



Scottish & Southern
Electricity Networks

SHE Transmission

New Suite of Transmission Structures: SSEN003 NeSTS

Project Progress Report

June 2020



1) Executive Summary

Overview of NeSTS

Scottish Hydro Electric Transmission plc (SHE Transmission) is developing a New Suite of Transmission Structures (NeSTS), which are planned to be deployed on the Transmission Network.

Overhead lines (OHLs) built using transmission structures are the most visible element of the transmission network. The impact OHLs have on the environment can cause stakeholders concern.

The only available alternative to the steel lattice structures traditionally used in OHL construction is the T-Pylon. Developed by National Grid, the T-Pylon reduces the visual impact of OHLs but may be unsuited to areas with challenging terrain and propensity for severe weather events.

Establishing new infrastructure in these areas is essential to connect renewable generation, so there is a need for a new type of structure to address stakeholder concern.

The NeSTS project is developing innovative designs for OHL structures based on new technologies and techniques. The new suite of structures will then be deployed on the transmission network.

The NeSTS Project seeks to prove the following benefits:

- Improved OHL environmental performance by lowering visual and construction impacts; and
- Lower OHL whole life asset costs via reduced land, construction, maintenance and outage requirements.

Progress within this Reporting Period

During this reporting period, the Project has focused on:

- Placing a contract with a dedicated testing facility;
- Interfacing with the OHL construction project team and main contractor;
- Testing full scale structures;
- Developing new operational practices, tools, and equipment;
- Publishing a report on the outputs of type testing; and
- Commencing construction of the NeSTS OHL.

A NeSTS 132kV Single Circuit OHL is designed for construction as part of the Aberarder wind farm connection project.

SHE Transmission was instructed to delay its construction in April 2020, just before this was due to commence.

The Project team is interfacing extensively with the Aberarder wind farm connection project team and its stakeholders, and is continuing type approval and supply chain development work during this delay.

The Project intends to construct a permanent repair to the Loch Quoich landslip using NeSTS 132kV Double Circuit supports to keep outputting learning in the meantime.

The Project is interfacing with the Skye project team to ensure the repair is compatible with future potential use of the Quoich - Broadford circuit.

1) Executive Summary

SDRC

The Project completed the delivery of its fifth SDRC, 11.5 Type Testing Agreement, with evidence submitted on 30 September 2019.

The Project completed the delivery of its sixth SDRC, 11.6 Completion of Type Testing, with a report on the Outputs of Type Testing submitted on 28 May 2020.

The next SDRC is 11.7 Energisation of NeSTS Overhead Lines. Its delivery is being impacted by the delay to the Aberarder windfarm connection, and by COVID19 control measures.

Risks

The main risks to the project are:

- That access to sites and availability of resources are delayed or otherwise impacted by COVID19 control measures. The Project is utilising video conferencing, local representation, and supply from territories where COVID19 is well controlled to the extent possible to mitigate this risk;
- That there is a failure to identify a suitable site for first NeSTS application. This risk has realised due to developer delay of the Aberarder windfarm connection project. A permanent repair to the Quoich – Broadford OHL which was damaged by a landslip at Quoich is being designed to mitigate this risk;
- That a supplier business could fail during the programme. Second sources have and are being contracted to mitigate this risk; and
- That capacity for full scale testing of the NeSTS supports is not available to meet the programme. Procurement of testing capacity from second sources has commenced to mitigate this risk.

Events

Prototyping Workshop events were held in July and September 2019, where full scale NeSTS prototypes were accessed by operatives and engineers from SHE Transmission, Energyline and construction contractor teams.

A spigot foundation was constructed to demonstrate the technique.

The Project team explained the design choices made and discussed ideas for further improvements.

Video profiles of the events are published in the presentation made to the LCNI conference on 30 October 2019 on the Project website (www.NeSTSproject.com).

Communications

During this reporting period, Project information has been shared directly with stakeholders and published on the Project website.

Updates on design progress and learning were presented at the Low Carbon Networks and Innovation (LCNI) conference on 30 October 2019.

Dissemination of Project learning has continued with the publication of the Outputs of Type Testing report on 28 May 2020.

2) Project Manager's Report

Project Summary

A New Suite of Transmission Structures is expected to be used to construct an overhead line in 2020/2021.

The design of the structures has been driven by stakeholder requirements and their response to the results is positive.

The NeSTS design was used in a parallel design of an OHL to enable comparison with a conventional lattice steel design, and the results informed SHE Transmission's recommendation to proceed to construction of a NeSTS OHL in Stage 2 of the Project.

Ofgem approved this recommendation, and the Project has refined and tested the structures for construction as part of the Aberarder wind farm connection project, resulting in submission of its SDRC 11.6 Completion of Type Testing on 28 May 2020.

In July 2019 SHE Transmission received an instruction from National Grid Electricity System Operator Ltd (NGESO) to stop working on the Aberarder wind farm connection.

A subsequent modified connection application was agreed, and the Project advised Ofgem of a resulting non-material delay to the submission of NeSTS SDRC 11.7 Energisation of NeSTS Overhead Lines.

The Project also advised it was investigating the feasibility of permanently repairing the landslip damaged Quoich – Broadford OHL using NeSTS structures in order to continue the flow of learning in 2020, and design work commenced in December 2019.

In April 2020 SHE Transmission received a second instruction to stop working on the Aberarder wind farm connection. The implied delay to its construction now extends past the planned completion of the NeSTS Project.

The Project therefore intends to base SDRC 11.7 Energisation of NeSTS Overhead Lines on the repair of the Quoich – Broadford OHL where it was damaged by a landslip at Quoich.

The Project is managed via six work packages. An update on the progress made on each work package during this reporting period is provided below.

Project Management

The Project team and internal stakeholders are engaged and holding regular update meetings.

The Project Steering Group is engaged and holding bi-monthly meetings.

Consultee, supply chain, landowners, the public and transmission operator (TO) stakeholders are engaged and contributing to the Project.

The Project is now interfacing with the Aberarder wind farm project and its prospective main contractors.

During this period, contracts have been awarded for the supply of:

- OHL Support Design Optimisation;
- Full Scale test structure design;
- Full Scale testing; and
- OHL Design.

The Project is currently in the 'Refinement' stage.

Prototyping and Initial Testing

This work package is complete.

Prototype structures were installed at SHE Transmission premises in Fanellan and at Energyline premises in Copgrove in 2018.

A video summary of a prototype workshop held at Copgrove is available on the Project website (www.NeSTSproject.com).

2) Project Manager's Report

Parallel Design Process

This work package is complete.

Parallel designs of a proposed OHL were completed by a main contractor to enable comparison of NeSTS based design outputs with those of a conventional lattice steel L7c design.

3D visualisations allowing comparison of the NeSTS and L7c options are published on the Project website.

A design adoption work package was also completed, detailing the main contractor's scrutiny and endorsement of the NeSTS designs.

SHE Transmission used these to inform its recommendation to proceed to construct a NeSTS OHL.

Full Scale Testing

This original scope of this work package is complete.

Test specifications have been developed and used to order the design of full scale structures and testing of the NeSTS 132kV Single Circuit suite.

A full scale cross arm and pole section were tested in July 2018 at a structure manufacturer's premises. The resulting design refinements have been embodied into the design of NeSTS structures.

Following subsequent design refinement, the Project's lead supplier of steel structures (and testing services) entered an insolvency process, and alternative supplies were engaged.

To mitigate against any further supply failure, and to provide competitive supply of NeSTS structures, the Project has engaged the supply of test structures and testing services from several suppliers.

Manufacture and testing of NeSTS structures from one manufacturer is complete, and underway with two other suppliers.

Testing of NeSTS 132kV Double Circuit structures is now required to enable the construction of the repair to the Quoich – Broadford OHL.

Planning, Construction and Monitoring Processes

3D modelling of NeSTS structures in OHL has enabled consultation with affected communities, landowners, and consultee stakeholders on multiple projects.

Following design refinement based on full scale prototyping and cross arm testing in 2018, two further prototyping exercises were completed in 2019 involving teams from SHE Transmission, main construction contractors, and another TO.

These have enabled the development of new operational practices and tools to suit the NeSTS designs.

Knowledge Dissemination

The Project website is live and is disseminating design information and updates on progress.

Project information has been shared directly with OHL engineers at GB TOs and with the TO / System Operator (SO) Collaboration Group during this reporting period.

NeSTS OHL design information was disseminated at the LCNI conference on 30 October 2019 and is available on the Project website.

The NeSTS 132kV Preliminary Technical Specification has been reviewed by the ENAs technical authors, and validated by full scale testing. It will be presented for review by the Overhead Line Panel at the ENA in Autumn 2020.

2) Project Manager's Report

SDRC

The Project completed the delivery of its fifth SDRC, 11.5 Type Testing Agreement, with evidence submitted on 30 September 2019.

The Project completed the delivery of its sixth SDRC, 11.6 Completion of Type Testing, with a report on the Outputs of Type Testing submitted on 28 May 2020. Its submission was delayed by late delivery of test structures and in conducting testing while complying with COVID19 control measures in the UK and Denmark.

The next SDRC is 11.7 Energisation of NeSTS Overhead Lines. Its delivery is being impacted by the delay to the Aberarder windfarm connection, and by COVID19 control measures.

3) Business Case Update

The Business Case for the NeSTS Project was updated to inform the Decision Point / Review of Business Case stage gate. It was submitted on 28 September 2018 and is published on the Project website (www.NeSTSproject.com).

4) Progress Against Plan

Summary of Progress

The Project has made good progress over the last 12 months and is progressing within budget. Two SDRC were delivered during the period and the Project is preparing to construct a NeSTS trial OHL.

Delays to the Aberarder wind farm project have necessitated the design of an alternative NeSTS OHL to enable scheduling the submission of SDRC 11.7 to avoid a material delay.

The imposition of COVID19 control measures in all jurisdictions working on the Project has delayed all Project workstreams. These are posing new risks to delivery which have been documented in the Project risk register.

The Project remains on schedule to deliver its remaining SDRC without material delay based on the design of a repair to the Quoich – Broadford OHL where it has been damaged by a landslip at Quoich.

Learning has been published and shared directly with stakeholders and on the Project website.

Focus This Reporting Period

The focus over this reporting period has been on:

- Placing a contract with a dedicated testing facility;
- Interfacing with the OHL construction project team and main contractor;
- Testing full scale structures;
- Developing new operational practices, tools, and equipment;
- Publishing a report on the outputs of type testing; and
- Commencing construction of the NeSTS OHL (halted following instruction from NGDSO April 2020)

Key Activities in Next Reporting Period

The Key Activities between 8 June 2020 and 4 June 2021 planned are:

- Designing a permanent repair to the Quoich – Broadford OHL at the Quoich landslip;
- Testing 132kV double circuit full scale NeSTS structures; and
- Interfacing with the OHL construction project team and main contractor;
- Commencing construction of the NeSTS OHL.

5) 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	£1,645.49k	£746.91k	On plan
Equipment			
Prototyping, testing, and modelling	£258.56k	£280.32k	See note 2.
Contractors			
Project team resource costs	£5,344.34k	£3,123.57k	On plan
IT			
IT Infrastructure	£204.79k	£578.09k	See note 3.
Travel & Expenses			
Travel & Expenses	£47.44k	£48.75k	On plan.
Total	£7,500.62k	£4,777.63k¹	

Notes:

1. Up to 30 March 2020 the project spent £4,692,673 (which has been processed through the Project Bank Account, see Appendix 1 for details). From 30 March – 30 April 20 the project spent £84,960 which has yet to be processed through the Project Bank Account, so the total Project spend to 30 April 2019 is £4,777,633 (as detailed in the table above).
2. The Project is conducting more prototyping, testing and modelling than originally planned. This will not affect the total budget.
3. The Project has produced more virtual design tools than originally planned. This will not affect the total budget.

6) Bank Account

A copy of the current project bank account statement is provided in Appendix 1.

7) SDRC

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

The NeSTS Project identified eight Successful Delivery Reward Criteria (SDRC) which span both the objectives and the lifecycle of the project.

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

7) SDRC







SDRC	Due	Description	Evidence	Status
11.1	30/9/2016	<p>NeSTS Design Selection</p> <p>The completion of the development of the Support Assessment Matrix. This will be offered to TOs to compare different types of overhead line supports in a technically balanced manner, incorporating the electrical, mechanical, environmental and construction and operational factors of overhead lines design.</p> <p>Selection of the final support designs.</p>	<p>Publish the initial outputs of the Support Assessment Matrix. An accompanying report will provide the technical details of the selected designs by 30 September 2016.</p>	<p>Completed (SDRC met)</p> <p>A report on NeSTS Design Selection and the completed Support Assessment Matrix were published on 30 September 2016.</p>
11.2	30/09/2017	<p>Output of Stakeholder Engagement</p> <p>Implement a programme of stakeholder engagement, supported by a suitable project supplier. This will include organised events and one to one interviews. Quantitative and qualitative analysis will be provided to understand key priorities. SHE Transmission will factor these viewpoints into the functional specification for NeSTS where practical.</p>	<p>Report to the Authority with an assessment on the need for a Customer Engagement Plan and/or data protection strategy by 30 June 2016.</p> <p>Publish a report describing the outputs from stakeholder engagement and demonstrate where these outputs have influenced the NeSTS designs by 30 September 2017.</p>	<p>Completed (SDRC met)</p> <p>An assessment that a Customer Engagement Plan was not required was submitted on 3 May 2016. The Authority agreed with this assessment on 5 July 2016.</p> <p>A report on Outputs of Stakeholder Engagement was published on 28 September 2017.</p>
11.3	30/8/2018	<p>Creation of Technical Specification</p> <p>The NeSTS overhead lines circuit will be designed in parallel with a traditional overhead lines support design - this is to create contingency in the event that NeSTS is not approved for demonstration at the stage gate process. The new technical specification for the supports will show how NeSTS design can be practically applied on a project, and is a key learning output for TOs and the supply chain. This will inform the procurement exercises for the initial deployment.</p>	<p>Publish a report on the outputs of the technical specifications of the NeSTS design stage by 30 August 2018.</p>	<p>Completed (SDRC met)</p> <p>A report on Creation of Technical Specification was published on 30 August 2018.</p>

7) SDRC

SDRC	Due	Description	Evidence	Status
11.4	31/12/2018	<p>Decision Point / Review of business case</p> <p>Review the NeSTS business case to conclude whether or not the Project should continue to Phase 2. The learning gathered at this point will be assessed to ensure that NeSTS still has a positive business case - impacts of any energy policy developments regarding renewable generation and the results of stakeholder engagement will be considered as part of the decision process.</p> <p>It will involve SHE Transmission's Director of Transmission and the SHE Transmission Steering Board.</p>	<p>Submit an update to Section 3 and Appendix 6, the business case of the Full Submission, to the Authority evaluating the project and recommending whether or not to proceed to Phase 2 by 31 December 2018.</p>	<p>Completed (SDRC met)</p> <p>A report on NeSTS Stage Gate – Decision to Proceed containing updates to Section 3 and Appendix 6 of the NIC Full Submission was submitted on 28 September 2018.</p> <p>The Authority approved the decision to proceed on 20 December 2018.</p>
11.5	30/09/2019	<p>Type Testing Agreement</p> <p>Within the first stage of Phase 2 (the demonstration part of the project), the detailed designs will enable the construction of a NeSTS overhead lines support structure, which will be tested at a dedicated testing facility.</p> <p>This is crucial in ensuring the design is supply chain ready and acceptable to other TOs.</p>	<p>A signed agreement with a dedicated testing facility by 30 September 2019.</p>	<p>Completed (SDRC met)</p> <p>A signed agreement with a dedicated testing facility was submitted on 30 September 2019.</p>
11.6	20/02/2020	<p>Completion of Type Testing</p> <p>The overhead lines support will be put through a series of tests in order to ensure that it complies with the relevant standards and specifications including BS EN 60652 and BS EN 61773.</p> <p>The completed test results will provide clear analysis regarding NeSTS's capabilities.</p>	<p>Publish a report on the outputs of the type testing conclusions by 20 February 2020.</p>	<p>Completed (SDRC met)</p> <p>A report on the outputs of the type testing conclusions was submitted on 28 May 2020.</p>
11.7	29/01/2021	<p>Energisation of NeSTS Overhead Lines</p> <p>The energisation of the NeSTS overhead lines circuit is the culmination of the construction and commissioning of a section of the project is a key milestone.</p>	<p>Publish a full report detailing outputs and knowledge capture including an evaluation comparing NeSTS construction, commissioning and energisation with that of a typical steel lattice tower project by 29 January 2021.</p>	<p>On Target</p> <p>Delay to the Aberarder wind farm connection project has necessitated the design of an alternative NeSTS trial OHL to repair the Quoich-Broadford OHL where is was damaged by landslip at Quoich.</p>

7) SDRC

SDRC	Due	Description	Evidence	Status
11.8	31/03/2022	<p>Publication of e-learning and visualisation tools and project closedown report</p> <p>Knowledge capture and dissemination is of high importance to the project and the acceleration of NeSTS into TOs' business as usual activities. SHE Transmission will develop an e-learning module to assist with training and familiarisation activities amongst TOs and the supply chain.</p> <p>A visualisation tool will also be created to assist TOs with network planning, and to share learning with stakeholders.</p> <p>At the end of the project, full evaluation and key learning points will be considered for inclusion in a comprehensive project closedown process. This will include learning gathered from knowledge events and the progress of the MASC substation during operation.</p>	<p>Complete development of both tools and share with TOs and deliver detailed closedown report to Ofgem by 31 March 2022.</p>	On Target

	Completed (SDRC met)		Emerging issue, remains on target		SDRC completed with material delay
	On target		Unresolved issue, material delay likely		Not completed and late

8) Learning Outcomes

The following learning objectives have been set for the NeSTS project:

- **Develop a proven series of NeSTS design specifications:** The NeSTS project will further develop outputs from the NIA project and demonstrate these on the live transmission network. This will allow us to create the project's key output – a set of design specifications which can be shared with licensees and the supply chain. The specifications will take into account NeSTS's electrical, mechanical and civil engineering requirements.
- **Inform policy and procedure:** Each stage of the project will inform new policies and procedures for construction, operation, maintenance and safety. The development of these documents is fundamental to the successful adoption of NeSTS by other licensees.
- **Create future usage options:** NeSTS will be deployed and assessed against a range of terrain and climate scenarios that are representative of conditions found across GB. We will also implement a programme of prototype and component testing to measure NeSTS against severe weather events. This allows licensees and the supply chain to understand the conditions in which NeSTS is optimally suited, and creates confidence in the new designs.
- **Evaluate acceptance of alternative OHL supports by the consent and stakeholder processes:** During the project's first phase, a comprehensive stakeholder consultation will include discussion with licensees, landowners, statutory authorities and the supply chain. This allows us to understand and accommodate key priorities into the design where practical. Subsequent planning and consent for the planned OHL project will be evaluated to see the benefits of using NeSTS in comparison to conventional OHL methodology, and outputs from

this learning objective will be shared with all stakeholders.

- **Develop and validate Support Assessment Matrix:**
The Support Assessment Matrix (SAM) was developed through the NIA NeSTS project to evaluate and compare a series of OHL support designs against a set of Main Design Aspects (MDAs). The SAM will be developed further and validated by NeSTS to produce a highly useful matrix available to the supply chain and to licensees. This creates a centralised vehicle to evaluate and facilitate future OHL support innovations.
- **Create a transmission infrastructure working group:**
The NeSTS project will form a working group to create and share best working practices for OHL supports, similar to the Energy Storage Operators' Forum. The OHL working group will review and share best practice worldwide to facilitate further improvements in OHL methodology.

These learning objectives will be met as the NeSTS Project progresses into the design phase through to installation and final operation.

8) Learning Outcomes

Learning during this reporting period

Develop a proven series of NeSTS design specifications

The Preliminary Technical Specification for NeSTS 132kV Double Circuit Medium Duty (DCMD) was published on 30 August 2018.

It has been used as the basis for the Preliminary Technical Specification for NeSTS 132kV Single Circuit (SC) which has been used to design the NeSTS OHL as part of the Aberarder wind farm connection project.

A corresponding Preliminary Test Specification for NeSTS 132kV SC has been developed and used to specify a programme of type testing.

The testing has been completed successfully and validates the NeSTS 132kV SC design.

Inform policy and procedure

Design refinements have been made in response to the prototyping reported in previous periods.

Further full scale prototyping was completed in 2019 and has validated the performance of NeSTS 132kV designs for construction and maintenance.

Create future usage options

A 132kV DCMD suite of supports was designed and used to inform the Decision point/review of business case.

A 132kV SC suite for use at high altitude has been designed for construction of the Aberarder wind farm connection project.

Refinements from the 132kV SC design process have been embodied in the 132kV Double Circuit design which is intended for use in construction of a permanent repair to the Quoich – Broadford OHL and be the NeSTS trial OHL.

Refinements from the 132kV DC work will be embodied in the 275kV DC designs following the construction of the NeSTS OHL.

Evaluate acceptance of alternative OHL supports by the consent and stakeholder processes

The Local Planning Authority and Section 37 applications for the Aberarder OHL were placed on hold in May 2020.

Stakeholder assessment of the NeSTS trial OHL will be reported following its construction.

Develop and validate Support Assessment Matrix

The completed Support Assessment Matrix was delivered as part of the first SDRC and is published on the Project website.

Create a transmission infrastructure working group

Learning from the OHL design process and supply chain engagement activities is being shared with GB TOs, and the TO/SO Collaboration Group.

The NeSTS 132kV Preliminary Technical Specification has been reviewed by the ENA's technical authors and, following its validation by type testing, will now be presented for review by the Overhead Line Panel at the ENA to prepare for its publication in the 43 series of national overhead line specifications.

9) IPR

No relevant IPR has been generated or registered during this reporting period, and none is forecast to be generated or registered in the next reporting period.

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

Risk Register

The current Project Risk Register is provided in Appendix 2.

11) 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 NeSTS 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 DSO & Innovation

Scottish and Southern Electricity Networks

3/6/2020

Date

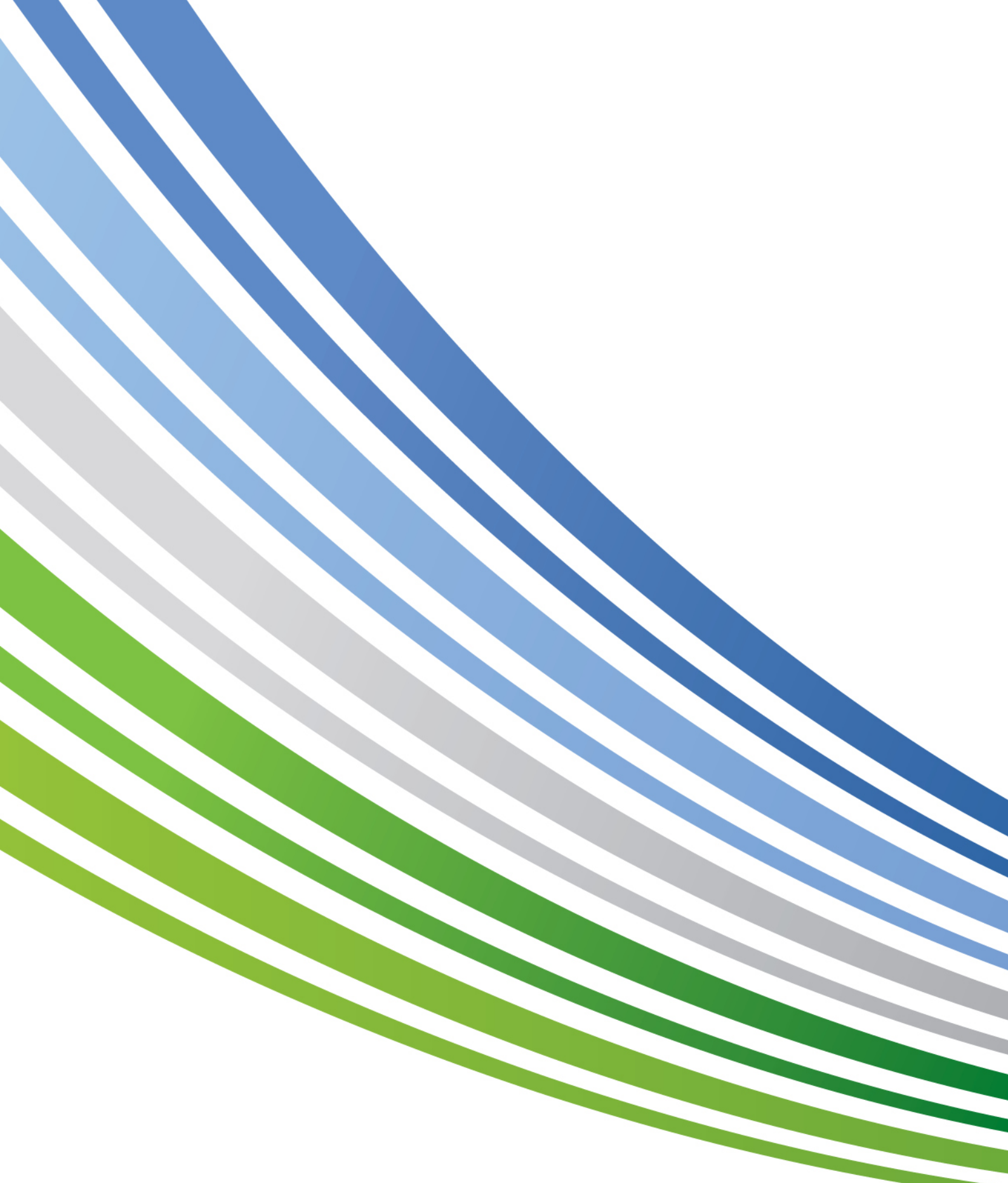
12) Appendices

Appendix 1

Project Bank Account Statement

Appendix 2

Risk Register



SSEN003 NeSTS Project Progress Report June 2020 Rev 1.0

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