

SHE Transmission

Multi-Terminal Test Environment for HVDC Systems (SSEN001)

Project Progress Report

June 2015

1) Executive Summary

Overview of MTTE

The Multi-Terminal Test Environment for HVDC (MTTE) Project, is a collaboration across the GB TOs which will support the feasibility, specification, procurement, testing, operation and maintenance of HVDC transmission systems in Great Britain (GB) and de-risk control interactions; using a real-time simulator and replica control panels from HVDC vendors.

This will reduce the cost, increase the efficiency and de-risk GB's investment in HVDC systems.

The MTTE Project is funded through the Electricity Network Innovation Competition (NIC) for 7 years; however the Project aims to create a long-term facility to support HVDC solutions in GB.

The facility that the MTTE Project will create, will be:



The National HVDC Centre will combine advanced real-time simulation capability with replica control panels from HVDC schemes, to maximise the benefits of GB's significant investment in HVDC systems by:

- Supporting transmission planning and improve specification of HVDC schemes;
- Facilitating multi-terminal solutions and interconnected DC hubs;
- De-risking control interactions between converters in electrical proximity, and with other

fast acting power electronic controllers embedded within the AC network;

- Training and developing Transmission Planning and Operations Engineers;
- Undertaking post-commissioning scenario planning and network analysis; and
- Modelling multiple HVDC technologies.

The National HVDC Centre will provide a facility where multiple HVDC schemes on the GB transmission network can be studied to anticipate and resolve potential issues, to ensure the integrity and security of the network.

Progress within this Reporting Period

The Project has focused on developing the designs of each aspect of the new Centre during this reporting period, which are captured within the Design Development Document. This document has been approved by the Project stakeholders.

Progress has also been made with finalising the key components of technology, with the Real-Time Simulator and the first set of replicas control panels.

The Project achieved a key milestone with Ofgem's decision on the "Evidence of Completing Additional Conditions 9 & 10 of the Project Direction". On 27th March 2015 Ofgem published their decision, where they agreed that the Project has met the additional conditions and so provided final approval to establish The National HVDC Centre.

The site for The National HVDC Centre has been selected, located in Cumbernauld, central Scotland; and we have finalised the design of the building.



1) Executive Summary

SDRCs

The first 3 Project SDRCs were successfully completed in the previous reporting period.

During this reporting period, the 4th Project SDRC was successfully completed:

- SDRC 9.4: Complete Design of MTTE Facility; with the Design Development Document and Requirements Specification being endorsed by the participating vendors (ABB, Siemens and Alstom), and signed-off by SHE Transmission, NGET, NETSO and SPT by end of May 2015.

Events

The Project held the 'Design Review Workshop' on 23rd April 2015 in Glasgow, which gave the Project stakeholders the opportunity to review and influence the design of all of the key components of 'The National HVDC Centre', including:

- The building design (incl physical security);
- The design of the IT infrastructure (incl IT security);
- The staffing of the Centre;
- The operation of the Centre; and
- The Communication Strategy.

A report on this event can be found in Appendix I.

Communications

Also during this reporting period, the Project launched the Website, issued the first Newsletter, made two short films about the Project, and presented at one conference.

- **Website (hvdcentre.com):** A dedicated Website has been created for The National HVDC Centre to provide information on the development of the Centre as the Project progresses, and disseminate knowledge to the Project stakeholders.
- **Newsletter:** The first quarterly Newsletter was published in April, to provide updates to those interested in the Project. During the development of the Centre, the focus will be on progress updates; when the Centre is operational, the focus will move to sharing the key learnings from the work undertaken at the Centre [refer to Appendix II for a copy of the Newsletter, which can also be found on the Website].
- **Films:** Two short films have been created for the Project to help communicate the Project. The first film is a general introduction to the Project, while the second focuses on the Design Review Workshop. These films can be accessed through the Website.
- **Conferences:** The Project presented at the ACDC IET Conference in February 2015.



2) Project Manager's Report

Project Summary

The Project is managed as a number of workstreams; an update on the progress made on each workstream during this reporting period is provided below:

IT Infrastructure and RTDS

- The contract for the Real-Time Simulator system has been finalised and signed with RTDS® Technologies.

Replica Control Panels

- The first set of replica control panels (for the Caithness-Moray Scheme) will be procured from ABB. They have allocated a project team to the delivery of the replicas, with whom we are working through the practical technicalities of their delivery.

Building

- The site for the building has been selected, and negotiations have concluded.
- The plans for the building have been agreed with the Project stakeholders.

Design Development Document

- Details of the design of all aspects of The National HVDC Centre have been captured in the Design Development Document, which has been endorsed by the Project stakeholders.

Academic Programme

- An initial programme of the academic support for the Centre has been defined, and the Project team are in discussion with universities on how best these can be delivered.

Communication & Stakeholder Engagement

- The Project launched the Website, issued the first Newsletter, made two short films about the Project, and presented at one conference.
- A Design Review Workshop was held to review the designs for the Centre with the Project stakeholders.

Project Management & Governance

- The Project has continued to hold monthly Steering Group meetings.
- The Project passed Gate 3 in May 2015, and is now in the 'Execution' stage.

Submission to Ofgem

- The Additional Submission was formally submitted to Ofgem on 29th December 2014.
- Ofgem's positive decision was published on 27th March 2015.



2) Project Manager's Report

SDRCs

The Project has previously met the first three Project SDRCs (which are detailed in the December 2014 Progress Report).

During this reporting period SDRC 9.4 (Complete Design of MTTE Facility) was completed.

The completed design of the MTTE facility, both technical design and physical design, and the agreement of this design with the Project stakeholders (including vendors), is a key milestone for the Project. The detailed design will be consolidated within the Design Development Document, and will adhere to the requirements defined in the requirements specification.

- **Requirement:** Design development document and requirements specification for the MTTE facility endorsed by participating vendors and signed-off by SHE Transmission, NGET, NETSO and SPT by end of May 2015.
- **Evidence:** The Design Development Document and Functional Specification document were issued to the Project stakeholders on 10th April 2015, and discussed at the Design Review Workshop on 23rd April 2015, following which each stakeholder provided written confirmation of their endorsement.
- Refer to Appendix III for a collation of the endorsements from the Project stakeholders.

Business Case Update

No changes have been made to the Business Case for the MTTE Project, described in the NIC Full Submission document.

Summary

The Project has made significant progress over the last 6 months developing the design of all aspects of the new Centre.



3) Progress Against Plan

Summary of Progress

Overall the Project is progressing on plan and on budget.

Risks

The main risk to the Project has been identified as the ability to recruit appropriately skilled and expert resources to the Centre. A 'People Strategy' has been developed which defines the recruitment strategy to mitigate this risk.

Focus This Reporting Period

As reported in the December 2014 Progress Report, the focus over this reporting period has been to:

- Support Ofgem's decision process on the additional provisions 9 & 10 submission;
- Complete the Design of MTTE Facility (SDRC 9.4);
- Finalise the IT infrastructure (which has been captured in the Design Development Document);
- Develop the Management and Operations document (which has been captured in the Design Development Document and People Strategy);
- Define the programme of academic support; and
- Completing the Tender process for the RTS system.

Key Activities Next Reporting Period

The Key Activities during the next reporting period are planned to be:

- Present The National HVDC Centre at the LCNI conference in November 2015;
- Gain planning permission for the building;
- Commence construction of the building;
- Set-up an RTS Demonstrator; and
- Establish the Operators' Forum.

4) Progress Against Budget

The table below details the spend to date against the Project budget for each cost category.

Cost Category	Total Budget	Spend to Date	Comment
Labour			
Project team resource costs	£2,181.68k	£328.0k	44% below plan (refer to Note 1)
MTTE resource costs	£2,032.13k	£0	On Plan
Contractors			
Project team resource costs	£288.44k	£25.3k	82% below plan (refer to Note 1)
IT			
IT Infrastructure (incl RTS and Replica Panels)	£3,828.21k	£2.5k	99.8% below plan (refer to Note 2)
Annual Running Costs of the MTTE	£304.37k	£0	On Plan
Travel & Expenses			
Travel & Expenses	£197.40k	£8.0k	64% below plan (refer to Note 1)
Other			
Academic Support	£827.07k	£0	100% below plan (refer to Note 1)
Learning & Dissemination	£165.41k	£1.6k	93% below plan (refer to Note 1)
MTTE Building Facility	£2,916.20k	£0	On Plan
Annual Running Costs of the MTTE	£515.09k	£0	On Plan
Recruitment & Training	£137.90k	£0	On Plan
Total	£13,393.91k	£365.4k	

Notes:

- 1) As requested by Ofgem, spend was kept to a minimum in year 1 (by deferring some activities).
- 2) Only 3 RTDS racks will be ordered in 2015, with the remaining racks ordered in 2016.
- 3) Project Spend as extracted from the finance system (Harmony) on 2nd June 2015.
- 4) There is no Project budget nor Project spend under the Cost Categories: Equipment, IPR Costs, Payments to Users, Contingency and Decommissioning.
- 5) Up to 31st March 2015, the project had spent £329,660, and this has been processed through the Project Bank Account. From 31st March 2015 to 31st May 2015 the project spent £35,750 (which has yet to be processed through the Project Bank Account) so the total project spend to 31st May 2015 is £365,410 as detailed in the above table.



5) Bank Account

A copy of the current Project bank account statement is provided in Appendix IV.

6) SDRCs

An update on the Project's SDRCs is provided below.

The MTTE identified eight Successful Delivery Reward Criteria (SDRC) which span both the objectives and the lifecycle of the Project, furthermore Ofgem's decision letter (27th March 2015) added an additional criteria (SDRC 9.9).







The following table lists each SDRC in chronological order and details the Project's progress towards their achievement.

SDRC	Due	Description	Evidence	Status
9.1	31/8/2014	<p>Formal Agreement with Project Partners.</p> <p>The success of this Project will be crucially dependent on the involvement of the Project partners & stakeholders. Therefore, an early indication of success of the Project is the establishment of formal agreements with the Project partners (National Grid, Scottish Power and NETSO) and HVDC expert support.</p>	<p>Signed agreements with Project partners (National Grid, Scottish Power and the NETSO)(note, agreement will include IP security requirements) and HVDC expert support.</p> <p>Refer to Appendix I for the Agreement between SP Transmission, National Grid Electricity Transmission and SHE Transmission.</p>	<p>Completed (SDRC met)</p> <p>Formal agreements with Scottish Power and National Grid were signed and concluded on 29 August 2014.</p> <p>Parsons Brinkerhoff was engaged as external HVDC expert support in February 2014.</p>
9.2	31/10/2014	<p>OFTOs and Renewable Developers Event</p> <p>Given the anticipated number of HVDC schemes in GB for connection of offshore renewable, the engagement of OFTOs and Renewable Generators is important to ensure the benefits of the MTTE are maximised, therefore the MTTE Project will hold an event to inform and encourage their participation.</p>	<p>Holding an event to which all OFTOs and Renewable Generators are invited, to inform and encourage their participation in the MTTE.</p> <p>Refer to Appendix II for the Letter of Support from the ENA OFTO Forum.</p> <p>Refer to Appendix III for a detailed report on the Engagement Event.</p>	<p>Completed (SDRC met)</p> <p>The OFTOs and Renewable Generators Event was held in Glasgow on 11 September 2014.</p> <p>In addition, the Project presented to the ENA's OFTO Forum on 20 August 2014.</p>
9.3	31/12/2014	<p>Engagement with 1st HVDC Project</p> <p>The purchase of the 1st set of replica control panels for the MTTE will be key to its success, and the panels will be purchased through an HVDC Project. Therefore the formal engagement of the initial HVDC Project is an important early milestone.</p>	<p>Formal agreement between the MTTE Project and an HVDC Project, which includes the intention to purchase/supply replica control panels through the HVDC Project's procurement process.</p> <p>Refer to Appendix IV for the Memorandum of Understanding between the MTTE Project and the Caithness-Moray Project.</p>	<p>Completed (SDRC met)</p> <p>A memorandum of understanding has been signed, between the MTTE Project and the Caithness-Moray Project, confirming the arrangement for the provision and use of replica control panels.</p>
9.4	31/5/2015	<p>Complete Design of MTTE Facility</p> <p>The completed design of the MTTE facility, both technical design and physical design, and the agreement of this design with the Project stakeholders (including vendors), is a key milestone for the Project. The detailed design will be consolidated within the</p>	<p>Design development document and requirements specification for the MTTE facility endorsed by participating vendors and signed-off by SHE Transmission, NGET, NETSO and SPT.</p>	<p>Completed (SDRC met)</p> <p>The Design Development Document and Functional Specification were reviewed at the Design Workshop on 23rd April</p>



6) SDRCs

		Design Development Document, and will adhere to the requirements defined in the requirements specification.		2015, following which each stakeholder provided written confirmation of their endorsement.
9.5	31/10/2015	Establishing HVDC Operators' Forum and Website A key component of our knowledge and dissemination strategy is the establishment of the HVDC Operators' Forum (to which all Network Licensees, including OFTOs will be invited), the associated members' Website (which provides a secure area to share the MTTE outputs with Transmission Licensees), and the public Website.	The establishment of the HVDC Operators' Forum (including holding the 1 st event), together with the publishing of the MTTE Websites.	On Target
9.6	31/5/2017	Commence Operation of the MTTE The criteria consolidates the: <ul style="list-style-type: none"> o Completion of the building/upgrade of the MTTE facility; o Commissioning of the IT/RTS infrastructure; o MTTE Resourcing; o Management structure in place; o Processes and procedures agreed; o Data sets of the AC network received (from NETSO); and o Plan of studies and tests agreed. When all of these are in place, the MTTE will be able to commence operations, therefore this is a key milestone and measure of success of the Project.	Commencement of MTTE Operations.	On Target
9.7	31/3/2018	Publishing Studies & Test results The key outputs from the MTTE are the reports on specific scenarios which are completed within the MTTE, which will be disseminated to transmission licensees. Therefore, a key success criterion is the publishing of studies or test reports on the MTTE members' Website.	Publishing the first set of reports on a specific Transmission Licensee led Project, on the MTTE members' Website.	On Target
9.8	31/3/2020	Future Business Model At least 12 months prior to the end of the funded operation of the MTTE (i.e. by end of March 2020), the MTTE management team will submit a proposal for the future operation and funding of the MTTE (post NIC funding), to Ofgem.	Submission of proposal regarding MTTE ongoing operation and funding to Ofgem.	On Target
9.9	31/3/2021	Second Replicas Use reasonable endeavours to secure the provision and testing of a second set of replica control panels for the MTTE from a second vendor. The panels would be provided by an HVDC Project, a transmission Licensee or a second vendor.	Submission of evidence of the use of reasonable endeavours for the provision and testing of the second vendor's replica control panels at the MTTE facility; by the end of March 2021.	On Target

	Completed (SDRC met)		Emerging issue, remains on target		SDRC completed late
	On target		Unresolved issue, off target		Not completed and late

7 Learning Outcomes

Since the last report to Ofgem, the Project has produced the following deliverables:

- Evidence of Completing Additional Conditions 9 & 10 of the Project Direction;
- Updated Functional Requirements;
- Design Development Document;
- Building Plans;
- Newsletter (April 2015);
- Website.

These deliverables have been shared with the Project stakeholders.

The following learning objectives have been set for the MTTE Project:

- **Support Transmission Planning of HVDC schemes:** The MTTE will produce analysis and reports on the development scenarios investigated, and will share these with the other TOs/OFTOs to increase the understanding of the impact of HVDC development scenarios on the existing network. In addition, the models developed will be shared with Network Licensees.
- **Improve Requirement Specification of HVDC schemes:** The MTTE will produce analysis and reports advising Network Licensees on the specification of HVDC schemes, and these will be shared with the other TOs/OFTOs to increase the understanding of specifying requirements for HVDC schemes.
- **Facilitate Multi-Terminal HVDC solutions:** The MTTE will produce analysis and reports on the Multi-terminal scenarios, and will share

these with the other TOs/OFTOs to increase the understanding of Multi-Terminal HVDC.

- **Facilitate Competition and Multi-Vendor HVDC schemes:** The MTTE will produce reports on multi-vendor compatibility to inform the development of HVDC standards and interoperability. Acceptance testing reports will also be produced.
- **De-risk Control interactions between co-located and electrically connected converters, and with other active controlled equipment:** The MTTE will produce reports on the impact of planned HVDC systems, providing detail on any control interactions with converter stations in close proximity and active controlled equipment. These reports will be shared with all Licensees to improve sector-wide understanding of the associated issues. This would include reports on the integration of generators into HVDC networks and the associated risk of adverse control interactions and their control protocols and strategies.
- **Train Transmission Planning and Operational Engineers:** The MTTE will produce training material which will be available to all Transmission Licensees.
- **Undertake Post commissioning scenario planning and operational optimisation:** The MTTE will produce recommendation reports on specific HVDC schemes to enable optimisation which will be shared with all Licensees.
- **Model New HVDC Technologies:** The MTTE will produce analysis and reports on the performance, impact and interactions of new HVDC technologies or active controlled devices in accurately simulated GB situations and their suitability for specific applications / locations.

These learning objectives will start to be achieved when The National HVDC Centre has been commissioned.



7 Learning Outcomes

IPR

No relevant IPR has been generated or registered during this reporting period

8) Risk Management

Risk Management Plan

The Project has a Project Risk Management Plan that describes how Project risks are managed throughout the Project.

The Project risk register is regularly reviewed by the Project team and the key Project risks are highlighted and discussed at the monthly steering group meetings, where mitigating actions are agreed.

Risk Register

The current Project Risk Register is provided in Appendix V.

9) Accuracy Assurance Statement

PPR Preparation Steps

To ensure that the information contained in this report is accurate and completed, the following steps have been taken, the report has been:

- Prepared by the Project Manager;
- Reviewed by the Project Team;
- Reviewed by the Steering Group; and
- Approved by the Project Director and Regulation.

Sign-off

As the senior manager responsible for the MTTE Project, I confirm that the processes in place and steps taken to prepare this PPR are sufficiently robust and that the information provided is accurate and complete.



Stewart A Reid

Future Networks Manager
Scottish Hydro Electric Transmission

Appendices

Appendix I

Design Review Workshop Report

Appendix II

April Newsletter

Appendix III

Design Development Document and Functional Requirements Endorsements

Appendix IV

Project Bank Account Statement

Appendix V

Risk Register

Note: Appendices, I, III, IV & V are considered 'Confidential'.



