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NIA Project Registration and PEA Document

Date of Submission

Mar 2018

Project Reference Number

NIA_NGSO0013

Project Registration

Project Title

Flexibility and Resource Adequacy for System Planning

Project Reference Number

NIA_NGSO0013

Project Licensee(s)

National Energy System Operator

Project Start

March 2018

Project Duration

1 year and 4 months

Nominated Project Contact(s)

Daniel Burke

Project Budget

£110,000.00

Summary

This project's scope focuses on addressing the research areas of understanding energy resource adequacy, and the approaches for resource expansion as the GB power system faces more installed penetration of wind, solar photovoltaic (PV) generation and energy storage. The project proposes methods and tools for network planners which consider the operational flexibility and resource adequacy needs of systems with increased penetration of variable generation. The variability and uncertainty related to wind and solar PV will require increased levels of operational flexibility to be accounted for in the planning timeframe and that capacity is available to meet a less predictable net load profile. This evolution of the GB power system requires updated metrics, methods and tools which can accurately assess the requirements, needs and solutions to enable the System Operator to better respond to operational challenges and access flexible mechanisms when necessary to do so.

Third Party Collaborators

Electric Power Research Institute

Nominated Contact Email Address(es)

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Problem Being Solved

The levels of installed wind, solar photovoltaic (PV) generation and energy storage is increasing and their importance is growing in the GB electricity system.

Experience gathered with wind power is extensive over the last 10-15 years or so, but duration-limited storage (batteries) and solar PV are relatively new and there is only a short track record of experience for modelling these. The Electricity Market Reform (EMR) modelling team at National Grid captures the contribution to security of supply from sources such as wind, solar, storage, interconnectors and their analysis feeds into the annual EMR Electricity Capacity Report, as well as the NGET-ESO Winter Outlook. Although National Grid as the GB System Operator has developed in-house expertise on modelling these resources, as well as liaising with external expert forums to improve the methods/assumptions, the contribution to security of supply of these resources is a challenge as they need expert stochastic modelling approaches.
In addition, network access planners manage short-term operational flexibility challenges and calculate the effectiveness of each generator to mitigate thermal overloads. The current methods and tools for planners are limited in their capabilities to consider the operational flexibility and resource adequacy needs of systems with increased penetration of variable generation.

Method(s)

EPRI research projects typically span multiple years. This EPRI project work stream PS173C will build on existing work to date to investigate and develop novel tools and methods. The following tasks are planned during 2018 and the proposed methodologies to pursue them are outlined below:

1. InFLEXion tool improvement: This task will involve refinement of the Inflexion system flexibility assessment tool to include usability and functionality improvements based on user feedback, an updated version will then be released. The System Operator team will review the tool, evaluate its capabilities and various flexibility/reliability insights it produces, thereby assessing whether it could inform the network access planning process and operational flexibility mechanism strategy.
2. Resource adequacy: This task focuses on developing updated methods to assess the capacity value of resources such as energy storage (continuing 2017 work), wind and solar generation, and conventional generation (including dependence on external factors such as fuel availability and temperature dependence, particularly relevant in light of increased reliance on gas generation and the potential for gas delivery issues). In many cases, heuristic values are used for the capacity values of both wind and solar generation in planning margin studies, Distributed Energy Resources (DER) are also not well considered. As these technologies continue to grow and contribute to capacity needs, a more effective means of assessing the contribution from these resources will be needed to ensure the risk of capacity shortfalls is appropriately identified in studies. The development of more appropriate assessments of resources' capacity value as part of this project is expected to provide National Grid, as the System Operator, with a more accurate view of the risk of load curtailment.
3. Resource expansion: The third task focuses on supporting network planners to resolve any shortfalls in capacity or flexibility in future power systems. Should the metrics identify a deficit, planners are faced with the challenge of either determining what the best solution should be, or determining how to incentivize an appropriate investment response. Given the interaction between the capacity and flexibility needs from new resources, this task focuses on reviewing the current expansion evaluation process used in the international energy sector, particularly considering the increased need for flexibility. Based on the outcome of this review, the project seeks to investigate and develop methods to identify optimal expansion and/or operational practice changes, to mitigate the identified risks. The findings are expected to be relevant to further inform National Grid's System Operator strategy, and guide the processes and mechanisms to manage capacity and flexibility whilst operating the GB system.

Scope

This project work stream PS173C under the EPRI program173 consists of a sub-project "P173.012: Flexibility and Resource Adequacy for System Planning" under which the above tasks will be carried out and outcomes delivered.
This project's scope focuses on addressing the research areas of understanding energy resource adequacy, and the approaches for resource expansion as the GB power system faces more installed penetration of wind, solar photovoltaic (PV) generation and energy storage. The project proposes methods and tools for network planners which consider the operational flexibility and resource adequacy needs of systems with increased penetration of variable generation. The variability and uncertainty related to wind and solar PV will require increased levels of operational flexibility to be accounted for in the planning timeframe and that capacity is available to meet a less predictable net load profile.
This evolution of the GB power system requires updated metrics, methods and tools which can accurately assess the requirements, needs and solutions to enable the System Operator to better respond to operational challenges and access flexible mechanisms when necessary to do so.

Objective(s)

The R&D efforts in this EPRI research project work stream PS173C aim to achieve the following objectives under its sub-project as outlined. These are expected to enhance National Grid's knowledge of these research areas, to aid with improving its transmission planning, security of supply and system operation capabilities.

The long-term objective of this EPRI research project is to develop planning processes and tools to ensure that systems are designed to facilitate long term renewable integration objectives in the most reliable and economic manner. Specifically, the objectives of the research and development in this project for 2018 will be to:

1. Develop a planning framework, metrics and tools to understand the needs for operational flexibility to manage variability of load and variable generation and for the adequate resource capacity to meet the emerging net load profile.
2. Develop methods to consider how different resources on the system – conventional thermal, hydro generation, demand response, energy storage and transmission resources – interact and provide capacity and flexibility.
3. Develop methods and tools to prioritize investments in new resources (including generation, demand side, storage and transmission) to provide the requisite capacity and flexibility and/or adopting/modifying operational processes.

A key outcome from the project is a tool, called InFLEXion, which could be relevant to National Grid as the System Operator and be used by network planners and stakeholders involved in managing operational flexibility and assessing system flexibility issues. The

EPRI project will also be sharing the algorithms developed as part of this tool which will allow the System Operator to further assess the techniques developed in the context of GB system operation and future planning strategies.

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 research evidence base provided by this EPRI project work stream PS173C through the following anticipated deliverables:

- Inflexion V5.2 release (Updated release of Inflexion tool reflecting feedback and algorithm improvements) – expected 31/12/2018
- Technical Update: Capacity Value of Storage – Study Outcomes (Technical update containing the completed report) – expected 31/12/2018
- Technical update: Capacity Value and Resource Expansion for Emerging Power Systems (Technical update on capacity value assessment of new resource types and a review of the existing incentive structure for investment in new generation technologies.) – 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 173 in 2018 is $3,000,000 and the project work stream PS173C has been allocated a total budget of $350,000.

Potential for New Learning

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

- The tools, metrics and methods developed in this project could support network planners within the GB System Operator to identify reliability risks related to insufficient operational flexibility and capacity, reducing the need for load curtailment or overbuild of new generation capacity.
- Improved capacity value estimates help to reflect the realistic contribution of resources to meeting reliability targets. When applied, these updated values are likely to better represent the system expansion needs as part of planning margin studies. This can potentially reduce the cost of generation and network investment requirements for the GB system.
- Facilitate improved integration of new resource types into the GB power system, ensuring reduced curtailment of these resources and more efficient operation of other resources. This can in the longer term, lead to a reduction in carbon emissions, and potentially allowing for higher penetrations to meet various renewable generation targets.

Scale of Project

This project work-stream PS173C and its associated projects are predominantly laboratory or desk-based research project.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

The research undertaken in EPRI P173 and this project work stream PS173C is predominantly carried out in the US with some activities 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 £110,000

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 this EPRI project work stream PS173C are expected to generate valuable learning which can improve and maintain the reliability of the GB system operator through benefits and expected savings in the following areas:

- Further validation of existing Electricity Market Reform (EMR) processes against the international state of the art and experience elsewhere
- Access to emerging modelling capabilities for duration-limited storage participating in various markets
- Learning from other system operators' challenges with integrating solar PV in modelling
- An improved planning framework to manage variability and operational flexibility
- Possibility of creating real-time flexibility metrics and forecasts

The outcomes will also provide planners with the ability to determine whether a system has both sufficient flexibility and capacity when considering different resource types including conventional generation, renewables, demand response and energy storage. The resulting processes and tools can be used to ensure reliable, efficient integration of variable generation into the bulk system. Although It is difficult to directly attribute precisely what additional value the EPRI collaboration could bring, it is expected that small proportional improvements on our modelling could have a potentially much greater order of magnitude impact from an overall consumer cost benefit point of view e.g. it is estimated that if the accuracy of current modelling capabilities is increased by 1%, this can lead to large overall savings for the GB consumer.

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 metrics, methods and tools delivered by this research project will be replicable and can be used by planners to enhance the capability they have to determine whether a system has both sufficient flexibility and capacity when considering different resource types.

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 will be facilitated through existing channels which the Energy Insights team use e.g. it

will feed into the annual EMR Electricity Capacity Report, as well as the NGET-ESO Winter Outlook. The learnings from the project will add to the in-house expertise on modelling these subjects as well as liaising with external expert forums to improve the methods/assumptions as required.
For the Network Access Planning teams, early engagement with the relevant National Grid IS infrastructure and control room teams will facilitate adoption of the learnings and outcomes (e.g. new metrics, tools and methods) to help manage short-term operational flexibility challenges and calculate the effectiveness of each generator.

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

This project's aims to provide novel methods and tools for planners will consider the operational flexibility and resource adequacy needs of systems with increased penetrations of variable generation.
The variability and uncertainty related to wind and solar PV represent key challenge areas for GB network licensees and will require increased levels of operational flexibility to be accounted for in the planning timeframe and that capacity is available to meet a less predictable net load profile. The updated metrics, methods and tools which this project seeks to deliver will therefore be relevant and benefit both National Grid as the GB System Operator and 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 (Managing volatility in a low-inertia system, creating markets for the future 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.

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 electricity industry is experiencing rapid changes with increasing amounts of wind, solar and storage connected to the GB electricity system. Although there is existing knowledge and experience with wind power modelling over the last 10-15 years, duration-limited storage (e.g. batteries) and solar PV are relatively new and there is only a short track record of experience in modelling them. The contribution to security of supply from these resources is a challenge as they need expert stochastic modelling which has not been done before and requires novel methods and techniques to be investigated.

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 developments in this research area, access to the EPRI network to discuss, share best practice and positively influence the direction of future research. This arrangement also provides a high level of funding leverage as of the collaborative approach facilitated by EPRI which would benefit the end consumer. The outcomes for enhanced modelling approaches and tools from this EPRI research project need to be carefully assessed before the System Operator can use this to benchmark its current in-house modelling capabilities against the international ‘state-of-the-art’ experience in this area. This EPRI research project also provides an opportunity to learn and validate the potential impact of the planning framework and flexibility approaches 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

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, the System Operator can evaluate (at a relatively low cost and minimal risk) the proposed models, framework and tools from this 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