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NIA Project Registration and PEA Document

Date of Submission

Jan 2014

Project Reference Number

NIA_NGET0125

Project Registration

Project Title

EPRI Research Collaboration on Grid Operations and Control

Project Reference Number

NIA_NGET0125

Project Licensee(s)

National Grid Electricity System Operator

Project Start

April 2013

Project Duration

1 year and 10 months

Nominated Project Contact(s)

Glyn Kirkland

Project Budget

£4,243,923.00

Summary

The Worldwide electricity industry recognises that there are parallel challenges within the field of electricity transmission 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, takes a key role in determining and delivering the most impactful R&D projects. This portfolio of work is focused on Grid Operations and Control (GOC) which address key aspects of National Grid's Innovation Strategy.

Today's power system must be operated to meet objectives for which it was not explicitly designed. The transmission system is operated to transfer larger amounts of energy over greater distances utilizing an increasingly higher percentage of non-traditional resources than were considered when it was built. Generation resources are more constrained and increasingly more variable and uncertain. Demand resources are now considered as an option for resource adequacy and providing ancillary services in many regions. All of the changes are occurring at a rate that is outpacing corresponding growth in transmission infrastructure. As a result, today's grid is operated much closer to the margin.

Under these circumstances, it is imperative that operators be provided with good information based on real-time data regarding the status of the system, as well as decision-making support to respond to rapid changes that might occur in the near future. The emergence of new sources of real-time data that are becoming available from synchrophasor measurements, asset health sensors, and forecasts of future load and variable renewable output levels enable the possibility of providing operators with increased situational awareness and advanced decision-support tools. System operators need such tools to continue reliably and economically to operate the system in the face of emerging challenges.

EPRI's Grid Operations research program is addressing these needs by improving real-time situational awareness, developing tools that use synchrophasor and other measurements to assess the present system operating point relative to thermal, transient, and voltage stability operating limits, and developing tools to manage the grid through extreme events and restore the system in the event of an outage.

Nominated Contact Email Address(es)

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Problem Being Solved

The Worldwide electricity industry recognises that there are parallel challenges within the field of electricity transmission which are more economically investigated and addressed through collaborative learning and knowledge generation among key industry stakeholders.

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Method(s)

EPRI is a non-profit organization which facilitates a variety of research projects relating to GOC 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 provide National Grid with valuable information, learning and knowledge which would be more expensive to formulate on an individual basis.

On an annual basis we work with EPRI to select a portfolio of projects which is made available to all collaborators; 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 for the GB Electricity Transmission Network. Each project that is chosen for National Grid to join is reviewed and agreed through our governance processes with authority for sanctioning innovation projects within the Company.

Of the 12 Grid Operations and Planning projects put forward by EPRI members for 2013/14 programme, National Grid has identified four of particular value to the GB system.

EPRI Project 39.011: Situational Awareness Using Comprehensive Information

EPRI Project 39.012: System Voltage and Reactive Power Management

EPRI Project 173A: Bulk Power System Integration of Variable Generation - System Planning Methods, Tools and Analytics, and

EPRI Project 173A: Bulk Power System Integration of Variable Generation - System Operation Methods, Tools and Analytics.

Scope

EPRI Project 39.011: Situational Awareness Using Comprehensive Information is focused on developing new tools and methods to improve operator's situational awareness and decision support to maintain system reliability and system outages.

EPRI Project 39.012: System Voltage and Reactive Power Management is focused on improving techniques to simulate and analyse voltage stability and performance within the network.

For further information relating to these projects following this link:

<http://portfolio.epri.com/ProgramTab.aspx?sld=pdu&rld=264&pld=7754>

EPRI Project 173A: Bulk Power System Integration of Variable Generation - System Planning Methods, Tools and Analytics is project focused on developing methods and tools for supporting resource adequacy and transmission planning for systems that must accommodate the variability and uncertainty of high levels of variable generation such as wind and solar PV.

EPRI Project 173A: Bulk Power System Integration of Variable Generation - System Operation Methods, Tools and Analytics is focused on developing methods and tools to use in the operational planning time frame. These include decision support to allow operators to more reliably and efficiently schedule resources to meet demand, improve frequency control, understand the possible transmission impact of baseload generation cycling, and to integrate variable resource forecasting

For further information relating to these projects following this link:

<http://portfolio.epri.com/ProgramTab.aspx?sld=pdu&rld=264&pld=7594>

Objective(s)

EPRI Project 39.011: Situational Awareness Using Comprehensive Information

- Visualization of multiple power system operating boundaries/margins in aggregated views for system operators
- Incorporating advanced asset condition related information into operations security analysis.

EPRI Project 39.012: System Voltage and Reactive Power Management

- Developing hybrid methods and tools that combine the measurement-based and simulation-based approaches to help system operators better monitor and control voltage stability
- Developing methods and tools to forecast day-ahead reactive power needs and develop optimized schedules for reactive power resources.

EPRI Project 173A: Bulk Power System Integration of Variable Generation - System Planning Methods, Tools and Analytics

- Research and validate models and tools for generic wind and photovoltaic generation to increase security and more efficient use of new and existing transmission assets
- Develop methods and tools to enable transmission planners to incorporate and considers the added uncertainty when evaluating system reliability and facility upgrades to support future generation and load requirements.
- Developing tools and guidelines protection to contribution to the reliable operation of system with existing renewable resources and assessing the integration of new renewables in the system.

EPRI Project 173A: Bulk Power System Integration of Variable Generation - System Operation Methods, Tools and Analytics

- Investigate and validate existing reserve schedules and determine optimal dispatches to respond to random forecast errors and contingencies.
- Develop an extensive understanding of forecast needs and value for system operations and improve methods and practices to integrate forecasting.
- Examine system voltage and frequency impact of high penetration of renewable resources; develop mitigating strategies and evaluate new technologies and resources to support these strategies.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

EPRI Project 39.011: Situational Awareness Using Comprehensive Information

- Develop reliability through improved system operators' situational awareness and improved system operators' monitoring of critical equipment utilization.
- Develop security through reducing the risk of cascading outages caused by insufficient operating margins or equipment failures.

EPRI Project 39.012: System Voltage and Reactive Power Management

- Provide guidance on study tools, techniques, procedures, and modelling for investigating voltage stability and identify mitigation measures.
- Provide situational awareness for potential voltage stability issues.
- Facilitate decision making to help avoid or mitigate a potential voltage instability scenario.

- Provide operators an ability to arrive at an optimized plan for reactive power resources allocation and voltage profile to be followed over the course of a day. Also, provide guidance and strategies to maintain system security under foreseen system changes and events, as well as unexpected contingencies.

EPRI Project 173A: Bulk Power System Integration of Variable Generation - System Planning Methods, Tools and Analytics

- Develop methods and tools for supporting resource adequacy and transmission planning for systems that accommodate high levels of variable generation such as wind power and solar PV.

EPRI Project 173A: Bulk Power System Integration of Variable Generation - System Operation Methods, Tools and Analytics

- Develop methods and tools to use in the operational planning time frame, for example: efficiently schedule resources to meet demand and improve frequency control.
- Future year tasks will collect use cases from utilities to generate recommended practices as well as identifying the potential gaps for improvement.

Project Partners and External Funding

Each project facilitated by EPRI is funded through collaborators, including National Grid, that contribute to the development of the projects portfolio and then express specific interest in being involved in a project once the portfolio is decided. Total external funding to the value of £3,490,850 million has been provided by other collaborators involved in all the GOC projects.

Potential for New Learning

EPRI's varied portfolio enables National Grid to select appropriate R & D projects that align to delivering benefits to consumers covering objectives relating of Grid Operations and Control. Each project provides opportunities for extensive learning and knowledge generation through collaboration which would not be economically feasible if carried out independently. All GOC Projects will create new learning opportunities into assessing the reliability and performance of the Network's operation systems.

Expecting impacts from the selected projects include:

- Increase reliability through improved system operators' situational awareness afforded by comprehensive operating boundary/margin visualizations.
- Increase reliability and equipment utilization through improved system operators' monitoring of critical equipment and potentially dangerous situations, and the integration of asset health into control room analysis functions.
- Increase security through reducing the risk of cascading outages caused by insufficient operating margins or equipment failures.
- Provide guidance on study tools, techniques, procedures, and modeling for investigating voltage stability.
- Identify mitigation measures.
- Provide situational awareness for potential voltage stability issues.
- Facilitate decision making to help avoid or mitigate a potential voltage instability scenario.
- Provide operators an ability to arrive at an optimized plan for reactive power resources allocation and voltage profile to be followed over the course of a day. Also, provide guidance and strategies to maintain system security under foreseen system changes and events, as well as unexpected contingencies.

Further information about the key research questions, approach, impact and how to apply the results is provided at the following websites

<http://portfolio.epri.com/ProgramTab.aspx?sld=pdu&rlid=264&pld=7754>

<http://portfolio.epri.com/ProgramTab.aspx?sld=pdu&rlid=264&pld=7594>

Scale of Project

All GOC projects will be predominantly laboratory or desk based and as such there is no scope to reduce the scale of the projects any further.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The results from these projects will be applicable across the electricity network throughout the United Kingdom.

Revenue Allowed for the RIIO Settlement

None.

Indicative Total NIA Project Expenditure

The total NIA expenditure is £753,072.

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 project will have different financial savings based on the outcomes and potential benefits gained. Each EPRI programme that National Grid joins has been through two stages of review that 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 provide potential value from a GB perspective as part of an annual review of which programmes to participate in. All GOC Projects will create new learning opportunities into assessing the reliability and performance of the Network's operation systems.

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

Each project can be applied to the maintenance and reliability of grid control and operation measures and strategies throughout the transmission and distribution network.

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

The estimated cost of implementation any policy or procedure improvement within Grid Operations and Control could range from as little as ten thousand to hundreds of thousands of pounds depending on the complexity of the change implications. The wider cost implications arising from such changes will be dependent on the specific outcomes generated from the project and typically will be subject to further stages of demonstration prior to roll out. 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

RIO-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 Grid Operations and Planning programmes are focussed on addressing the challenges presented by the changes taking place in power systems that have a significant impact on the System Operator. The effects of the changes taking place will affect the development needs of all the Distribution and Transmission networks,

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

By participating in collaborative projects through EPRI National Grid can ensure that unnecessary duplication with other projects under NIA is avoided.

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