SIF Alpha R2 Close Down Report

Date of Submission

Jun 2024

Project Reference Number

UKRI10079053

Initial Project Details

Project Title

INSIGHT - Innovative Network Status Intelligence Gathered by Holistic use of Telemetry

Project Contact

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Project Start

01/10/2023

Project Duration (Months)

6

Lead Funding Licensee

SSEN - Scottish Hydro Electric Transmission

Funding Licensee(s)

SSEN - Scottish Hydro Electric Transmission

Project Summary

The UK Government's Net Zero strategy to decarbonise the power system by 2035 means the volume of renewable generation on the network will increase massively. Inverter-Based Resources (IBRs), e.g. wind and solar, introduce new dynamics compared to traditional fossil fuel-driven synchronous generation. System instabilities that manifest as power system oscillations have occurred, presenting a severe threat to the security of the system.

INSIGHT aims to address this issue by delivering a real-time alert and control system that monitors and mitigates different types of power network oscillation events. The Project combines learnings from past events with new modelling and simulation techniques to better understand the nature of these new oscillations and how to predict and address them in network design and operation for future events.

INSIGHT will improve our ability to manage weaker networks, enhancing stability and reliability and avoiding alternative operations that would reduce the levels of renewable generation able to run on the network.

Performance and Outcomes

Project phase summary

The Alpha Phase of the INSIGHT project addresses the SIF Round 2 Innovation Challenge area 2 'Preparing for a net zero power system. The **focus of the project** has been on:

• Stakeholder engagement: ESO projects in the related fields and with technology providers.
• Development of a real-time test network model to replicate and understand oscillation events induced by IBRs.
• Creating a roadmap of GB system monitoring including operational practices, licence obligations, industry codes, and the future network.

Key Findings

• More detailed analytical modelling is required to enhance the understanding of IBR-driven oscillation mechanisms and support informed modelling tuning for replicating and simulating such events.
• Traditional measurements (Phasor Measurement Units, PMUs) have limitations in monitoring and analysing emerging oscillations.
• Existing oscillation analysis and location methods can be unreliable and inadequate for emerging IBR-driven oscillations.
• The existing measurement and analysis methods for IBR-induced low-frequency oscillations are immature.
• Current technology providers do not have mature solutions.

Innovation Aspects

Whilst stability in systems dominated by power electronics is currently an industry focus area, no projects are developing the type of solution to manage system oscillations and disturbances proposed in INSIGHT.

Projects like TOTEM and other initiatives like Grid Code Modification GC0141 have progressed GB activities in modelling and simulation, supporting the further investigation of oscillatory stability proposed herein.

Current projects like INCENTIVE, or past projects like Phoenix and EFCC, have developed and demonstrated the types of technologies that could be used to mitigate oscillations.

Project Outcomes

• Understanding the requirements for measurement techniques and the data reporting rate for the analysis of IBR-induced oscillations.
• Representative network model and simulated oscillations.
• Understanding of technology providers' capabilities and gaps.
• Developed a greater understanding of existing monitoring systems and plans for a test platform.

User needs

User Needs

A questionnaire was sent to a broad range of organisations in the UK and globally, and the project partners held an expert workshop to gather stakeholder feedback. The responses highlighted growing concerns that the current oscillatory damping capability is insufficient for the future network with an increased risk of oscillation events.

INSIGHT will combine experience and learnings from past events/projects with new modelling and simulation techniques to better understand the origin and nature of a variety of oscillations and investigate potential methods for predicting them. State-of-theart techniques for detecting, classifying, and responding to oscillation events will be reviewed, evaluated, and trialled. The project will also inform codes and standards relating to new oscillations, potentially leading to a new form of service targeted at control actions for oscillation damping.

Innovation-funded Relevant Work

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Current projects like INCENTIVE, or past projects like Phoenix and EFCC, have developed and demonstrated the types of technologies that could be used to mitigate oscillations, with the ESO's Stability.

Past projects like VISOR and MIGRATE, and subsequent code modification like that to STCP 27-01 on sharing of real-time monitoring data, have advanced the TOs' and ESO's approach to real-time measurement, with an ongoing programme through RIIO-T2 to deploy more equipment and collate data.

Impacts and benefits

Financial - future reductions in the cost of operating the network

The current process of managing oscillations on the system is to restrict the output of generation (which is suspected to be one of the sources of the oscillations) or to operate TO devices to prevent them from interacting with the oscillations.

The cost of these options is two-fold:
• There is a need to buy off generation in the balancing mechanism.
• Restrict the capability of the system and therefore introduce constraints that require costly intervention to manage flows within the imposed limit.

These mitigations need to be in place for an unspecified time until investigations have concluded the source of the oscillations and put mitigations in place.

A CBA has been developed to demonstrate the improvements to the network's system operability because of the INSIGHT solution. The annual balancing mechanism cost for the UK network is £2.61 billion (2022/23). Implementing the INSIGHT technology could deliver an annual cost saving of approximately £25.5 million (based on an assumption of a 1% cost saving). In addition, there is a reduced risk of whole or localised network blackouts leading to a combined estimated saving of £17.7 million. Thus, the total estimated benefits could reach £43.2 million per annum.

One example of balancing costs incurred previously is the actions taken after significant oscillations, most evident in northern Scotland, in August 2021. The response included paying hydro generators to switch on, constraining wind off, and adjusting outage plans. These types of events are expected to become more frequent unless projects like INSIGHT can identify appropriate mitigation.

The benefit of INSIGHT will ultimately be measured through a reduction in balancing costs incurred by the Electricity System Operator due to the occurrence, or the perceived risk, of oscillatory instability. Short of the financial metric, the benefit could be measured by the number of actions taken to address oscillatory instability, which may include instructions to TOs that do not incur balancing costs.

Environmental - carbon reduction - indirect CO2 savings per annum

Currently, the balancing actions taken to manage oscillations on the system have the potential to increase CO2 emissions, as low-carbon sources of generation are replaced with carbon-based sources of generation as they can be turned on/off and up or down as needed to balance the system.

INSIGHT will help reduce the CO2 emissions that occur when trying to manage oscillations on the network by providing the technology to predict or mitigate them ahead of time.

New to market - services
As described above, oscillations on the system are currently managed in a way such that the source(s) of the oscillations are located, and mitigations put in place. There is work underway to implement a stability market, though this does not address oscillations directly as it aims to address exacerbating factors (a gradual "weakening" of the transmission system), to prevent oscillations from happening.

A future outcome of INSIGHT is that users may be contracted to modify their operating point, adjust settings, or activate different

control functionality to mitigate oscillatory stability risks. The development of a market for these new types of services is dependent on the learning expected from the project.

Risks, issues and constraints

The project risk register (see attached) was regularly reviewed and updated during the Alpha Phase to ensure it remained relevant and up-to-date. Risks were rated according to the standard metrics; probability and impact. The main constraint within Alpha was the availability of key staff although it is worth mentioning that this was not extensive, nor did it affect all partners. The size and scale of Alpha were such that this resource constraint did not compromise the delivery of INSIGHT as planned. However, it highlighted an area the next phase (not Beta Round 2 in this case) of the project should address before initiation.

There were no other constraints Policy-wise, Commercially, or otherwise. Within Alpha, Work Package 4 (UK System Monitoring Roadmap)sought to understand the measurement types for identifying faults (e.g., system oscillations), and their capabilities alongside the Code requirements (STCP 27-1) to ensure that any future INSIGHT solution was compliant.

Working in the open

The approach to working throughout the Alpha Phase has focused on the following, as was the case through Discovery:

- Collaboration
- Openness wherever possible
- Results driven

Work has been open and collaborative with key documents uploaded and managed using a dedicated SharePoint set-up during Discovery. A weekly project meeting (via Teams) to discuss all matters about the project including any concerns or potential issues - this regular means of communication worked well. The project's short duration (6 months) meant an agile approach was used to help ensure its successful delivery.

A crucial part of the work was engagement with stakeholders and technology providers which was the basis of Work Package 2 (WP2). This work included holding a face-to-face knowledge sharing with the ESO (project partner) in which their technical staff presented their other projects in this technical area and learned about INSIGHT seeking potential areas of collaboration that could be explored.

WP2 also included holding a series of open webinars with prospective technology providers
with the purpose being to:

- Provide a comprehensive oversight of INSIGHT;
- Share the results of the Alpha Phase so far;
- Provide an opportunity for questions to be posed;
- Invite interested to organise a separate one-on-one call;
- Begin the process of identifying organisations that could be further engaged in the next phase of the project.

The webinars proved effective and were well attended given the highly specialist nature of the requirements.

Transparency across the project partner and beyond was demonstrated, in summary, through:
- Weekly project meetings
- Several face-to-face reviews were held including a Kick-off Meeting and Knowledge Sharing Session
- Sharing of project Deliverables on the SharePoint
- ‘Show and Tell’ event, open to any interested party
- Uploading of selected documents onto the ENA smart portal.

Costs and value for money

A summary of the project expenditure required to deliver the Alpha Phase of INSIGHT is shown in the table attached. The project was underspent, but this did not affect the quality of the results which were reviewed by the Ofgem-UKRI representatives.

The Project did not employ any subcontractors for the Alpha Phase and, INSIGHT did not ask for the full amount of SIF funding available for this Phase (£500,000). The funding requested was £227,093, equivalent to just 45% of the maximum. The Project

Partners carefully planned and delivered the Alpha phase project ensuring that the fewest number of days to deliver a quality output were used. The day rates are considered competitive further demonstrating that this project represents value for money to the Customer.

Special conditions

INSIGHT had the three standard Project Specific Conditions connected with all SIF Alpha Phase projects. In each case, the condition was met as described.

Condition 1

The Funding Party must not spend any SIF Funding until contracts are signed with the Project Partners named in Table 1 for the purpose of completing the Project.

Condition met: The Funding Party maintained the SIF Funding until after the contract (Collaboration Agreement) had been signed by all Project Partners.

Condition 2

The Funding Party must report on the financial contributions made to the Project as set out in its Application. Any financial contributions made over and above that stated in its Application should also be reported and included within the Project costs template.

Condition met: The Funding Party asked each Project Partner to provide their costs every month to track spending against actuals. Financials were reported to UKRI during the Mid-point project meeting and at the End of Phase with estimates given in the absence of actuals. The final set of figures was shared using the Project costs template.

Condition 3

The Funding Party must make reasonable endeavours to participate in all meetings related to the Project that they are invited to by Ofgem, UKIR and DESNZ during the Alpha Phase.

Condition met: All Project meetings organised by the UKRI were attended by all Project Partners. There were no meetings requested by Ofgem or DESNZ.

Document Upload

File Upload

INSIGHT Alpha Risk Register.pdf - 176.9 KB
INSIGHT Alpha Expenditure.pdf - 150.9 KB

Documents uploaded where applicable?

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