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

Jan 2014

Project Reference Number

NIA_NGET0111

Project Registration

Project Title

Facilitating Enhanced Network Capacity Evaluation

Project Reference Number

NIA_NGET0111

Project Licensee(s)

National Energy System Operator

Project Start

November 2013

Project Duration

0 years and 10 months

Nominated Project Contact(s)

Anna Blackwell

Project Budget

£195,000.00

Summary

This project is in essence a feasibility study to verify the potential in pursuing an ENCE system. In order to answer the fundamental technical questions behind any future ENCE system, we have limited the scope of this project to a small subset of the GB network in the South West of England, nominally west of a line bounded by Hinckley Point and Lovedean 400kV substations. While the choice of this section of the network does not necessarily reflect the primary target of a demonstrator installation in the future, it is the most suited in terms of data availability and offers a relatively benign set of characteristics for the testing of new algorithms.

Third Party Collaborators

University of Southampton

Southampton Dielectric Consultants

Oxford Computer Consultants

Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

Problem Being Solved

This project investigates how to create a tool which will reliably identify how much capacity will exist in given transmission circuits 48 hours in advance, to allow for appropriate handling of constraint actions and resultant reduction in costs.

Method(s)

Research & Development

This Technical Development project will examine the underlying technical requirements for a novel new Enhanced Network Capacity system, capable of providing the GBSO with accurate predictions of circuit capability up to 48 hours in advance. We will address the stated Problem through four strands of activity, each targeted on a different aspect of the Enhanced Network Capacity system.

Algorithms:

A key requirement for the success of the project is the ability to predict what will happen to network conditions (load, temperature etc) between the current time and a given time up to 48 hours ahead. The project will examine a range of different algorithms which may prove suitable for this task. Tests will be conducted against simulated data, built from subsets available from existing data. The necessary granularity of the data would be determined, along with the likely rate at which new data would need to be fed back into the system to refine the predictions. We will conduct a very broad review in order to investigate algorithms which are used to analyse large data sets outside in technology application areas outside of electrical networks.

System Monitoring Equipment:

The rollout of an Enhanced Network Capacity Evaluation tool across the network would require considerable investment in monitoring equipment to report back to the ENCE system. To determine the appropriate balance between the quality of predictions and reducing the cost of acquiring the necessary data, we will evaluate the minimum possible amount of data required and identify suitable sensing techniques which could be readily implemented into existing communications systems.

The feasibility study will concentrate predominantly on transformer and cable assets, drawing on innovation projects underway (eg the Twenties NETFLEX project) for overhead line monitoring devices.

User Requirements:

We will consult widely with System Operations staff to identify the prime user requirements from an ENCE system. This would cover a range of issues from the method of presenting the data visually, through to technical detail such as appropriate ways to handle uncertainties as time to zero moves from 48hrs through to the final system balancing. We will also consult with staff with network development and forward planning roles to ascertain what impacts the availability of such a system (which could provide extra capacity across key boundaries) might have on future capital spend. This process will be enhanced by the provision of demonstration interfaces to further engage staff within National Grid.

Computational Architecture & Requirements:

Completion of the three previous steps would allow a detailed framework to drawn up of the overall system architecture, with particular identification of relevant data flows. Consideration would be given to a range of approaches, including substation level local processing through local GPUs. The scope would be initially confined to that required to set up a demonstrator in the given target area (see Scope below). A technical risk analysis would be conducted to identify remaining uncertainties in the required computational methods.

This approach to the Problem relies upon the creation of a multidisciplinary project team with skills in power engineering, signal processing & applied mathematics and computing.

Scope

This project is in essence a feasibility study to verify the potential in pursuing an ENCE system. In order to answer the fundamental technical questions behind any future ENCE system, we have limited the scope of this project to a small subset of the GB network in the South West of England, nominally west of a line bounded by Hinckley Point and Lovedean 400kV substations. While the choice of this section of the network does not necessarily reflect the primary target of a demonstrator installation in the future, it is the most suited in terms of data availability and offers a relatively benign set of characteristics for the testing of new algorithms.

Objective(s)

The principle objectives of the work will be as follows:

1. Verification that suitable algorithms exist to support the necessary prediction technologies.
2. Identification of suitable condition monitoring equipment which could be used at a demonstrator level

3. Ensure that any future ENCE system fits within existing control room operating protocols
4. Development of a risk register to highlight areas which require further Research or Development activity before deployment of an ENCE system could be considered.
5. Review the potential savings GB wide from the availability of an ENCE system in terms of constraints avoided

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

1. Clear identification of the best technical approach to take in designing a demonstrator ENCE system
2. Development of a set of criteria to maximize benefit of an ENCE system to the GBSO
3. Identification of the proportion of existing constraints which are thermal, indicating possible future savings from an ENCE system.

Project Partners and External Funding

University of Southampton, Southampton Dielectric Consultants, Oxford Computing Consultants

No external funding.

Potential for New Learning

Based on the outcomes of the project, we expect the following learning outcomes which would be of interest to other transmission license holders:

- Suitable numerical algorithms for circuit capability prediction
- Extent of condition monitoring equipment which would be needed to run an ENCE system, thus informing future asset design choices
- Extent to which such data might need to be communicated to the GBSO, again influencing future design choices

The learning will be disseminated to other transmission license holders through a workshop at the end of the project to discuss the results and determine appropriate next steps. Journal articles on suitable numerical algorithms and monitoring inputs will also be published in the wider technical literature.

Scale of Project

This project is intended to be a feasibility study. Prior to embarking on a larger programme of work to create an ECNE system, the underlying technology requirements must be established to contain project risk. By focusing the testing on simulated data from a small part of the 400kV network, we will be able to test a wide range of algorithms in a timely fashion. Carrying out the work stated in the Method section would demonstrate whether the technology is in place to permit a demonstrator system to be developed.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

Within NGET, initially using the network in South West England for simulations.

Revenue Allowed for the RIIO Settlement

None.

Indicative Total NIA Project Expenditure

The total NIA Project Expenditure is £195,000

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)

This project aims to demonstrate that it is feasible to cut the constraint costs associated with the GB Electricity Transmission network through the application of a novel ENCE system. NGET constraint costs in the 2011/12 year were £323m and are currently forecasted to increase further as renewable energy penetration increases. Thus even if 10% of constraint costs can be solved by identifying additional thermal capacity, the saving is equivalent to >£30m recurrent per year. Although this project itself will not be able to deliver this level of saving, it is an essential first step in the design of a future demonstrator ENCE system.

Please provide a calculation of the expected benefits the Solution

Not required for research project.

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

This project is intended to demonstrate whether a UK wide ENCE could be technically feasible – if this is proved to be the case, then the Methods used would be applicable across all UK TNO networks.

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

As this study examines merely the technical feasibility of such a project, it is difficult to provide an estimate of the cost of rolling out a method of this size across the whole of the UK. Initial estimates are that a TRL level 6 demonstrator could be created in one target area of the network (comprising around 10 substations and associated circuits) for £9million.

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 outcomes of this project are key to demonstrating that an ENCE system could be developed, and that the result of this would lead to platform through which all GB TNOS and the GBSO can make informed choices about where it might be appropriate to target such systems.

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

n/a

☑ 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.

No previous IFI or NIA research has been undertaken on the specific Problem. Such a project needs to be run with significant input from the GBSO, who have not carried out this work previously.

The project will review and incorporate innovation projects, such as the EU Twenties project, which are looking at monitoring tools associated with Dynamic Line Ratings, however the majority of this project is associated with establishing network conditions, in particular those associated with transformer and cables

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