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

Dec 2013

Project Reference Number

NIA_NGET0072

Project Registration

Project Title

Alternative Differential Unit Protection for Cable only and Cable & OHL hybrid installations

Project Reference Number

NIA_NGET0072

Project Licensee(s)

National Grid Electricity Transmission

Project Start

January 2012

Project Duration

2 years and 1 month

Nominated Project Contact(s)

Tahasin Rahman

Project Budget

£112,000.00

Summary

This R&D Project aims :

- To evaluate the practicability, reliability and benefits of implementing alternative non conventional current sensors (i.e. Rogowski coil) based differential unit protection for Cable systems (i.e. Cable only and Cable & OHL hybrid installations) over conventional Current Transformer (CT) based protection. To carry out the preliminary evaluation a pilot installation is recommended on Pitsmoor-Wincobank cable circuit on April 2012 as monitoring unit.

- To determine the systems suitability to be utilised as Emergency Return to Service (ERTS) system.

This will help to formulate a technical and operational knowledge base for Non Conventional Instrument Transformer (NCIT) protection systems which could lead to evaluation of future technical and procurement strategy to deploy as replacement and/or new Cable system protection.

Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

Problem Being Solved

Public perception towards overhead lines (OHLs) and limitations on rights-of -ways in populated areas could potentially lead to an increase in construction of cable only and cable & OHL hybrid circuits in future. This situation presents a unique challenge for cable protection systems especially on the hybrid one as protection system must differentiate between cable and OHL faults to ensure the greater reliability of the power system.

Current practice in National Grid is to implement two main unit protection schemes sourced from two different suppliers by using conventional CTs for 275kV and 400kV cable systems. However, CT installation and maintenance on cable circuit is immensely cumbersome due to bulk structure of CTs and space constrains associated to cable tunnels and trenches.

Moreover, CTs on cable circuits are subject to high magnitude of charging/discharging current during switching on and off condition which could lead to potential CT core saturation and mal operation of the protection relays. For green field application these constrains may be addressed by appropriate design solution; however on refurbished circuits especially where part of the OHL circuit is underground by using cables, it becomes challenging to achieve the prescribed selectivity and security with conventional CT based protection scheme.

In addition, to increase the operational reliability and reduce down time it is imperative to detect and discriminate transient faults i.e. lighting strikes on OHL of hybrid system to enable the Delay Auto Re-close as stated in TS 3.24.7 and PS (T) 10.

Through work with CIGRE and contacts with other utilities, an alternative non conventional current sensor i.e. Rogoswki coil base cable protection system by Cooper power systems have been identified as ideal solution which could offer greater operational, safety, and construction benefits over conventional protection systems.

Method(s)

The method that has been proposed for this project includes;

1. Initial Appraisal and a set of application interface designs and layouts
2. Stakeholder review and a finalised set of application interface designs and layouts
3. Pilot installation commissioned on Pitsmoor-Wyncobank circuit
4. Decommissioning of pilot installation
5. Evaluation and Recommendations

Scope

This R&D Project aims :

- To evaluate the practicability, reliability and benefits of implementing alternative non conventional current sensors (i.e. Rogowski coil) based differential unit protection for Cable systems (i.e. Cable only and Cable & OHL hybrid installations) over conventional Current Transformer (CT) based protection. To carry out the preliminary evaluation a pilot installation is recommended on Pitsmoor-Wincobank cable circuit on April 2012 as monitoring unit.
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Objective(s)

To report on the practicalities reliability and potential benefits of implementing alternative non conventional current sensors.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

To identify potential of implementing non conventional current sensors across the transmission network.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

This project will be trialed on one site to gain experience and data of equipment. As a result we cannot reduce the scale any further and still provide benefits to the customers.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

This project will deliver tools and techniques applicable to the whole transmission system.

Revenue Allowed for the RIIO Settlement

Zero

Indicative Total NIA Project Expenditure

IFI=£99k

NIA=£13k

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)

The estimated commercial cost for this equipment is approx £200k which is a saving of 25% cost of the traditional approach.

Please provide a calculation of the expected benefits the Solution

For budgetary comparison with traditional approach: -
Installed cost of 400kV single phase CT is £50k = £300k for 2 x 3phase sets
Traditional two ended NICAP installed Feeder Protection Panel typically £500k. Total cost is approx £800K.

The estimated commercial cost for this equipment is approx £200k which is 25% cost of the traditional approach.

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

This if proven successful will be replicable across the whole of the GB network once implemented into policy.

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

£200k per installation.

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

- [ ] 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

n/a

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 project addresses reliability in terms of optimized asset management.

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

Is the default IPR position being applied?

- [x] 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