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NIA Project Registration and PEA Document

Date of Submission

Dec 2013

Project Reference Number

NIA_NGET0038

Project Registration

Project Title

Design of a smart tool for detecting hidden errors in protection setting files

Project Reference Number

NIA_NGET0038

Project Licensee(s)

National Grid Electricity Transmission

Project Start

September 2011

Project Duration

4 years and 11 months

Nominated Project Contact(s)

Ray Zhang

Project Budget

£222,000.00

Summary

This project will deliver an intelligent tool (a computer software application or expert system) which can open a setting file (from Alstom Micom Relays) and interoperate the protection functions and settings in the file. A simple power system model will be used by the tool to test the settings and detect any hidden errors by applying various in-zones and out-zone faults on the power system model.

Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

Problem Being Solved

On 15th March 2011 at 05:32hrs, Tilbury SGT4 tripped. Coincident with the trip, SGT2B at Littlebrook and the Tilbury – Littlebrook 2 circuit also tripped. Investigation found that the trip of the Tilbury-Littlebrook circuit and the SGT2B was caused by incorrect backup protection setting calculated and applied on the relay at Littlebrook. The setting calculation engineer and site commissioning engineer failed to spot the setting error. The cause of the above multi-circuit tripping is similar to the incidents which caused the Birmingham and London blackouts.

Relying solely on people and procedures to assess the validity of protection relay setting files has not always been successful and occasionally hidden errors were not detected until after a relay mal-operated. In addition, a mal-operation related to an inappropriate setting may only become apparent when the power system is operating in a stressed or abnormal state and consequently might cause a local black-out or trigger a regional collapse.

Setting errors, or hidden problems in the setting files used in protection relays, have resulted in mal- operations. This project will investigate a method based on an intelligent system (often referred to as “expert system”) that will detect hidden errors in a setting file.

Method(s)

Setting errors, or hidden problems in the setting files used in protection relays, have resulted in mal- operations. This project will

investigate a method based on an expert system that will detect hidden errors in a setting file

This will be done by proposing the following methods;

- Literature survey on issues of management of protection settings, current tools available for detecting hidden errors in a protection setting file
- Literature survey on expert systems – what tools are available and what computer language is best to use for this project
- Understanding National Grid protection application policy and Alstom's Micom protection devices. Development of a simple power system model and allocate protection functions to the model (feeder and transformer protection functions)
- Research on how to open Alstom's MICOM relay setting files and interoperate intelligently the enabled/disabled protection functions and settings.
- Produce a design specification for the smart tool
- Start to write a computer program (i.e. the smart tool) for implementation of the power system model and protection function block.
- Produce a database of line and transformer parameters of National Grid's 400 kV and 275 and 132 kV networks and impellent the database in the tool. – Report & the computer program Nov 2012
- Determine the fault levels and fault currents to be applied for various faults on the power system model
- Development of the smart tool for detecting hidden errors in protection setting files (Alstom's MICOM setting file only)
- Trial of the tool and further development
- Finalise the test report after a setting file is tested - Report & the computer program
- Write up PhD thesis and a user manual for the smart tool

Scope

This project will deliver an intelligent tool (a computer software application or expert system) which can open a setting file (from Alstom Micom Relays) and interoperate the protection functions and settings in the file. A simple power system model will be used by the tool to test the settings and detect any hidden errors by applying various in-zones and out-zone faults on the power system model.

Objective(s)

The objectives for this project are to ensure that vulnerability is reduced and reliability is increased through an intelligent tool for detecting hidden errors in setting files to help prevent the re-occurrence of a similar incident to above.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

This project will be successful if we can develop a tool that can identify hidden protection file settings in protection relays. Further success would be to ensure these setting are then changed, however this is outside the scope of the project.

Project Partners and External Funding

Project Supplier – University of Strathclyde

Linked Partners – Alstom Grid and other utilities

There is no external funding being brought to this project.

Potential for New Learning

The project will develop a tool that can be used on site. This knowledge will be disseminated through the ENA Smart portal, Conferences, and academic papers.

Scale of Project

This project is being developed on a laboratory scale, but with a site demonstration at the end.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

This work is being done in Strathclyde

Revenue Allowed for the RIIO Settlement

Zero

Indicative Total NIA Project Expenditure

IFI - £95k

NIA - £127k

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)

Unknown, but this is crucial to ensuring the switchgear trips safely and properly in the event of a fault, non-tripping or defective tripping could pose hazardous & expensive consequences depending on the situation.

Please provide a calculation of the expected benefits the Solution

Base = Unknown but will avoid major costs due to an incident of >£1m

Method = 195k

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

This can be applied to all sites, specifically where there are Alstom Micom relays.

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

Unknown, this project is not to build a tool, but to deliver the design. As such, it is unknown how much the hardware would cost to roll out Nationally.

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

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)

This project addresses the reliability theme with a focus on avoiding failures and minimizing the need for human intervention.

- 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.

Having checked our standard supply base, including the ENA portal, Universities and EPRI, National Grid confirm that this work has not been done before.

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