Scottish and Southern Energy
Power Distribution

Date of Submission

July 2013

NIA Project Registration and PEA Document

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.

Project Registration

Project Title		**Project Reference**
Dynamic Line Rating CAT1		NIA_SHET_0004
Project Licensee(s)	**Project Start Date**	**Project Duration**
Scottish Hydro Electric Transmission	Apr 2009	6 Years
Nominated Project Contact(s)		**Project Budget**
Ben Gloag		£636,179

Problem(s)

Transmission lines are essential for moving power from generation sources to load centres. In simple terms, the amount of current flowing in a transmission line varies depending on the power needs of the connected loads and generation output. As the current increases, there is a corresponding increase in conductor heating resulting in expansion of the metallic conductor and increased sagging of the line. Strict statutory safety clearances are stipulated from high voltage (HV) overhead conductors and the ground (and structures) such that the thermal rating of an overhead line is set to maintain at least minimum clearance from ground level (and other structures). It is therefore conventional to stipulate fixed thermal ratings based on the statutory clearance requirements. These ratings are generally conservative and, although they vary with the season, they do not always take full account of all factors e.g. wind, which may affect the heating or cooling of the conductors.

Network operators usually increase the transfer capability of the transmission network by increasing the conductor size on existing line routes or building new transmission lines. A potentially cost–effective alternative is to use dynamic ratings for existing transmission lines. This method involves monitoring the thermal and ambient conditions of lines in real time and using that information to determine appropriate loading based on actual prevailing conditions. This method maximises the use of existing network capacity and may reduce the need to uprate the network.

This project proposes to expand on an earlier study which modelled sections of an overhead line for theoretical dynamic ratings. A dynamic rating system with real time monitoring will be trialled on this line to establish if it can be operated closer to its thermal limits whilst maintaining statutory ground clearances.

Method(s)

This project proposes a technical trial installation of a system called CAT-1 from Valley Group which consists of sag-tension measurement, a communication link and a local data concentrator which is then interfaced with SHE Transmission's Supervisory Control and Data Acquisition System (SCADA).

The transmission line choice for the trial is based on a previous study which successfully produced theoretical ratings from a model.

Once the dynamic line rating equipment is installed, the line will be monitored for up to 12 months to ensure compliance with the theoretical model.

Scope

To install a CAT-1 Transmission Line Monitoring system on a SHE Transmission line and demonstrate whether it can enable dynamic line rating resulting in safe and cost-effective line operation close to its thermal rating.

Objective(s)

- Investigate the ease of integration of CAT-1 proprietary software with SHE Transmission's SCADA system
- Evaluate levels of additional capacity achievable on the trial line through use of the installed CAT-1 equipment
- Verify the correlation between practical observations and the theoretical model already established
- Investigate the extent to which the technology can be applied without need for physical line uprating
- Estimate potential Capex and Opex savings from use of dynamic ratings based on the data obtained

Success Criteria

- Successful installation of the CAT-1 system and collection of sufficient data from the monitoring phase
- Successful utilisation of collected data to review and evaluate technical and financial benefits and hence establish recommendations on future viability of the technology

Technology Readiness Level at Start	Technology Readiness Level at Completion
5	7

Project Partners and External Funding

None

Potential for New Learning

The results of this project have potential for learning in the following areas:

- Potential savings in Capex and Opex
- Potential levels of additional transmission line capacity achievable by using the method
- Unforeseen challenges and risks associated with dynamic ratings
- Ease of integrating supplier proprietary systems with existing SCADA system
- Complexity of system planning required in case of wider adoption of the method

The learning will be disseminated by conference presentations

Scale of Project

A live operational trial at this scale is required to provide decision makers (Transmission Network Operators and System Operator) with sufficient confidence in the method to consider it as a viable alternative to current practice from technical, economic and operational perspectives.

Geographical Area

SHE Transmission's licence area in Scotland

Revenue Allowed for in the RIIO Settlement

No RIIO-T1 revenue has been allowed for work related to this particular method. However, there may be potential for savings on load related network upgrades during the period, depending on the success of this project.

Indicative Total NIA Project Expenditure

IFI - £542,200

NIA - £93,979, of which 90% is allowable NIA expenditure

Project Eligibility Assessment

Specific Requirements 1

1a. A 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 systems and 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	☐

Specific Requirements 2

2a. Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees ☒

Please answer one of the following:

i) Please explain how the learning that will be generated could be used by relevant Network Licenses.

The learning from this project will enable other Network Licensees to make informed decisions about the suitability of the method as a means of increasing available network capacity.

ii) Please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the Project.

2b. Is the default IPR position being applied?

Yes	☒
No	☐

If no, please answer i, ii, iii before continuing:

i) Demonstrate how the learning from the Project can be successfully disseminated to Network Licensees and other interested parties

ii) Describe any potential constraints or costs caused or resulting from, the imposed IPR arrangements

iii) Justify why the proposed IPR arrangements provide value for money for customers

2c. Has the Potential to Deliver Net Financial Benefits to Customers ☒

i) Please provide an estimate of the saving if the Problem is solved.

Dynamic line rating is expected to increase the rating of a transmission line by at least 50% of its static rating. This could remove the need for reconductoring a transmission line resulting in substantial financial savings. When implemented with a new line, instead of

selecting a conductor cross-section that is larger than technically required, appropriate sizing can be used with reduction in capital expenditure by several millions.

Use of dynamic ratings is also envisaged to provide incremental capacity to the network such that if applied to an adequate number of transmission lines, there is potential for increased flexibility to deal with outages. An extra margin of capacity in the network is likely to lead to corresponding reduction in system constraints and costs caused by outages. As a result, system reinforcement work to cater for increased renewable connections can be expedited accordingly if associated constraints can be sufficiently absorbed through capacity freed in other parts of the network.

ii) Please provide a calculation of the expected financial benefits of a Development or Demonstration Project (not required for Research Projects). (Base Cost – Method Cost, Against Agreed Baseline).

Dynamic line rating is expected to reduce the need for reconductoring of lines and the associated steelwork and foundation reinforcements. The cost of reconductoring a typical circuit is £9m and where dynamic line rating can be successfully applied such that that reinforcement works are delayed then the annual saving will be as estimated below :

Base case cost: £9,000,000

Method cost: £250,000

Annual financial savings : £9,000,000 - £250,000 = £8,750,000

iii) Please provide an estimate of how replicable the Method is across GB in terms of the number of sites, the sort of site the Method could be applied to, or the percentage of the Network Licensees system where it could be rolled-out.

All TOs are faced with the challenge of increasing network capacity to cater for the increase in renewable generation and to mitigate the risk of running constrained networks during outages. If there is a successful outcome from this project, this method will be applicable to all TOs' networks.

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

Procurement of the proposed system unit currently costs around £100,000. It is expected that wider adoption of the technology and improved efficiency in installation and integration processes through experience would result in reduction of procurement and other overhead costs.

2d. Does Not Lead to Unnecessary Duplication 

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

There are two other known projects in transmission and distribution which seek to address the same problem as identified in this project. However, the methods used in those projects are completely different to the one proposed in this project.

The other projects use different methods of assessing weather conditions and use the obtained weather data to calculate resulting conductor temperature, tension, sagging and hence ground clearance.

This project uses strain gauges which directly measure tension in the conductor and hence sag and ground clearance.

As these methods differ and are likely to lead to different conclusions regarding implementation of dynamic ratings, there is no unnecessary duplication from embarking on this project.

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