



Scottish & Southern
Electricity Networks

SHE Transmission

New Suite of Transmission Structures: SSEN003 NeSTS

Project Progress Report

June 2022



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 Electricity Transmission, 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 has developed innovative designs for OHL structures based on new technologies and techniques and driven by stakeholder engagement, and these have been 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:

- Completing construction and energisation of the NeSTS trial OHL.

The Project has constructed and energised a trial OHL using the NeSTS 132kV Double Circuit suite of structures to repair the Quoich - Broadford OHL at Loch Quoich where it was damaged by landslide.

The trial OHL was energised in October 2021 and has operated satisfactorily to date.

Survey and monitoring of the trial OHL have confirmed it has sustained its as-built condition.

Assessment of stakeholder response to the trial OHL has been delayed pending completion of the Dalchork – Loch Buidhe OHL which will be used as a lattice steel comparison. This work is scheduled to be completed in 2022 to enable the Project to report its closedown without material delay.

SDRC

The Project submitted its SDRC 11.7 Energisation of NeSTS Overhead Lines on 28 January 2022.

The Project intends to submit its final SDRC—11.8 Publication of e-learning and visualisation tools and project closedown report—in 2023, without a material delay.

1) Executive Summary

Risks

The main risks to the project are:

- That the NeSTS solution is not readily accepted by statutory consultees; and
- That there may be difficulty driving NeSTS into BAU if savings and environmental benefits are not optimised.

The Project has designed NeSTS in response to stakeholder input and has measured stakeholder response to the designs before construction to mitigate these risks.

Events

The Project has been unable to conduct any in-person events due to COVID19 control measures in this reporting period.

Communications

During this reporting period, Project information has been shared directly with stakeholders and published on the Project website (www.NeSTSproject.com).

Updates on design progress and learning were presented at the Energy Networks Innovation Conference ENIC in October 2021.

2) Project Manager's Report

Project Summary

The Project has constructed and energised a trial OHL using the NeSTS 132kV Double Circuit suite of structures to repair the Quoich - Broadford OHL at Loch Quoich where it was damaged by landslide.

This required repeating the design and validation work the Project had already completed for the NeSTS 132kV Single Circuit suite for deployment on the Aberarder windfarm connection OHL project which has been delayed by the developer.

It also involved a change in scope, as it necessitated the Project procuring and managing the trial OHL construction.

The trial OHL will provide the basis for stakeholder assessment of the NeSTS designs in the real environment and subsequently the Project's final SDRC, 11.8 Publication of e-learning and visualisation tools and project closedown report.

The design of the structures has been driven by stakeholder requirements and their response to the results pre-construction has been positive. This interaction has been reported in SDRC 11.1 Design Selection and 11.2 Outputs of Stakeholder Engagement.

These requirements were embodied in technical specifications which have been reported in SDRC 11.3 Creation of Technical Specifications.

The resulting NeSTS structures were 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 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 April 2020 SHE Transmission received an instruction from National Grid Electricity System Operator Ltd (NGESO) to stop working on the Aberarder wind farm connection. The subsequent modified connection

application will delay its construction well past the planned completion of the NeSTS Project.

The Project and Ofgem agreed that an alternative trial OHL would be based on the use of NeSTS to permanently repair the landslip damaged Quoich – Broadford OHL, enabling the Project to proceed without material delay.

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 has procured and is now managing the construction of an OHL adjacent to the Quoich Dam and is interfacing with the Aberarder wind farm project and its prospective main contractors.

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

- OHL construction; and
- OHL design, survey, and site investigation services.

The Project is currently in the 'Execution' stage.

2) Project Manager's Report

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.

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.

Video summaries of the prototype work are available on the Project website (www.NeSTSproject.com).

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 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 and Double Circuit suites.

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.

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

Manufacture and full scale testing of the NeSTS Single Circuit structures for the Aberarder OHL from two manufacturers was completed successfully in 2020.

One of these was selected to manufacture and test the NeSTS DC structures required for the Quoich repair OHL.

This work was successfully completed in early 2021 and video summary of it was presented at the ENIC Conference in October 2021 and published on the Project website.

2) Project Manager's Report

Planning, Construction and Monitoring Processes

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

The Project has constructed and energised a trial OHL using the NeSTS 132kV Double Circuit suite of structures to repair the Quoich - Broadford OHL at Loch Quoich where it was damaged by landslide.

Survey and monitoring of the trial OHL have confirmed it has sustained its as-built condition.

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 during this reporting period.

NeSTS OHL design information was disseminated at the ENIC conference in October 2021 and is available on the Project website.

The NeSTS SC 132kV Preliminary Technical Specification has been reviewed by the ENAs technical authors. The NeSTS DC Preliminary Technical Specification is currently being written and will be presented for review by the Overhead Line Panel at the ENA in 2022.

The assessment of NeSTS' environmental performance by stakeholders is scheduled in 2022 and will be a key Project output.

SDRC

The Project completed the delivery of its seventh SDRC, 11.7 Energisation of NeSTS Overhead Lines on 28 January 2022.

The next SDRC is 11.8 Publication of e-learning and visualisation tools and project closedown report. Its delivery is being impacted by the construction of the Dalchork – Loch Buidhe OHL which will be used as the lattice steel comparator for stakeholder assessment of the NeSTS designs.

It is currently scheduled to be delivered in 2023 without material delay.

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.

The Project has constructed and energised a NeSTS trial OHL, repairing the QB1 OHL where it was damaged by landslide.

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

The culmination of the Project is approaching, where stakeholders will assess the trial OHL in comparison to a newly constructed lattice steel equivalent OHL to assess to what extent NeSTS has delivered improved environmental performance by lowering visual and construction impacts.

The extent to which Lower OHL whole life asset costs via reduced land, construction, maintenance and outage requirements can be realised will be estimated in the Project's final SDRC 11.8 Publication of e-learning and visualisation tools and project closedown report.

The imposition of COVID19 control measures in all jurisdictions working on the Project delayed all Project workstreams. The likelihood of further impact has been reduced in the risk register to account for the current situation.

The Project remains on schedule to deliver its remaining SDRC without material delay.

Focus This Reporting Period

The focus over this reporting period has been on:

- Completing the construction of the NeSTS OHL.

Key Activities in Next Reporting Period

The Key Activities between 6 June 2022 and 2 June 2023 planned are:

- Submission of technical specifications to the OHL Panel at the ENA;
- Publication of e-learning and visualisation tools; and
- Publication of project closedown report.

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	£1,003.99k	
Equipment			
Prototyping, testing, and modelling	£258.56k	£389.36k	See note 2.
Contractors			
Project team resource costs	£5,344.34k	£5,364.21k	
IT			
IT Infrastructure	£204.79k	£616.92k	See note 3.
Travel & Expenses			
Travel & Expenses	£47.44k	£53.63k	
Total	£7,500.62k	£7,428.11k¹	

Notes:

1. Up to 31 May 2022 the project spent £7,428,112 (which has been processed through the Project Bank Account, see Appendix 1 for details).
2. The Project has conducted more prototyping, testing and modelling than originally planned. This will not affect the total budget.
3. The Project is producing 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. Its delivery was delayed by COVID19 control measures and discussed with Ofgem.</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>Completed (SDRC met)</p> <p>A report detailing outputs and knowledge capture including an evaluation comparing NeSTS construction, commissioning and energisation with that of a typical steel lattice tower project was submitted on 28 January 2022. It was delayed by a change in site agreed with Ofgem.</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 NeSTS OHL during operation.</p>	Complete development of both tools and share with TOs and deliver detailed closedown report to Ofgem by 31 March 2022.	<p>On Target</p> <p>Stakeholder assessment of the trial OHL has been delayed to allow comparison with the Dalchork – Loch Buidhe line in construction.</p>

 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 was used as the basis for the Preliminary Technical Specification for NeSTS 132kV Single Circuit (SC) and to design the NeSTS OHL as part of the Aberarder wind farm connection project. This specification has been reviewed by technical authors at the ENA.

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

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

Following the delay to the Aberarder project, and the decision to construct an alternative NeSTS OHL to repair the QB1 OHL where it was damaged by landslide, the development of the NeSTS 132kV Double Circuit (DC) design has been prioritised.

Learning from the Aberarder OHL design process has resulted in a change of structure variant designation and design in the DC specification—the deviation degrees bases used previously has been replaced by strength bases. This aims to produce a more efficient OHL design process where structure utilisation can be better matched to loads, and designers can utilise a wider range of spans.

There are 4 strength variants of suspension structures and 5 strength variants of tension structures specified in the DC suite.

The DC specification will be reviewed by ENA technical authors and presented for review by the ENA OHL panel by the end of 2022.

Following discussion of this learning with ENA technical authors, the same change of bases will be made to the SC specification before it is presented to the OHL panel for review.

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.

A Construction and Maintenance Manual for NeSTS structures will be published in 2022, following any refinement informed by construction of the NeSTS OHL.

Create future usage options

A 132kV DC suite of supports was designed and used to inform the Decision point/review of business case. It is currently being revised as discussed in this document, and its technical specifications will be published in 2022.

A 132kV SC suite for use at high altitude has been designed for construction of the Aberarder wind farm connection project. It will also be revised as discussed in this document, and its technical specifications will be published in 2022.

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

The Local Planning Authority and Section 37 applications for permission to construct the Aberarder OHL have been granted.

Stakeholder assessment of the NeSTS trial OHL will be reported following its assessment by stakeholders in comparison with an equivalent steel lattice OHL as part of the Project's final SDRC.

8) Learning Outcomes

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, the TO/SO Collaboration Group, and the RICA project (managed by NGET).

The NeSTS 132kV Preliminary Technical Specifications are being reviewed by the ENA's technical authors and will be presented for review by the Overhead Line Panel at the ENA to prepare for publication in the 43 series of national overhead line specifications.

Review of the Project's SDRC in preparation for closedown will be conducted by another of the GB TOs.

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.



1/6/22

Stewart A Reid

Head of DSO & Innovation
Scottish and Southern Electricity Networks

Date

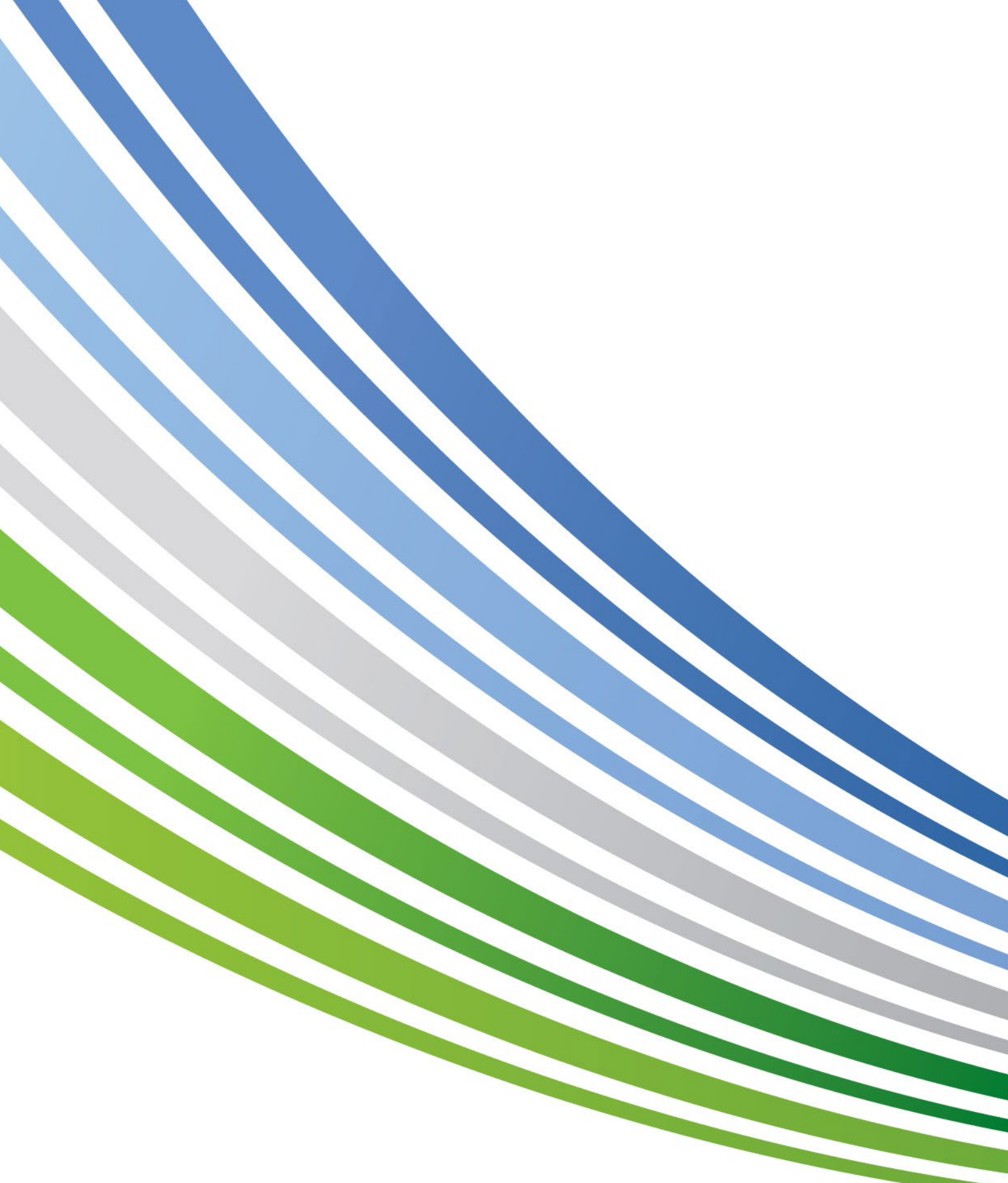
12) Appendices

Appendix 1

Project Bank Account Statement

Appendix 2

Risk Register



SSEN003 NeSTS Project Progress Report June 2022 Rev 1.0

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