



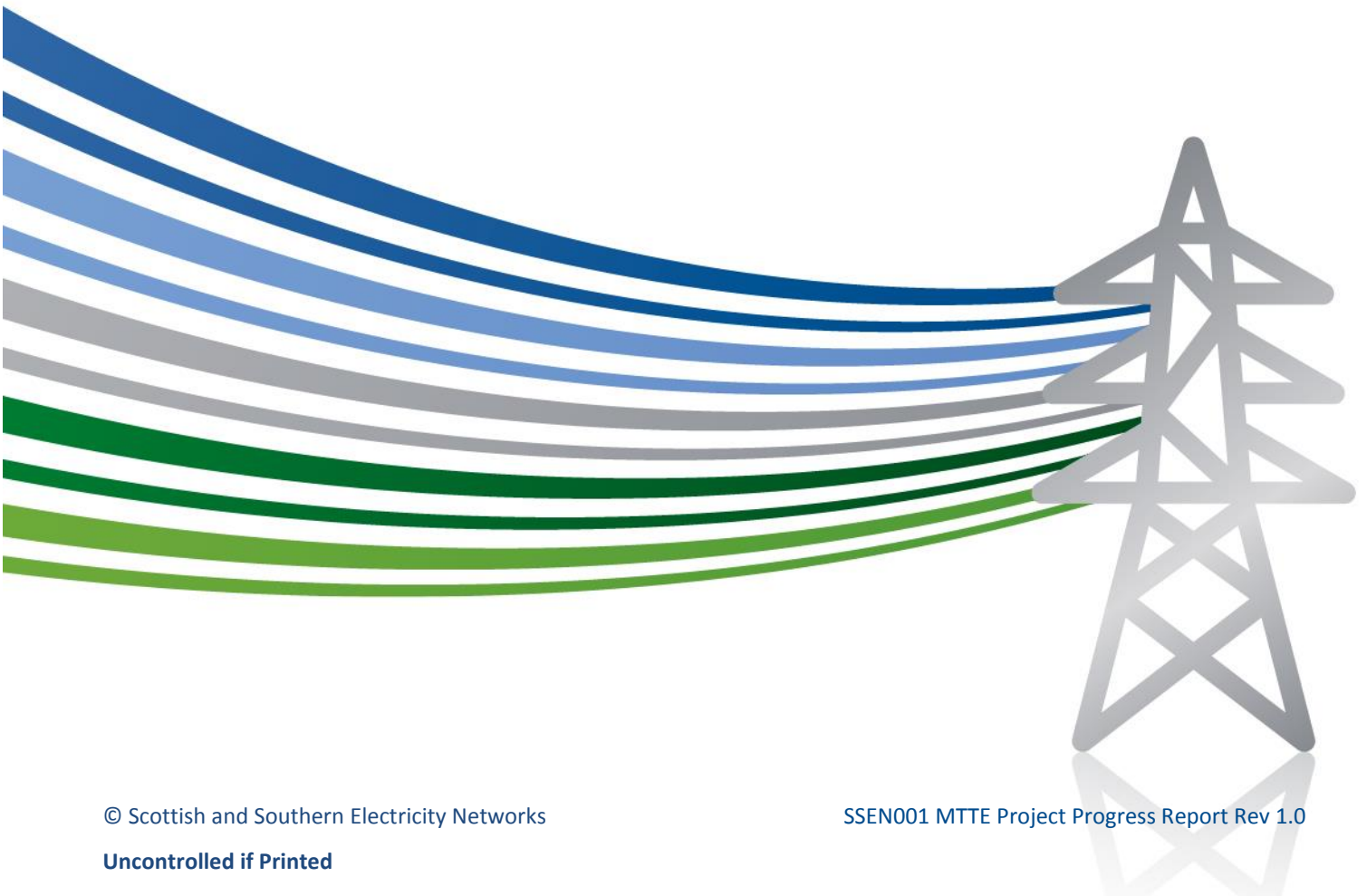
**Scottish & Southern**  
Electricity Networks

# SHE Transmission

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

**Project Progress Report** (for reporting period June 2018 to May 2019)

June 2019



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# 1) Executive Summary

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## Overview of MTTE

The Multi-Terminal Test Environment for HVDC (MTTE) Project, has established 'The National HVDC Centre', which formally opened on 26 April 2017.

The National HVDC Centre is a simulation and training facility, supporting the integration and successful operation of all HVDC schemes connecting to the Great Britain's (GB's) Grid Network.

The Centre is also:

- GB's real-time testing facility for HVDC schemes using replica hardware to study and resolve network interactions; and
- A National hub for HVDC knowledge exchange, expertise and innovation.

The Centre uses state-of-the-art simulators to model and resolve potential issues in real-time before they impact on the delivery (or operation) of HVDC projects, to ensure the integrity and security of the GB Network.

## Successful Delivery Reward Criteria (SDRC)

The first seven Project SDRCs have been successfully completed in previous reporting periods. No further SDRCs were planned to be completed during the period covered by this report (June 2018 – May 2019).

# 1) Executive Summary

## Progress within this Reporting Period

The key progress this period has been:

- **July '18:** Replica control panels for the Caithness-Moray (CM) Project were successfully installed and commissioned at the HVDC Centre.
- **August '18:** User Acceptance Testing of the Replicas was successfully completed.
- **August '18:** Completed building a real-time (RTDS®) model of the north of Scotland network for use in the Factory System Tests 4 (FST4) testing of the CM HVDC control hardware.
- **August '18:** Supported the testing of the Emergency Power Control (EPC) functionality of the CM controls using the CM Replicas.
- **September '18:** Paper submitted to the ACDC Conference (which was then presented at the conference in February '19).
- **September '18 – October '18:** Ran a series of training courses for the operators of the CM project (utilising the Replicas).
- **October '18:** Successfully completed 'FST4' (grid integration testing) of the CM project Replicas against the network model developed of the AC Grid.
- **November '18:** Produced a report on DC GIS (Gas Insulated Switchgear), for the PROMOTioN project.
- **December '18:** The Caithness-Moray HVDC Link was successfully commissioned.
- **December '18:** Completed the Innovation project "Converter and GB Network Modelling" with the University of Strathclyde, which produced open-access enhanced converter models. Reports and models published on the Centre website.
- **January '19:** The Centre ran the first supplier-approved 3-day RTDS® training course (becoming the only other organisation endorsed by RTDS Technologies to run RTDS training courses on its behalf).
- **February '19:** Participated in the IET's ACDC Conference: delivered a tutorial on the practical uses of real-time simulation, introduced the open-access converter models developed in collaboration with the University of Strathclyde and shared lessons learnt from the provision of commissioning support to the Caithness-Moray HVDC transmission project.
- **November '18 – February '19:** Ran a 2-stage process calling for academic proposals on HVDC innovation - three innovation projects were selected from the 18 proposals received.
- **February '18:** Produced a report on the Compatibility of HVDC Converters Supplied by different Manufacturers.
- **March '18:** The HVDC Centre hosted a knowledge sharing event on the Caithness-Moray Project; sharing the lessons learnt during the CM project with an external audience of over 30 participants.
- **March '18:** Completed a report on "Risk Reduction using HVDC Replicas", posted on Centre website.
- **April '19:** Completed the Phase1 Shetland Fault Level Study for SHE Transmission.
- **April-May '19:** Organized and hosted the kick-off meetings for the three Innovation projects.
- **April '19:** Installed the Intelligent Electronic Device (IED) HVDC Grid Protection device at the Centre as part of the PROMOTioN Project.
- **April-May '19:** Ran the second 3-day RTDS training course.
- **May '19:** Installed a Protection Relay at the Centre, interfacing with the RTDS system (as part of the EPRI project on HVDC protection coordination).
- **May '19:** Ran a PSS/E Training Course at the Centre.

## 2) Project Manager's Report

### Project Summary

The first 6 months of this reporting period (June-December '18) were mostly concerned with supporting the delivery of the CM Project.

The Second 6 months (January-May '19) has focused on:

- Establishing the innovation programme;
- Delivering the PROMOTioN Project (WP9);
- Developing our Training programme; and
- Engaging with HVDC schemes connecting to GB.

The second 6 months also saw a significant change of resources at the Centre.

### Caithness-Moray Support

During the commissioning of the CM Project the Centre focused on de-risking the integration of the CM link with the AC network, specifically this has included:

- Supporting the testing of the Emergency Power Control (EPC) functionality of the CM controls using the CM Replicas. Utilising the Replica for this testing avoiding the need for shipping the main control system back to the supplier (which would have incurred significant cost and time);
- Working with the CM project team to demonstrate grid code compliance of the CM scheme to the System Operator;
- Integrating the Replicas with a detailed real-time representation of the AC network (developed in-house) to test the operation of the HVDC scheme in conjunction with the AC network (this was referred to as FST4);
- Pre-running commissioning tests on the Replicas, to show the results that should be anticipated;
- Reviewing (on a daily basis) the outputs of the on-site commissioning tests, to provide in-depth analysis;
- Analysing and diagnosing faults and events that occurred during CM commissioning; and
- Providing ongoing operational support for the link.

### Innovation

The "Converter and GB Network Modelling" project with the University of Strathclyde was completed and published this period (and the outputs are already being used by the Centre).

The HVDC Centre ran a two-staged evaluation process for selecting research projects from universities and research institutions. The research projects are intended to support the objective of de-risking the deployment of HVDC schemes in GB.

The call for research proposals attracted 18 projects from 12 different institutions, with 7 full proposals invited from 4 institutions in the second round. Out of these, 3 proposals were selected for funding by the HVDC Centre (with a total budget of £283k):

- Coordination of AC network protection settings during grid energization from HVDC schemes (with EPRI);
- Stability assessment and mitigation of converter interactions in HVDC schemes (with University of Strathclyde); and
- Improving Grid Code Compliance of existing and upcoming HVDC Schemes in GB (with Cardiff University).

The Electric Power Research Institute (EPRI), University of Strathclyde and Cardiff University are working with HVDC Centre staff and with representatives from GB Electricity Transmission Owners/System Operator to deliver these projects collaboratively.

### PROMOTioN

SHE Transmission is leading Work-Package 9 of the European PROMOTioN Project (<https://www.promotion-offshore.net/>). This work package demonstrates the operation of the DC grid protection systems using hardware prototypes with real-time simulation to test and demonstrate interoperability of DC Grid protection systems.

## 2) Project Manager's Report

Progress this period has included:

- Received and installed the IED (Intelligent Electronic Device – HVDC Grid Protection device) from KTH (the Royal Institute of Technology in Stockholm), as part of WP4, at the HVDC Centre;
- Agreed schedule for use of an equivalent IED from MELCO (Mitsubishi Electric Corporation);
- Progressed development of the real-time models for use with the IEDs;
- Performed initial testing with the KTH IED; and
- Held face to face WP9 meeting and initiated weekly progress calls.

### Training

The Centre has delivered a number of training courses, including:

- A series of training courses for the operators of the CM project (utilising the Replicas); and
- Two, 3-day RTDS training course (endorsed by RTDS Technologies).

### HVDC Projects Engagement

The Centre is engaging with all HVDC projects connecting to the GB Grid, focusing on the following upcoming projects:

- Moyle interconnector which plans to replace its control systems (hardware & software), connecting South Ayrshire to Northern Ireland completing in 2021.
- The Shetland island link extension to the Caithness-Moray project is working towards delivery – subject to the outcome of the island generation projects' success or otherwise in the CfD bidding process. Since this will form a multi-terminal system it has been decided that the system testing will be undertaken at the Centre. Commissioning is expected in 2021.
- North Sea Link interconnector will connect the UK and Norway. It will be the world's longest subsea interconnector when operational in 2021.

- Aquind interconnector is expected to commission an HVDC converter station in Lovedean connecting to France in 2022.
- Dogger Bank offshore windfarm has situated its converter stations between Beverley and Cottingham, connecting to the substation at Creyke Beck. The project aims to begin commencing construction in 2022 (comprising multiple DC links).
- Viking Link interconnector is a link between the UK and Denmark. It is due to be operational in 2022.
- Hornsea Project 2 & 3 offshore windfarm landing at Horshore Point in Lincolnshire, and connecting to a substation in North Killingholme due to commission in 2022 & 2025 (comprising multiple DC links).
- Greenlink interconnector is expected to commission an HVDC Converter station in Pembroke connecting to the Republic of Ireland in 2023.
- Western Isles embedded link between Arnish Point, Stornoway to Beaully is expected in 2023.
- NorthConnect interconnector is expected to commission an HVDC converter station in Peterhead connecting to Norway in 2023/2024.
- Norfolk Vanguard offshore windfarm will connect to Happisburgh in eastern Norfolk. The project's onshore cable route connects to the National Grid substation at Necton, due to be fully commissioned by 2026 (expected to comprise multiple DC links).
- The Eastern HVDC reinforcements in development by the three GB Transmission Owners currently comprise two separate HVDC links, one connecting Peterhead to Hawthorn Pit/ Cottam/Drax commission in 2029, and the other connecting Torness with Hawthorn Pit/ Cottam/Drax for 2027.

### Resourcing

The Centre has benefited from the expertise brought by the people recruited during this period:

- **Oluwole Daniel Adeuyi** is a chartered engineer with the UK Engineering Council. Daniel comes with over six years' experience gained from working on major EU and UK electricity networks research and

## 2) Project Manager's Report

innovation projects as a researcher at Cardiff University.

- **Md Habibur Rahman** brings over four years' research experience on Multi-terminal HVDC systems; focused on fault management, system topology, and control and protection schemes, having started his career with the Department of Electronic and Electrical Engineering at the University of Strathclyde.
- **Bharath Ponnalagan** brings a manufacturer's perspective, having been a lead engineer with GE and a team manager with ABB; he has expertise on the practical design of control and protection for HVDC projects.

While also during this period the following people left the HVDC Centre: Tarun Sharma, Dumisani Simfukwe and Yash Audichya.

### Dissemination Activity

#### Newsletter & Website:

- Newsletter: Editions of the Centre's Newsletter were published in: July, September, December and March, providing updates on the activity at the Centre [refer to Appendix I for copies of the Newsletters]; and
- Website (hvdccentre.com): The website continues to be updated to support knowledge dissemination.

#### Dissemination Events

- 8<sup>th</sup> June 2018: COWI (Japanese delegation) of offshore wind consortia. Discussion about their project to form an offshore meshed grid in Japan, Project Nedo;
- 21-22<sup>nd</sup> June 2018: Annual HVDC Operators' Forum, this 4<sup>th</sup> Forums was held at the Centre, bringing together owners and operators of HVDC schemes in GB to share knowledge and experiences;
- 26<sup>th</sup> June 2018: Visit from Nalcor Energy, a Canadian based transmission operator and HVDC link owner; to share HVDC Centre experience, as they plan to establish a similar facility for real-time hardware-in-the-loop study of their HVDC projects;

- 10<sup>th</sup> July 2018: Energy Network Association had tour and presentation of the work of the Centre;
- 11<sup>th</sup> July 2018: Stuttgart University visit, Undergraduate course doing an energy assets tour in Scotland - the Centre gave relevant presentations on HVDC and environmental consents process;
- 7<sup>th</sup> September 2018: Aalborg University visited, with a tour and presentation on the work of the Centre;
- 2<sup>nd</sup> October 2018: The Development team from North Lanarkshire Council visited the Centre to see how they can develop links with the Centre;
- 25<sup>th</sup> October 2018: The SSEPD stakeholder advisory panel visited the Centre to learn more about the work of the Centre to provide a secure GB network;
- 31<sup>st</sup> October 2018: The Energy team of Scottish Enterprise visited to learn more about HVDC contribution to the low-carbon strategy for the Scottish energy sector, and the work of the HVDC Centre to facilitate this;
- 5-7<sup>th</sup> February 2019: At the IET's ACDC Conference in Coventry, the Centre ran a real-time simulation tutorial, and presented a paper on Replicas;
- 18<sup>th</sup> February 2019: The Technical Advisory Board meeting was held, which brought together Scottish Power Energy Networks, National Grid (TO & SO) and SHE Transmission to discuss the Centre's activity and plans;
- 19<sup>th</sup> March 2019: Strathclyde University's Energy Technology Partnership (ETP) visited the Centre to learn more about HVDC and the Centre's work; and
- 28<sup>th</sup> March 2019: CM Knowledge sharing event, to share the experience and lessons learnt from integrating the Caithness-Moray (CM) HVDC Link into the (electrically weak) North of Scotland electricity grid; focusing specifically on the control challenges and learnings, to an open external audience.

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### 3) Business Case Update

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

## 4) Progress Against Plan

### Summary of Progress

During this reporting period, The National HVDC Centre has delivered the following programme of work:

#### Supported Replica Hosting

- The Caithness-Moray Project Replicas have been commissioned at the Centre (and used to de-risk project delivery);
- Replicas of the proposed Shetland multi-terminal extension have also been installed at Centre;
- Following consultations with the HVDC Centre, a number of GB HVDC projects have included Replicas in their specification (and the Centre has supported their specification);
- The PROMOTioN IED (HVDC Grid Protection device) has been installed at the Centre; and
- A Protection Relay has been installed at the Centre (as part of the EPRI project on HVDC protection coordination).

#### Analysis/Studies

- Risk Reduction through use of Replicas on HVDC Projects;
- Compatibility of HVDC Converters Supplied by different Manufacturers Report;
- VSC HVDC Fault Infeed Modelling: Existing Modelling Guidance;
- DC GIS (Gas Insulated Switchgear) report, for the PROMOTioN project;
- FST4 model validation report;
- FST4 results report;
- Emergency Power Control (EPC) report;
- Replicas installation and commissioning (paper presented at the IET's ACDC conference); and
- CM commissioning report.

#### Training

- Ran a series of training courses for the operators of the CM project (utilising the Replicas);
- Delivered two 3-day RTDS training course at the Centre (both fully booked), endorsed by RTDS Technologies;
- Ran an externally delivered PSS/E Training Course at the Centre; and
- Delivered a tutorial on the practical use of real-time simulation, at the IET's ACDC Conference.

#### Research & Innovation

- Completed the Innovation project "Converter and GB Network Modelling" with the University of Strathclyde, which produced open-access enhanced converter models, and published the reports and models.
- Ran a 2-stage process calling for proposals on HVDC innovations; three innovation projects taken forward:
  - Coordination of AC network protection settings during grid energization from HVDC schemes (with EPRI);
  - Stability assessment and mitigation of converter interactions in HVDC schemes (with University of Strathclyde); and
  - Improving Grid Code Compliance of existing and upcoming HVDC Schemes in GB (with Cardiff University).



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## 4) Progress Against Plan

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### Risks

Refer to Appendix III for an extract of the project risk Register.

There are currently no 'high' risks, however there are two 'medium' risks which are highlighted below:

- **R004 A sustainable business model is not achieved for the MTTE after the funded period:** The future business model is currently being developed by the Project; and
- **R012 Lack of continuity in the project team resource during the project:** There has been a significant change of resources during this period, however team working and knowledge sharing has ensured a smooth transition.

The following risk has been closed:

- **R007 Technical difficulties compromise the interfacing between the RTS system and the replica control panels supplied by vendors;** closed since the Replicas were successfully interfaced with the RTS system.

### Focus This Reporting Period

The focus over this reporting period has been:

- Commissioning of the CM Replicas at the HVDC Centre;
- Supporting the commissioning of the CM HVDC Link;
- PROMOTioN (WP9); and
- Developing further work for the Centre.

As described above, the CM Replicas have been commissioned, the Centre supported the CM project commissioning (with the CM link successfully commissioned in December '18), work on the PROMOTioN project is progressing well, and the Centre is engaging with HVDC projects planning to connect to the GB Grid, and providing support.

### Key Activities Next Reporting Period

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

- Completing the PROMOTioN (WP9) Project, including two formal demonstration events held at the Centre;
- Supporting the operation of the CM Project;
- Completing the three innovation projects (with EPRI, University of Strathclyde and Cardiff University);
- Publishing reports based on the studies undertaken;
- Submitting the Centre's future operation and funding proposal to Ofgem (to meet SDRC 9.8); and
- Progressing an industry conversation on the appropriateness of current frameworks for HVDC network integration.

## 5) Progress Against Budget

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

Cost Category <sup>(9)</sup>	Total Budget	Budget to Date <sup>(1)</sup>	Spend to Date <sup>(2)</sup>	Comment <sup>(1)</sup>
<b>Labour</b>				
<b>Project team resource costs</b>	£2,181.68k	£1,838.84k	<b>£1,328.72k</b>	27.7% below plan <sup>(refer to Note 3)</sup>
<b>MTTE resource costs</b>	£2,032.13k	£879.11k	<b>£689.46k</b>	21.6% below plan <sup>(refer to Note 3)</sup>
<b>Contractors</b>				
<b>Project team resource costs</b>	£288.44k	£259.38k	<b>£45.64k</b>	82.4% below plan <sup>(refer to Note 3)</sup>
<b>IT</b>				
<b>IT Infrastructure</b> (incl RTS and Replica Panels)	£3,828.21k	£2,347.27k	<b>£3,299.30k</b>	40.6% above plan <sup>(refer to Note 4)</sup>
<b>Annual Running Costs of the MTTE</b>	£304.37k	£161.26k	<b>£107.72k</b>	33.2% below plan <sup>(refer to Note 8)</sup>
<b>Travel &amp; Expenses</b>				
<b>Travel &amp; Expenses</b>	£197.40k	£134.66k	<b>£55.27k</b>	59% below plan <sup>(refer to Note 5)</sup>
<b>Other</b>				
<b>Academic Support</b>	£827.07k	£595.89k	<b>£386.73k</b>	35.1% below plan <sup>(refer to Note 6)</sup>
<b>Learning &amp; Dissemination</b>	£165.41k	£119.18k	<b>£38.15k</b>	68% below plan <sup>(refer to Note 7)</sup>
<b>MTTE Building Facility</b>	£2,916.20k	£2,916.20k	<b>£2,857.05k</b>	2% below plan
<b>Annual Running Costs of the MTTE</b>	£515.09k	£272.91k	<b>£88.38k</b>	67.6% below plan <sup>(refer to Note 8)</sup>
<b>Recruitment &amp; Training</b>	£137.90k	£104.88k	<b>£3.18k</b>	97% below plan <sup>(refer to Note 7)</sup>
<b>Total</b>	<b>£13,393.91k</b>	<b>£9,629.57k</b>	<b>£8,899.58k</b>	15.6% below plan <sup>(refer to Note 10)</sup>
<b>Revenue</b>		<b>Budgeted Revenue</b>	<b>Revenue to Date</b>	<b>Comment</b>
<b>Revenue Generated</b>		£0	£32.87k	Revenue received from Scottish Enterprise and Training Courses <sup>(refer to Note 11)</sup>

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## 5) Progress Against Budget

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### Notes:

- 1) Budget-to-date is calculated as a pro-rata of the annual budget in the Full Submission Spreadsheet (to May 2019). The percentage below plan refers to spend-to-date as a percentage of the budget-to-date.
- 2) Project Spend as extracted from the finance system (Harmony) on 3 June 2019.
- 3) Current spend on project team/MTTE resource costs is lower than planned, however additional resources are being recruited; and the total spend is forecast to be within 5% of the total budget.
- 4) Spend is above plan since payment for the replicas was originally planned for 2019-20 (and budget is prorated across the whole year).
- 5) Travel and expenses spend is being kept to a minimum.
- 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 and Recruitment & Training is lower than the average spend profile assumed in the Full Submission Spreadsheet.
- 8) Annual running costs (both IT and non-IT) are currently below plan; however the total spend is forecast to be within 5% of the total budget.
- 9) There is no Project budget nor Project spend under the Cost Categories: Equipment, IPR Costs, Payments to Users, Contingency and Decommissioning.
- 10) Up to 31 May 2018 the project spent £7,004,540, since then the project has spent £1,895,042 (up to 31 May 2019); totalling spend of £8,899,582 (as detailed in the table above).
- 11) Revenue has been received from Scottish Enterprise as part of their support of Business Development for the Centre; and from training course participants.

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## 6) Bank Account

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

## 7) 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.	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.	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.	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.
9.5	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 establishment of the HVDC Operators' Forum (including holding the 1 <sup>st</sup> event), together with the publishing of the MTTE	Completed (SDRC met) The first HVDC Operators' Forum event was held on 8 October 2015, the second


## 7) SDRCs

SDRC	Due	Description	Evidence	Status
		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.	Websites.	on 27 April 2017. The website (hvdcentre.com) was launched in April 2015.
9.6	31/5/2017	<p><b>Commence Operation of the MTTE</b></p> <p>The criteria consolidates the:</p> <ul style="list-style-type: none"> <li>○ Completion of the building/upgrade of the MTTE facility;</li> <li>○ Commissioning of the IT/RTS infrastructure;</li> <li>○ MTTE Resourcing;</li> <li>○ Management structure in place;</li> <li>○ Processes and procedures agreed;</li> <li>○ Data sets of the AC network received (from NETSO); and</li> <li>○ Plan of studies and tests agreed.</li> </ul> <p>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.</p>	Commencement of MTTE Operations.	<b>Completed (SDRC met)</b> The facility was formally opened on 26 April 2017. The building, IT infrastructure, resourcing, governance, processes, data/models and work plan were all in place to enable operation to commence.
9.7	31/3/2018	<p><b>Publishing Studies &amp; Test results</b></p> <p>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.</p>	Publishing the first set of reports on a specific Transmission Licensee led Project, on the MTTE members' Website.	<b>Completed (SDRC met)</b> The first set of four reports was published on the Centre's Website on 30 March 2018.
9.8	31/3/2020	<p><b>Future Business Model</b></p> <p>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.</p>	Submission of proposal regarding MTTE ongoing operation and funding to Ofgem.	<b>On Target</b>
9.9	31/3/2021	<p><b>Second Replicas</b></p> <p>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.</p>	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)

 Emerging issue, remains on target

 SDRC completed late

 On target

 Unresolved issue, off target

 Not completed and late

## 8) Learning Outcomes

### Learning during this reporting period

During this reporting period, the HVDC Centre has produced a significant number of reports, held a number of dissemination events, and run a number of training courses to share the project learnings. These are categorised against the project's learning objectives below.

Learning Objective	Reports, Events & Training
<b>Support Transmission Planning of HVDC schemes</b>	<ul style="list-style-type: none"> <li>○ Published open-access enhanced converter models;</li> <li>○ Delivered a tutorial on the practical use of real-time simulation at the ACDC conference;</li> <li>○ Published report on "Risk Reduction using HVDC Replicas"; and</li> <li>○ Completed the Phase1 Shetland Fault Level Study for SHE Transmission.</li> </ul>
<b>Improve Requirement Specification of HVDC schemes</b>	<ul style="list-style-type: none"> <li>○ The HVDC Centre hosted a knowledge sharing event on the Caithness-Moray Project. Sharing the lessons learnt during the CM project with an external audience of over 30 participants.</li> </ul>
<b>Facilitate Multi-Terminal HVDC solutions</b>	Produced a report on the Compatibility of HVDC Converters Supplied by different Manufacturers.
<b>Facilitate Competition and Multi-Vendor HVDC schemes</b>	<ul style="list-style-type: none"> <li>○ Produced a report on the Compatibility of HVDC Converters Supplied by different Manufacturers.</li> </ul>
<b>De-risk Control interactions between co-located and electrically connected converters, and with other active controlled equipment</b>	<ul style="list-style-type: none"> <li>○ Successfully completed 'FST4' (grid integration testing) of the CM project Replicas against the network model developed of the AC Grid; and</li> <li>○ Supported the testing of the Emergency Power Control (EPC) functionality of the CM controls using the CM Replicas.</li> </ul>
<b>Train Transmission Planning and Operational Engineers</b>	<ul style="list-style-type: none"> <li>○ Ran a series of training courses for operators of the CM project (utilising the Replicas).</li> <li>○ Delivered two, 3-day RTDS training course.</li> </ul>
<b>Undertake Post commissioning scenario planning and operational optimisation</b>	No specific learning were published/shared this period.
<b>Model New HVDC Technologies</b>	<ul style="list-style-type: none"> <li>○ Produced a report on DC GIS (Gas Insulated Switchgear), for the PROMOTioN project; and</li> <li>○ Installed and tested the IED (Intelligent Electronic Device – HVDC Grid Protection device) from KTH (the Royal Institute of Technology in Stockholm) at the HVDC Centre.</li> </ul>

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## 9) IPR

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



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# 10) 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 steering group meetings, where mitigating actions are agreed.

## Risk Register

An extract of the current Project Risk Register is provided in Appendix III.

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# 11) 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 Centre Manager;
- Peer Reviewed ;
- Reviewed by the Centre Sponsor; and
- Approved by Regulation and Data Assurance representatives.

## 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.



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**Stewart A Reid**

Head of Future Networks  
Scottish and Southern Electricity Networks

*7<sup>th</sup> June 2019*

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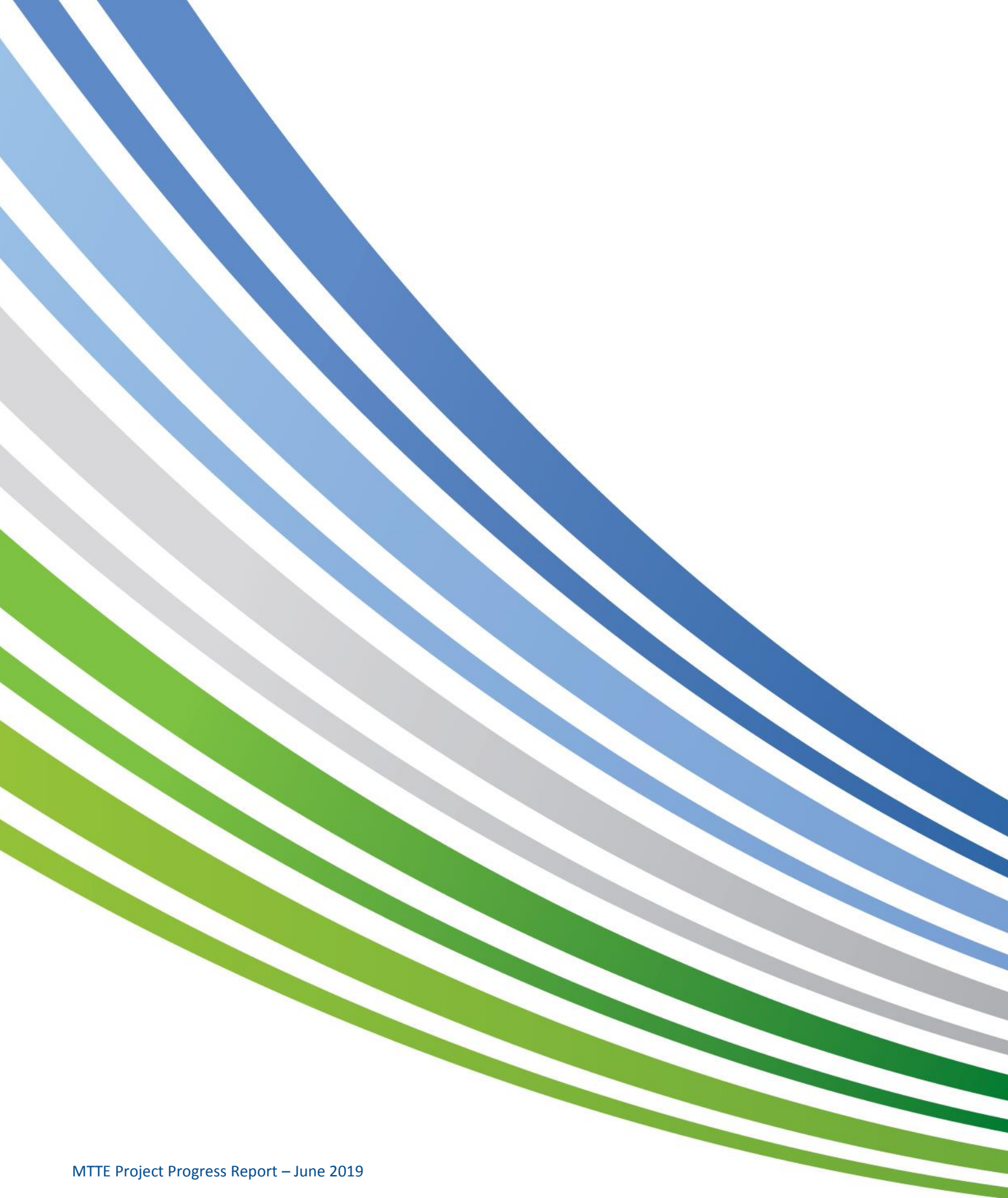
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## 12) Appendices

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<b>Appendix I</b>	Newsletters
<b>Appendix II</b>	Project Bank Account Statement
<b>Appendix III</b>	Project Risk Register



## MTTE Project Progress Report – June 2019

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