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NIA Project Registration and PEA Document

Date of Submission

Apr 2015

Project Reference Number

NIA_WPD_005

Project Registration

Project Title

Losses Investigation

Project Reference Number

NIA_WPD_005

Project Licensee(s)

National Grid Electricity Distribution

Project Start

April 2015

Project Duration

4 years and 2 months

Nominated Project Contact(s)

Chris Harrap - WPD Innovation & Low Carbon Engineer

Project Budget

£2,580,000.00

Summary

This project aims to further our understanding of technical losses on the distribution network and help us target them in a cost effective manner. As 72% of technical losses occur on the HV and LV networks, these will be the focus of the project. Losses before the feeder circuit breaker, beyond the meter as well as non-technical losses will not be investigated. The initial investigations will cover the effects of different loading types and patterns on the various networks, determining their effects on losses and where they are most prevalent. This will be incorporated into an initial losses model to test our understanding against the measured values. The second stage of the project will move to predicting losses with reduced data sets. The accuracy of these predictions will be tested against the measured values. This will allow us to determine the minimum information required to target losses and help create the template for a losses register.

Third Party Collaborators

Manx Utilities

Problem Being Solved

Distribution Network Operators have an obligation to operate efficient and economic networks. As such the effective management of distribution losses is paramount. Current estimates put the technical losses at between 5.8% and 6.6% of electricity delivered ("Management of Electricity Distribution Network Losses" IFI report) worth approximately £900 million across the UK. Approximately £640 million of these losses occur after transformation down to 11kV. Some improvements with clear cost benefits across the network are being rolled out, as outlined in WPDs losses strategy, however these are restricted to broad brush techniques due to a lack of detailed understanding of the distribution of losses across our network. As such reductions in losses cannot be targeted and the network cannot be optimised.

Method(s)

This project will fully monitor several LV and HV feeders to measure all the in-feeds and out-feeds to the networks. This will enable us to gain a much fuller understanding of flows on the feeders as well as determining network losses. We will also investigate the causes and effects of certain loss influencing parameters such as imbalance and power factor. The monitored feeders will enable us to build a

reference for different loss estimation models which will be developed using restricted data sets. These models will predict the losses using data such as customer types and circuit length and will be compared against the reference allowing us to understand the importance and value of the data. The comparisons will allow us to determine the minimum information needed to assess network losses accurately.

Scope

This project aims to further our understanding of technical losses on the distribution network and help us target them in a cost effective manner. As 72% of technical losses occur on the HV and LV networks, these will be the focus of the project. Losses before the feeder circuit breaker, beyond the meter as well as non-technical losses will not be investigated. The initial investigations will cover the effects of different loading types and patterns on the various networks, determining their effects on losses and where they are most prevalent. This will be incorporated into an initial losses model to test our understanding against the measured values. The second stage of the project will move to predicting losses with reduced data sets. The accuracy of these predictions will be tested against the measured values. This will allow us to determine the minimum information required to target losses and help create the template for a losses register.

Objective(s)

- 1) Understand technical losses on the LV and HV network
- 2) Determine the minimum information to accurately predict network losses

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

- 1) Construction of fully monitored HV and LV networks
- 2) Measurement of network losses on monitored feeders
- 3) Accurate modelling of losses with full information
- 4) Several models with limited data sets created and tested
- 5) Conclusion on level of information needed to accurately predict losses

Project Partners and External Funding

Manx Utilities

Academic partners (TBC)

Potential for New Learning

The installation of fully monitored LV or HV networks hasn't been done on this scale in the UK. It will allow us to better understand the flows in our network as well as the losses. It should also help us fully understand the effects of different parameters such as imbalance and power factor on losses. The high granularity of the monitoring equipment will also allow us to investigate previous misunderstanding of losses due to averaging effects. The development of the prediction models will allow us to transfer this improved knowledge onto our unmonitored network and enable a targeted reduction in losses.

Scale of Project

The project has been sized to optimize learning whilst minimizing costs. The range of feeders monitored has been chosen to cover most typical network types to enable the learning to be as broadly applicable as possible.

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

The project will take place in two distinct areas.

- The investigations into the HV network will build on the monitoring network installed as part of WPDs FALCON project around Milton Keynes.
- The LV investigation will take place on the Isle of Man. This has been chosen as it is representative of the UK networks whilst

avoiding any interference with the Smart meter roll out. The vertically integrated structure of Manx Utilities will also facilitate the installation of equipment at domestic premises.

Revenue Allowed for the RII Settlement

Nil

Indicative Total NIA Project Expenditure

£2,322,000

Project Eligibility Assessment Part 1

There are slightly differing requirements for RII0-1 and RII0-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RII0-2 / RII0-1).

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 RII0-2 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 (RII0-1 projects only)

This project should allow us to accurately target the most economically viable mitigation techniques allowing us to reduce losses where action presents a net benefit.

If 10% of distribution losses after transformation to HV were reduced with a 10% lifetime saving this would equate to a saving of £1.61 million per year in terms of direct energy savings and £896 thousand per year in terms of carbon reduction.

Please provide a calculation of the expected benefits the Solution

The base cost for the reduction in losses is to do nothing.

From the Digest of UK Energy Statistics 2014 (DUKES) the final electricity consumption across the UK was 317TWh in 2013. Of this approximately 25.2% or 83.7TWh is consumed within WPDs network. With the conservative figure of 5.8% losses in the distribution network this means that 4.64TWh is lost on WPDs network, of this approximately 3.34TWh (72%) is lost after transformation down to HV. Using the Ofgem value of £48.42/MWh this is worth £161.9 directly with a further contribution of £103 million from the value of the carbon emitted generating it (figures of 524.62 TCO₂/GWh and £59/TCO₂ was used from the NIA benefits guide)

Base cost = £161.9 million+ £103.5million=£265.4million per year

If we can target losses and reduce 10% of the technical losses on the LV and HV networks with a saving of 10% then the method cost would be:

Method cost = $(1-0.1*0.1)* 265.4= £262.75$ million per year

This gives a financial benefit in WPDs network of £2.65 million a year

Financial benefit = $265.4-262.75= £2.65$ million per year

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

The feeders monitored in the project shall be selected to cover most typical network types. These will be chosen to cover a range of IIS 11kV circuit types and different LV templates found in the “LV network templates” project. This should insure that the learning is as applicable as possible. Certain circuit types have not been included in the investigation as the monitoring costs would be too high or the benefits too low. These exclusions have been kept to a minimum with only 8.86% of HV circuits and only LV template 10, “Public lighting”, discounted.

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

Across the whole of the UK the losses in distribution networks after transformation down to HV equates to approximately 13.24TWh, or £1.05 billion per year. If the above savings, 10% reduction for 10% of losses, were scaled up across the UK the benefits would be £10.5 million per year

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 from this project will allow all network licenses to assess the data needed to evaluate losses. This will facilitate the targeted reduction of losses across the UK. The feeders monitored in the project will be selected to cover most typical network types allowing the knowledge gained to be as broadly applicable as possible.

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 fill the significant gap in our data and knowledge of network losses as specified in section 6.8.7 of WPD’s innovation strategy. The project also addresses section 8.1 of WPD’s losses strategy, increasing our understanding of losses.

- 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.

This project is building on learning from the IFI "Management of electricity distribution network losses" project. It will add real measurements to help refine the assumptions in the report and help implement some of the conclusions.

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