SIF Discovery Round 2 Project Registration

Date of Submission

May 2023

Project Reference Number

10061355

Project Registration

Project Title

Trinity

Project Reference Number

10061355

Project Licensee(s)

UK Power Networks

Project Start

Apr 2023

Project Duration

3 Months

Nominated Project Contact(s)

innovation@ukpowernetworks.co.uk

Project Budget

£149,770.00

Funding Mechanism

SIF Discovery - Round 2

SIF Funding

£134,793.00

Strategy Theme

Optimised assets and practices

Challenge Area

Improving energy system resilience and robustness

Lead Sector

Electricity Distribution

Other Related Sectors

Funding Licensees

UKPN - Eastern Power Networks Plc

Lead Funding Licensee

UKPN - Eastern Power Networks Plc

Collaborating Networks

UK Power Networks

Technology Areas

Control Systems, Modelling, Network Automation, Resilience

Equality, Diversity And InclusionSurvey

Yes

Project Summary

Trinity aims to address Challenge 3: Improving energy system resilience and robustness through the implementation and testing of control room simulation environments.

The pace of change for distribution level networks and markets is rapid -- the world in which DNOs operate is changing quickly and frequently. Maintaining this pace without a robust parallel control environment to enable this will only exacerbate the challenge. The rapid scaling of data volumes, control points and failure modes cannot be accommodated in a BAU environment without considerable risk. DNOs require the agility to test, learn and develop solutions in collaboration with distributed energy resource (DER) owners in a safe virtualised world to ensure the network is optimised and can handle any detrimental scenarios. They also need the capability to simulate future scenarios in safe, reliable environments that are representative of real-world network conditions, without risk of impact on the live production control system. This will also enable learning of how control engineers will interact with new technological solutions and respond to adverse network conditions.

Trinity has three key project partners:

GE - Developer of ADMS (PowerOn), a fully integrated, advanced network management solution that completely automates real-time management, monitoring, and control of electrical distribution networks. Trinity will build upon existing GE proof-of-concepts utilising UK Power Networks' expertise and data. They will provide expertise, environments for development, integration, and testing throughout the project.

UK Power Networks - DNO serving 8.4m homes and businesses across three distribution network areas and an end user of the integrated simulator. Will provide expertise, users, environments and data for development, integration, and testing. Embedding the project team alongside control room, and control systems and automation staff will ensure any solution meets user needs and can be practically implemented and scaled.

PNDC - Energy systems research, test and demonstration environment that concentrates on three primary research areas to enable the delivery of whole energy system solutions. Their core Control Room of the Future research programme is focused on developing the digital control room of the future to meet the UK's net zero energy targets. The vision for the focus area is to have a demonstrator of an intelligent and interoperable control room available for use by all DNOs.

SSEN have declared an interest in being involved if the project moves beyond the Discovery Phase and would introduce a complementary perspective and requirements of another DNO.

Project Description

Electricity networks are becoming increasingly complex. Flexibility and digitalisation are key enablers of efficiency and net zero. Rapid industry transition presents a raft of new challenges, unforeseen failure modes, complex system interactions, and highly dynamic decision-making requirements. Meanwhile, increasing complexity of the system can lead to conflicts between different priorities, parties, and functionalities.

DNOs face this increased complexity whilst managing uncertain levels of demand and generation, maintaining system resilience, and developing their Distribution System Operator (DSO) capabilities alongside systems such as DERMS that require integration with current DNO control systems. This stretches their ability to observe or coordinate the increased level of interaction on their networks in a safe and reliable manner. This enables DNOs to manage the network safely today, but it will not suffice as we move into a further decentralised world whilst expanding distribution level markets. Neither do control room teams have the capacity to unravel these complexities as they focus on running the network 24x7. As the distribution network becomes more complex, and the role of the control room augments through the introduction of the DSO and related new systems, we must start delivering operational control solutions to address these challenges now and ensure they do not threaten critical national infrastructure.

It is essential to design and test systems to plan for disruptive events with the operator in the loop. There are currently no means for radically evolving and testing the operation of a control room. Trinity will develop an innovative and scalable control room simulator that will enable DNOs to address these challenges through:

- training facilities for new control room staff, simulating different scenarios and testing with those staff in a safe and reportable manner
- opportunity to create, test and understand scenarios that control engineers have not had the access to previously (credible events, black start, protection operations, new technology integrations) and stress testing control room integrity (comms failure, cyber security penetration testing)
- sandbox for trials, demos, and validation of innovative solutions going into the control room to solve existing problems and add new capability

Innovation support is required to safely develop this method at scale and apply the appropriate system architecture and how it can best be applied to enable maximum value from available and emerging data sources. In addition, it will identify any skills gaps required to manage the complex system of the future and how those gaps must be bridged.

Nominated Contact Email Address(es)

innovation@ukpowernetworks.co.uk

Project Description And Benefits

Applicants Location (not scored)

- UK Power Networks: 237 Southwark Bridge Road, London SE1 6NP
- PNDC: 62 Napier Rd, Wardpark North, Cumbernauld, Glasgow G68 0EF
- GE Digital UK: Lauder House, Almondvale Way, Livingston EH54 6BX

Project Short Description (not scored)

By determining and then implementing the requirements, specifications and architecture for control room simulator facilities, Trinity seeks to address the increasing complexity facing control room staff and systems that is being driven by the Net Zero transition. If successful, it will enhance DNOs' abilities to handle conflicts between different priorities and parties, better manage uncertain levels of demand and generation, maintain system resilience, develop DSO capabilities, and test and exercise innovative solutions ahead of implementing into the production system.

Video description

https://www.youtube.com/watch?v=yRJo9J4dy50&list=PLrMOhOrmeR6ldr-EVoT8ABGhTCxgyBKqs&index=33

Innovation justification

With the increasing volume of interactions coming into the DNO control room, and rapidly evolving network conditions, a fully integrated simulation environment is needed to create a way for DNOs to test new and challenging network scenarios. Fast and safe integration of new solutions which require control engineer's interaction for decision making are also needed. Simulator facilities will significantly enhance understanding of the distribution system and the assets connected to it allowing the level of disruptive risk associated with new network conditions to be more accurately assessed and mitigated against multiple scenarios that control engineers can learn from.

Whilst complex simulation occurs in both transmission and generation, it is still in its infancy in the distribution sector. For DNOs, there is less data available, a higher number of potential operational, and commercial scenarios, and more asset owners and network participants; all of which combine to increase complexity and challenges. Innovation support is required to safely develop this method at scale.

The NIA funded Future Control Room project led by SSEN with UK Power Networks and PNDC as partners serves as a strong foundation on which to launch Trinity. However, the NIA project was purely desk-based and the output was a conceptual simulator design. Trinity seeks to evolve and then implement this design. Consequently, GE have been included as Project Partners and are committed to making Trinity a success by building on ongoing work they are undertaking with UK Power Networks and other network operators in the UK and internationally.

Question 6, summarises the expected value at distribution level over the modelled period (2023-2050) against expenditure in three counterfactual categories:

- Annual load-related reinforcement expenditure
- Annual flexibility expenditure
- Annual control room expenditure

SIF governance is perfectly suited to Trinity as it ensures counterfactuals, costs and benefits are regularly reassessed and provides an opportunity to adjust scope, course correct or fast fail. Potential project costs estimated by the Future Control Room project include £10-20m capex and £1m annual opex. It is unlikely that any single DNO would make the level of investment necessary to address the scale and complexity of the problem alone.

Furthermore, SIF provides the opportunity for new partners to be added. The project will start with the minimum number of partners required, but at the end of each SIF phase we will reassess and bring in other technology partners and network operators as the specifications, design, and architecture evolve.

Benefits Part 1

Financial - cost savings per annum for users of network services
Financial - cost savings per annum on energy bills for consumers
Financial - future reductions in the cost of operating the network

Benefits Part 2

The future reductions in the cost of operating the network from Trinity generally fall into three expenditure categories: load-related reinforcement (LRR), flexibility over-procurement, and control room expenditure. The estimated NPV of the project's impact on these categories is ~£138m for UK Power Networks alone over 2023-2050, which corresponds to an annual net present benefit of ~£4.9m.

The benefits are estimated based on UK Power Networks' average expected expenditure on the three categories based on numbers published in RIIO-ED2 business plans. These are scaled to 2050 using UK Power Networks' DFES load projections at primary substations as Trinity is expected to deliver annual long-term benefits beyond the project. A higher bound of £20m project CAPEX is used to calculate overall net present value, as this demonstrates the net positive impact of Trinity even when higher implementation costs are factored in.

To capture the benefits associated with increased use of flexibility and therefore reduced LRR, it is assumed that once Trinity is fully developed the number of substations with active flexibility in each modelled year will increase by 5% compared to the annual number in the absence of Trinity. In addition, it is assumed that Trinity increases the amount of flexibility used per substation by 2% in the last year of the project (2026/27) and 10% thereafter. It is further assumed that each £ of flexibility expenditure results in around £14 of LRR deferral, with a deferral period of nine years. This deferral ratio was calculated based on available RIIO-ED2 data across all DNOs by comparing their planned expenditure on flexibility with the LRR deferral this corresponds to.

The benefits associated with the decrease in flexibility over-procurement are captured through a partial reduction in the estimated amount of flexibility over-procured by DNOs. Whereas 30% of flexibility procured by DNOs is assumed to be usually over-procured to account for potential disruptions in the provision of flexibility services, Trinity is expected to reduce the amount of flexibility that is over-procured to 10%.

Finally, the benefits associated with lower costs of operating the control room are captured through an avoided cost of increased FTE employment units thanks to efficiencies driven by Trinity, with FTEs avoided by five in 2025/26 and by six thereafter compared to the number of FTEs that would have been required without Trinity. This is a high estimate and is subject to additional innovation being built atop of Trinity.

Project Plans And Milestones

Project Plan and Milestones

WP1: Scope and needs

Lead: UKPN

Aim: Agree scope and prioritise user requirements for subsequent phases

Scope:

- Consolidate user/system requirements for the simulators, categorised into two areas:
- Training -- Control engineers on credible events and scenarios
- Testing -- Network configuration arrangements and scenarios
- Identify potential scenarios that cannot be met by the simulators

Success criteria: UKPN acceptance of the scope and prioritised requirements

Deliverables:

- Baselined user requirements document (D1 - UKPN)

SIF allocated funding: £ 24,684.00

WP2: Simulator design

Lead: PNDC

Aim: Initial architecture and functional design for the integrated solution

Scope:

- Define the simulators' solution architecture, exploring different integration options whilst considering user and system requirements defined in WP1
- Map requirements to the architecture for trials, demos, and validation of new control room solutions to solve existing problems and add new capabilities

Success criteria: UKPN is satisfied the technical feasibility has been established and value has been demonstrated

Deliverables:

- Simulator design and architecture recommendation, showing options and technical challenges (D2 - GE)
- Detailed plan for development and trial of the simulators in the Alpha and Beta phases (D3 - PNDC)

SIF allocated funding: £ 68,791.00

WP3: Route to market

Lead: GE

Aim: Clear ownership and route to market for each component of the solution

Scope:

- Further exploration and verification of the strategic vision, business case, route to market and IPR arrangements

Success criteria: UKPN acceptance of strategic vision and proposed route to market tested with at least one other DNO

Deliverables: Preliminary strategic roadmap (D4 - GE)

SIF allocated funding: £ 34,886.00

WP4: Project Management

Lead: UKPN

Aim: To deliver the project objectives on time and to budget

Scope:

- Updated cost benefit analysis
- Identification of necessary resources for subsequent phases

Success criteria: Project delivered to plan, budget and UKPN satisfaction

Deliverables:

- A full resourced plan and budget with benefits case for the Alpha phase (D5 - UKPN)

SIF allocated funding: £ 19,409

The key risks and risk mitigation strategies for this project are set out in the accompanying risk register, which will be used to manage and report risks and issues and will be refreshed weekly for project meetings.

The primary risk to the Discovery Phase is our ability to reach consensus on the requirements, architecture, and priorities. Our mitigation approach is to devolve final decision making to UKPN as the end customer representative of the simulator facilities. The primary constraint is the complexity of the problem being addressed.

Regulatory Barriers (not scored)

The project will be delivered in line with current regulations. We do not anticipate any regulatory barriers that will hinder delivery of the Alpha or Beta Phases at this stage. Therefore, no derogation or exemption is anticipated. Neither do we foresee any barriers for embedding our expected project outcomes into business as usual.

If successful, the simulation environments could be used to test future consultation, policy, and regulation on DNO or DSO related subjects. A current and important example of this is the impact of rota load disconnection events on the distribution networks. As the project progresses, engagement with stakeholders responsible for policy and regulation decisions will be necessary to understand their needs and assess the extent to which those needs could be accommodated.

Commercials

Route To Market

Trinity will deliver the technological innovation that opens a route to market for innovate third party products and existing innovation offerings to DNOs. In doing so, competition in DSO markets will be increased and further opportunities to find lowest cost solutions for customers created. By integrating these new products directly into the control room, customer needs and behaviours will be incorporated into real-time decision making.

UK Power Networks is the largest DNO in terms of customer representation (28%)*, whilst GE and PNDC are deeply embedded within our industry and provide products, services and deliver innovation to network operators at independent, distribution, and transmission level across GB. Involving both from the beginning will help avoid bespoke solutions being developed in silos that would lead to cumulative costs to our collective customers.

Whilst this is large scale technology development, it needs to be proven for future commercialisation and go-to-market adoption. Once proven, it would be fully deployable by the end of the Beta Phase and ready to be scaled up to GE customers internationally. On the other hand, Trinity will be delivered using an agile approach that will drive opportunities to test and release solution components before the end of the Beta Phase. Until the design and architecture are finalised in the Discovery Phase, it is impossible to state which components these will be.

To ensure the simulator facilities can integrate and scale, it is anticipated that the bulk of the simulator facilities will be built within the GE ADMS architecture and therefore GE will lead the development. UK Power Networks' systems, expertise and data will be required to test and deploy the simulator whilst PNDC will provide both expertise and challenge to ensure that whatever is built has wider applicably to DNOs and TOs. The route to market for any components built on the ADMS architecture will follow a similar route to GE's existing product offerings.

The project will explore opportunities to build components outside of the ADMS architecture to enable development to run in parallel and reduce costs. The route to market for any external components is less clear as they could be built by other technology providers outside of the partners listed and the route to market, and IP arrangements, could be different in each instance.

*If SSEN join the project in a subsequent phase this would increase to 43% and ensure that even greater learning is transferable.

Intellectual property rights (not scored)

The IPR arrangements for the Discovery Phase of this project will be in line with the terms set out in the SIF Governance Document Chapter 9 and the project participants agree to comply with the default IPR conditions.

At the end of each SIF phase the IPR arrangements will be reassessed as the specifications, design, and architecture evolve and we bring in other technology partners and network operators where necessary.

Costs and value for money

Total project costs: £149,770.00

How our project will fund the minimum 10% of total project costs:

The balance of funding across the Project Partners:

GE: £35,000.00 (SIF funding: £ 35,000.00)

PNDC: £55,270.00 (SIF funding: £55,270.00)

UK Power Networks: £59,500.00 (SIF funding: £44,523.00)

There are no subcontractor costs for the Discovery Phase as the Project Partners have the necessary expertise and experience to deliver the Discovery Phase without incurring additional costs.

Answers to previous questions have described how Trinity delivers value for money if successful, but in summary:

- The estimated net present benefit on UK Power Networks' network operations alone could be in the region of ~£138m over 2023-2050, which corresponds to an annual net present benefit of ~£4.9m.

- Speed up the uptake of LCTs across the distribution system through enabling the right type of products and assets to connect with an increasingly more dynamic system.
- Trinity will build on work done in other innovation projects, such as the NIA funded Future Control Room, and ensure any sunk costs are avoided.
- Provide a foundation on which to efficiently test, demonstrate and deploy innovation such as artificial intelligence and machine learning in the future control room and systems.
- Help avoid disparate and bespoke solutions being developed in silos by individual network operators that would lead to cumulative costs to our collective customers.

When delivered, this project will underpin a transformation of distribution network control enabling hundreds of millions of pounds of benefits that even with the most exorbitant project costs would represent a significant return. Benefits will be returned to customers via the network operators, seen directly by other parts of the energy supply chain such as DER/LCT owners and billpayers, as well as indirect environmental benefits.

Document Upload

Documents Uploaded Where Applicable

Yes

Documents:

SIF Discovery Round 2 Project Registration 2023-05-30 10_25

SIF Round 2 Discovery - Trinity End of Phase (for upload).pdf

SIF Round 2 Discovery - Trinity Show and Tell (for upload).pdf

This project has been approved by a senior member of staff

☑ Yes