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

Jun 2016

Project Reference Number

NIA_NGET0191

Project Registration

Project Title

EPRI Research Collaboration on Grid Planning (P 40)

Project Reference Number

NIA_NGET0191

Project Licensee(s)

National Grid Electricity Transmission

Project Start

July 2016

Project Duration

0 years and 11 months

Nominated Project Contact(s)

Le Fu

Project Budget

£2,225,276.00

Summary

The nature of the programme is that almost all of the three individual packages will take more than a single year to complete, therefore they are not all expected to report specific milestones in 2016. The key expected areas of progress in 2016 include the following:

- Deliverable for P40.016: develop and validate static and dynamic models of system components such as HVDC and loads, including completion of the VSC HVDC dynamic models that can be used in system planning studies. Additionally, methods for system-wide model validation based on measurements will be developed.

- Deliverable for P40.022: develop probabilistic and risk-based planning methods and tools incorporating all sources of system uncertainty. Evaluate fault location algorithms to determine their suitability in estimating fault locations in networked transmission systems.

- Deliverable for P40.023: develop methods and guidance for modelling transmission systems for evaluating the impacts of harmonic distortion which might result from specific occurrences such as geomagnetic induced currents flowing through system transformers or high levels of inverter-based resources.

Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

Problem Being Solved

National Grid recognises that there are parallel challenges within the field of electricity transmission globally which are more economically investigated and addressed through collaborative learning and knowledge generation among key industry stakeholders. The Electric Power Research Institution (EPRI), with its wide international membership, plays a valuable role in identifying and delivering innovation projects aimed at addressing many of the challenges faced by electricity industry participants, including Transmission Network Owners and System Operators.

Traditional power system planning methods and tools are becoming less effective in today's power system environment. Transmission

owners and operators not only need to plan for future demand growth and increasingly uncertain generation portfolios, but also to provide transmission services from generation resources that include significant portions of variable generation (VG) technologies that are often remote from load centres and have significantly different dynamic behaviour from synchronous generation. The challenge of meeting reliability requirements with the changing landscape and increasing levels of uncertainty may necessitate adjusting and augmenting transmission planning criteria and methods.

This research programme 40 (P40) on Grid Planning is to support the development and validation of planning study models, planning processes and frameworks, and reliability assessment analytics that will be required to build a reliable and economic transmission grid that integrates and uses an evolving generation mix to supply an increasingly complex load that can also act as a system resource.

Method(s)

EPRI is a non-profit organization which facilitates a variety of research projects within the electricity industry. These collaborative projects bring together scientists, engineers and academic experts in the industry to help assess recognised challenges within the field. EPRI's approach in managing collaborative projects is beneficial to National Grid and our customers, providing valuable information, learning and knowledge which would be more expensive to formulate on an individual basis.

By participating in a given EPRI programme, National Grid not only contributes resource to a much wider portfolio of work, we receive the results of that work and are able to directly influence the detailed content and priorities of a programme through attendance at steering groups, known as Area Councils.
On an annual basis National Grid's asset and system specialists review the portfolio of proposed projects for the coming year that have been identified by the expert task forces at EPRI as being of common value to members. This annual portfolio review includes an overview of the project's research value, the approach and alignment of objectives with the needs of and priorities specifically for the GB Electricity Transmission Network. Each project that is selected for National Grid to participate in is further reviewed and ultimately approved by a panel of representatives from across the main directorates within National Grid. This review has identified that membership of P40, the Grid Planning program, in 2016 will be of value.

Associated with programme 40 (P40) are the following three research projects which are key to address the above challenges that National Grid is facing today:

- P40.016: Model Development, Validation and Management
- P40.022: Incorporation of Risk Analysis into Planning Processes
- P40.023: Special Planning Study Methods and Tools

Scope

The nature of the programme is that almost all of the three individual packages will take more than a single year to complete, therefore they are not all expected to report specific milestones in 2016. The key expected areas of progress in 2016 include the following:

- Deliverable for P40.016: develop and validate static and dynamic models of system components such as HVDC and loads, including completion of the VSC HVDC dynamic models that can be used in system planning studies. Additionally, methods for system-wide model validation based on measurements will be developed.
- Deliverable for P40.022: develop probabilistic and risk-based planning methods and tools incorporating all sources of system uncertainty. Evaluate fault location algorithms to determine their suitability in estimating fault locations in networked transmission systems.
- Deliverable for P40.023: develop methods and guidance for modelling transmission systems for evaluating the impacts of harmonic distortion which might result from specific occurrences such as geomagnetic induced currents flowing through system transformers or high levels of inverter-based resources.

Objective(s)

The purpose of the grid planning programme is to address the following primary areas:

- Model Development, Validation, and Management: develop computer simulation model for HVDC and dynamic load behaviour together with methodology to validate these models.
- Develop new risk based analysis methods and tools that can be integrated with existing planning processes such that uncertainties in the planning environment are assessed and understood.
- Special Planning Study Methods and Tools especially for evaluating the impacts of harmonic distortion: further development of existing analysis tools for FACTS and HVDC related devices

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

Progress for each P40 work package is expected during 2016. However, because this is ongoing research, not all of the packages will be completed or produce significant publications in that time. The success criteria are that most, if not all, of the set of deliverables will be achieved.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The Grid Planning programme is predominantly laboratory or desk based and as such there is no scope to reduce the scale of the project any further. Much of the value of the programme comes from its scale ($3.25m, this amount includes funding from other utilities), allowing it to be run as a coordinated programme rather than a series of stand-alone projects.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The research undertaken in the EPRI Grid Planning programme is predominantly carried out in the US, Canada, and various European countries, although the programme also reviews the latest research from across the world.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

The total indicative NIA expenditure is £330,000

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)

Each EPRI programme will provides different financial savings based on the outcomes and potential benefits gained within the programme. Prior to joining an EPRI programme, National Grid undertakes two stages of review to consider the potential to deliver financial benefits. In the first instance, within EPRI's governance, the Research Advisory Committee provides guidance on policies and issues that impact the power industry to inform the content of the research programmes. Within National Grid, the technical leader for each aspect of the GB Transmission Network undertakes a review of the proposed EPRI programme relevant to their technical expertise and responsibilities and evaluates which programmes provide potential value from a GB perspective as part of an annual review of programme participation.

The P40 Grid Planning portfolio provides key knowledge and learning for system planners to ensure system resilience, whilst providing the potential to develop quicker grid connection to electricity transmission and distribution customers:

- P40.016 Model Development, Validation and Management - the development of simulation models for new technology, such as HVDC, will provide benefits to system planners by enabling the investigation of system behaviour in more detail.
- P40.022 Incorporation of Risk Analysis into Planning Processes - greater understanding of the risks of uncertainty will benefits system planners by allowing further optimisation of requirements on system reinforcements to meet relevant codes and standards.
- P40.023 Special Planning Study Methods and Tools - further improvements in study methods and tools can provide benefits to system planners by providing further assistance to customers when meeting Grid Code requirements on harmonics.

Please provide a calculation of the expected benefits the Solution

Not required for research projects.

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

This Programme provides knowledge and learnings which are replicable to planning process of all GB license holders from transmission to distribution levels. With the increasing amount of converter based technology and variable generation to be connected into the energy network, connection challenges have been seen at sites all across GB energy network. This programme will provide system planners with essential tools to meet such challenges therefore can be rolled-out to all Network Licensees.

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

The direct cost of rolling out the learning from this programme will be based on changing computer simulation tools used by specific

UK licence holders. It is expected to range from as little as ten thousand to hundreds of thousands of pounds depending on the complexity of the changes required, to include potential existing or new software requirements. Further information regarding roll out costs can be provided prior to demonstration 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

All electricity Transmission and Distribution networks are facing the challenge of large amount of variable generation. Therefore, the knowledge gained by this programme will be beneficial to all network licensees in the GB.

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 fits within the Efficient Build and Service Delivery value areas of the Electricity Transmission Owner Electricity Innovation Strategy.

☑ 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