Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.

NIA Project Registration and PEA Document

Date of Submission

Feb 2015

Project Reference Number

NIA_SPT_1503

Project Registration

Project Title

Protection Settings to Cater for the Evolving Transmission Network

Project Reference Number

NIA_SPT_1503

Project Licensee(s)

SP Energy Networks Transmission

Project Start

March 2015

Project Duration

0 years and 5 months

Nominated Project Contact(s)

James Yu (Future Networks Manager)

Project Budget

£25,711.00

Summary

The suitability of the identified methods and tools, and their associated advantages and limitations, will be assessed and compared along with initial recommendations on the most suitable tool(s) to be used in the future. This activity will also consider existing resources and practices that are utilised within ScottishPower, e.g. the DIgSILENT PowerFactory GB power system model, protection settings registers and databases, ten year statement and other “outlook” documents published by National Grid (including the recently-published “System Operability Framework” document), protection settings policy documents, etc. A validation process will be proposed with the use of the identified and proposed selected tool(s) in conjunction with the appropriate existing resources.

This will act as an initial specification for a future second stage of the project, which will be concerned with population and configuration of the identified tool(s) to enable the validation process to be rolled out across the entire population of ScottishPower transmission protection schemes and utilised as a “business as usual” activity.

If possible, a demonstration and verification of the proposed process using an agreed case study will be undertaken and included in the report and presentation of findings at the end of the project, subject to availability of the identified settings validation tools(s) and appropriate resources to facilitate the execution of the case study.

The benefits of undertaking this work are that the risk of unexpected and incorrect protection operations in the future will be quantified, enabling appropriate mitigation plans to be put in place. The cost of future potential partial or total system blackouts could therefore be avoided.

Third Party Collaborators

University of Strathclyde

Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

Problem Being Solved

The existing transmission system in the UK (and in Scotland in particular) is experiencing significant changes, with decommissioning of large fossil-fuelled synchronous generation, introduction of large amounts of wind energy, distributed generation and possibly energy storage, HVDC infeeds and embedded links and FACTS devices. These developments could mean that assumptions regarding transmission (and in some cases distribution) protection system performance may no longer be valid. The anticipated reductions in system inertia and strength, as a result of the aforementioned developments, may lead to significant reductions and variations in fault levels and immediate post-fault system behaviour. Furthermore, converter-interfaced sources may not begin to supply fault current, and/or provide an inertial response, until after a delay during which the controller ascertains the desired response, and this could be tens of milliseconds or more. Consequently, there is a risk that traditionally-applied protection schemes and setting policies, based on the assumption of stable fault levels, well-understood and readily-simulated system behaviour, may no longer be valid.

While the impacts of changes on transmission and distribution system behaviour have been extensively studied and modelled, there has not been a great deal of activity in terms of detailed analysis of protection system performance under future scenarios. The aforementioned changes in the GB power system could potentially lead to protection mal-operation and, in worst cases, large area blackout events. To maintain a high level of reliability and security of the protection system, actions must been taken to assess the adequacy and suitability of existing protection methods, their settings and the associated protection setting polices in existing and future networks. A new process, assisted by a protection setting and performance validation tool, is required to allow protection settings and performance to be fully checked under a wide range of scenarios against a radically-changing backdrop of system behaviour in the next 5-10 years and beyond.

Method(s)

The research methodology in this project will be based on two key components:

1. Comprehensive review of research activities, developed methods and commercially-available products that may be available for protection setting validation under a range of primary system conditions.
2. Illustrative case studies to demonstrate the potential uses of the proposed settings verification process.

Scope

The suitability of the identified methods and tools, and their associated advantages and limitations, will be assessed and compared along with initial recommendations on the most suitable tool(s) to be used in the future. This activity will also consider existing resources and practices that are utilised within ScottishPower, e.g. the DIgSILENT PowerFactory GB power system model, protection settings registers and databases, ten year statement and other “outlook” documents published by National Grid (including the recently-published “System Operability Framework” document), protection settings policy documents, etc. A validation process will be proposed with the use of the identified and proposed selected tool(s) in conjunction with the appropriate existing resources.

This will act as an initial specification for a future second stage of the project, which will be concerned with population and configuration of the identified tool(s) to enable the validation process to be rolled out across the entire population of ScottishPower transmission protection schemes and utilised as a “business as usual” activity.

If possible, a demonstration and verification of the proposed process using an agreed case study will be undertaken and included in the report and presentation of findings at the end of the project, subject to availability of the identified settings validation tools(s) and appropriate resources to facilitate the execution of the case study.

The benefits of undertaking this work are that the risk of unexpected and incorrect protection operations in the future will be quantified, enabling appropriate mitigation plans to be put in place. The cost of future potential partial or total system blackouts could therefore be avoided.

Objective(s)

The project objectives are as follows:

- A comprehensive review of the existing techniques and tools identifying associated advantages, limitations and costs.
- Selection of one (or several) tools that are most suitable for the intended application, along with the development of a process for protection settings validation and performance verification using the selected tool(s).
- Assessment of the suitability and feasibility of the proposed process and the tool through actual validation exercise using network and protection setting data.

- Identify a route forward to adopt the method and tool(s) for business as usual activity.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The project will be considered successful if the aforementioned project objectives are realised.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

This project is relatively small in scale and is only expected to last for three months – this is the minimum time required to complete the exercise that will lead to the following deliverables

- **Month 1:** review of existing commercial products that may be suitable for validation of protection settings and performance assessment: the methodology, suitability, capability and the cost of these products will be studied and reported upon.
- **Month 2:** review of existing research activities relevant to protection settings validation and performance assessment: the methodology, suitability, and potential for practical implementation will be studied and reported upon.
- **Month 3:** selection of the most suitable tool(s) and development of a process for protection settings validation through performance assessment under a range of future scenarios – execution and verification of the proposed method using a case study. Preparation and submission of final report and presentation of outcomes.

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

University of Strathclyde, Glasgow, UK. The network that will be analysed will be sections of the SPT network in the South of Scotland.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

The total NIA project expenditure is £25,711

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)

If the tool identifies setting issues that could result in blackouts then there is the potential for financial benefits to customers. Any assessment will, however, be subsequent to this initial piece of work.

Please provide a calculation of the expected benefits the Solution

Not applicable for this research activity.

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

To be determined at a subsequent stage.

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

Not applicable at this stage.

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

Other licensees will benefit directly in that any identified tool will be generally applicable to their networks and protection systems (perhaps with a degree of customisation to align with other licensees' databases and software tools).

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

The specific challenge identified in SPT's innovation strategy is one of controllability. The increasing transmission network complexity requires new approaches to observing, modelling and controlling the interactions between generation, transmission, distribution and loads and the potential impact of this modified network behaviour on the transmission network protection systems.

☑ 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.

n/a

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

n/a

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

n/a

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

n/a

This project has been approved by a senior member of staff

☑ Yes