Scottish and Southern Energy Power Distribution

Date of Submission

April 2015

NIA Project Registration and PEA Document

Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.

Project Registration

Project Title		**Project Reference**
Impact of Electrolysers on the Distribution Network		NIA_SSEPD_0006
Project Licensee(s)	**Project Start Date**	**Project Duration**
Scottish Hydro Electric Power Distribution	Oct 2013	2 Years 6 Months
Nominated Project Contact(s)		**Project Budget**
David MacLeman		£165,000

Problem(s)

The primary problem addressed is the increased network investment required to accommodate additional demand from the potential future volume of electrolysers connected to the network. We anticipate they will have a cumulative impact similar to EVs but with more focus on the HV network. A UK Government study (UKH2Mobility) anticipates this could add up to 350MW of new demand by 2030. Based on current estimates from DECC/Ofgem Smart Grid Forum Work Stream 3 transform model, this could result in over £160m of network reinforcement. This increase in the number of electrolysers, while presenting a demand growth challenge in its own right, is likely to appear alongside other disruptive low carbon technologies e.g. heat pumps. The use of electrolysers to provide a network service could be a method of managing some of the challenges posed by these other devices.

Problem 1 - There is limited understanding on the technical characteristics of a hydrogen electrolyser and the factors that will influence their potential location.
Problem 2 - There is limited information on the actual performance of electrolyser systems and their impact on the electrical network, in particular their likely demand profiles.
Problem 3 There in no information on the ability of an electrolyser to act as controllable demand to allow comparison with other methods of demand management.
Problem 4 - There is no information on the contractual or technical integration of the electrolyser equipment with the electrical network in order to mitigate its unmanaged potential impact i.e. to understand the extent to which electrolysers have the potential to offer a service to the network operator to help manage and alleviate other network constraints

Method(s)

Both technical and commercial methods will apply learning gained elsewhere e.g. from SHEPD's Orkney smart grid, and from the NINES project on Shetland. We will also engage with other DNOs and appropriate experts in this area to learn from their experiences.

Method 1 - Working with the Electrolyser Operator to investigate applicable codes, standards and regulations which need to be factored into the siting decision. Electrical and constraint modelling to identify network impact based on manufacturer-stated characteristics. Consultation with internal and external parties relating to consenting process to capture learning from site identification and consenting process.
Method 2 - Analytical comparison of a variety of scenarios for the connection and running of the electrolyser will be used to understand the impact on the electricity distribution network. Trials will be undertaken to monitor and assess the electrolyser's

response to real and simulated network conditions. Investigation and summation of applicable learning from past projects and various suppliers to quantify the expected performance and value of the network service.
Method 3 - Develop further operational scenarios using ANM system to investigate how the impact of electrolysers on the electricity network can be minimised.
Method 4 - Evaluate trial results to assess what potential electrolysers have to provide other network services.

Scope

Scope: To design and test an operational system for the safe, efficient operation of an electrolyser connected to the distribution network and establish a commercial framework for carrying out trials. To allow us to assess impacts of a large scale electrolyser on the network and produce a technical design for the ANM system which will allow a full range of trials to be undertaken.

Objective(s)

Objectives:
1) demonstrate and understand safe and efficient connection and operation of electrolysers and their impact on the system;
2) develop operational strategies to minimise the potential impact of electrolysers on the network;
3) identify the potential to provide other network services.

Success Criteria

Success Criteria 1: Development of operational practices and commercial arrangements to support the system implementation and operation.
Success Criteria 2: Identification of the extent to which an electrolyser can be controlled to minimise its impact on the network and if it can be used as a tool to manage issues caused by other disruptive technologies.
Success Criteria 3: Production and dissemination of learning around the expected operation of electrolysers, their impact on the network and strategies to deal with any impact.

Technology Readiness Level at Start	Technology Readiness Level at Completion
7	8

Project Partners and External Funding

This project forms part of the Aberdeen Hydrogen Project which has a total cost of approx. £20m. The project has received significant public sector funding from FP7, TSB, Scottish Government and Aberdeen City Council. Private sector partners include BOC Linde, Stagecoach and First Group. This application only relates to the funding of the works on the distribution network, the ANM scheme, learning capture and knowledge dissemination. For clarity the funding is not being used to fund the purchase of the electrolyser.

Potential for New Learning

The project will provide new learning in relation to the following topics:
1 - Factors influencing siting of electrolysers and their connection requirements, including practical and technical characteristics;
2 - Electrolyser operating profiles and their impacts on network peak demand;
3 - Potential for developing operational and commercial strategies for electrolysers to minimise any network impacts;
4 - Potential for electrolysers to provide other network services.

Scale of Project

The size of the proposed electrolyser is 1MW and the proposed connection arrangement represents a reasonable representation of the likely scale for the future growth of distributed hydrogen production based on the UKH2Mobility Study. It is sized to have sufficient capacity by 2015 to produce the required hydrogen for ten buses to be operated in Aberdeen City centre but with a higher degree of operational flexibility to allow the full range of planned electricity distribution network trials to be evaluated. This will allow a fuller exploration of the potential impact of the technology on the electrical network.

Geographical Area

An important part of the project is to identify a suitable site where electrolyser technology could be deployed. This will focus on the SHEPD network area. In particular, there is an identified hydrogen demand (secured through the external funding) for ten fuel cell buses operating in Aberdeen city centre and the site will be optimised to meet this demand. The location chosen will provide a safe environment such that the trials can be carried out without any detrimental impact on customers or security of supply.

Revenue Allowed for in the RIIO Settlement

At this stage no saving on expenditure can be expected during project implementation.

Indicative Total NIA Project Expenditure

The Tier 1 project originally had an approved budget of £753,000. No additional funds are required to complete the project. The project is transferring from LCNF Tier 1 to NIA on account of delays beyond the control of SHEPD. Total (2015-16 NIA) = £165,000 of which 90% (£148,500) is allowable NIA Expenditure

Project Eligibility Assessment

Specific Requirements 1

1a. A 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 systems and 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	☐

Specific Requirements 2

2a. Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees ☒

Please answer one of the following:

i) Please explain how the learning that will be generated could be used by relevant Network Licenses.

UKH2Mobility identifies that the rollout of the hydrogen fuel cell electric vehicles will be focused in areas of high car ownership, population and proximity to major roads and that 51% of the hydrogen demand will be met by electrolysers. The impact of electrolysers will potentially be seen across all License Network areas by 2030.

ii) Please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the Project.

2b. Is the default IPR position being applied?

Yes ☒

No ☐

If no, please answer i, ii, iii before continuing:

i) Demonstrate how the learning from the Project can be successfully disseminated to Network Licensees and other interested parties

ii) Describe any potential constraints or costs caused or resulting from, the imposed IPR arrangements

iii) Justify why the proposed IPR arrangements provide value for money for customers

2c. Has the Potential to Deliver Net Financial Benefits to Customers ☒

i) Please provide an estimate of the saving if the Problem is solved.

If the Problem is solved Network Operators will be potentially able to offer a type of managed connection for electrolysers, whilst still fulfilling their commercial obligations, and avoid costly network reinforcement.

ii) Please provide a calculation of the expected financial benefits of a Development or Demonstration Project (not required for Research Projects). (Base Cost – Method Cost, Against Agreed Baseline).

The baseline reinforcement NPV cost to the DNO would be £194,000 over 10 years and the NPV cost by offering the managed connection would be £140,000. Therefore, there would be a saving of £54,000 to the DNO.

iii) Please provide an estimate of how replicable the Method is across GB in terms of the number of sites, the sort of site the Method could be applied to, or the percentage of the Network Licensees system where it could be rolled-out.

The analysis assumes that 25% of sites could be enabled through a managed connection and that this would equate to 142 sites throughout the UK.

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

It is anticipated that the managed connection could be facilitated through the use of an Active Network Management system at an estimated cost of £240,000 per site.

2d. Does Not Lead to Unnecessary Duplication ☒

i) Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

A global review of hydrogen projects was undertaken in 2012 as part of an IFI project (ref. SHEPD IFI 2012_02) and it was found that the project was unique on account of the scale of the electrolyser and the commercial requirement to meet the necessary hydrogen demand for a fleet of 10 inter-urban buses operated by two independent bus companies. Research by the US National Renewable Energy Laboratory (NREL) published in September 2014 concluded that electrolysers had the potential to provide electrical network services but that additional testing is required to assess the flexibility of large electrolysers (> 1MW) to ensure that they are adequately responsive (ref http://www.nrel.gov/docs/fy14osti/61758.pdf). This project will achieve this and compliment the NREL research previously undertaken. In addition the ENA Smarter Networks portal was reviewed and no similar projects were found.

ii) If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.