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## NIA Project Registration and PEA Document

### Date of Submission

Oct 2019

### Project Reference Number

NIA\_SHET\_0029

## Project Registration

### Project Title

Phasor Based Monitoring for HVDC Applications

### Project Reference Number

NIA\_SHET\_0029

### Project Licensee(s)

Scottish and Southern Electricity Networks Transmission

### Project Start

October 2019

### Project Duration

2 years and 6 months

### Nominated Project Contact(s)

Collin Mathieson

### Project Budget

£321,000.00

## Summary

Phasor Monitoring Units (PMUs) are being more widely installed across the UK electricity network; as protection and control technology develops. The PMUs can detail the shape of the AC electrical wave at the monitoring point; which can be used to provide several key electrical system parameters and significantly aids knowledge of how the network operates under both normal and abnormal conditions.

### Nominated Contact Email Address(es)

transmissioninnovation@sse.com

## Problem Being Solved

Phasor Monitoring Units (PMUs) are being more widely installed across the UK electricity network; as protection and control technology develops. The PMUs can detail the shape of the AC electrical wave at the monitoring point; which can be used to provide several key electrical system parameters and significantly aids knowledge of how the network operates under both normal and abnormal conditions.

The VISOR project successfully proved that PMU wide area monitoring is possible; this allows multiple PMUs to be viewed simultaneously. This project aims to further develop the PMU wide area monitoring by means of investigating if transmission network parameters in real-time can be introduced into HVDC power control systems.

The GB Electrical Transmission Network is expanding with a marked increase in the number of High Voltage Direct Current (HVDC) connections applications. An HVDC connection introduces very large volumes of electrical energy onto the network, which ensures the 'lights remain on'. The control systems for HVDC connections are very complex, requiring the key transmission network parameters at the point of Transmission system connection. These key parameters, such as;

- electrical system strength;

- local system fault levels; and
- electrical system inertia;

are calculated on computer simulations and incorporated into the HVDC control philosophy.

The present approach to controlling HVDC onto the Transmission System has worked well, however with potentially more HVDC power sources being introduced there is also the need to explore if using real-time system parameters within the control functionality brings additional benefits.

### Method(s)

This project will use the HVDC facilities at Cumbernauld. PMU wide area monitoring will be applied to the AC Transmission computer simulation from which the calculated real-time system parameters will be incorporated into the HVDC control system.

### Scope

The scope of the project is to investigate if any benefits are achievable from incorporating PMU wide area monitoring into an HVDC control system.

HVDC has been selected to trial in principal the use of PMU wide area monitoring to calculate real-time network system parameters and feed them into a source of electrical power injection. However, the knowledge and learning from this project will have much wider applications in progressing active network system control logic and ability.

### Objective(s)

There are two key objects with this project;

- Explore if electrical system phasor measurements can be used as a means of HVDC control; and if successful; Exploring if there are benefits to phasor measurement HVDC Control systems against present methods.

### Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

### Success Criteria

Confirming if it is possible to use PMU wide area monitoring to control power from an HVDC source and documenting the learning along the way.

### Project Partners and External Funding

N/A

### Potential for New Learning

PMU equipment is becoming more common on both the Transmission and Distribution networks, but the full potential of PMUs is not being utilized as there is lack of knowledge and evidence of their ability. This project using powerful computerized simulations of the electrical network will enable PMU applications to be tested safely to their full potential.

### Scale of Project

At this stage the project will use real-time computerized electrical system simulations to evaluate the if it's possible to use PMU wide area monitoring data in the real-time system control of electrical power infeed from an HVDC source.

### Technology Readiness at Start

TRL4 Bench Scale Research

### Technology Readiness at End

TRL5 Pilot Scale

### Geographical Area

N/A

## **Revenue Allowed for the RIIO Settlement**

No allowance has been made for exploring the gathering and active management of PMU information.

## **Indicative Total NIA Project Expenditure**

The total expenditure for the project is £321,000.

90% (£288,900) is allowable NIA expenditure.

## 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:

n/a

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

n/a

### 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

N/A

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

N/A

### 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 knowledge gained from managing the real-time flow of data, with subsequent system parameter calculations and then the onward use of the information in the control of electrical energy onto the network will be shared with the relevant Network Licensees.

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

This project is specifically targeting network reliability / availability and efficiency.

- Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

### Is the default IPR position being applied?

- Yes

## 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.

Based on published NIC information the VISOR Project proved that wide area monitoring of PMUs was possible. This project will progress with the learning and explore if it is possible to control using real-time system data the injection of electrical power.

### 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

The 'close looping' of real-time measured electrical system parameters into the control philosophy of an HVDC power connection.

### Relevant Foreground IPR

n/a

### Data Access Details

n/a

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

We do have PMUs embedded within the electrical networks presently, but they are only used for monitoring purposes. Research and confidence is required that the PMU wide area monitoring can be used in real-time to control the flow of energy safely, efficiently and with a high level of reliability. Working on an electrical system simulator will help to safely prove the theory and inform what is required to achieve a business ready solution.

**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**

This type of project needs to be carried out off-line; so customers are not put at risk of their electricity supplies being turned off.

**This project has been approved by a senior member of staff**

Yes