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NIA Project Registration and PEA Document

Date of Submission

Aug 2023

Project Reference Number

NIA_SSEN_0068

Project Registration

Project Title

New Approach to Losses

Project Reference Number

NIA_SSEN_0068

Project Licensee(s)

Scottish and Southern Electricity Networks Distribution

Project Start

September 2023

Project Duration

1 year and 2 months

Nominated Project Contact(s)

Tim Sammon, Innovation Programme Delivery Manager SSEN

Project Budget

£390,000.00

Summary

As electricity is transported across the distribution network some of it is lost. The volume of lost electricity is apportioned across network users according to their responsibility for those losses. The current losses apportionment model, 'newLAF', was created in 1995 when distribution networks were almost entirely demand based systems. As more generation connects to the distribution networks, regions such as SHEPD are becoming increasingly generation dominant with periods of net export to the transmission network. There is an emerging risk that the current model was not designed for this background. This project proposes to develop a new losses apportionment model and supporting engineering models using best available data to ensure the apportionment of losses across network users remains accurate and fair.

Third Party Collaborators

Capgemini

Nominated Contact Email Address(es)

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Problem Being Solved

Background:

An electricity distribution network links sources of electricity (the transmission network and generators attached directly to the distribution network) to demand customers (domestic, commercial, and industrial) at different voltage levels. There are two types of technical losses seen on the network, fixed and variable. Fixed losses, which do not vary according to current, take the form of heat and noise and occur as long as assets are energised. Variable losses change according to the pattern and magnitude of the power flow. The total magnitude of technical losses for the networks of the Distribution Network Operators (DNOs) is historically estimated to be in the order of 5-7% per annum.

A measure of the proportion of distribution losses for each network user (excluding transmission) is given by assigning them a Line Loss Factor Class for each voltage of user. This code is made up of a small series of Loss Adjustment Factors (LAF), one for each seasonal time of use as defined by the DNO. The Loss Adjustment Factor represents the ratio between the amount of power that needs to be added to the system at the GSP to deliver a certain amount of power to the end user. For example, in a demand-dominated scenario, for demand customers, if the LAF is 1 then no losses are incurred. If the LAF is greater than 1 then losses have been incurred between power coming onto the system and being delivered to the end user. If the LAF is less than 1 then the power is compensating for losses. The opposite is the case for generators where a LAF greater than 1 indicates that it is reducing losses.

DNOs are obliged under Standard Licence Condition 14 to publish a statement of charges and charging principles for the use of the distribution system. This statement is required to contain a schedule of adjustment factors to be made for Distribution losses. The losses calculation principles and publication requirements are specified by Elexon under BSCP128, and they audit each DNO's losses methodology, process, and outputs on an annual basis.

A second type of losses, non-technical losses, also known as commercial losses, incorporate measurement errors, recording errors, theft and timing differences. Appropriate treatment of these will be considered and included in the new model.

Customers connected at voltages of 22kV and above (EHV) are required under the BSCP128 to be assigned site-specific LAFs (and LLFCs) calculated from load flows which determine the effect on the total changes in variable losses caused by the connection of the customers maximum power flow. The only exception to this is when a newly connected EHV site does not have 12-months of valid settlement data. Customers connected at lower voltage levels (with some exceptions) are assigned 'generic' LAFs which only consider the voltage level of connection and whether the connection is immediately adjacent to the output of the supplying transformer or whether it is connected downstream on the network.

All DNOs, in compliance with the requirements set out in the Balancing and Settlements Code, calculate their electricity distribution network generic LAFs every two years. All DNOs use the newLAF model, however they are not mandated to. This model was originally developed in 1995 by EA Technology in partnership with some DNOs. At the time all networks were almost entirely demand dominated and the definition of LAFs treated generation as negative demand. Subsequently the methodology was further developed by Mathematical & Computer Modelling to include site-specific LAFs and more complex networks but still with the assumption that the power flows were driven by demand.

Problem:

The process of calculating LAFs is based on a large number of assumptions, in particular in regard to the treatment of generation connected to the distribution network. Since the inception of the LAF methodology there has been a large increase in generation connected to the distribution system with some networks such as SHEPD becoming more generation dominated with a significant proportion of exporting GSPs. This will also become an issue for other networks in the UK with substantial increases in distributed generation forecast for the next few years as DNOs transit to smarter, more actively managed networks to achieve government Net Zero carbon targets.

The existing newLAF methodology assigns the same generic LAFs for generators as for demand customers, that is the generator is, effectively, given a credit for reducing losses equal to the charge assigned to a demand customer attached at the same theoretical point on the network. However, while adding generation in general doesn't change fixed losses, depending on the location of the connection, the generator may be responsible for some variable losses. The New Approach to Losses model will take account of this.

At the Low Voltage level, the model simply divides the apparent losses associated with it by forecasted usage volumes to create a single set of generic LAFs. Historically there was limited information about power flows on the LV network on a half hourly basis. This means that, as losses are better understood at higher voltages, any errors or improper assumptions in the model may filter down to LV with the risk that customers may be apportioned a greater share of losses than they are responsible for.

Because of the age of the current losses apportionment model and the proliferation of distributed generation, it is unclear whether the model is still producing accurate results. This project will investigate where losses are incurred on the network using the best data available and if it is found that the newLAF model is not producing accurate results, will develop a new methodology for apportioning them across network users. If a new model is required, it will also require new engineering assessments to underpin it.

Method(s)

Calculation of total network losses

In order to apportion losses between different network users the total volume of losses needs to be understood. As the schedule of Line Loss Factors is published in advance of implementation, the calculations used are, necessarily, a forecast. The project will review the methodology to calculate network total losses and will undertake research into the use of historical settlements half-hourly and non-half-hourly (NHH) metering data for demand and generation (export) as a basis to forecast future year losses. This will be a top-down exercise using aggregated data to work out the difference between what is metered going onto the network and what is metered

coming off the network. This will need to include generation onto the distribution network from transmission and from distributed generation; it will also account for total demand on the network and any export onto the transmission network.

Modelling of losses on network – Engineering Model

A number of engineering assessments of the EHV and HV networks are carried out already. These will be reassessed to see if they give the level of granularity required. The type and number of network assessments required to feed into the new losses apportionment model will be examined and updated as required. Modelling of losses on the LV network will use smart meter and LV monitoring data that has not been available previously. This will be an entirely new element to the losses model and will leverage the data provided by previous innovations.

Currently, a relatively small number of test sections of the network are modelled, and the results from these are extrapolated across the network. The project will need to ensure that the number of test sections assessed allows for accurate representation of the network as a whole. This will be a bottom-up exercise using granular data to model the wider network.

Apportionment of Losses

The project will use the network data collected from the engineering assessments of where losses occur on the network and also metering data from various points on the system to build up a picture of losses across the network and create a methodology for apportioning them across network users. This must be fair but also in accordance with any requirements set out in the Balancing and Settlements Code.

The outputs of this work will be compared against the results of the newLAF model to understand if the newLAF model is producing accurate results or if a new methodology is required.

If a new model is required, it will be constructed from the work carried out in the project.

It must have a mechanism to verify that the outputs are accurate. It must also be understood by SSEN staff who can audit its performance and provide feedback on early versions of the model. As far as possible, the model must be contained within an easily accessible IT package, Microsoft Excel, for example.

Data Quality Statement (DQS):

The project will be delivered under the NIA framework in line with OFGEM, ENA and SSEN internal policies. Data produced as part of this project will be subject to quality assurance to ensure that the information produced with each deliverable is accurate to the best of our knowledge and sources of information are appropriately documented. All deliverables and project outputs will be stored in our internal systems with appropriate backup and version management. Relevant project documentation and reports will also be made available on the ENA Smarter Networks Portal and dissemination material will be shared with the relevant stakeholders.

Measurement Quality Statement (MQS):

The methodology used in this project will be subject to the supplier's own quality assurance regime and the source of data, measurement process and equipment as well as data processing will be clearly documented and verifiable. The measurements, designs and assessments will also be clearly documented in the relevant deliverables and final project report made available for review.

Scope

The project will investigate the accuracy of the current losses apportionment methodology by using a new approach to calculate and apportion network losses. If the current model is found to not be accurate, then the project will create a new losses apportionment methodology, underpinning engineering models and prepare them to a standard where they can be submitted to Elexon for approval.

It is not envisioned that this project will produce net benefits to customers as a whole, some customers will benefit from a lower apportionment of losses while others will have a higher level. However, it may result in a more equitable process for the apportionment of losses across all network users.

Objective(s)

The objectives of the project are to

1. Calculate losses on the SHEPD network using a new approach.
2. Compare the results with those from the newLAF model.
3. If required, construct a new losses apportionment methodology along with supporting engineering model.
4. Gain internal approval for submission to the BSC Panel, for the new methodology (if required).

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

Refer to Figure 1

Success Criteria

The project will either demonstrate that the current losses apportionment methodology produces accurate results or it will produce a new methodology that will gain internal approval for submission to the BSC Panel for the project, If either of these points are achieved the project will be a success.

Project Partners and External Funding

N/A

Potential for New Learning

The project will develop a new understanding of where losses are incurred on the distribution network, using new data sources such as Smart meters and LV monitors. It will use the new data to construct a new and equitable losses apportionment methodology ensuring that the costs of network losses are incurred in proportion to those user's contribution to those losses, for comparison with the current model.

Scale of Project

The current uncertainty regarding the apportionment of losses in the newLAF model is focussed on the SHEPD network due to the high penetration of distributed generation. However, any new model produced must also work efficiently for the SEPD network.

The intention is that the model will be able to be used by other DNOs. We will involve another DNO at the review stage so that feedback can be provided as to how the applicability of the model can be improved so that the outputs of the model can be applied across GB

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

As the project intends to create a new commercial methodology there will be no trial sites in the distribution network. However, engineering studies will be done using sections of network in both SEPD and SHEPD.

Revenue Allowed for the RIIO Settlement

No revenue has been allowed for this project in the RIIO-T2 settlement.

Indicative Total NIA Project Expenditure

The total project expenditure is expected to be £390,000.

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:

This project is aimed at helping to ensure that there is a just transition to a low carbon energy system. Currently the high volume of renewable generation connecting to the distribution system in SHEPD may be distorting the results of the current losses apportionment model. Understanding the distribution of losses on the network will ensure that the DNO is able to put measures in place to equitably apportion losses across all network users.

How the Project has potential to benefit consumer in vulnerable situations:

Not applicable.

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)

N/A

Please provide a calculation of the expected benefits the Solution

The project is not expected to provide any overall financial benefits. It will ensure that losses on the distribution network are equitably apportioned across all network users.

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

It is intended that the outputs of the project will be able to be used by all DNOs either directly or with minor modifications depending on differences in the network and network users.

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

The methodology and engineering models will be freely available to all DNOs. We will work with another DNO to understand whether the model is directly applicable to their network and if not, will attempt to tailor it so that it meets their requirements while still meeting our needs. With this in mind, we anticipate that roll out costs will be minimal.

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 learning generated will be a greater understanding of where losses are incurred on the network This new learning will be able to be applied by all DNOs to allow fair apportionment of losses.

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

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.

There are no other innovation projects that have looked, or are looking at the apportionment of losses.

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

A full assessment of where losses are incurred on the distribution network and how they are apportioned across the customer base has not been undertaken for over 25 years. This project will leverage new data sources such as smart meters and LV monitoring and consider the role distributed generation plays in regard to losses.

Relevant Foreground IPR

The project will generate a losses apportionment methodology and a set of engineering models that are required to provide input to the losses methodology. As these are intended to benefit all DNOs, should their deployment be justified, the models will be freely available to all DNOs as part of the dissemination activities.

It is unlikely that any Background IPR will be required to use the new models.

Data Access Details

For information how to request data gathered in the course of this project, see Network Innovation Competition (NIC) and Network Innovation Allowance (NIA) Data Sharing Procedure at https://ssen-innovation.co.uk/innovation-strategy/.

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

Currently all DNOs use the same losses apportionment methodology and engineering models which have been in use since 1995. Because of the way the use of the distribution system has changed since that time, in particular the proliferation of distributed generation, there are concerns that the model being used is not producing equitable results. Because this project will use new sources of data such as smart meters and substation monitors and is intended for use by all DNOs it is appropriate that it forms part of the NIA programme.

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

Understanding how losses are incurred on the network from first principles will require an appropriate sample size of different data points in order to ensure that the modelling can produce accurate assumptions for the network as a whole. The number and type of these data points is not yet understood and in the case of smart meters and LV monitors may not be available in the required number and density to allow for accurate modelling.
This development is out with the scope of our ED2 business plan and has the potential to benefit customers of the DNOs, and therefore this project is suitable for NIA funding.

This project has been approved by a senior member of staff

☑ Yes