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NIA Project Registration and PEA Document

Date of Submission

Oct 2017

Project Reference Number

NIA_SSEN_0031

Project Registration

Project Title

Risk Assessment and Modelling of Smart nEtwork Solutions (RAMSES)

Project Reference Number

NIA_SSEN_0031

Project Licensee(s)

Scottish and Southern Electricity Networks Distribution

Project Start

October 2017

Project Duration

1 year and 1 month

Nominated Project Contact(s)

SSEN Future Networks Team

Project Budget

£230,624.00

Summary

The project will run for a period of 9 months and is broken down into three work packages. The scope of each work package is shown below with clearly defined deliverables.

Phase One

1. Consolidated list of non-conventional solutions considered for the risk analysis.
2. Summarised outputs of expert interviews.
3. Detailed risk analysis of each non-conventional solution using PESTLE framework and associated insights.
4. Risk curves for each solution prioritised which will consist of the different risk types relevant to the solution along with a probability function outlining risk of sub-optimal outputs put together evidenced by desk research of relevant projects, lab tests/simulations and expert interviews.

Phase Two

5. Set of quality controlled input data to be used for core modelling and sensitivity analysis.
6. Quantitative outputs from detailed core network modelling indicating materiality of various factors including network types.
7. Quantitative outputs from sensitivity analysis using network modelling (IC) which will test factors beyond core modelling as identified in the 1st phase.

Phase Three

8. Key insights from desk research and interviews in terms of non-conventional risk identification and communication in both within and outside the energy sector.
9. List of key stakeholders in the process of risk communication and a brief profile of motivations and expectations.
10. Draft risk communication framework to act as high-level guidance on estimating and communicating risks focusing on glossary of terms, key metrics, methods and presentation styles.
11. Close down report summarising method, key learnings, recommendations and identified next steps.

Third Party Collaborators

Carbon Trust

Carbon Trust

London School of Economics

Nominated Contact Email Address(es)

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Problem Being Solved

The growing integration of Distributed Energy Resources (DERs) and electrification of heat and transport brings new challenges and complexities to network management and operation. The impact on changing electricity demand and supply brings direct challenges to current networks given the increased capacity required for safe and robust operation. Examining options beyond conventional grid reinforcement provides large financial savings From recent work on examining the value of flexibility to the UK electricity system, there is ample evidence of the significant cost savings that can be unlocked through deploying flexibility solutions. Recent government funded research for Business Energy & Industrial Strategy (BEIS) shows that flexibility reduces the total system costs across a range of future scenarios. Of particularly interest is the reduced need for capital investment in distribution networks, which is estimated to account for up to £13bn of savings by 2050.

While there is general consensus on the benefits flexible assets could bring in deferring or avoiding distribution network reinforcement, there is much less understanding on how they impact the existing risk landscape for a network operator. The reliance on new non-conventional assets, such as storage or demand side response, for deferring network reinforcement brings new risks and complexities that are currently not well understood or quantified compared to conventional network assets. Combining different types of non-conventional assets together could potentially introduce new risks due to their interactions which are not presently understood. Given there is a large consensus that network management and operation in the future will involve these new assets, evaluating and understanding the risks better will allow for these new assets to be appropriately included in strategic planning decisions.
Currently there is an established and validated practice that allows DNOs to produce and communicate an overall risk score for conventional grid assets by estimating probability of failures from asset health and then combining them with an estimated consequence of failure. This allows DNOs to calculate risk scores for their assets and communicate them to Ofgem in a transparent manner, which allows analysis of network performance across operators over time. Nevertheless, while there is a reasonably established process for conventional assets, there are no similar guidelines or frameworks to identify, quantify or communicate risks associated with deploying non-conventional assets on the network.

The expected deployment of non-conventional assets on the grid justifies the need to define a new process, acknowledging that there are differences between the two types of assets from a risk perspective due to the following

- Technically non-conventional assets are different from assets currently used on the grid and so have different failure modes
- They introduce new types of risks such as supply chain, regulatory, political, commercial and others that are not prevalent in existing conventional assets
- When used in combination with other non-conventional assets, they sometimes produce combinatorial risks which are uncommon in conventional assets
- There may be as yet unknown risks associated with non-conventional assets that cumulate over time
- The ownership of non-conventional assets lies outside the DNOs who therefore have limited information on condition and limited control over maintenance schedules.
- The “outsourcing” of asset ownership and management itself increases the risk of tampering and manipulation

In a more dynamic electricity demand and supply future, understanding the risk profile of deploying non-conventional assets will enable DNOs to optimise investment and management of the network.

This project is eligible for NIA funding as presently we have no understanding of the risks related to deployment of non-conventional assets. The learnings developed through this project will allow DNOs to understand risks in more detail than was previously possible, allowing more informed decisions to be made, whilst improving network reliability. As this research has never been done before in the UK or globally it is a novel project that will progress our understanding of future energy networks.

Method(s)

The project is a technical method which will be delivered over three key phases:
Phase One: This phase incudes collecting all input data and putting together risks curves for non-conventional technologies through expert interviews
Phase Two: This phase is focussed on designing model runs, enhancing model capability, running the core model runs, sensitivity analysis and iteration of the model run

Phase Three: The final phase will develop risk communication frameworks through analysing best practice examples in energy and other sectors and will also include writing the close down report summarising findings and next steps

Carbon Trust and Imperial College have been selected as project partners as they are able to provide industry expertise and modelling expertise, respectively.

Phase One

Development/adaptation of future energy scenarios - While there are several Future Energy Scenarios (FES) developed by a variety of organisations, there are no established scenarios that focus on laying out the various pathways of flexibility solutions. The FES from National Grid has started to provide some detail on the non-conventional solutions in their various pathways and we propose to use this as the starting point. The importance of this step is to mainly draw out key external factors such as policy, regulation, social willingness and development of supply chain and their impact on overall risk landscape and also the relative magnitude of the different categories of risk across different futures.

This phase will also include a high-level horizon scanning exercise to draw out experience (successes and failures) from other sectors such as finance and banking in understanding and mitigating evolving risks in complex systems. In addition, relevant projects and initiatives evolving approaches to whole energy systems in the UK such as the Future Power Systems Architecture (FPSA) will be engaged at a high level to complement the horizon scan.

Analysis of non-conventional solutions and risk assessment: Using a mixture of desk research, literature reviews and using internal datasets and expert interviews, we will put together data sheets for the key non-conventional solutions. Some of the solutions we will examine include:

- Demand side response (industrial and commercial)
- Demand side response (residential)
- Distributed electricity storage (lithium ion)
- Backup generators

The exact list of attributes and their source data will be finalised once the project is kicked off and will include for example:

- Typical power rating
- Duration of response
- Robustness of communications link
- Percentage (%) availability

Once the key attributes of the solutions are consolidated and validated, the next key step in this phase is developing a detailed risk register for each of the solutions. We propose to use a Political, Economic, Social, Technological and Environmental (PESTLE) framework for guidance to ensure the different categories of risk are considered and outlined where possible. These qualitative risk descriptions will then be converted to quantitative estimates mainly in terms of reduced capacity or reduced availability for specific scenarios using outputs from the 1st phase. As part of the risk assessment, we will also include the assessment of potential combinatorial risks i.e. those that emerge as a result of interactions between different risks. Once the preliminary list of risk categories are identified, an initial prioritisation exercise will be carried out based on desk research further supplemented by expert interviews. The main parameters proposed for driving the prioritisation is “likelihood” and “severity” to produce a shortlist set of “high risk” categories. This phase will also identify those types of risks against relevant flexible network technologies where further work may be necessary to better understand their impact.

Phase 2

Probabilistic quantitative modelling: The probabilistic model aims to quantify the risk of unserved energy (energy not delivered to customers) and determine the inherent costs of deploying different grid reinforcement strategies. The strategies will include a combination of conventional and non-conventional assets deployed for increasing the grid’s capacity over the period of analysis. Modelling will also include the effects of mitigation measures on overall risk score. Imperial College has an existing model that is able to model certain network risks. This phase will involve configuring Imperial’s model to ensure it can be utilised effectively to simulate the risks we are attempting to model.

Phase 3

Development of a framework to communicate risk: This phase of the work will first carry out a high-level landscape assessment of existing reporting frameworks particularly those used by network operators currently to estimate and report risk to Ofgem such as the common indices methodology.

The risk reporting frameworks and standards used in the financial sector will also be examined to see if there are opportunities for transferring best practices. Based on the learnings from the risk reporting frameworks and outputs from the modelling exercise, we will

put together a high-level guidance on estimating and communicating risks focussing on glossary of terms, key metrics, methods and presentation styles.
This phase will end with a final internal dissemination event with stakeholders to present and discuss the findings.

Scope

The project will run for a period of 9 months and is broken down into three work packages. The scope of each work package is shown below with clearly defined deliverables.

Phase One
1. Consolidated list of non-conventional solutions considered for the risk analysis.
2. Summarised outputs of expert interviews.
3. Detailed risk analysis of each non-conventional solution using PESTLE framework and associated insights.
4. Risk curves for each solution prioritised which will consist of the different risk types relevant to the solution along with a probability function outlining risk of sub-optimal outputs put together evidenced by desk research of relevant projects, lab tests/simulations and expert interviews.

Phase Two
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Phase Three
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9. List of key stakeholders in the process of risk communication and a brief profile of motivations and expectations.
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Objective(s)

Understanding the risks and complexities of new flexible assets are critical to allow network operators to balance costs, network reliability and resilience.
The objective is to:
1. Enable better understanding of the underlying risks that arise from deployment of non-conventional network assets.
2. Develop and configure an existing modelling tool that is able to test different investment strategies and calculate their associated risks
3. Use model results to develop a new framework and communication strategy that highlights the risks associated with deployment of non-conventional network assets.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

This project will be a success if:
1) Understanding of risks associated with deployment of non-conventional network assets is improved compared with current understanding and these learnings are documented coherently. Where understanding is not improved any further, a clear path to improving understanding is documented, as well as the failures/learnings encountered by this project.
2) A model is developed/configured that is able to test different investment scenarios in order to provide risk outputs, which can help inform investment and strategy decisions. Where a model is created to test different scenarios but is unable to provide usable risk outcomes to inform investment decisions then a clear roadmap on how to improve the model to meet this goal must be provided as well as documenting lessons learned/failures.
3) A framework/communication strategy is created that utilises the learning from this project to inform DNOs of the different risks associated with non-conventional network assets. Where learnings are inadequate to produce a framework/communication strategy then learnings must be documented with a clear research path necessary to meet this objective.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The project has been carefully structured so as to start on a relatively small scale focusing firstly on developing and testing a method (including model) to understand and quantify the risks for deploying flexible network solutions. The focus of this project is to therefore to design, test and validate the method and to generate sufficient learnings around risks and potential consequence in terms of cost and also network security. This will enable more informed next steps around the particular areas to focus on and where more detail analysis would be required.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

The project will only be conducting model simulations of the network and not actual network trials. The specific part of the network that will be simulated will be finalised during the initial phase of the work.

Revenue Allowed for the RIIO Settlement

None. This is a novel field of research that has not yet been previously considered, the learnings of which will impact all DNOs within the UK and globally.

Indicative Total NIA Project Expenditure

230,624

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 reduced need for capital investment in distribution networks when more flexible solutions are deployed, are estimated to be up to £13bn by 2050). This means through the appropriate deployment of smart/flexible network solutions, a much more efficient and lower cost network can deliver the same needs of the system which translates to net financial benefits to consumers.
Deployment of these flexible solutions needs careful consideration particularly from a risk perspective to ensure the network security or resilience is not reduced in any way and this has to be fully accounted for in investment decisions. This project aims to examine these underlying risks, quantify them and identify methods to best incorporate into the network operator's investment decisions. The learnings are thus very important to ensure a more informed strategy drives investment into flexible network solutions that fully accounts for all risks.

Please provide a calculation of the expected benefits the Solution

NA – Research Project
The learnings from this project will help understand risk, which can reduce the risk of reliability issues and assist with contract development to ensure security of supply is not compromised.

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

This method once fully developed and validated is highly replicable across all the network licensees. This would be relevant to any operator who wants to deploy flexible network solutions to better integrate distributed generation and deal with growing electrification of heat and transport. Given that these trends can be seen across the whole of the UK, there might be particular networks where these challenges are acute and so this method would be more applicable.

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

Too early TRL to provide GB costs. Further development and maturity of the model is required. It is likely that an investment tool will need to be developed in order to provide true costs to the GB network.

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 key learning out of this project is better understanding the underlying risks associated with deploying flexible network solutions and how best to incorporate these into investment decisions. Given that all network operators have the ambition to test and integrate more flexible solutions as part of their network plans, learning from this project has important implications for all their decisions. This project will also initiate more focused discourse among network operators, BEIS and Ofgem of these novel solutions from a risk perspective which will seek to raise the importance of considering such solutions more holistically.

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

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