN-T play important roles in ensuring the safety of our power networks, including reviewing compliance of designs and operations with the relevant codes and standards. The development of new tools for monitoring and data interpretation will help improve those compliance processes.

National Physical Laboratory (NPL), whose area of expertise is the development and maintenance of measurement standards, will contribute its expertise and ongoing work in related areas to enable SYSMET to help the industry evolve its standards related to measurement of system strength metrics. SSEN-T does not envisage that the Alpha Phase or any future Phase of SYSMET will require a specific derogation or exemption from any current industry codes, standards or policy.

Imperial College will consider the type (step versus swept sine etc.) and amplitude of perturbation need to measure an impedance spectrum and relate this to standards on harmonic disturbances to establish the compliance of future practical measurement in Beta Phase. It is anticipated that amplitudes will be in line with routinely occurring perturbations from normal operation of the system from, for example, an end of a settlement period. A review will be undertaken of standards on immunity of connected equipment to disturbances. If modification of standards and grid codes will be required for future deployment these will be proposed in the normal way.

The Project Team will consider any longer-term implications of interaction with the grid code that are identified. Specifically, we have identified and proposed grid code modification GC0163 (Removal of Virtual Impedance restriction) as being of interest since it allows for a wider range of virtual impedances to be emulated rather than purely a physical reactance, and these will need to be accurately measured in a wide range of frequencies, including the system frequency.

Value for money

Costs Summary

The total Project cost for the Alpha Phase is £532,701.

The Project is requesting £478,612 of funding (90% of the total cost), with the remainder being provided by the Project Partners from private funds, demonstrating commitment to this highly innovative Project and satisfying the minimum 10% compulsory contribution.

SSEN-T costs are £57,158 to lead this Project and provide technical input. The SYSMET Project proposal has been developed to complement and be additional to SSEN-T BaU activity.

UKPN costs are £33,375 to support this Project representing the Distribution Network Operators (DNOs) and ensuring the DNOs are recognised as part of the solution.

NGET costs are £44,884 to support this Project, by gaining a better understanding of user requirements, utilisation of and integration with existing infrastructure and trial implementation planning and leading Stakeholder Engagement and Governance Processes (WP5).

NPL costs are £223,600 to lead on technical specifications for measurement system hardware, engagement with technology providers, testing and validation and simulation of system strength measurement scenarios.

Imperial College of London (ICL) costs are £163,534 to lead Specifications for System Strength Monitoring Software (WP3).

SSER costs are £10,150 to assess the potential role of generators in supporting system strength monitoring and of potential impact on generators.

No sub-contractors are required to deliver this Project.

Value for money

There is a proportionate division of costs across the Project Partners appropriately calculated in line with the amount of work they are delivering. SSEN-T and the Project Partner rates are competitive and consistent with previous SIF innovation projects and in full accordance with the terms set out in the UKRI costs guidance. Therefore, these are cost rates without profit that offer more competitive rates than standard industry rates that the Partners would apply to commercial work.

SYSMET is an ambitious Project and SIF funding provides the incentive to bring together a consortium of leaders in their fields. We are confident that the future benefits of the Project significantly outweigh the investment. The benefits to the Consumer of the Project have been calculated through the development of a detailed Cost Benefit Analysis. The estimated cumulative discounted net benefit of SYSMET (assumed to begin in 2031) for the whole GB network, up to 2050, is £221 million.

Alpha and future Beta Phase are realistic and achievable and will aim to commercialise solutions ready for adoption as BAU by Network Owners to significantly improve operations and resilience delivering value for money.

This Project was borne out of prior research by NPL so will benefit from other investments in the solutions proposed and is not ‘starting from scratch’. Project learnings will be widely relevant and beneficial and will be shared publicly allowing for the best insight and value for money in the solution developed for Project SYSMET.

Use of pre-existing assets and facilities

The Project will benefit from NPL utilising its facilities as a national laboratory to undertake measurements. Existing equipment in the form of multifunction calibrators, digital multi-meters, power amplifiers, transconductance amplifiers, transducers and current shunts will be used for measurement test setups. The provision of calibration for any equipment used will be undertaken from secondary reference standards maintained by NPL.

Associated Innovation Projects

- (●) Yes (Please remember to upload all required documentation)
- ( ) No (please upload your approved ANIP form as an appendix)

Supporting documents

File Upload

SIF Alpha Round 3 Project Registration 2025-02-21 11_08 - 86.9 KB

Documents uploaded where applicable?

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