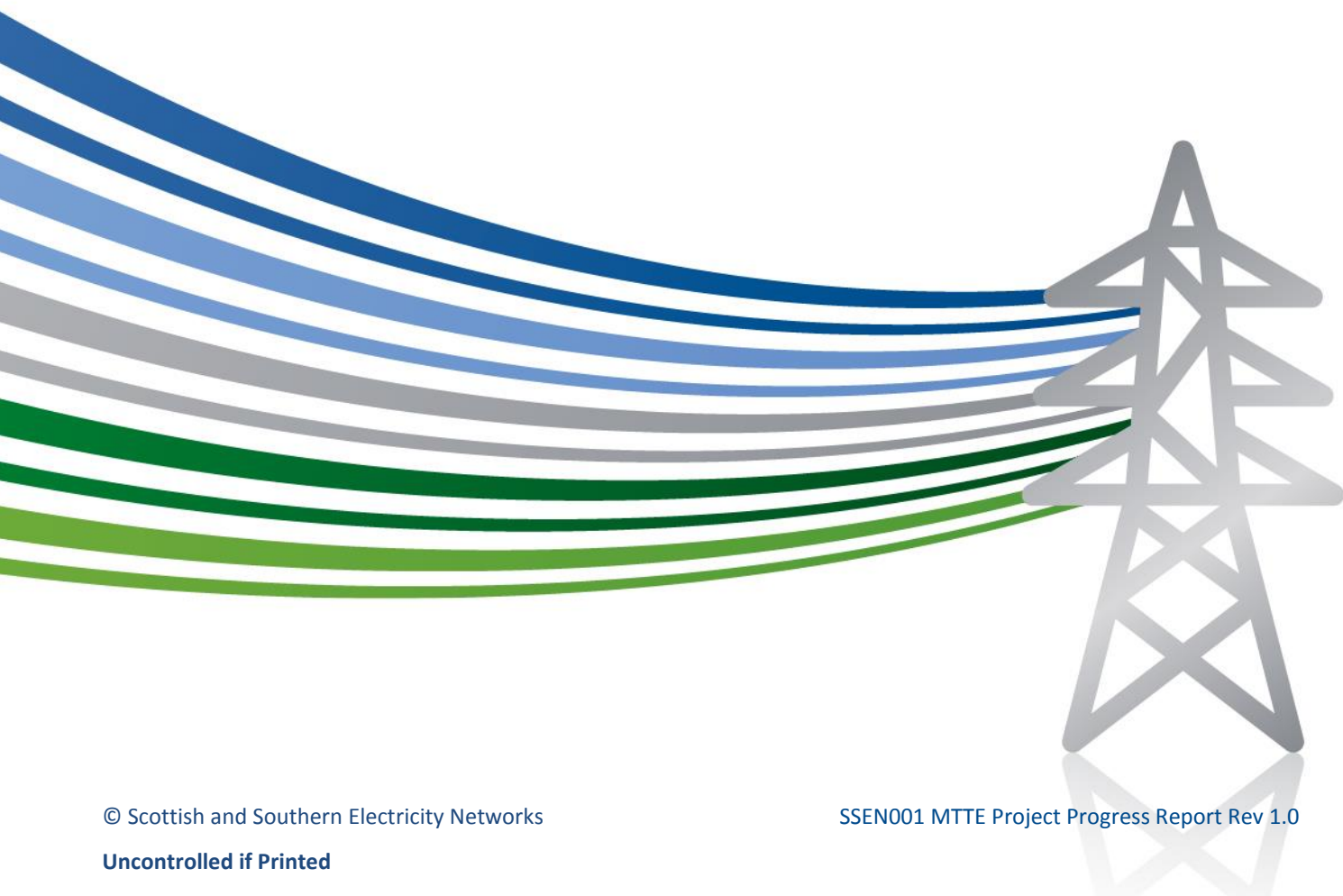


# **SHE Transmission**

**Multi-Terminal Test Environment for HVDC Systems (SSEN001)**

**Project Progress Report**

**December 2016**



# 1) Executive Summary

## Overview of MTTE

The Multi-Terminal Test Environment for HVDC (MTTE) Project, is a collaboration across the Transmission Owners (TOs) to support the feasibility, specification, procurement, testing, operation and maintenance of HVDC transmission systems in Great Britain (GB) and de-risk control interactions; using real-time simulation 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 name of this new facility is 'The National HVDC Centre'.



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

During this reporting period, the Project has focused on the building works and recruiting the core roles.

## SDRCs

The first five Project SDRCs have been successfully completed in previous reporting periods.

No SDRCs were planned to be completed during this reporting period.

The next SDRC is 9.6: Commencement of MTTE Operations; which is on-plan to be completed before the end of May 2017.

## 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:

#### Safety

- Regular safety audits have been undertaken on the site, and there have been no safety incidents.

#### IT Infrastructure and RTDS®

- The procurement process for the Audio–Visual requirements of the Centre has been completed, and ordered.
- The detailed design of the IT infrastructure has been completed and approved.
- The support and maintenance arrangements for the IT infrastructure have been defined and approved.
- The RTDS® system requirements have been reviewed and will be ordered in January.
- The BT Network Circuit has been ordered and installation is planned for January 2017.

#### Replica Control Panels

- ABB have completed the building of the replica control hardware, and are progressing on-plan.
- The project team have held monthly teleconferences with ABB to discuss progress.

#### Building

- The building work is progressing well and is planned to be completed in March 2017.
- An event to mark the start of the building work was held on 1 September with the Minister for Employability and Training, Jamie Hepburn MSP.
- The official opening of the building is being planned for 26 April 2017.

#### Academic Programme

- The first academic project, with the University of Manchester, has been successfully completed.
- The project is working with Strathclyde University to define their support for the project.

#### Communication & Stakeholder Engagement

- **Website (hvdcentre.com):** The website has been kept up-to-date with project progress and news, and continues to see a strong number of visitors per day.
- **Newsletter:** The sixth and seventh editions of the quarterly Newsletter were published in July and October, providing updates to stakeholders and other interested parties [refer to Appendix I for a copy of the Newsletters].
- **Bi-Monthly Partner Teleconferences:** Teleconferences have been held with National Grid, Scottish Power and the Project Team.
- **LCNI Conference:** The project team presented at the Low Carbon Networks and Innovation (LCNI) conference, and had a presence on the Scottish and Southern Electricity Networks Stand.
- **Other Conferences:** Members of the project team also attended and presented at the CIGRE Session, and RTDS European User Group.
- **Social Media:** LinkedIn and Twitter are being used to communicate key messages on the Project and also share our Newsletters.

#### Recruitment

- The first simulation engineer was recruited in September; the other two simulation engineers have been recruited and are expected to start in Q1 2017.

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## 2) Project Manager's Report

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### Project Management & Governance

- The Project has continued to hold monthly Steering Group meetings.
- The Project is in the 'Execution' stage.

### SDRCs

The Project has previously met the first five Project SDRCs (which are detailed in prior Progress Reports).

### 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 and is on-plan to deliver the project SDRCs on-time and within budget.

All of the key elements of the project: people, process, technology and the building; have progressed well. With the core team recruited, the operational processes drafted, all the IT defined and selected, and the building work progressing well.

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## 3) Progress Against Plan

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### Summary of Progress

Overall the Project is progressing within plan and within budget.

### Risks

In the last report, the risk of 'the ability to recruit appropriately skilled and expert resources' was highlighted. This risk has now been closed, following the successful recruitment of three simulation engineers.

The next highest risk, is insufficient external utilisation of the facility. To address this we are in discussion with a number of organisations, and are also going to recruit (through Scottish Enterprise) a dedicated Business Development Manager.

### Focus This Reporting Period

As reported in the June 2016 Progress Report, the focus over this reporting period has been to:

- Substantially complete building works;
- Order the full RTDS® system; and
- Recruit the initial roles for the Centre.

The building works have progressed well and, although running slightly behind schedule, the building is expected to be completed in March 2017.

The full RTDS® system will be ordered in January 2017.

The three Simulation Engineers and the ICT Engineer have all been recruited.

### Key Activities Next Reporting Period

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

- The formal opening of The National HVDC Centre; and
- Completion of SDRC 9.6 (Commence Operation of the MTTE).

## 4) Progress Against Budget

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

Cost Category <sup>(10)</sup>	Total Budget	Spend to Date <sup>(2)</sup>	Comment <sup>(1)</sup>
Labour			
Project team resource costs	£2,181.68k	£784.13k	32% below plan (refer to Note 3)
MTTE resource costs	£2,032.13k	£0	On Plan
Contractors			
Project team resource costs	£288.44k	£42.19k	78% below plan (refer to Note 3)
IT			
IT Infrastructure (incl RTS and Replica Panels)	£3,828.21k	£565.60k	70% below plan (refer to Note 4)
Annual Running Costs of the MTTE	£304.37k	£0	On Plan
Travel & Expenses			
Travel & Expenses	£197.40k	£14.20k	78% below plan (refer to Note 5)
Other			
Academic Support	£827.07k	£28.23k	90% below plan (refer to Note 6)
Learning & Dissemination	£165.41k	£16.25k	73% below plan (refer to Note 7)
MTTE Building Facility	£2,916.20k	£1,151.68k	59% below plan (refer to Note 8)
Annual Running Costs of the MTTE	£515.09k	£0	On Plan
Recruitment & Training	£137.90k	£0	Below plan (refer to Note 9)
<b>Total <sup>(11)</sup></b>	<b>£13,393.91k</b>	<b>£2,602.30k</b>	

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## 4) Progress Against Budget

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### Notes:

- 1) The percentage below plan refers to spend-to-date as a percentage of the budget-to-date. The budget-to-date is calculated as a pro-rata of the annual budget in the Full Submission Spreadsheet (to May 2016).
- 2) Project Spend as extracted from the finance system (Harmony) on 1 December 2016.
- 3) Current spend on project team resource costs is lower than the average spend profile assumed in the Full Submission Spreadsheet; the total spend is forecast to be within 5% of the total budget.
- 4) The Full Submission Spreadsheet assumed that all RTDS® racks would be delivered in 2015, however the remaining 6 RTDS® racks will be delivered in 2017 (as planned by the project team).
- 5) In-line with the resource cost, travel and expenses spend is lower than the average spend profile assumed in the Full Submission Spreadsheet; the total spend is forecast to be within 5% of the total budget.
- 6) Academic support projects started on 1 June 2016, later than assumed in the Full Submission Spreadsheet; the total spend is forecast to be within 5% of the total budget.
- 7) Current spend on Learning & Dissemination is lower than the average spend profile assumed in the Full Submission Spreadsheet; the total spend is forecast to be within 5% of the total budget.
- 8) Current spend on the MTTE Building facility is lower than planned due to the later start date of the building works.
- 9) No recruitment costs have been incurred by the project.
- 10) There is no Project budget nor Project spend under the Cost Categories: Equipment, IPR Costs, Payments to Users, Contingency and Decommissioning.
- 11) Up to 23 May 2016 the project spent £1,548,808; and from 24 May 2016 to 22 November the project spent £1,016,428 (which has been process through the Project Bank Account, see Appendix II for details), totalling spend of £2,565,236. From 23 November 2016 to 30 November 2016 the project spent £37,059, which has yet to be processed through the Project Bank Account, so the total project spend to 30 November 2016 is £2,602,296 (as detailed in the table above).

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## 5) Bank Account

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**A copy of the current project bank account statement is provided in Appendix II.**



## 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, dated 27 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	Formal Agreement with Project Partners. 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.	Signed agreements with Project partners (National Grid, Scottish Power and the NETSO)(note, agreement will include IP security requirements) and HVDC expert support. Refer to Appendix I for the Agreement between SP Transmission, National Grid Electricity Transmission and SHE Transmission.	Completed (SDRC met) Formal agreements with Scottish Power and National Grid were signed and concluded on 29 August 2014. Parsons Brinkerhoff was engaged as external HVDC expert support in February 2014.
9.2	31/10/2014	<b>OFTOs and Renewable Developers Event</b> 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.	Holding an event to which all OFTOs and Renewable Generators are invited, to inform and encourage their participation in the MTTE. Refer to Appendix II for the Letter of Support from the ENA OFTO Forum. Refer to Appendix III for a detailed report on the Engagement Event.	Completed (SDRC met) The OFTOs and Renewable Generators Event was held in Glasgow on 11 September 2014. In addition, the Project presented to the ENA's OFTO Forum on 20 August 2014.
9.3	31/12/2014	<b>Engagement with 1st HVDC Project</b> 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.	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. Refer to Appendix IV for the Memorandum of Understanding between the MTTE Project and the Caithness-Moray Project.	Completed (SDRC met) 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.
9.4	31/5/2015	<b>Complete Design of MTTE Facility</b> 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.	Design development document and requirements specification for the MTTE facility endorsed by participating vendors and signed-off by SHE Transmission, NGET, NETSO and SPT.	Completed (SDRC met) The Design Development Document and Functional Specification were reviewed at the Design Workshop on 23rd April 2015, following which each stakeholder provided written confirmation of their endorsement.



## 6) SDRCs



SDRC	Due	Description	Evidence	Status
<b>9.5</b>	31/10/2015	<b>Establishing HVDC Operators' Forum and Website</b> 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 <sup>st</sup> event), together with the publishing of the MTTE Websites.	<b>Completed (SDRC met)</b> The first HVDC Operators' Forum event was held on 8 October 2015; and the second event is planned for April 2017. The website (hvdccentre.com) was launched in April 2015; to tie-in with the HVDC Operators' Forum enhanced functionality was deployed in October 2015, providing discussion forum functionality, and a secure library.
<b>9.6</b>	31/5/2017	<b>Commence Operation of the MTTE</b> The criteria consolidates the: <ul style="list-style-type: none"> <li>o Completion of the building/upgrade of the MTTE facility;</li> <li>o Commissioning of the IT/RTS infrastructure;</li> <li>o MTTE Resourcing;</li> <li>o Management structure in place;</li> <li>o Processes and procedures agreed;</li> <li>o Data sets of the AC network received (from NETSO); and</li> <li>o Plan of studies and tests agreed.</li> </ul> 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.	<b>On Target</b>
<b>9.7</b>	31/3/2018	<b>Publishing Studies &amp; Test results</b> 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.	<b>On Target</b>
<b>9.8</b>	31/3/2020	<b>Future Business Model</b> 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.	<b>On Target</b>

## 6) SDRCs

SDRC	Due	Description	Evidence	Status
<b>9.9</b>	31/3/2021	<b>Second Replicas</b> 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.	<b>On Target</b>

 Completed (SDRC met)  
 On target

 Emerging issue, remains on target  
 Unresolved issue, off target

 SDRC completed late  
 Not completed and late

## 7) Learning Outcomes

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

- **Support Transmission Planning of HVDC schemes:** The National HVDC Centre 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 National HVDC Centre will produce analysis and reports advising Network Licensees on the specification of HVDC schemes. These reports will be shared with other Network Licensees to increase their understanding.
- **Facilitate Multi-Terminal HVDC solutions:** The National HVDC Centre 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 National HVDC Centre 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 National HVDC Centre 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 National HVDC Centre will provide on-site training (available to all Transmission Licensees) and will share the associated training material.
- **Undertake Post commissioning scenario planning and operational optimisation:** The National HVDC Centre will produce recommendation reports on specific HVDC schemes to enable optimisation which will be shared with all Licensees.
- **Model New HVDC Technologies:** The National HVDC Centre 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.

### IPR

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

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## 8) Risk Management

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### 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 III.

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## 9) Accuracy Assurance Statement

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### 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**

Head of Asset Management & Innovation  
Scottish and Southern Electricity Networks

9-12-16

**Date**

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## 10) Appendices

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### Appendix I

July & October Newsletters

### Appendix II

Project Bank Account Statement

### Appendix III

Risk Register





## Issue Revision 1.0 – December 2016

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