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NIA Project Registration and PEA Document

Date of Submission

Mar 2018

Project Reference Number

NIA_NGSO0012

Project Registration

Project Title

Risk-Based Analysis into Planning and Resiliency Processes

Project Reference Number

NIA_NGSO0012

Project Licensee(s)

National Energy System Operator

Project Start

March 2018

Project Duration

1 year and 4 months

Nominated Project Contact(s)

Qi Li

Project Budget

£130,000.00

Summary

As the GB electricity industry experiences changes which increase the level of uncertainty in the transmission planning process, these changes may have ramifications for reliability and the cost of providing reliable electric service.

These changes are significantly increasing the uncertainty as to future supply resources to be developed, future demand levels that must be served, and the resulting generation dispatch and associated power flows that will result. As such, it is becoming increasingly difficult for planners to evaluate all near- and long-term reliability impacts when considering planning projects.

Nominated Contact Email Address(es)

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Problem Being Solved

The GB electricity industry is experiencing rapid physical and regulatory changes that are increasing the level of uncertainty in the transmission network planning process. This is making it increasingly difficult for planners to evaluate all near and long-term reliability impacts.
From Year Ahead Planning to Day Ahead, the Network Access Planning teams conduct contingency analysis for approximately more than 7000 power outages per year. It is not possible to fully study all the scenarios and current tools have limited capabilities to conduct risk-based assessments for long-term network planning. With the number of changes impacting outages, this has knock-on effects which result in outages being cancelled and delayed due to system security issues.
The existing network planning processes and tools, which are mostly deterministic, are not future proof to address these developing

challenges. The lack of refined processes and tools may result in a failure to study a particular scenario that may have reliability implications, or the tendency to over-build the system to account for the uncertainty. There is a need to develop new risk-based analysis methods and tools that can be integrated with existing planning processes, to explicitly consider many of these noted uncertainties.

Method(s)

EPRI (Electric Power Research Institute) research projects typically span multiple years. This EPRI project work stream 40.022 and the tasks involved in 2018 are listed below as well as the methodologies they will follow:

Task 1: Development of Risk-Based Indices & Decision Criteria

In 2017, the project performed a case study to clearly demonstrate the value of incorporating risk-based concepts in making reliability improvement decisions. In 2018, the project will focus on:

- Developing power flow scenarios around peak and off-peak system conditions by considering uncertainties in load, renewable generation, hydro, demand-side variability, economic variability, and generation retirement.
- Analyzing the scenarios developed using risk-based indices to identify weak links and critical components in the system.

Task 2: Grid Reliability and Resiliency Investment Framework Development and Demonstration

In 2017, the project developed a prototype version of the Resiliency Investment Framework (RIF) that allows planners to analyze High Impact Low Frequency (HILF) events and compare different options to improve system resiliency to withstand HILF events. The framework is designed to also allow analysis if reliability improvement options can help system resiliency and vice versa. The framework has power system analytical components as well as cost-benefit methodology for economic evaluation. The work in 2018 will focus on improving the framework using a practical case study, as well as delivering a software tool based around PSS/E- Python.

Task 3: Investigation and Enhancement of Risk-Based Transmission Reliability Tools

This task will be a continuation of the work on development, enhancement, and testing of various probabilistic transmission reliability tools. The work in 2018 will involve refinements to Scenario Builder, TransCARE and other supporting tools which this EPRI project is investigating.

Task 4: Co-Optimization of Generation and Transmission

This is a new task which will initiate in 2018. The research will look at approaches for possible combinations of generation and transmission investment decisions to identify the optimum solution from a physical and economic perspective. The work in 2018 will focus on state-of-the art for this topic and identify any need for further R&D. The research will also look into the role of energy storage in the co-optimization process.

Scope

As the GB electricity industry experiences changes which increase the level of uncertainty in the transmission planning process, these changes may have ramifications for reliability and the cost of providing reliable electric service. The main drivers of these changes which are relevant to the GB System Operator and its Innovation Strategy are:

1. The growing prominence of remote variable generation resources such as wind and solar photovoltaic,
2. Demand-side resources such as demand response, residential/commercial PV, and electric vehicles

These factors are significantly increasing the uncertainty as to future supply resources to be developed, future demand levels that must be served, and the resulting generation dispatch and associated power flows that will result. As such, it is becoming increasingly difficult for planners to evaluate all near- and long-term reliability impacts when considering planning projects.

Objective(s)

The objectives of the project are to enhance the System Operator's awareness and understanding of:

- Approaches to developing an analytical and investment framework using risk-based planning concepts that will more rigorously address increasing uncertainty and provide better insights to planners than the existing deterministic approaches. In developing such a future framework, the following objectives will be achieved as part of this R&D project.

1. Develop/refine risk-based analysis methods and associated metrics and data requirements/sources that are required for conducting probabilistic transmission planning analyses.
2. Investigate/develop probabilistic criteria that can be applied with existing deterministic standards that planners can use for investment decisions
3. Enhance and/or develop risk-based tools for performing transmission planning risk-based analyses.

- Develop an analytical and investment framework for grid resiliency. This framework concept will incorporate the risk-based planning framework described in the above objective, but will have additional components related to analyzing High Impact Low Frequency (HILF) events and compare various investment decisions to harden the system.

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 and processes in network planning, using a robust research evidence base provided by this EPRI project. The key deliverables and outcomes expected are:

1. Software: Tools for grid resiliency framework assessment (These tools will be in the form of scripts that can be used for performing reliability and economic assessments - software) – expected 31/12/2018
2. Software: TransCARE (A new version based on the modifications made in the tool - software) – expected 31/12/2018
3. Software: OFCT (New version of Outage File Creation Tool - OFCT (software) - expected 31/12/2018
4. Software: Risk-Based Planning Scenario Builder Tool (RBPSB) (A new version of RBPSB tool - software) – 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 40 in 2018 is $4,750,000 and the project work stream 40.022 has been allocated a total budget of $400,000.

Potential for New Learning

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

- Novel approaches and metrics for improving system reliability by ensuring that the transmission system is designed to reliably operate under high-risk scenarios that might not be assessed through deterministic analysis
- Availability of a decision framework concept that illuminates the value of transmission investments across traditional deterministic scenarios as well as higher impact, lower probability events.

Scale of Project

This project work-stream associated with P40 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 P40 and this project work stream 40.022 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)

The objectives, deliverables and tasks proposed within 40.022 are expected to generate valuable learning which can improve and maintain the reliability of the GB system operator through enhanced capability for risk management, as well as short-term and long-term network access planning. The specific areas identified below are where savings are expected:

- Using the framework, methods and tools from the project will facilitate rapid analysis without detailed contingency study to provide accurate enough data for fast decision making in longer-term planning stage. This would deliver time saving and operational efficiencies to handle the increasing number of outages (estimated 7000 per year) and the impacts of changes resulting from them. There are potential savings coming from outages which are not delivered due to lack of resources to perform sufficient analysis. The anticipated cost savings are expected to come from the number of failed outages every year and the cost of those outages being cancelled.
- The risk assessment tool will allow better prediction of potential risks to plan network changes which can further optimise the outage plan for the whole planning year. This can lead to potential commercial savings from optimising the system operation cost as the GB System Operator. By optimizing constraints management and planning more efficiently using such a tool, potential benefits and cost savings of about 25% are anticipated.
- Reduced resource/ hours for outage planning and reduced amount of re-work in these processes: It is expected that if the prototype tool and methods from this EPRI research project are adopted and implemented by National Grid, these could provide a time saving of approximately 25% in Year Ahead planning and Day Ahead planning activities, which could lead to a total of about 11,544 hours saved annually.

Please provide a calculation of the expected benefits the Solution

Not required as this is a low TRL research project.

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

It is expected that the risk management framework, methods and analysis tools delivered from this project will be relevant to various network planning teams (National and Regional) who look after the GB network. The knowledge will also benefit and be transferrable to the DNOs' operations and the regional distribution 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 with existing activities to tackle the outlined challenges, it is expected that the rollout and adoption of the methods, assessment metrics and software tools delivered from the project can be facilitated through early engagement with the National Grid network access planning teams (regional and national),

Transmission Operators, and Global Information Systems (Global IS) stakeholders in the project. This will help us understand and evaluate the considerations for using these within our planning processes and on the National Grid systems.

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 project will develop an analytical and investment framework using risk-based planning concepts to help develop the capability for the GB System Operator to more rigorously address increasing uncertainty in short term and long term network planning. It will also provide better insights to planners than the existing deterministic approaches.
The learnings with regards to risk-based analysis methods, associated metrics and data requirements/sources would be relevant to National Grid as the GB System Operator as well as other network licensees.

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, enabling more non-synchronous connections, supporting voltage and reactive power, optimising constraint management and unlocking flexibility) 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.
The scope of this project also complements an NIA innovation project completed by National Grid last year on Transmission Network Topology Optimisation (NIA_NGET0169) which focused mainly on constraints management.

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 GB electricity industry is experiencing rapid physical and regulatory changes that are increasing the level of uncertainty in the transmission network planning process. The continued rapid growth in renewable generation, together with the increase in interconnection to external systems, is also significantly changing the operational characteristics of the power system and rendering historic experience increasingly less relevant. Network Access Planning teams now conduct contingency analysis for approximately more than 7000 outages per year and there are too many scenarios which need to be studied. Current tools do not provide the capability and timeliness to analyse all the scenarios, risks of changes to the network from the outages and longer term impacts. This project is innovative as it will address these new challenges through a risk-based framework to enable rapid analyses to be carried out supported by novel methods and proposed tools which are aimed at providing more accurate data for planners and network manages to make decision in the short-term and longer-term planning stages.

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. The potential for using innovative tools, methods and frameworks as part of the Year Ahead and Day Ahead planning processes need to be carefully assessed as they can be disruptive to system operation and existing planning 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 network access planning and control room strategies especially with regards to the tools, systems and infrastructure we need to be future ready as the GB System Operator and how we work with other parties to plan the network in the short-longer term. 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 evaluate (at a relatively low cost and minimal risk) the proposed framework, metrics, methods and tools from the EPRI project research group, assess early on the risks and implications if the learnings are to be operationalized. It also enables the System Operator to 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