WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Date of Submission

April 2020

NIA Project Registration and PEA Document

Notes on Completion: Please refer to the **NIA Governance Document** to assist in the completion of this form. Please use the default font (Calibri font size 10) in your submission. Please ensure all content is contained within the boundaries of the text areas. The full-completed submission should not exceed 7 pages in total.

Project Registration

Project Title		**Project Reference**
Take Charge		**WPD_NIA_052**
Funding Licensee(s)	**Project Start Date**	**Project Duration**
Western Power Distribution	April 2020	Years: 1 / Months: 8
Nominated Project Contact(s)		**Project Budget**
Yiango Mavrocostanti		£1,380,000

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Lead Sector

Electricity Distribution	☒	**Gas Transmission**	☐
Electricity Transmission	☐	**Gas Distribution**	☐

Other Sectors

Electricity Distribution	☐	**Gas Transmission**	☐
Electricity Transmission	☐	**Gas Distribution**	☐

Research Area

Network improvements and system operability	☐
Transition to low carbon future	☒
New technologies and commercial evolution	☒
Customer and stakeholder focus	☐
Safety, health and environment	☐

Problem(s)

The development and roll-out of rapid EV charging is becoming increasingly important as EV manufacturers aim to minimise the time and disruption associated with customers charging their vehicles.

Motorway Service Areas (MSAs) have been identified as a specific location where rapid EV charging would need to be deployed on a large scale to allow simultaneous charging by multiple customers when undertaking long journeys. MSAs are currently supplied either directly via the local Low Voltage (LV) networks or via a distribution substation connected to the 11kV network. However, the deployment of rapid EV charging at MSAs is likely to require a power supply capacity of up to 20MVA to ensure that customers can simultaneously charge their vehicles at peak times.

Providing this level of capacity using traditional solutions would require the installation of a new 33/11kV substation with associated transformers, compound, switchroom, switchgear and auxiliary equipment. The delivery of this solution would be expensive, time consuming and often far too complex for the needs of the customer.

Method(s)

The Motorway Services Take Charge project will specify, design, test and trial a brand new standardised package solution for delivering large capacity to MSAs in a far more cost and time effective manner when compared with the traditional solution, to enable rapid car and van EV charging.

Investigation and research on charging point data, vehicle movements and customer behaviours will be conducted to understand the optimal size, configuration and capability of the new package solution, which in turn will be used to produce a detailed functional specification.

The new package solution will be developed and built by Brush, a leading manufacturer in switchgear and transformers, and will be installed at a Moto MSA within one of our licence areas. It will be connected to the existing 33kV network within the vicinity of the selected MSA and deliver supplies to both existing and new charging infrastructure. The new solution will provide up to 20MVA of capacity and will be specifically tailored towards the requirements of the new rapid chargers and the need to integrate with future Battery Energy Storage Solutions (BESSs) and Distributed Generation (DG).

The installation will be trialled over a six month period to evaluate the performance of the new solution, the benefits generated and the associated learning.

Scope

The duration of the project is expected to be 20 months and will be split across four work packages:

Work Package 1 – System Capacity Optimisation
The first work package will involve assessing the predicted level of demand for all Moto MSA sites within our licence areas to ascertain the optimised capacity to inform the device design. The assessment will utilise data made available through OLEV's Project Rapid, forecast data provided by charging point installers and EV charging data that has been made available from other innovation projects.
This work package will also determine the most appropriate site to trial the new solution. Using the demand data already captured, we will work closely with Moto to assess each potential site against a set of criteria to ensure that the selected site offers the best value in terms of costs and benefits for the trial.

Work Package 2 – Develop and Design the Connection Solution
The second work package will use the information gathered in the first work package and produce the design requirements and detailed functional specification for the new package solution. The design will be focused on developing a solution with most of the capabilities of a conventional substation but in a far more compact and low cost solution. Another key element will be complete off-site assembly and testing, ensuring a standard design to minimise on site construction activities, reducing cost and time to connect.
The design will be developed in conjunction with Brush, who will be building the new solution and have a wealth of experience in the design and installation of switchgear and transformers.

Work Package 3 – Build and Install the Connection Solution
In the third work package we will coordinate with Moto to install and integrate the innovative new solution at the chosen trial site determined in work package 1. The new solution will be connected to our existing 33kV network and will integrate with the 11kV network that currently supplies the trial site. The solution will therefore supply existing EV charging infrastructure and the new charging infrastructure planned by Moto. The new solution will also be connected to our Network Management System (NMS) to provide our engineers with the necessary levels of control and visibility of monitoring information.

Work Package 4 – Trial and Evaluation
The last work package involves a six month trial period to evaluate the performance of the new solution and capture the associated learning following connection to the live network. Working alongside Moto, we will assess how the new solution performs against the original aims of the project and verify the benefits that have been generated.
Information on the technical performance of the solution will be regularly reported both internally within WPD and externally to the wider industry via number of dissemination events. The results of the project will also be captured in a report produced by the project partners.

Objective(s)

The project objectives are as follows:

- Determine the optimal capacity for the new solution
- Select an appropriate site to install the new solution
- Produce a standardised design for large capacity, compact substations at MSAs
- Manufacture, install and energise the new solution at the trial site
- Measure and demonstrate the effectiveness of the new solution on the live network
- Analyse the findings from the trial and collate results that can be shared and disseminated across the industry
- Minimise disruption to Moto's business operation during the trials

Success Criteria

The project success criteria are as follows:

- Analysis of information and data to inform the design of the new solution
- Selection of a suitable trial site for the installation

- Development of a design for the new package solution
- Installation and integration of the new package solution at the trial site
- Monitor and analyse information and data during the trial phase
- Dissemination of key results, findings and learning to internal and external stakeholders

Technology Readiness Level at Start	Technology Readiness Level at Completion
4	7

Project Partners and External Funding

There are two Project Partners that will help deliver the project:

Brush will be responsible for the detailed design and build of the new package solution
GHD will conduct research and analysis and also provide technical support and project management services

Potential for New Learning

The project will generate learning on the following:

- Charging patterns for rapid EV charging at MSAs
- Design considerations for the development of new substations to supply high volumes of rapid EV chargers
- How to optimally configure substation components to achieve a high capacity, low cost solution
- How to successfully integrate a new package substation at an MSA
- New policies and procedures for the design, installation, operation and control of the new package solution
- The benefits that can be achieved by implementing the new package solution

Scale of Project

Motorway Services Take Charge is a design and demonstration project that aims to produce a standardised solution that could be implemented at all major MSAs across GB. The project will use information that has been generated through previous and current innovation projects that have investigated EV charging. This valuable information will be used by the project partners to develop a robust solution to supply high volumes of rapid EV chargers at MSAs.
The project will install, integrate and trial a new package solution at a Moto MSA within one of our licence areas. Moto operates the most MSAs across GB (44 in total), however, the solution could also be implemented at MSAs operated by Welcome Break and Roadchef (26 and 21 MSAs respectively).

Geographical Area

The trial site will be located at a Moto MSA within one of our four licence areas. Initial research has shown that there are 14 Moto MSAs across our licence areas (North and Southbound services are considered as one MSA). A site selection methodology will be prepared and implemented as part of the initial stages of the project to determine the most suitable site for the trials.

Revenue Allowed for in the RIIO Settlement

£0.00

Indicative Total NIA Project Expenditure

£1,242,000

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.

The project will develop and demonstrate a brand new package substation that can be rolled out to MSAs across GB. MSAs across all licence areas will need to install high volumes of rapid chargers to facilitate the increase of EVs as detailed in the Government's Road to Zero Strategy. The learning from the project will develop a solution that can be adopted by all DNOs.
In addition, the trials will develop valuable learning in relation to the integration and benefits of the new package solution.

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

Motorway Services Take Charge addresses a number of objectives in our Innovation Strategy, namely:

- Developing new smart technologies that will accommodate increased load and generation at lower costs than traditional reinforcement
- Delivering solutions that are compatible with the existing network
- Enabling solutions that can be quickly transitioned to become business as usual (BAU)

In addition, the project will specifically address the challenges and opportunities that are detailed within the Transport section of our Innovation Strategy. In particular, the project will address the challenge of "large proportion of the current cars and vans on the road will become EVs and these will need to be able to charge in a manner that suits the customer".

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

N/A

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

N/A

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

N/A

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

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

The Government's Road to Zero strategy sets the ambition that by 2050 almost every car and van will be zero emission, and has since moved its planned date for ending the sale of petrol and diesel vehicles from 2040 to 2035. It is therefore highly likely that large scale roll-out of rapid EV chargers at all major MSAs will be required to meet future demand from EV customers. In GB there are three main MSA site owners. The following list indicates the number of MSA sites attributed to each owner:

- Moto – 44 sites
- Welcome Break – 26 sites
- Roadchef – 21 sites

There is a total of 91 sites where the solution could be installed. The post-trial method cost of the solution has been estimated as £0.47m (A).
The base case is the scenario that a traditional primary substation is constructed to supply the rapid charging demand for each MSA site. The average cost of a 33/11kV primary substation is £0.96m (B). Therefore the solution offers a saving of £0.49m per site (B –A) (C).
We anticipate that 68 MSA sites (75% x 91) will require the packaged substation solution. The total saving across the GB roll-out is therefore £33.3m (68 x C).

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 base case cost has been calculated in (B) above as £0.96m.
The post-trial method cost has been calculated above in (A) above as £0.47m
Therefore the financial benefits of a development or demonstration project is £0.49m (B –A) (C).

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 solution is a packaged substation arrangement that is built and tested offline in the factory and installed at the site with minimal commissioning activities. Since the solution is standardised and designed to be as compact as possible, it will be replicable across most MSA sites. We anticipate that 75% of sites will require the packaged substation solution to solve the problem.

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

The costs for the GB roll-out will be the post-trial method cost multiplied by the number of sites in the roll-out. The post-trial method cost is lower than the trial method cost as the solution has been designed and performance tested. The post-trial method cost will only incorporate:

- Site specific engineering design
- Substation build, factory testing, installation and commissioning
- Site specific civil works**

** Note that the site works do not include the 33kV electrical connection as this is the same between the counterfactual and the base case, and could vary considerably across all the sites.
As per the analysis above, the post-trial method cost of the solution has been estimated as £0.47m (A) which total would be £31.96m (68 x A) if rolled out across 68 sites.

2c. Does Not Lead to Unnecessary Duplication ☒

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

The solution is a novel substation that is purposefully specified and designed for the facilitation of large scale rapid EV charging at MSAs. There are no known projects that are carrying out trials of a similar technology and therefore it is not foreseen that there will be any duplication as a result of this project.

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

N/A

Additional Governance Requirements

Please identify that the project is innovative (i.e. not business as usual) and has an unproven business case where the risk warrants a limited Research, Development or Demonstration Project to demonstrate its effectiveness ☒

i) Please identify why the project is innovative and has not been tried before

The project will develop a highly innovative standardised, pre-constructed and pre-packaged “one size fits all” 33/11kV substation solution that will deliver large scale, high power, rapid EV charging at MSAs, to cater for the projected levels of demand at these locations from widespread EV uptake. It will do this with little disruption to the customer due to minimal on-site testing and commissioning activities. It will be a “plug-and-play” device.
The base case solution is the construction of a traditional primary substation to achieve the same supply capacity to the site. However, this would be at significant cost to the customer as well as large amounts of space being required for the substation brick building and compound. Furthermore, the customer would experience significant disruption during the installation and commissioning works.
Developing a standardised, cost and space optimised unit represents significant technical, operational and safety challenges that will need to be specified, designed and trialled before the device can be considered as BAU. After the unit has been developed and trialled it will be able to be quickly rolled-out, installed and connected at any MSA location in GB, representing a significant innovation in EV charging capability.

ii) Please identify why the Network Licensee will not fund such a Project as part of its business as usual activities

As described in previous sections, the solution presented in this project represents a novel and highly innovative substation specifically designed to deliver very high power rapid charging to large numbers of EVs projected to use the facilities of MSA sites. A innovation funded trial is required as the TRL of the technology is low and there is significant innovation risk to achieve the required optimisation of the physical dimensioning and cost of the device, as well as to ensure that the unit is fully standardised (to ensure maximum replication), whilst also compliant with all DNO safety requirements.

iii) 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

Please see the section above for a detailed description of why the solution can only be undertaken with the support of the NIA.
The main specific risks associated with the project will be technical and operational in nature:

- The rating of the device will need to be carefully studied and selected to ensure the device can supply forecast EV demand whilst remaining cost effective
- A detailed technical design will be carried out to optimise the footprint of the unit without affecting the safe operation and maintenance of the equipment

Additional Registration Questions

These are required for summary section of registration; some areas can be copied from sections above.

Technologies (select all that apply)

☐ Active Network Management	☐ Environmental	☐ Network Monitoring
☐ Asset Management	☐ Fault Current	☐ Overhead Lines
☐ Carbon emission Reduction Technologies	☐ Fault Level	☐ Photovoltaics
☐ Commercial	☐ Fault Management	☐ Protection
☐ Condition Monitoring	☐ Harmonics	☐ Resilience
☐ Community Schemes	☐ Health & Safety	☐ Stakeholder Engagement
☐ Comms & IT	☐ Heat Pumps	☐ Substation Monitoring
☐ Conductors	☐ High Voltage Technology	☒ Substations

☐ Control Systems	☐ HVDC	☐ System security
☐ Cyber Security	☐ Low Carbon Generation	☐ Transformers
☐ Demand Response	☐ LV & 11Kv Networks	☐ Voltage Control
☐ Demand Side Management	☐ Maintenance & Inspection	☐ Gas Distribution
☐ Distributed Generation	☐ Measurement	☐ Gas Transmission
☒ Electric Vehicles	☐ Meshed Networks	☒ Electricity Distribution
☐ Energy Storage	☐ Networks Automation	☐ Electricity Transmission

Project Short Name

Take Charge

Project Introduction

The Take Charge project will specify, design, test and trial a brand new standardised package solution for delivering large capacity to Motorway Service Areas (MSAs) to facilitate large scale rapid EV charging at these locations. The solution will achieve this in a far more cost and time effective manner when compared with the traditional solution.

Project Benefits

The project will develop a highly innovative standardised, pre-constructed and pre-packaged “one size fits all” 33/11kV substation solution that will deliver large scale, high power rapid EV charging at MSAs, to cater for the projected levels of demand at these locations from widespread EV uptake. It will do this with little disruption to the customer due to minimal on-site testing and commissioning activities. It will be a “plug-and-play” device. After the unit has been developed and trialled it will be able to be quickly rolled-out, installed and connected at any MSA location in GB, representing a significant innovation in EV charging capability.

PEA Version	**1**		
	Name and Title	**Signature**	**Date**
Prepared by			
Approved by			