Scottish and Southern Energy Power Distribution

Date of Submission

April 2014

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**
Modular Approach to Substation Construction - Design Development		NIA_SHET_0013
Project Licensee(s)	**Project Start Date**	**Project Duration**
Scottish Hydro Electric Transmission	Apr 2014	2 Years
Nominated Project Contact(s)		**Project Budget**
Frank Clifton		£405,000

Problem(s)

The GB transmission system faces a number of significant challenges due to the ever increasing demand for renewable connections. This has resulted in a significant requirement to build new infrastructure and reinforce existing network. Traditional techniques for substation design and construction have changed very little in the last 40 years. However, advances in technology have allowed suppliers to increasingly offer an innovative range of containerised or modular components including switchgear, transformers etc.

To date they have relied on combining a range of appropriately rated components to produce a near “bespoke” design. This has tended to produce a substation designs which, whilst meeting the needs of the TO, are relatively inflexible giving little scope for low cost options for expansion or contraction.

Key aspects of this approach to substation design and construction are as follows:

· Renewables connections need a greater degree of flexibility than current traditional designs allow (e.g. flexibility to increase size as more turbines are built over time).

· Speed of connection is an important factor for renewables connections – and substations can be on the critical path (therefore, both reducing the impact of a substation to minimise impact on the planning process, and speeding up its construction, will be of benefit).

· Renewables connections are often in more remote locations, making on-site working a cost premium.

· Specific requirements for substations are becoming more bespoke, and this is driving up their cost; more standard designs would be cost effective.

· The relatively short operational life of renewables (typically 25 years), leads to the risk of ‘stranded assets’.

A more modular approach may allow TOs to reduce costs via economies of scale, reduce construction times and costs, and produce more flexible designs. In addition the use of a modular or containerised approach may result in a less intrusive design with a reduced overall footprint.

Method(s)

In consideration of the potential limitations of traditional substation design and implementation highlighted in the previous section, SHE

Transmission propose to develop functional requirements and designs for modular substations as an alternative to the established approach.

The use of a more modular approach has the potential to:

· Give greater flexibility to provide timely increase/decrease substation rating in the future to meet changing demands;

· reduce construction times by optimizing use of off site manufacture;

· reduce costs by providing economies of scale from serial production;

· allow a more flexible approach to operation and maintenance, whilst maintaining safety and reliability standards.

This approach also introduces a next generation approach to substation design which can be used to enable serial, rather than bespoke, production of substations.

A staged approach to the development of the new designs and options is proposed:

Stage 1 – Requirements and Information Gathering

- Identify the generic functional requirements across our portfolio of anticipated substations (focusing on connections for renewables). Initially this will probably focus on designs up to 132kV.

- Gather and review technologies for modular substations components (e.g. containerised switch-gear) from a range of suppliers.

- Investigate options for more modular and faster to deploy methods for the non-electrical components of a substation, including fencing, foundations, civil works, cabling etc.

- **Stage 2 – Design Competition**

- Based on the above requirements, engage with the supply chain on a competitive basis to develop a set of solutions which will meet the functional requirements, using the most appropriate available technology.

- **Stage 3 – Select & Progress**

- Identify preferred standardised design(s) utilising modular components.

- Identify specific appropriate sites for which the new substation designs could be used in future.

This will include ensuring that any new developments or innovations can be implemented by a wide range of manufacturers and suppliers.

Scope

The scope of the project will include the following:

· Identify the requirements and standards that govern transmission substations up to a voltage of 275kV and 400kV - however, it is anticipated that this will initially focus on 132kV designs;

· Assess new design options and techniques, including the use of new materials, from a review of what is being built internationally, and other innovations;

· Develop a functional requirement specification for Modular Substations ;

· Engage with the supply chain on a competitive basis to identify potential innovative solutions ;

· Assess the impacts of the new designs, including safety and environmental impact, operational considerations,, requirements for additional training etc; and

· Review the economics of the new designs (taking into account foundations, access requirements, construction time and maintenance).

Objective(s)

1) Define the requirements for a modular approach to transmission substation from design to construction

2) Assess the alternative approaches to traditional substation design and construction techniques

3) Create recommendations for Transmission Operators to employ these new approaches, including potential changes to design and operational standards.

If successful SHE Transmission will then look to deploy this approach on a selected project.

If successful this project has the potential to

· Reduce costs for substation design, construction, installation and operation

· Increase speed of deployment

· Develop lower cost options for increasing substation capacity to give increased flexibility

· Allow substations to be better matched to the anticipated connection – especially for renewables – and to provide flexibility to increase capacity

· Reduce consenting times

· Reduce the overall carbon footprint of the development

Success Criteria

The project will be successful if it delivers a recommendation from which a Modular Approach to Substation Construction policy can be developed by December 2015. This will allow more informed decisions to be made when considering design and construction options for future substation projects.

Technology Readiness Level at Start	Technology Readiness Level at Completion
5	6

Project Partners and External Funding

None

Potential for New Learning

This project aims to produce a set of functional requirements for the design, construction and operation of Transmission Substations which will be made available to other relevant network licensees. This could include some of the following as appropriate:-

· SHE Transmission-hosted events for other TOs and relevant other third party organisations;

· ENA Learning Portal to upload presentations and lectures;

· Regular press releases will be published as appropriate;

· Annual progress report; and

· We may undertake case studies with manufacturers to show best working practice

It is anticipated that the learning would be applicable to a broader range of transmission voltages up to 275kV and 400kV.

Scale of Project

The scale of the Project is considered appropriate to the scale of the potential benefits. SHE Transmission is required to install around 2000MW of new substation capacity by 2022, which will potentially cost in excess of £1000m. The other TOs will have similar requirements to increase capacity on their networks. The majority of these costs will be borne by Transmission customers.

Given the future investment levels anticipated in this area, this level of funding is considered appropriate.

Geographical Area

As a development project, the project will be managed by SHE Transmission staff from their offices in either Perth or Glasgow. The

resulting designs are intended to be applicable to new 132kV, 275kV and potentially 400kV transmission infrastructure across GB.

Revenue Allowed for in the RIIO Settlement

This project is an early stage investigation to develop a set of requirements which, if proven, could in the future save significant capital expenditure. However, at this stage no saving on expenditure can be assumed.

Indicative Total NIA Project Expenditure

The project plans to be funded through SHE Transmission's NIA allowance.

£405k has been budgeted for the project (of which 90% is allowable NIA spend).

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 resulting reports and recommendations will be shared with relevant network licensees. They will be able to use the outcomes from the project to further develop a Modular Approach to Substation Construction. The extent to which network licensees will be able to apply this learning will depend upon the requirements and economics of individual projects.

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.

The new design solutions that will be developed from this project will have the potential to reduce costs for future substation projects.

These savings will potentially come from a number of areas including:

· Economies of scale from having a using a standard sized unit;

· Reduced time on site – make better use of “off site manufacture” and testing;

· More rapid deployment;

· Increased flexibility to increase/reduce substation capacity; and

· Reduced visual impact

For SHE Transmission alone there is a need to invest in excess of £2000m in substation infrastructure, and the other TOs have similar programmes. This solution has the potential to provide indicative savings of between 3% to 10% when compared with the overall cost of the conventional solution.

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).

As stated above the financial benefits from this project are likely to arise from a number of potential areas, including:

· Economies of scale from having a using a standard sized unit leading to reduced capital costs (3-10%)

· Reduced time on site – make better use of “off site manufacture” (3-5%)

· More rapid deployment (3-5%)

· Increased flexibility to increase/reduce substation capacity (5-15%)

· Reduced visual impact / consenting costs etc (3-5%)

The current anticipated average cost for carrying out these works is in the order of approximately £500k per MW. The potential savings identified are based on initial internal studies and early engagement with the supply chain. The extent to which these will be applied to each project will be slightly different for each site, however it is envisaged that the overall savings will be in the order of 5 to 10% when compared with the current techniques. In order to illustrate the benefits which could be accrued from this approach, we have assumed that this alternative technique will only be applicable to around a third of the future anticipated projects – for SHE Transmission this equates to around 1350MW, and for this volume of projects we have assumed an average cost reduction of 7.5%.

Base case cost

1350 x £505,000 = £681m

Method cost

1350 x £467,000 = £629m

Base case cost - Method cost = Estimated annual saving

£681m – £629m = £52m

We believe that the other TOs and relevant licence holders will be able to secure similar levels of savings.

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.

This method is potentially applicable to the entire GB power system network and decisions on use at individual sites would be made on case by case basis. From the initial studies and engagement, this solution may be particularly suited to the connection for new renewables, where works are often required in remote locations with access challenges.

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

This project intends to produce developed designs and requirements which will be freely available to all GB Network Licensees. The decisions on use at individual sites would be made on case by case basis.

2d. Does Not Lead to Unnecessary Duplication ☒

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

Based on published IFI and NIA information, discussion with equipment suppliers and discussion with National Grid and Scottish Power, there are no known projects being undertaken by other network licensees. Whilst individual components have been subject to previous projects no other project has looked to utilise these in combination to assess the full range technological advances to substation construction.

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

Not Applicable.