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NIA Project Registration and PEA Document

Date of Submission

Oct 2023

Project Reference Number

SPEN_NIA_11098

Project Registration

Project Title

T&D Operations Control Centre - Electricity System Restoration Service Simulator/HiL

Project Reference Number

SPEN_NIA_11098

Project Licensee(s)

SP Energy Networks Transmission

Project Start

August 2023

Project Duration

1 year and 2 months

Nominated Project Contact(s)

Ian MacPherson

Project Budget

£838,134.00

Summary

In the coming years the control and operability of both the DNO and TO networks is likely to undergo significant challenges, particularly with the loss of large transmission connected conventional generation, growth of Distributed Energy Resources and industry movement towards DSO control.

As such there is a growing requirement to simulate the complex interaction of networks and generation under intact network conditions, along with outage, restoration and black start scenarios.

Particularly with regards to black start restoration, there is currently no means for control engineers to investigate the validity of existing LJRP and ESRS restoration procedures; or to allow for future combined transmission and distribution restoration options to be tested, given the evolution and fluidity of the generation portfolios on the transmission and distribution networks.

Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

Problem Being Solved

In partnership with GE this project will seek to deliver a Glasgow based operational training simulator, and associated training for all TO and DSO control engineers, to improve practical skills and knowledge related to real time power system ESRS operation:

- Creation of system replica of SPT and selected areas of SPD network in the operator training simulator;
- Restoration training to bring the system back to a safe state after a black out (top-down and bottom-up restoration will be considered).
- Emergency training to deal with handling critical grid situations and measures to prevent a black out, or a further extension to the occurred disturbance.

This project is planned to take 24 months. Project phases will broadly cover system deployment, simulation setup of three Electricity

System Restoration Zones (D&G, Dersalloch, C&F), OCC personnel training and report output.

- Simulator preparation
 - Creation of the SPEN system ESRZs
- Model Validation Training
- Black Start Strategy Training
- SPEN Operator Training
 - In the Introduction phase participants will gain familiarity with the GE simulation Environment with a presentation of simulator functionality and handling. Short presentations by the GE trainers will reinforce SPEN Operator's knowledge of key technical areas.
 - The (main) simulator scenario(s) "Restoration" will deal with a coordinated system restoration after a blackout of the implemented ESRZs. The goal is to bring the system back to a safe state with no violations of operational criteria. The session is moderated and supported by GE trainers.
- Trainer's Training
 - For operation of the GE Simulation Environment in the SPEN Glasgow HQ 2 people at a minimum (superusers) will be trained in handling the simulator and functionalities

Method(s)

The method comprises:

1. Opal-RT real-time dynamic simulation platform with ePHASORSIM software simulating at 50 frames/second and interacting with the Synergy system through synchrophasor IEEE C37.118 data streams and IEC 61850 GOOSE IO
2. Matlab/Simulink licenses¹ required to run Opal-RT system
3. GE ADMS and FEP software, with associated licenses for a training/simulation environment, configured with the required transmission and distribution network assets for the zones
4. GE WAMS DE software, with associated licenses for a training/simulation environment, presenting the zone PMU data and external transmission boundary data (B6 boundary) and inertia estimation/emulation
5. PhasorController hierarchy with virtualized devices representing each of the controllers in the Synergy network, hosted on the server platform, including Synergy Central PhC, DRZC Zone Controller PhCs for each zone, Field Interface Controller PhCs and a further PhC to integrate Synergy SCADA commands and information with Opal-RT
6. Configuration of the system to represent three Distribution Restoration zones based on the Synergy and Distributed Restart Trials along with a reduced equivalent model of the GB network:
 - a. Galloway
 - b. Dersalloch (WF+BESS)
 - c. Central & Fife

Scope

- HiL Simulator Preparation
- Model Validation Training
- Black Start Strategy Training
- SPEN Operator Training
- Trainer's Training
- Hardware in the Loop simulation for new or modified Electricity System restoration Zones

Objective(s)

- Creation of system replica of SPT and selected areas of SPD network in the operator HiL simulator
- Restoration training to bring the system back to a safe state after a black out
- Emergency training to deal with handling critical grid situations and measures to prevent a black out, or a further extension to the occurred disturbance.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This project has been assessed as having a neutral impact on customers in vulnerable situations.

This is because it is a transmission project.

Success Criteria

The delivery of the above objectives, within budget and within agreed timelines, as is reasonable depending on the knowledge at this stage of the development phase.

Production of the final technical reports containing all the learnings and recommendations.

HiL Simulator is ready for new Distributed Restart zones simulation for BaU ESO Tenders

Project Partners and External Funding

Project Delivery Team

General Electric Vernova

Potential for New Learning

This is the first time that HiL simulator has been created that integrates to the utility networks ADMS system utilising GE PowerOn and OPAL-RT. The learnings from this project can be applied to other utility companies that either support GE PowerOn system or required to use the OPAL-RT network simulation platform for an equivalent HiL solution. This will also supply to ability to refine and optimise the BlackStart operating procedures by allowing the operational centre engineers to drive restoration services through the GE PowerOn system.

Scale of Project

This type of HiL solution is a prerequisite to the deployment of restoration services on to a live network.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL9 Operations

Geographical Area

The project will be delivered as an on-premise solution hosted on SPEN headquarters

Revenue Allowed for the RIIO Settlement

0

Indicative Total NIA Project Expenditure

SP Energy Networks: £838,134

Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

The transition from synchronous generators to renewables requires a large scale number of renewables to be utilised for the equivalent of coal fired power stations. This requires a control scheme that can interact with multiple DER assets compared with the coal fired power stations. This facilitates the utility company testing and proving the complex control schemes can function based on the HiL simulation nature of the solution.

How the Project has potential to benefit consumer in vulnerable situations:

This project facilitates the deployment of restoration services on the utility network and this will support the UK Directive to provide power to the network based on 60% within 24 hours under black start condition

Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

N/A

Please provide a calculation of the expected benefits the Solution

N/A

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

The work from this project will be fully applicable to GB Transmission and Distribution network. The solution can be utilised by any utility company that has a GE PowerOn system and utility companies may need some additional integration to their ADMS of choice.

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

This will become a centralised black start control scheme simulator and tester for SP Energy Networks once proven and will not be rolled out across GB unless another operator wanted to purchase a similar system for their utility network.

Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

- A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).
- A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)
- A specific novel operational practice directly related to the operation of the Network Licensees system

- A specific novel commercial arrangement

RIIO-2 Projects

- A specific piece of new equipment (including monitoring, control and communications systems and software)
- A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven
- A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)
- A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology
- A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution
- A specific novel commercial arrangement

Specific Requirements 4 / 2a

Please explain how the learning that will be generated could be used by the relevant Network Licensees

The learnings will allow us to deploy in the operational network with confidence that the control schemes have been tested and the analysed data obtained from HiL simulation will allow us to refine the control schemes due to the inclusion of PowerFactory models due to the incorporation of the OPAL-RT in the solution.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

n/a

Is the default IPR position being applied?

- Yes

Please demonstrate how the learning from the project can be successfully disseminated to Network Licensees and other interested parties.

We can supply a report on how OPAL-RT has been configured and utilised but anything related to PowerOn will be subject to GE and the relevant utility companies supporting PowerOn.

Please describe how many potential constraints or costs caused, or resulting from the imposed IPR arrangements.<

N/A

Please justify why the proposed IPR arrangements provide value for money for customers.

N/A

Project Eligibility Assessment Part 2

Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

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

We have reviewed the ENA portal and have not identified any other past or ongoing projects that would give rise to unnecessary duplication of research effort.

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

N/A

Additional Governance And Document Upload

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

There hasnt been a HiL Simulator that has incorporated a GE PowerOn with OPAL-RT

Relevant Foreground IPR

N/A

Data Access Details

Access to this data must be requested by contacting SPInnovation@spenergynetworks.com Please provide the following information in your request:

Affiliation, position and contact details of requesting party

Relevant project and type of data required

Reasons for requesting this data and evidence that this data will be used in the interest of the UK network electricity customers

How data will be shared internally and externally by the requesting party

Any data request deemed unsuitable for sharing will be highlighted to the appropriate requesting party. After receiving the request we will provide the estimated date for completing the data provision based on other requests and our team workload at that time. All requested data remains the property of SP Energy Networks.

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

There is no funding in the current price control to accomodate this expense

Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

There is no funding in the current price control to accomodate this expense

This project has been approved by a senior member of staff

Yes