

Scottish Hydro Electric Transmission

Modular Approach to Substation
Construction (MASC)

Successful Delivery Reward Criteria 1:
Stakeholder Engagement

Successful Delivery Reward Criteria 1: Stakeholder Engagement

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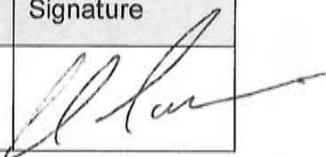
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Version Control

Version	Date	Author	Reviewed by	Date	Signature
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Executive Summary

This document fulfils Scottish Hydro Electric (SHE) Transmission's first Successful Delivery Reward Criteria (SDRC) for the Modular Approach to Substation Construction Project (MASC). This SDRC is to:

Create a report detailing the outputs from stakeholder engagement activities and their impact on MASC's functional specification requirements.

This report evidences:

- the rationale and approach for consulting with stakeholders during the project's first stage;
- outputs from stakeholder engagements;
- ways in which outputs have been incorporated into the modular substation's design specification; and
- our plan to disseminate knowledge from this stage of the project.

Rationale: SHE Transmission's aim is to prove the benefits of modular substations for the GB electricity network. Network infrastructure is of interest to a wide range of stakeholders. The successful wide-scale integration of MASC into GB depends on it maintaining or improving today's safety and reliability levels, reducing the on-site installation time, achieving a competitive price, and improved visual, community and environmental impacts. Extensive stakeholder engagement from the project's inception was therefore fundamental to understanding key priorities.

Approach: Social Market Research (SMR) acted as a MASC project supplier to support stakeholder consultation and provide independent, impartial analysis.

Outputs: The stakeholder consultation programme clearly demonstrated overwhelming support for the MASC project.

Dialogue with manufacturers has provided SHE Transmission with confidence that the MASC approach will shorten the duration of site-based construction activities as well as reducing the geographical footprint of substations.

A workshop attended by all GB distribution network operators (DNOs), transmission operators (TOs) and Ofgem showed that licensees supported the aims and objectives of the project whilst understanding the risks considered with a modular approach.

Surveys and in-depth interviews with planners and statutory authorities evidenced their approval for a move to modular substations in terms of potential environmental, community and visual impacts.

Influencing MASC's functional specification:

From analysis of the data collected from the various stakeholder engagement events, a proposal on structure of the MASC functional specification and an overview of the information to be included has been possible.

Knowledge dissemination plan: SHE Transmission is committed to sharing the outputs from the consultation phase of the project. Outputs from the project have been added to the company website: www.ssepd.co.uk/innovation and promoted through the SSEPD Future Networks Knowledge Sharing Group on LinkedIn. A webinar is scheduled for September 2015, and MASC will be presented at the Low Carbon Networks and Innovation Conference 2015.

Additional knowledge will be captured and shared on an incremental basis throughout the project's lifecycle. This will incorporate all elements of the project such as:

- desk-top design;
- factory fabrication;
- onward transportation;
- on-site installation & commissioning; and
- monitoring during operation.



1. Introduction

About the Network Innovation Competition

As part of the RIIO-T1 price control, Ofgem introduced the Electricity Network Innovation Competition (NIC). The NIC is an annual competition in which electricity network companies may compete for funding for the development and demonstration of new technologies, operating and commercial arrangements.

Projects are assessed on their potential to deliver environmental benefits, cost reductions and security of supply as Great Britain (GB) moves to a low carbon economy. Up to £81m per annum is available through the Electricity NIC.

The MASC project successfully bid for £2.8 million in the 2014 NIC and commenced in January 2015.

About the MASC project

SHE Transmission intends to demonstrate and deploy a permanent substation, designed using a Modular Approach to Substation Construction (MASC). The current approach to substation construction differs little from that of 60 years ago; meanwhile many innovations in design and civil engineering could create a substation which is cheaper, faster to deploy and more suited to GB's low carbon energy future. MASC seeks to prove the following benefits:

- **Faster deployment:** MASC maximises off-site construction so that timescales associated with extensive, on-site civil engineering works are shorter.
- **Improved whole life asset value:** MASC substations could offer up to 20% savings over an asset's whole life, compared to conventional builds.
- **Increased flexibility for network configuration:** MASC capacity can be easily modified to suit changes in generation plant capacity.
- **Improved environmental impact:** MASC's smaller geographical footprint and off-site construction ensures improvements in visual

amenity and reduces disruption to local communities, wildlife and land.

The project is expected to last for approximately five years, providing incremental learning and new standards in substation design and operation.

The full submission document can be viewed on the ENA Learning Portal at www.smarternetworks.org

Successful Delivery Reward Criteria

SHE Transmission is obliged to present evidence of the MASC project reaching key milestones. The first milestone is delivered through this report, which describes the outputs from stakeholder consultation and their impact on MASC's functional specification requirements. In the MASC submission, this is described as follows:

A key milestone of MASC's success involves the outputs of engagement with key stakeholder groups to include:

- Internal contact with SHE Transmission business areas;
- External contact with other transmission and distribution license holders;
- External dialogue with manufacturers and broader supply chain; and
- External stakeholders such as planning and other statutory bodies

Work undertaken to achieve this milestone will also seek to inform the development of the technical and functional aspects of the MASC substation.



2. Rationale and Approach for Engagement

Rationale

SHE Transmission’s MASC project aims to create a step change in how new substations are developed and built in GB. It is predicted that a substantial number of new substations will be required over several decades to accommodate new connections to renewable energy sources. If MASC’s benefits can be proven through the NIC project, modular substations may increase in numbers between now and 2050.

SHE Transmission considers consultation with a wide range of stakeholders as fundamental to MASC’s successful delivery. All stakeholders’ views are welcomed and will be respected. It is recognised that there are selections of stakeholder groups that will particularly influence the modular substation’s functional specification.

Figure 1 illustrates the stakeholder groups requiring significant engagement throughout the project. Our plans to consult with stakeholder groups can be viewed in Appendix I.

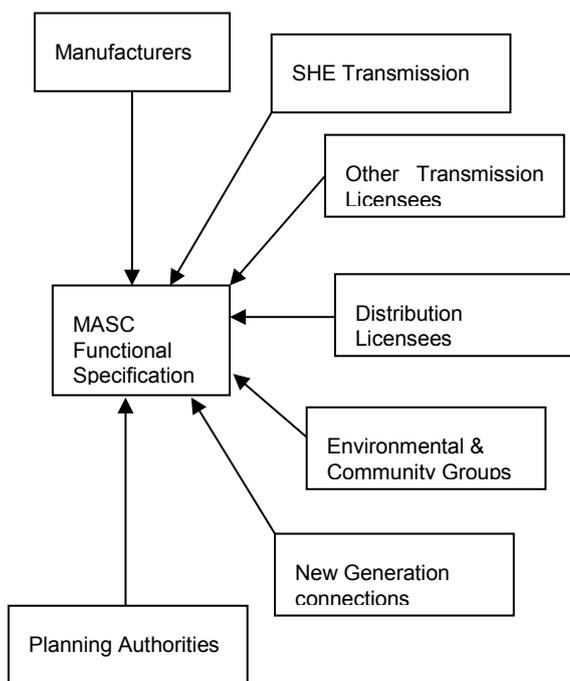


Figure 1. Key stakeholder groups with greatest influence on MASC’s functional specification.

Table 1 below provides details on why we believe these stakeholder groups will be interested in the MASC project.

Stakeholder	Interest in MASC
Manufacturer	Producer of MASC type solution.
SHE Transmission	Will be the MASC asset owner. The product selected must meet with all requirements from its visual appearance through to system security.
Distribution Licensees	Potential purchasers of the MASC solution. Therefore MASC requirements need to reflect their requirements.
Other Transmission Licensees	Potential purchasers of the MASC solution. Therefore MASC requirements need to reflect their requirements.
Environmental & Community Groups	Representative of Parties interested in the end product. These groups are concerned about the impact on the people, animals and resources in the direct vicinity of the MASC substation.
New Generation Connections	The Customer connected into the MASC solution. They may include the details of the MASC substation as part of their planning permission. Interested also in quicker connection times and associated cost reductions.
Planning Authorities	Approve new infrastructure builds. Keen on solutions that minimise all forms of nuisance and which are sympathetic to the landscape.

Table 1 Stakeholders Interest in MASC



2. Rationale and Approach for Engagement

Approach

Consideration was given as to how best to interact with each of the identified stakeholder groups, and share the MASC vision whilst gathering their opinions, recording their experiences and identifying concerns. [Table 2](#) below shows the level of interaction decided upon for each of the stakeholder group.

	Meeting	Workshop	On-line Survey
Manufacturer	✓		
SHE Transmission	✓	✓	
Distribution Licensees		✓	
Other Transmission Licensees		✓	
Environmental & Community Groups	✓		✓
New Generation Connections		✓	
Planning Authorities			✓

Table 2 Engagement Methods with Stakeholders

More detail on the stakeholder engagement approaches are provided in the following sub-section.

2.1 Internal Stakeholders

SHE Transmission is organised into teams; each looking after a specific area with associated responsibilities. It has therefore been necessary to identify key people within the following teams;

- Transmission Engineering Team;
- Transmission Procurement Team;
- Transmission Policy Team;
- New Connection Agreement Managers;
- New Connection Delivery Project Managers;

- Real Time Systems Team;
- Operational Team Managers.

MASC Workshops have been held. The aim has been to keep the Team Leaders informed and to seek support in the form of resources to further specific investigations into realising and delivering a MASC type substation onto the SHE Transmission network.

As the volume of information increases, more regular discussions have occurred with members of the specific teams. This has enabled focused development of ideas and the quantification of the challenges.

2.2 Manufacturers

The formal procurement process for a modular substation has commenced in line with SHE Transmission's goal of installing a MASC type solution.

An advert was first placed in the European Journal that advertises new construction opportunities. This generated 31 notes of interest from a range of parties. [Appendix II](#) lists the parties that registered a note of interest. Following on from this, a pre-qualification questionnaire was issued to gain a better understanding of the experience the parties has had with modular type substations. Nine parties responded and after assessment five parties were invited to formally tender a MASC solution.

On the 31st March 2015 and the 1st April 2015 four parties were invited to individual interviews. This provided an opportunity to learn more about their design proposals and enable a better appreciation of the areas that challenge SHE Transmission's processes and procedures.

On the 5th June 2015 three parties returned compliant tenders. Evaluation of the tender returns is currently underway. [Figure 2](#) below illustrates the Manufacturers engagement process.



2. Rationale and Approach for Engagement

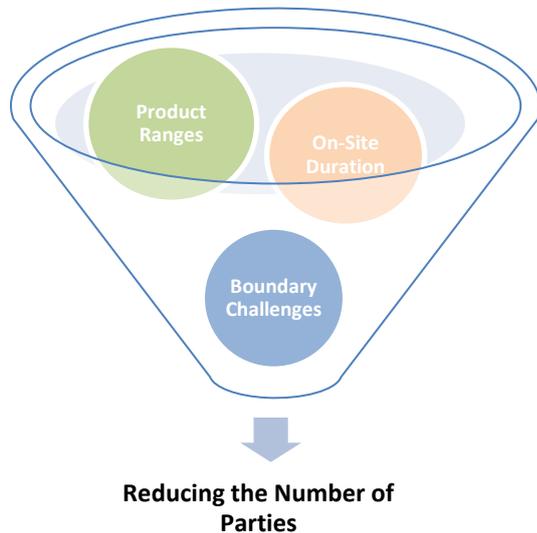


Figure 2. Symbolising the journey through the selection process and key knowledge gathered along the way.

2.3 External Stakeholders

The first external event that provided information from external stakeholders on the MASC project was the Low Carbon Networks and Innovation Conference (LCNI) held in Aberdeen in October 2014. [Appendix III](#) contains the poster displayed.

SHE Transmission then procured Social Market Research (SMR) to conduct an external stakeholder engagement programme. This was implemented in the following three phases;

- Phase 1: Engagement workshop with representatives from across the Power Industry. This took place on the 21st April 2015 in London.
- Phase 2: Interviews with key community and environmental representatives. This took place between the 11th and 27th May 2015.
- Phase 3: Online survey of local authority planners. This ran from the 5th May 2015 through to the 22nd May 2015.

Summary of Activities

Analysis was carried out into which stakeholders should be contacted at which stage of the MASC project. At present the catchment pool is limited to those parties most impacted over the lifecycle of the MASC project. Presently there is limited involvement from the general public, as the location of the MASC substation has still to be determined.

Internal workshops and focused discussion groups have been held. This is an ongoing key activity and only the more formal events have been highlighted.

The manufacturers are crucial to the MASC solution options. The more interaction there is with these manufacturers the more that is understood about the end product on offer. However knowledge gathering sessions must be conducted fairly and in-line with procurement policies as the formal contracting process has started.

Engagement of external stakeholders was mapped out and managed by SMR. SMR are independent from the industry. They have provided direction on the material to be shared and are skilled at drawing out opinions and recording the data.

[Table 3](#) below provides a high-level overview of the key stakeholder engagement activities that have been undertaken.

2. Rationale and Approach for Engagement

	Manufacture	Internal	External
Q2 2014	Presentations on Product Ranges	MASC Workshop : MASC Viable Solution	Consultant researching applications of modular substation use world wide
Q3 2014	Notice Issued in the European Journal		
	Prequalification Questions	Assessment & selection of Manufacture to invite to formal Tender Stage	
		MASC Workshop: Shaping the initial MASC Functional Specification	
Q4 2014	Invite to Formal Tender		LCNF Conference MASC posters displayed
Q1 2015	Initial Tender Return, providing more information on designs	MASC Workshop: An overview of Initial Tender Return information	Press releases detail NIC MASC funding award
Q2 2015	Invitation to Interview	Sub-discussion to further investigate the areas of the MASC proposed design that challenges present practices	Phase 1: Deliberation Event with representatives from across the Power Industry
	Final Tender Return		Phase 2: Community and environmental interviews
			Phase 3: On-line survey of local planning authorities

Table 3. Summary of the stakeholder engagement activities.



3. Information Gathered

Data has been collected from the stakeholders during the various engagement activities and there is now a wealth of information on their opinions, ideas and concerns in relation to the MASC project.

3.1 Internal Stakeholders

Discussions internally have enabled an initial MASC functional specification to be developed. This functional specification formed the basis of the MASC tender documentation.

To comply with SHE Transmission system requirements, the initial MASC functional specification was highly descriptive and included very specific details of all the equipment deemed necessary. The purpose of the document was to enable the manufacturers to identify where they proposed to move away from current SHE Transmission standard requirements.

3.2 Manufacturers

Following a posting in the European Journal, SHE Transmission received notes of interest from 31 parties interested in manufacturing or producing a permanent modular substation. Parties who responded had a varied range of skills and in several cases they specialised in only one aspect of the MASC solution, for example the substation container.

Following on from these notes of interest, a pre-qualification questionnaire was issued to all parties to seek further information on their products and capability to deliver a MASC type solution. The pre-qualification questionnaire is included as [Appendix IV](#).

Below is a summary of the learning gathered from the pre-qualification questionnaire;

- Factory build has taken place in Europe prior to transportation to the on-site location;
- Modular substation solutions at varying degrees and voltages have been developed world wide. Predominately the modular solutions have been mobile and used as temporary solutions;

- There are several independent / non-equipment manufacturing companies that have sourced the key components and successfully project managed the factory build phase through to site delivery and commissioning of a MASC type solution.
- The largest solution presently that allows a transformer and switchgear to be transported on a single lorry trailer bed is a 45MVA solution. If the transformer required is larger than 45MVA, then the transformer will require transportation separately; and
- Transportation of the modular substation from the factory to the field location tends not to be an issue as it can be factored in at the desktop design stage and the modules sized correctly.

At the end of February 2015 the initial tender returns were received. In reviewing the tender returns the following can be summarised;

- all solutions had smaller footprints than a typical air insulated substation today, and
- all programmes showed a marked reduction in on-site times.

[Appendix V](#) identifies further findings in a PowerPoint format which was shared at an internal stakeholder meeting in relation to the learning identified during the initial tender returns.

Following on from the initial tender returns, interviews were held with each party to allow them to further explain their designs. This was also an opportunity to learn more from the parties about their aspirations for modular substation development.

Confirmation was also received that a number of the proposals for alternative materials, equipment or operational features had been driven by and accepted as normal practise by other utilities or industries world-wide.

Positively, during the interviews there were several questions regarding how far SHE Transmission were



3. Information Gathered

willing to deviate from the original MASC Functional Specification. This in itself provided confidence that there were further possibilities to be explored.

Appendix VI summaries the technical opportunities the manufacturers discussed during the interviews. The information has been presented in equipment groups for ease. It is also worthy of note that a number of the suggestions can be provided by all manufacturers and there are also a handful which are very specific to the particular manufacturers' strengths.

Following a review with the SHE Transmission internal teams of the information received and recorded in Appendix VI, it became apparent that additional technical information could also be identified. Technical opportunities have therefore now been grouped into three categories, to show their level of readiness to be incorporated within the MASC functional specification. The three groups are:

- Those which are easily adoptable,
- Those where a more cautious approach is required as further investigation into the effect introducing the change would have is necessary; and
- Those which may potentially influence a future evolution of MASC.

The grouping is helping to focus the evaluation efforts and progress shaping of the MASC functional specification. Appendix VII details the further quantification of the opportunities discussed by the manufacturers with comments to validate the quantification.

3.3 External Stakeholders

There was a three phased approach used to interface with key external Parties; an on-line survey, a stakeholder workshop and one-to-one interviews. The full report can be viewed in Appendix VIII.

The information shared with the external audiences aimed to draw out opinions and concerns on the following areas;

- Design at the desk-top stage;
- Environmental impact;
- Visual impact;
- Factory fabrication phase;
- On-site construction duration; and
- Safety, operation and maintenance once installed.

Table 4 below summarises the key findings;

	Benefits	Challenges
Design	Reduce bespoke designs, via developing a standard configuration	Standardising the design
Environment	Welcomed reduction to the level of nuisance the local community would experience through reduced site activity	Reduce even further the substation footprint
Visual Impact	Concealment of the components is preferable	Micro-sighting MASC to minimise the visual impact
Factory Fabrication	The majority of work undertaken away from the site location	Commissioning the equipment as much as possible in the factory
On-site Construction Duration	Minimising activities on-site reduces the number of people required and enables work to occur at optimum times.	Reduce further the time onsite
Safety, Operation and Maintenance	Minimal activity on-site is welcomed	MASC will challenge today's culture, developing practise and changing mind-sets will take considerable work

Table 4. Summary of the MASC Benefits and Challenges External Stakeholders expressed.

During the London stakeholder engagement event, as well as seeking opinions on the information that



3. Information Gathered

should be included in the MASC functional specification, we wanted to share SHE Transmission learning to date. [Figure 3](#) below shows a graph generated by SMR in relation to how the delegates felt their knowledge on MASC had developed over the course of the day.

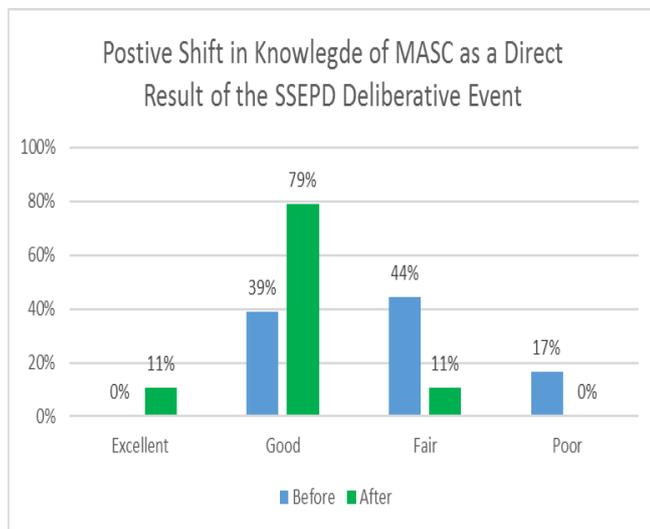


Figure 3. MASC knowledge level of delegates before and after the April event

The SMR report attached as [Appendix VIII](#) contains all the feedback received from all three phases of the stakeholder engagement programme. During the evaluation of the data collected by SMR it became increasingly apparent that the statements could be separated into two data groups;

- **Data A:** Statements that were either technical, environmental or associated with the end product or a mixture. [Figure 4](#) shows their interaction.

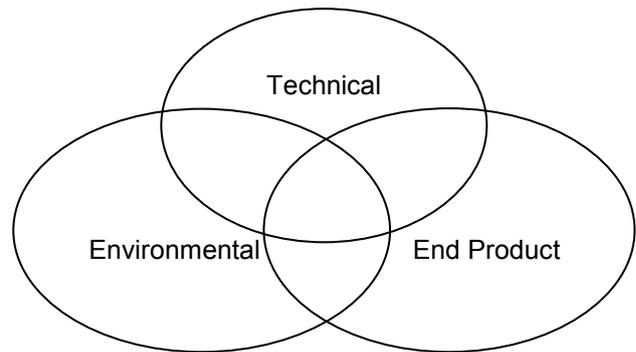


Figure 4. Three Distinct Areas Data A Feedback Falls Under

- **Data B:** A concern which addressed one of the following areas:
 - Time/efficiency
 - Cost
 - Safety
 - Design
 - Factory build
 - Transportation
 - Site installation
 - Operation & maintenance
 - Quality control / risk assessment

[Appendix IX](#) and [Appendix X](#) separate the SMR data collected into either Data A or Data B groups respectively.

Further analysis of this data identified a number of very supportive and positive statements. [Figure 5](#) below shows a word cloud which is generated from the positive statements, the actual bullet points are recorded in [Appendix XI](#)



3. Information Gathered



Figure 5. Word Cloud generated from positive statements.

Summary

The stakeholder engagement activities have shown collectively that there is a high degree of interest in, and support for the MASC project.

Stakeholders confirmed the potential for realising significant benefits in terms of reducing the land take, the on-site construction time, as well as the environmental, visual and community impacts from the installation of a MASC type solution.



4. Influencing the MASC Functional Specification

Structure of the MASC Functional Specification

Positive feedback was received in support of a generic MASC Functional Specification. The following challenges were identified as being key to structuring the document to ensure maximum benefit to the industry as a whole;

- the preference for a performance based specification;
- the need to clearly define the elements of a modular type substation;
- the need to clearly define the interface points;
- promotion of solutions that enable additional efficiencies to be achieved; and
- the need for further collaboration in producing a suitable MASC Functional Specification.

Information within the MASC Functional Specification

The starting point for the performance based MASC functional specification was generated via a brain storming workshop with internal stakeholders. The aim was to define the parameters of the MASC solutions. These were;

- Controllable;
- Influenced marginally; and
- Non-controllable.

Appendix XII details the information gathered under the three distinct headings. Table 5 provides an overview as to how the information under each of the three headings will be treated in the performance based MASC functional specification;

	Treated in the MASC Functional Specification
Controllable	<p>Clear direction provided on what is expected.</p> <p>Example: Operational life of the equipment.</p>
Influenced Marginally	<p>The acceptable boundaries defined.</p> <p>Example: The location will determine the final appearance of the modules</p>
Non - Controllable	<p>Mitigation measures to be stated.</p> <p>Example: Test the soil resistivity levels and design the earthing mat accordingly.</p>

Table 5. How the parameters of the MASC solution will be treated in the MASC functional specification



4. Influencing the MASC Functional Specification

Figure 6 below identifies a high-level preliminary outline content structure for the performance based MASC functional specification.

<u>MASC Functional Specification Content Outline</u>
<u>Introduction</u>
-Project Description
-Requirements
-Existing System
<u>Functional Description</u>
-Design & Operational Expectations
-Civil Works
-Electrical Primary Plant
-Electrical Secondary Plant
-Protection & Control
-Site Infrastructure
<u>Information Annex's</u>
-Parameters of the Design
-Site Specific Information
-Safety
-Quality Control
-Standards and Code Compliancy Requirements
-Technical Tables

Figure 6. Preliminary Outline of the MASC functional specification Contents.

Presently the content of the MASC functional specification is limited to three sections. The introduction provides clear direction on the MASC end product requirement, example to state the anticipated operational life of the structure.

The next section provides a detailed functional description. For instance the auxiliary batteries must be sized to allow 24 hours of power after an event interrupts the main power supply. In this section the first sub-group is titled design and operational expectations. This is first as it is of the upmost importance to define these requirements as they determine the subsequent shape of the solution.

Finally there is an information annex. This will contain the technical data and cornerstone information which is likely to vary greatly between the other power industry parties. This section will define the rating of switch gear, the technical standards that it must comply with and quality assurance processes to be undertaken in the manufacture of the switchgear.

Appendix XIII further expands upon the introduction and functional description sections and in bullet point format summarises the stakeholder data collected and documented in the SMR report. These bullet points are then colour coded to represent;

- information which is easily included within the MASC functional specification,
- information that requires further investigation as it is necessary to understand the effect introducing the change would have; and
- information which potentially could be included in a future evolution of MASC.

Summary

The information gathered through the various stakeholder engagement forums will go much further than just influencing the MASC functional specification. It will also help focus investigation into areas that will drive further efficiencies in reducing the size of the substation footprint, reducing the on-site construction duration, as well as seeking out additional cost savings.

Given the multiple challenges with the design aspects it was suggested that a working group be established to draft the specification (for MASC) and then to offer this for consideration/deliberation to a wide range of industry peers. There was concern about how long such a process would take. However, it was acknowledged that it was important to bring parties impacted by the MASC approach up to a common level of understanding of the technology, its capabilities and limitations.



5. Next Steps including Knowledge Dissemination

A large volume of valuable information has been gathered from the various stakeholder engagement activities. The Appendixes show how the data has been sorted, quantified and ultimately the influence it has on the MASC functional specification.

The data collected by SMR also contained a number of questions and statements which highlighted concerns. [Appendix XIV](#) addresses these challenges by either providing an answer or a mitigation measure.

The honesty of the stakeholders was very much appreciated and highlighted the need to build confidence amongst the industry that the new MASC substation approach will perform at least as well as the traditional substation in terms of:

- Functionality/operational effectiveness;
- Health and safety;
- Everyday comfort e.g. warm and dry;
- Asset life;
- Ease and cost of asset management;
- Aesthetics;
- The environment; and,
- Ease of securing planning permission

Knowledge Dissemination

During the first week of August, the SMR report [Appendix VIII](#) and [Appendix XIV](#) will be sent out to the stakeholders that participated in the various engagement activities. The information along with this report will be placed on the following websites:

LinkedIn

- https://www.linkedin.com/grp/home?gid=8249399&goback=%2Egmr_8249399

SSE Power Distribution

- www.ssepd.co.uk/innovation

In mid September, a webinar will be scheduled to discuss the progress and direction in which the MASC project is developing. This session will also provide an opportunity for the stakeholders to ask further questions and express their opinions.

The MASC project will also be presented during the November 2015 Low Carbon Network and Innovation (LCNI) Conference in Liverpool.

Summary

The MASC project is about to enter the detailed design phase with a manufacturer on-board. This will enable more meaningful drawings, requirements and risks to be identified.

Together with this and results from the Stakeholder engagement activities, it will be possible to further refine and add depth to the performance based MASC Functional Specification which is included as [Appendix XIII](#).

Additional knowledge will be captured and shared on an incremental basis throughout the project's lifecycle with the stakeholders. This will incorporate all elements of the project such as:

- desk-top design;
- factory fabrication;
- onward transportation;
- on-site installation & commissioning; and
- monitoring during operation.



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- V. PowerPoint presentation summarising information returned by the parties invited to tender
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The Appendixes where applicable will be made available on request: futurenetworks@sse.com



List of Acronyms

Acronym	Definition
GB	Great Britain
DNOs	Distribution Network Operators
LCNI	Low Carbon Networks and Innovation
MASC	Modular Approach to Substation Construction
MVA	Mega Volt Amperes (measure of electrical power)
NIC	Network Innovation Competition
Ofgem	Office of Gas and Electricity Markets
RIIO	Revenue = Incentives + Innovation + Output (Ofgem's price control mechanism for electricity and gas company's)
SDRC	Successful Delivery Reward Criteria
SHE Transmission	Scottish Hydro Electric Transmission
SMR	Social Market Research
SSEPD	Scottish and Southern Energy Power Distribution
TOs	Transmission Owners



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