NIA Project Registration and PEA Document

Date of Submission

Mar 2018

Project Reference Number

NIA_NGSO0010

Project Registration

Project Title

Situational Awareness Using Comprehensive Information

Project Reference Number

NIA_NGSO0010

Project Licensee(s)

National Energy System Operator

Project Start

March 2018

Project Duration

1 year and 4 months

Nominated Project Contact(s)

James Kelloway

Project Budget

£130,000.00

Summary

Situational awareness is critical for National Grid as the GB System Operator to maintain system reliability and reduce the risk of wide-scale power outages, especially given the rapid changes happening to the GB power system with the amount and complexity of data which has to be interpreted and processed by the control room to make timely decisions. The scope of this project work stream "39.011 Situational Awareness Using Comprehensive Information" within the EPRI research program 39 aims to use new sources of data and develop new methods and tools to improve the capability for control room operators' situational awareness and decision support.

Nominated Contact Email Address(es)

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Problem Being Solved

As the GB System Operator, National Grid is increasingly challenged with interpreting more data on the system and more uncertainties impacting planning and real-time operations. The Electricity National Control Centre (ENCC) operations including the role of the control room operators on shift is becoming more complex and situational awareness is critical to maintain system reliability, reduce the risk of wide-scale power outages and achieving economic operation. Our current operational toolset within ENCC has limited functionality to support more advanced visualisation tools. Many user interfaces are simply text-based, which is not ideal for rapid assimilation of information under critical operational conditions.

In addition, the continued rapid growth in renewable generation, together with the increase in interconnection to external systems, is significantly changing the operational characteristics of the GB power system. This is rendering historic experience increasingly less relevant, so that the need for improved user interfaces is steadily growing.

Method(s)

Research projects run by the Electric Power Research Institute (EPRI) typically span multiple years. The research work planned in 2018 for this EPRI project work stream 39.011 is divided into two sub-projects which will take place during 2018:

1. P39.011A: Identification and Visualization of Operating Boundaries
This sub project will continue its efforts to investigate advanced methods for determining critical operating boundaries and displaying those boundaries to operators in a way in which they can easily assess the present situation as well as what-if operating scenarios and contingencies; and, respond accordingly. Key research activities will be to address methods to determine the most critical transfer analyses and associated operating boundaries; and, how to identify and prioritize the corresponding operator actions once these are understood. These new methods will be incorporated into the Visualization of Operating Boundaries (VOB) and BOUNDARY software applications.
2. P39.011B: Alarm, Equipment Condition, and Protection Information in Control Rooms
This sub project will focus on advancing the techniques and prototype tools developed in 2017 as per the below approach:

- Update the Alarm Management Philosophy document as needed based on application to specific member alarm management processes.

- Further develop the prototype of the alarm visualization software platform for grouping and prioritizing alarms based on an identified root cause through application to member historical alarm data.

- Further develop the operator protection status impact visualization software prototype.

Scope

Situational awareness is critical for National Grid as the GB System Operator to maintain system reliability and reduce the risk of wide-scale power outages, especially given the rapid changes happening to the GB power system with the amount and complexity of data which has to be interpreted and processed by the control room to make timely decisions.
The scope of this project work stream "39.011 Situational Awareness Using Comprehensive Information" within the EPRI research program 39 aims to use new sources of data and develop new methods and tools to improve the capability for control room operators' situational awareness and decision support.

Objective(s)

The R&D efforts in this EPRI research project work stream 39.011 aim to achieve the following objectives under its two sub-projects as outlined below. These are expected to enhance National Grid's knowledge of these research areas to aid with improving its system operation capabilities:
P39.011A:

1. Develop and test new visualization approaches that provide greater, more effective support for situational awareness in operating the system through ways that allow faster root cause analysis and clear pathways to appropriate actions. This can be achieved by integrating comprehensive operating boundary/margin information and it has the potential to provide learning which can be applied in a GB context and for National Grid's ENCC operations to reduce the quantity of information to be processed and retained.
2. Prototype software tools that implement the visualization approaches which will be investigated. It is expected that these concept tools would be available for the System Operator to review and look into how they can be tested in the context of our operations..

P39.011B:

1. Develop specifications for the information, communication, and visualization analytics and tools This could provide National Grid with additional knowledge to inform real-time decision support for emerging or improved sources of data such as equipment condition information, prioritized system alarms, and system protection schemes.
2. Improve Alarm Management systems to a state where they provide system operators with actionable information under different system conditions and avoid information overload at all times. The proposed Alarm Management Philosophy document can help the control room and support teams at National Grid to better group and prioritize alarms.
3. Improve operations awareness regarding the potential impact of protection system status changes on system operating conditions, anticipated contingencies and reliability.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The project will be successful if National Grid is able to pursue new activities, or modify existing activities, using a robust evidence base provided by this EPRI research project work stream through the following deliverables anticipated at the end of each sub-project:

P39.011A:

- BOUNDARY, version 2 (Software Update for identifying critical operating boundaries and appropriate operator actions, integrated with commercial tools and VOB) – expected 31/12/2018

- Visualization of Operating Boundaries (VOB), version 7.0 (Software Update for visualizing operating points and investigating appropriate operator actions) – expected 31/12/2018

- Case Study on the Application of COB and VOB in Practice and Summarizing the Utility Forum Discussions and Conclusions– expected 31/12/2018

P39.011B:

- Alarm Event Root-Cause Analysis and Alarm Grouping – Alarm Visualization and Analysis Tool (AVAT) (Software) – expected 30/11/2018

- Impact of Protection System Status Changes on Operations – Grid Consequences of Protection Status Tool (Software) – expected 30/11/2018

- Results from Case Studies of Alarm Visualization and Analysis Tool and Grid Consequences of Protection Status Tool (Technical Update) – expected 31/12/2018

- Alarm Management Philosophy Update (Technical Update) – expected 31/12/2018

- EMS Display Design Update (Technical Update) – expected 31/12/2018

- (Optional) Managing Control Centers under Stressed Conditions (Technical Update) – expected 31/12/2018

Project Partners and External Funding

Each project facilitated by EPRI is funded through collaborators, including National Grid, that contribute to the development of the project portfolio and then express interest to be involved with a specific project once the portfolio is decided.
The total contribution from all EPRI members for the EPRI Program 39 in 2018 if $5,600,000 and the project work stream 39.011 has been allocated a total budget of $750,000 ($400,000 for 39.011A and $350,000 for 39.011B).

Potential for New Learning

This project will help National Grid by providing new learning in the following areas:

- Methods and examples of concept tools for the control room and support teams to visualize the present operating point relative to multiple operating limits, to assess the most critical, or "nearest" operating limit to the present operating point, and to provide recommended operator actions to avoid the critical limits.

- Methods and examples of concept tools which can better integrate and assimilate alarms, equipment and protection system status data into the control center operations including methods to aggregate and prioritize alarms and visualize the implications of protection system changes.

Scale of Project

This project work-stream associated with P39 is predominantly a laboratory or desk-based research project.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The research undertaken in EPRI P39 and this project work stream 39.011 is predominantly carried out in the US with some in the UK. However, the programme carries out reviews of the latest research from across the world and also engages with participating EPRI members globally.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

The total indicative NIA expenditure for this project for 2018 is £130,000.

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)

National Grid as the GB System Operator uses a large amount of data of varied complexity to provide accurate information and visualization tools to the Electricity National Control Centre (ENCC) in managing energy demand and supply, as well as responding to real-time system events. The current operational toolset for situational awareness and alarm management capabilities have limited functionality to support more advanced visualisation tools and data types.
If the learnings and outputs from the project are implemented as part of National Grid's operations, the below areas of operational efficiencies have been identified leading to potential time and efficiency savings:

- Increase reliability through improved capabilities in ENCC for situational awareness afforded by comprehensive operating boundary/margin visualization.

- Increase security through reducing the risk of cascading outages caused by insufficient operating margins. Some examples of operational areas where this project can deliver value are:

    o Flawed situational awareness has been implicated in several major power   system outages, most notably the 2003 blackouts in the Northern US and Italy.
    o Reduce the risk of wide-spread power outages by operating securely within   safe margins and avoid preventable equipment failures.
    o Operate the system within system and equipment margins for improved   efficiency. Avoiding equipment failures would have additional safety benefits and   potentially helping extend equipment operational life thus reducing costs.

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

It is expected that the alarm management and situational awareness tools and methods delivered from this project will be relevant to various control centre operations across the GB network and would also be transferrable to the DNOs operations and the regional networks they manage.

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

As this project aligns with the strategic innovation areas for the GB System Operator and it aligns with existing activities to tackle the outlined challenges, it is expected that the rollout and adoption of the methods, review of the concept software tools delivered from the project can be facilitated through early engagement of the National Grid control room, control room support teams and Global

Information Systems (Global IS) stakeholders in the project and understand the considerations for using them on the National Grid systems and critical network infrastructure.

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

National Grid as the GB System Operator and other electricity network licensees own and manage data as well as systems to support their control room operations. All are increasingly challenged with interpreting more data and more uncertainties impacting daily operations, requiring enhanced situational awareness. The learnings from this EPRI research project are relevant to GB network licensees specifically in the following areas:

• The Alarm Management Philosophy document and prototype alarm visualization software platform will guide in grouping and prioritizing alarms based on an identified root cause through application to historical alarm data.

• The potential new visualization approaches which the project will investigate is expected to provide greater, more effective support for control room operators' situational awareness in ways that allow faster root cause analysis and clear pathways to appropriate actions.

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 will help address the strategic innovation areas (Developing DSOs & whole system operability, Leveraging analytics in a data-enabled future, Supporting voltage and reactive power, Optimising constraint management and Harnessing a digitized grid) in the National Grid System Operator Innovation Strategy document published Feb 2018.

☑ 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

The continued rapid growth in renewable generation, together with the increase in interconnection to external systems, is significantly changing the operational characteristics of the GB power system and rendering historic experience increasingly less relevant. With the increasing challenge of needing to interpreting more data, of varied complexities, to make decisions in the control room, there is a need for improved user interfaces and novel approaches to how the new types of data can be visualized and used by ENCC to support their decisions. Current operational tools and systems have limited functionality and are primarily based on text-based user interfaces. The objectives and scope of work in this project will help deliver innovative learnings in these areas by making use of new sources of data and develop new visualisation methods and tools in the context of real-time operation in the control room. These have not been investigated before as they are unprecedented scenarios which the System Operator is facing.

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

Through participating in this project as a member of the Electric Power Research Institution (EPRI) provides National Grid access to the latest state-of-the-art developments in this research area, access to the EPRI network to discuss, share best practice and positively influence the direction of future research. In addition, any changes to the systems, technologies and infrastructure used by National Grid as the System Operator need to be very carefully assessed as they can be disruptive to system operation and existing processes. This EPRI research project provides an opportunity to learn and validate the potential impact of such innovative developments before they can be considered for implementation into business as usual operations.

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

This project and its outcomes would help inform the future control room strategy especially with regards to the tools, systems and infrastructure we need to be future ready as the GB System Operator. NIA funding is the chosen funding route for this project as this would enable an easy way to participate in this EPRI project to be part of a worldwide network of experts in this field, whilst also benefiting from the learnings from other EPRI members who are System Operators in their respective geographies. By using NIA funding, this would also allow National grid as the System Operator to reduce the risks involved in evaluating these innovation areas from the EPRI project research group, assess early- on the implications if the learnings are to be operationalized, and disseminate the learnings to enhance the capability of the GB system and energy sector as well as enabling the transfer of the learnings to other network licensees.

This project has been approved by a senior member of staff

☑ Yes