QUEST
An overarching control system

electricity north west
Bringing energy to your door

QUEST Project Process Report 1

Issue: V0.1

Submission Date: 9th December 2021

Project Partners

nationalgridESO FUNDAMENTALS Schneider Electric

smarter grid solutions IMPACT FROM INSIGHT TO INFLUENCE

VERSION HISTORY

Version	Date	Author	Status	Comments
V0.1	15/11/21	Maurice Lynch QUEST Programme Manager	First Draft	
V0.2	01/12/21	Maurice Lynch QUEST Programme Manager	Second Draft	Update from internal review
1	09/12/21	Maurice Lynch QUEST Programme Manager	Final	Update with final figures and graphics

REVIEW

Name	Role	Date
Elizabeth Pattison	Discretionary Funding Manager	

APPROVAL

Name	Role	Signature & date
Dan Randles	Head of Network Innovation	Daniel Randles Digitally signed by Daniel Randles Date: 2021.12.09 16:39:59 Z
Maurice Lynch	QUEST Programme Manager	Maurice Lynch Digitally signed by Maurice Lynch Date: 2021.12.09 16:28:41 Z

CONTENTS

1 EXECUTIVE SUMMARY 4

1.1 The Project 4

1.2 Project progress 4

1.3 Risks 5

1.4 Learning and dissemination 6

2 PROJECT MANAGER'S REPORT 7

2.1 Project background 7

2.2 Project Partners 7

2.3 General 9

2.4 QUEST Initial Report - Use Cases, and QUEST System Design and Architecture Lessons Learned 10

2.5 Customer workstream 11

2.6 Learning and dissemination workstream 12

2.7 Project trial and test area 12

3 BUSINESS CASE UPDATE 13

4 PROGRESS AGAINST PLAN 13

5 PROGRESS AGAINST BUDGET 14

6 BANK ACCOUNT 15

7 PROJECT DELIVERABLES 15

8 LEARNING OUTCOMES 17

9 INTELLECTUAL PROPERTY RIGHTS (IPR) 17

10 RISK MANAGEMENT 17

11 CONSISTENCY WITH FULL SUBMISSION 18

12 ACCURACY ASSURANCE STATEMENT 18

13 APPENDICES 19

Appendix A: Status of risks from the full submission 19

Appendix B: Project deliverables 24

Appendix C: Project direction budget 26

Appendix D: Detailed project expenditure 28

Appendix E: Project bank account 29

Appendix F: QUEST communications register 30

Appendix G: Glossary of terms 33

Appendix H: Whitegate GSP Geographical Network Area 34

1 EXECUTIVE SUMMARY

1.1 The Project

For the purposes of this report, “the project” refers to the Network Innovation Competition (NIC) funded project, “QUEST” refers to the overarching system, and the “optimisation software” refers to the software used to enable QUEST.

The project officially started in April 2021 and is due to finish in April 2025. It will identify and trial novel methods to holistically integrate multiple, concurrent system voltage control and optimisation techniques across the whole distribution system. The method will be integrated into the NMS (Network Management System), thus providing the full co-ordination needed to unlock the available benefits.

In addition, the new holistic voltage control methodology will:

- Ensure the network operates as efficiently as possible, optimising the system voltage to connected customers and minimising losses.
- Further boost the benefits available from existing voltage management techniques.
- Facilitate the increased connection and use of LCTs.
- Maximise benefits to all customers through demand reduction at High Voltage (HV) and Low Voltage (LV).

By providing a means of command arbitration, the optimisation software will ensure that potential clashes are avoided, and overall benefits are maximised through co-ordination of previously discrete techniques. Furthermore, the project will provide a solid foundation upon which issues associated with conflict resolution, i.e. independent activation of Distributed Energy Resources (DERs), can be addressed.

The project will explore the co-ordinated operation of voltage management techniques to enable a reduction of the built-in operating margins, creating capacity for our customers. The project will also develop and introduce a distribution network-wide, fully co-ordinated, overarching system to manage voltages, with an appropriate balance between centralised and decentralised control hierarchy.

1.2 Project progress

This is the first annual project progress report (PPR). This report covers the period from 9 December 2020 to 9 December 2021.

The project is currently on track to meet its aims, objectives, and all deliverables (outlined within the full submission), as per the project plan. One of the main challenges within the early stages of the project were the strict travel restrictions due to the pandemic, which meant all meetings and project discussions were held virtually until October 2021. Despite this challenge, the project was still able to deliver all planned key project milestones.

The key project milestones delivered during this reporting period are outlined in Figure 1.2.1, below:

Figure 1.2.1: Project milestones delivered in this reporting period

Date	Milestone
February 2021	Mobilisation of project team
March 2021	QUEST partner agreements have been finalised
March 2021	Creation of QUEST website

April 2021	Project kick off workshop held involving partners and stakeholders
May 2021	QUEST trial and test site selection completed
July 2021	Completion of the first project deliverable “QUEST Initial Report - Use Cases”
September 2021	Procurement in place for the OLTCs and AVC equipment for the tests and trials
October 2021	Awarding of voltage demand relationship study research works
October 2021	Dissemination of the QUEST project at ISG and ENIC 2021

There was one deliverable due in this reporting period (“QUEST Initial report - Use Cases”). This report details the use cases and scenarios for QUEST and was successfully submitted to Ofgem on 31 July 2021 and published on Electricity North West’s (ENWL’s) QUEST project website. The project subsequently moved on to the next project deliverable, “QUEST System Design and Architecture Lessons Learned”, which will document project progress, include a review of the architecture options and provide a specification for the network models and modelling regime, and is due for submission on 31 December 2021. This project deliverable is on track and due to be submitted in line with the project plan.

The project actual costs to date (end-Nov) are £618,592 and the estimated at completion costs is now £9,095,968 which is to project budget (including contingency).

1.3 Risks

ENWL employs recognised, tested and audited risk management systems and processes as part of its day-to-day operations. The project will benefit from this approach, which will be further refined to fully accommodate the requirements of QUEST and to incorporate learning from previous experience in the delivery of NIC projects. This approach considers risks and issues that are business as usual (BAU) and those specifically related to the project, all of which will be articulated in a common format.

Risks identified and outlined in the full submission have been initially reviewed by the delivery team alongside additional risks identified as the project has progressed. Over the last 12 months, two additional risks have been added to the risk log – these relate to cyber security and the increased cost of plant materials due to the current shortage of supplies as a result of COVID. It is also worth noting that all the risks identified within the bid, and the scores applied to them, have not changed over the course of this reporting period.

Cyber Security: During development of the architecture options it was identified that the integration of the decentralized ANM within QUEST may have complexities, as this will be an external program feeding into QUEST that sits within ENWL’s NMS. At present this risk is thought to be low, as the ENWL architecture design authority is working with the decentralized ANM supplier to ensure there are no issues when this system is integrated with the optimisation software.

Increased Plant Materials: During the pandemic, material costs within all industries increased by around 20%. This, of course, had an impact on procurement of the OLTCs and AVC equipment for the project tests and trials. As there were ten OLTCs budgeted for within the bid, and only seven needed within the trial area, this means the budget for the OLTCs should not need to use its contingency.

It is anticipated that additional risks will be identified and mitigated over the next six months as the project starts to define and develop the architecture for the optimisation software. Risks are monitored on a continuous basis, including the potential risks that were documented in the full submission. The status of these is outlined in Appendix A.

1.4 Learning and dissemination

The project team will utilise a range of tools to disseminate knowledge and learning with stakeholders throughout the project lifecycle. At this stage of the project there is one learning outcome to report.

Early engagement with project partners Schneider Electric, Smarter Grid Solutions, Fundamentals, Impact Research and National Grid ESO has proved crucial for learning development and understanding.

ENWL announced the funding decision for QUEST and promoted the project internally via our weekly bulletin, “Connect”, and externally via a press release published on our website in December 2020. Project progress so far was also presented and discussed with the wider industry at the virtual Energy Networks Innovation Conference (ENIC) in 2021.

As outlined within the bid submission, an ISG (Industry Steering Group) has been set up to provide targeted stakeholder engagement. ISG sessions will take place quarterly throughout the project to inform the project direction and help to construct a plan to transfer the solution to BAU.

The project website was set up in November 2020, using a structure and style in line with ENWL’s previous NIC-funded projects. Learning from the project will be uploaded to this website throughout delivery.

2 PROJECT MANAGER'S REPORT

2.1 Project background

To cater for the subsequent increase in electricity demand and generation caused by decarbonisation targets, DNOs have investigated and deployed techniques such as Customer Load Active System Services (CLASS), Smart Street and Active Network Management (ANM) optimisation systems. Whilst these systems have proven successful in helping DNOs to manage the network, they do have limitations. For example:

- They are often applied in isolation of one another and do not operate in a co-ordinated manner.
- It is possible that one technique could counteract another, resulting in reduced effectiveness and potentially failing to maintain operation within acceptable limits.
- They use worst-case planning assumptions, which build in large safety margins, resulting in operation below the theoretical maximum.
- They require a resilient communications infrastructure at all times and are set up to fail safe. Therefore, if there is a communications failure any voltage optimisation or ANM benefit is significantly reduced or removed.

The QUEST project will aim to integrate the above voltage optimisation systems into one overarching, co-ordinated and optimised system, with appropriate balance between centralised (global) and decentralised (zone) control hierarchy. This will enable voltage optimisation for the whole distribution network. By viewing and controlling the whole network, QUEST will co-ordinate the often-competing objectives of these existing systems to ensure optimised operation whilst maximising benefits for customers. In addition, the QUEST software will allow demand and generation to automatically self-adjust in response to changing voltage requirements, creating an innovative, self-regulating distribution network.

QUEST Voltage Optimizer is the overarching software system that has the ability to control other individual systems on the network, i.e. Enhanced AVC including CLASS, Smart Street and ANM. These systems provide voltage control, thermal constraint management and demand control. Where appropriate, the QUEST Voltage Optimizer will optimise system voltages to provide additional benefits, e.g. by reduction of system losses.

2.2 Project Partners

There are five project partners on QUEST: SE, SGS, Fundamentals Ltd, National Grid ESO, and Impact Research. The partners will make a combined contribution to the project, Figure 2.2.1, below, outlines each partner's role and responsibilities in the project.

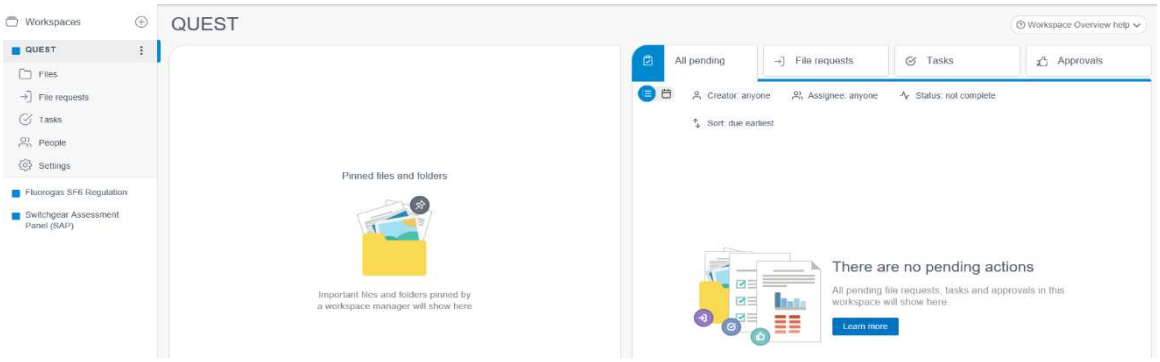
Figure 2.2.1: Project partner details

Project Partner	Prior Experience	Role on Project
Schneider Electric (SE)	Design of our new NMS, which will replace our current, bespoke NMS.	Overarching control system will form part of new NMS: • Will specify, design, and develop the overarching system. • Will assist with implementation of system.
Smarter Grid Solutions (SGS)	Have valuable knowledge about operation of software systems such as ANM and have worked with a number of DNOs on this technique.	• Will help to define use cases and architecture. • Will implement voltage control strategy in their system. • Will conduct technical research, involving modelling, to inform

		control methodology and trial design. • Will participate in trials. • Will analyse trial data to identify benefits and update business case and carbon plan.
Fundamentals Ltd	Have expertise in end-to-end voltage control and management, desire to be at the leading edge of approaches, and have previously worked on the roll-out of CLASS.	• Will help to define both hardware and software architecture and use cases. • Will help to design control methodologies. • Will implement voltage control strategy in their AVC relays.
National Grid ESO	ESO experience interacting with DNOs and using services such as CLASS.	• Will help to explore the expected benefits of QUEST for the transmission system, including real-time visibility of our network and dynamic adjustment of interface voltage parameters, for both steady state and emergency conditions.
Impact Research	Have worked on the customer element of previous innovation projects, such as CLASS, Smart Street, Celsius, and VoLL2.	• Will assist with customer research, including engagement via surveys, interviews, and focus groups. • Will support customer communications strategy.

One of the tools used to support collaboration between project partners within workstreams is the project collaboration portal. This portal was created to support interaction and work-sharing during development of the project deliverables. Within the earlier stages of the project face to face meetings were not possible due to COVID restrictions, and this portal allowed for some interaction to share and review project works. Figure 2.2.2 shows a screen shot of the collaboration portal.

Figure 2.2.2: QUEST collaboration portal



An action log is being kept and regularly updated to ensure that all project partners are aware of and up to date with progress on all project actions. The action log is reviewed at each project progress meeting and all actions are clearly allocated to the relevant party. Figure 2.2.3 shows a screen shot of the action log.

Figure 2.2.3: QUEST action log

QUEST ACTION/DISCUSSION ITEM LOG

TEAM: ENWL, SE,SGS,Fundamentals,Impact & ESO

DATE OF LAST UPDATE: 08 December 2021

NO	DONE	ACTION	ASSIGNED TO	DATE DUE	PRIORITY	STATUS	% COMPLETE	NOTES
3		Appoint third party Independent peer review of project (Ricardo)	ML	05/31/21	Medium	Complete	100%	Provided feedback to Ricardo on there proposal, they have agree to add another step in the peer review progress. (27/05/21)Ricardo have amended their proposal based on comments from ENWL, ML/DR are satified with approach, Jayne
		Voltage / Demand Reseach Study	ML		Medium	On Hold	50%	SGS, Ricardo and UM all showing keen instrest in this work. 21/05/21 Discuss in the last meeting that this work does not start for another 2 years so there is no urgency as of yet. (27/05/21) Had a meeting with MCU on this work they are keen to get involved and are going to produce a proposal for the work. However, I still feel this work is better placed with SGS. (03/06/21) UM have sent back a proposal for this work; however, we are still waiting on the quotation for the work. SGS has told me they will provide their proposal by the end of next week. (17/06/21) Quotations have now being received back from Ricardo, SGS & UM. All of which are well over budget ENWL to engage with all parties to understand cost variance. (24/06/21) All proposals and prices are back and are being reviewed. (08/07/21) Proposal douments have being send to DR for reiview. (14/07/21) Dan had some comments about the SGS modelling these have now being clarified, Delroy has also asked about when this study will be done as this could feed into the smart heat project. (21/07/21) SGS have provided addtional comments how they will do the voltage demand relation study. (29/07/21) This has been parked the last two weeks due Use Case report. But It looks like we need some further clarifcation from SGS/UM before deciding.(19/08/21) We had meeting with SGS in regards to there proposal of the VD study and asked that this is amended to future more on network chamges based LCT uptake. (08/09/21) Resvised proposal has been sent to Dan for his review. (22/09/21) This piece

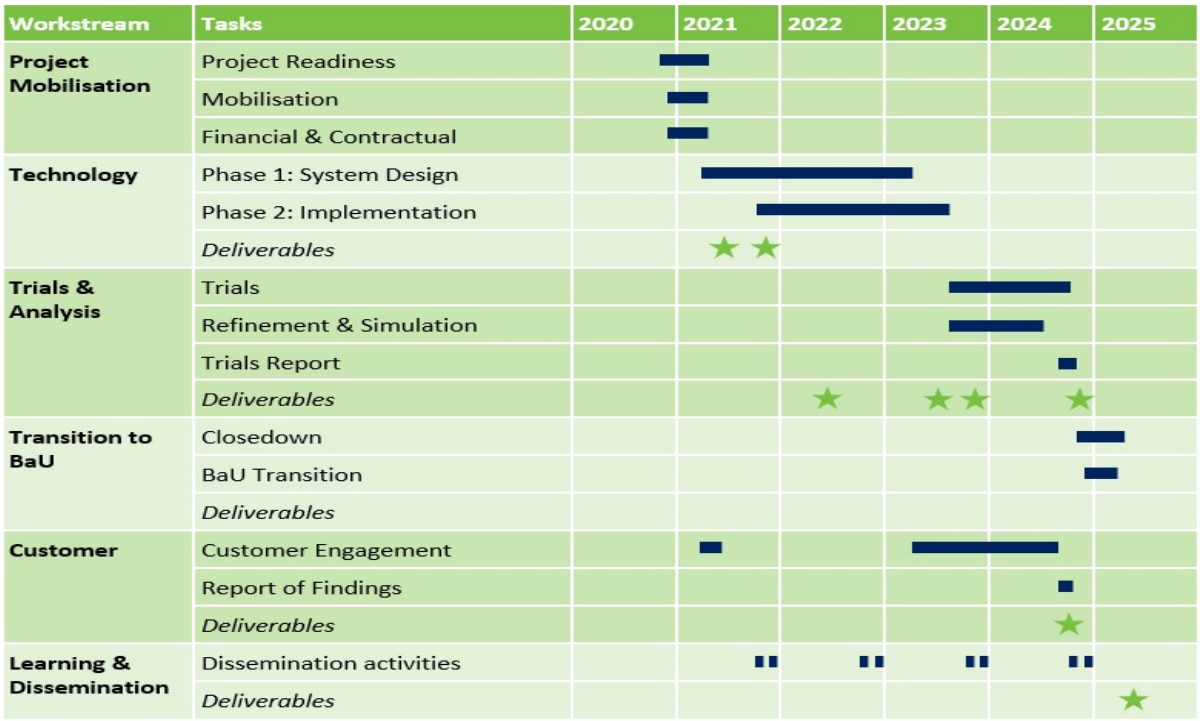
2.3 General

Following the award of funding for QUEST, significant effort has been made to mobilise the project and to develop structures and processes within the team. The project team was appointed during February 2021 and was fully mobilised by March 2021. The project has been handed over to the delivery team from the bid team, who will remain involved with the project in an assurance role.

Contracts have been agreed with project partners Schneider Electric, Smarter Grid Solutions, Fundaments Ltd, Impact Research & National Grid ESO.

Workstreams have been used to group and streamline the tasks required for completion of a specific project activity. These workstreams can run in parallel as the project team works towards completion of multiple, separate project activities and were used for the first and second deliverables. Figure 2.3.1 shows a high-level snapshot of the project workstreams.

Figure 2.3.1: QUEST project workstreams



A series of weekly meetings were held between the ENWL project team and relevant partners in relation to each workstream and the associated deliverables.

These meetings were followed by a comprehensive project kick-off meeting, with partners and key stakeholders attending a full day workshop to ensure a common understanding of the project.

Project finances including bank accounts, partner contracts and initial purchase orders were set up to meet the challenging delivery dates for the optimisation software and modelling development, feeding into the second project deliverable, and also the installation of AVC systems and OLTCs within the identified project trial area.

The key project management activities undertaken during this reporting period are summarised below:

- **Management of project resources:** The internal resources required for the delivery of QUEST have been identified and placed. A number of these resources bring experience from other second tier projects (Celsius, CLASS, Smart Street and Respond).
- **Project monitoring and control:** Processes for the monitoring and control of the delivery of the QUEST project are now in place. These processes build on those developed during earlier NIC-funded projects to ensure that QUEST progresses in a controlled manner and that the outputs are of the highest quality.
- **Regular engagement with project partners:** The QUEST project team will engage and hold regular meetings with project partners. A “kick-off” meeting was held with project partners on 11 May 2021, and the first project steering group will be held on 20 October 2021.

2.4 QUEST Initial Report - Use Cases, and QUEST System Design and Architecture Lessons Learned

The key activities undertaken by the project team within this reporting period were completion of the first project deliverable, “QUEST Initial Report - Use Cases” and work on

developing the architecture options and modelling regime for the second project deliverable, “QUEST System Design and Architecture Lessons Learned” – due to be completed in early December 2021. The individual workstreams during the reporting period are summarised below:

- Meetings held with technical partners to discuss QUEST use cases, architecture options and modelling regime to understand process of this work and how it would be delivered.
- Weekly conference meetings established to draft and develop QUEST use cases and then focus on the architecture and modelling regime development with project partners Schneider Electric, Smarter Grid Solutions and Fundamentals Ltd.
- A full review of site selection data and process resulting in an agreed list of distribution sites (feeder circuits) that we will use to carry out the project tests and trials.
- Successful submission of the first project deliverable to Ofgem, “QUEST Initial Report - Use Cases”, which is a document critical to the development of the architecture options and modelling regime.
- Data gathering required for network modelling to allow time-based load analysis to be carried out, simulating conflict of resolutions in line with the project hypothesis.
- Development of site survey templates, to be used to detail and specify required works within the BSP and primary substations in the project trial area. These surveys will support the development of design reports for each individual site that will be reviewed and assessed before work can commence.
- Pre-design site assessment of OLTC installation at the identified distribution substations within the project trial and test area.

In the next reporting period, the “QUEST System Design and Architecture Lessons Learned” and the “QUEST Trials, Design and Specification Report” deliverables will have been submitted, these provide the below project outputs as result of this upcoming work.

- Functional specification for chosen architecture.
- Functional specification for the voltage control methodology.
- Trial and test design specification.
- Detailed design report for each BSP, primaries and distribution substations for AVC, feeder measurement and OLTCs installation.
- Specification on QUEST software development and testing.

2.5 Customer workstream

The key activities undertaken within the customer workstream during this reporting period are summarised below. The Customer Engagement Plan (CEP) was completed on 26 July 2021 and uploaded on the QUEST website shorty after. This plan sets out the research strategy within the project to support, explore and understand the answers to the following questions:

- Do customers notice when project trials and tests are applied, and, if so, how?
- Are the operating characteristics of various generators and sensitive customers affected by the optimisation software and, if so, how and in what circumstances?
- Are there any special requirements in respect of the supply voltage for certain customer types?
- What are the impacts of voltage profiling on generator customers?
- What is the appetite amongst customers for voltage-driven, self-managed connections, particularly for generators and/or large demand customers?

Work has also commenced with Impact Research on developing customer literature outlining the changes taking place at ENWL regarding its transition to net zero. This document will outline to customers what existing and future systems are doing to further optimise the running arrangement of the network, and what customers need to do to ensure they are not affected if they have voltage sensitive equipment.

2.6 Learning and dissemination workstream

The project remains within its early development stage and has delivered one learning outcome to date.

After the funding decision was announced, the project was publicised on ENWL's website via a press release published in December 2019. Shortly after this, internal communications were delivered via ENWL's weekly email bulletin, "Connect", to reach our internal stakeholders.

The project website was built and went live in November 2019. All relevant project documents and learning have since been uploaded and are now available through the website, including the above learning outcome, "QUEST Initial Report - Use Cases", and the Customer Engagement Plan – both published in July 2021.

ENWL hosted the kick-off meeting virtually on 11 May 2021, due to COVID restrictions. The purpose of this meeting was to present the project objectives to partners and identify risks and opportunities across all workstreams.

The first QUEST ISG was held on 7 July 2021 and was attended by Northern Power Grid and National Grid ESO representatives. As described in the bid submission, the function of the ISG is to inform the project direction and help to construct a plan to transfer the solution to BAU.

ENWL attended the ENIC 2021, where a short video on QUEST was made available for download from the virtual stand, and a presentation on the project and our progress to date was delivered to the wider industry.

An Innovation Newsletter featuring an update on QUEST was sent out to innovation stakeholders and published on the project website in November 2021. This included some background information on the project and an update on project progress.

The QUEST communications register details and evidences all communications to date and is available in Appendix F.

In the next reporting period, the learning and dissemination workstream will undertake the following activities:

- Re-publicise QUEST on the company intranet and in the internal email bulletin, this will be done in May 2022.
- Update the QUEST website with Project Progress Report 1 (PPR1) and second deliverable, "QUEST System Design and Architecture Lessons Learned" these will be added in December 2021.
- Hold the second and third ISG dissemination sessions, the next ISG is scheduled for April 2022.
- Hold a knowledge sharing event – could be seminar/conference/workshop – film and add to YouTube/ project website to reach wider audience, this is planned in for August 2022.
- Attend the ENIC 2022, which is currently scheduled for October 2022.

2.7 Project trial and test area

As per the QUEST FSA (Full Submission Application), the preliminary subset of the network identified for trialling QUEST is a region fed from Whitegate GSP, where the ENWL network takes an infeed from National Grid's 275kV network via three 240MVA super grid transformers. The reason Whitegate was identified within the submission as a potential network area for conducting trials and tests is that it provides a range of demand types: from highly commercial to dense urban, suburban and semi-rural areas. In addition to the usual

domestic and commercial customers, there are a number of larger HV connected customers, such as hospitals and a large semiconductor factory.

During this reporting period, this network area was further accessed from site survey and desktop exercise, which showed suitability for installation of the AVC relays within the BSPs and primaries. Also, one HV circuit out of Royton primary, which feeds seven distribution substations, was identified as being suitable for the installation of OLTC transformers in all seven substations; this analysis further validated Whitegate as a suitable trial area for QUEST.

The Whitegate GSP trial area feeds around 6% of our total connected customers. Geographically, this network covers a diverse area ranging from the north-east side of Manchester City Centre out towards the Pennines.

Further technical details of the network are contained in Figure 2.7.1 below, and the geographical area of Whitegate is available in Appendix H.

Table 2.7.1: Technical overview of Whitegate GSP

Peak demand	340MVA
Number of BSPs	4
Number of Primaries	21
Number of connected customers	158,000
Connected generation	2 x 20MW at 33kV
Length of underground cable	744km
Length of overhead line	13.9km
Total connected network	758km

3 BUSINESS CASE UPDATE

The project team are not aware of any developments that have taken place since the issue of the QUEST project direction that affect the business case for the project.

4 PROGRESS AGAINST PLAN

The project plan is monitored, reviewed and updated on a continuous basis. This process takes into consideration potential risks that were documented in the full submission and any change to these risks. The process also considers newly identified risks and issues that are highlighted during the project lifecycle.

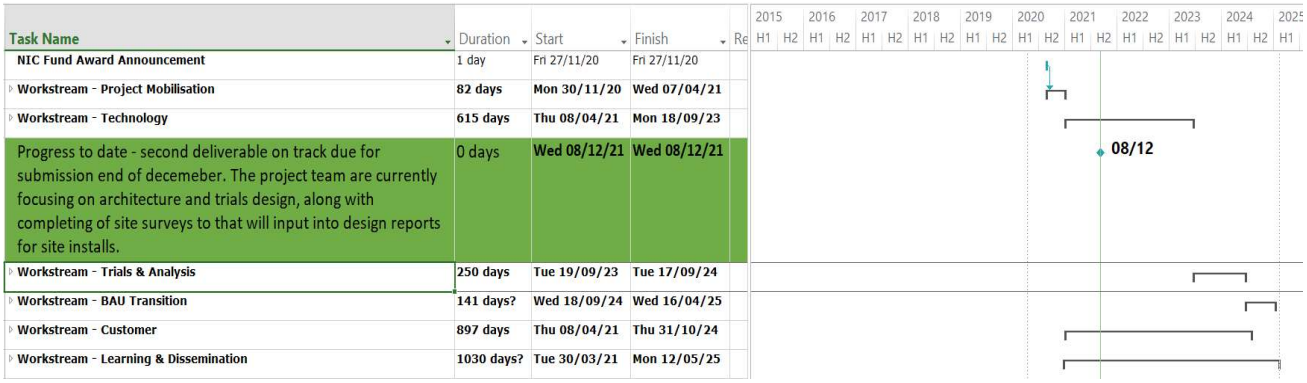
Progress against the project plan as outlined in the full submission is currently on track with no substantial issues raised in the first reporting period that are expected to affect delivery. Some points worth noting:

- The voltage demand research study was not due for submission until December 2024. This research piece has recently been awarded to SGS and work has already begun on its delivery. This work crosses over into elements of upcoming deliverables, including the modelling regime and power system model development, on which SGS are also leading. Hence it was of benefit to the project to start this work early as it allows for modelling analysis already completed to feed into voltage demand research.

- Project partners SGS and Schneider Electric are in the process of finalising the architecture options and modelling regime reports for the second deliverable, “QUEST System Design and Architecture Lessons Learned”, this work is ahead of schedule and nearing completion, with a submission date of 31 December 2021. The progress made on this second deliverable will allow for an earlier start on the third deliverable “QUEST Trials, Design and Specification Report” which is due on 30 June 2022.
- Procurement of the OLTC transformers is underway; an order is placed with Kyte Powertech and due for delivery in February 2022. This is ahead of the project plan, which stipulated an order date of January 2022. Early procurement will ensure the OLTCs are available and minimize potential delays.
- Work on the first deliverable, “QUEST Initial Report - Use Cases”, commenced on 5 April 2021 and the document was submitted to Ofgem on 31 July 2021. This is a critical document that is now supporting the development of the architecture and power system design for QUEST. This document may be revised and updated as analysis and further learning within the project is established over the course of the project.

There are no current issues or risks identified at this stage in the project that are expected to affect the project plan. A screenshot of the project plan can be seen in Figure 4.1; the purpose of this is to demonstrate where the project is versus the plan. The keynotes from this to note is that the second deliverable is on track for submission end of December 2021 and that site surveys and procurement of equipment is a month ahead of schedule. The project is already starting to look at the next deliverable, which is the QUEST trials and architecture design.

Figure 4.1: Project Plan Versus Process



5 PROGRESS AGAINST BUDGET

The project budget as defined in the project direction is shown in Appendix C.

Actual spend to date compared to project budget is summarised in Table 5.1 below. The report includes expenditure up to and including 30 November 2021.

It will be noted that the project is currently performing favourably relative to budget. Project expenditure as at the end of November 2021 was £618,592 compared to a cost baseline of £1,107,779.

As already indicated, all ENWL resources are now in place. The favourable variance in IT costs reflects the delay in submission of invoices from suppliers. These invoices are expected in early December 2021 and therefore will be evidenced in the next project progress report in December 2022. This variance in IT cost is due to early completion of project milestones on decentralised ANM architecture, which cannot submit for approval until the QUEST architecture options and modelling regime report deliverable has been completed and signed off in December 2021.

Furthermore, while orders have been placed, not all goods and services covered by those orders have been received and invoiced. This accounts for the favourable variance relative to the projected costs for equipment and contractors.

Table 5.1: Summary of project expenditure

£'000s Excluding Partner Funding Ofgem Cost Category	Spend to date			Total Project		
	Actual	Plan	Variance	Forecast	Plan	Variance
Labour	180,013	177,614	(2,399)	1,995,616	1,988,643	(6,973)
Equipment	0	0	0	563,986	563,986	0
Contractors	294,648	290,034	(4,614)	2,018,261	1,960,565	(57,696)
IT	133,156	519,310	386,154	3,371,533	3,339,666	(31,867)
Travel & Expenses	0	3,688	3,688	16,085	16,085	0
Payments to Users	0	0	0	19,998	19,998	0
Contingency	0	43,362	43,362	707,511	707,511	0
Decommissioning	0	0	0	29,021	29,021	0
Other	10,775	73,771	62,996	373,958	373,959	1
Total	**618,592**	**1,107,779**	**489,187**	**9,095,968**	**8,999,432**	**(96,536)**

Detailed expenditure is shown in Appendix D at project activity level.

6 BANK ACCOUNT

The project bank statement is shown in Appendix E. The statement contains all receipts and payments associated with the project up to the end of November 2021.

7 PROJECT DELIVERABLES

There was one Ofgem deliverable due for submission in this reporting period, “QUEST Initial Report – Use Cases”. This was submitted on 30 July to Ofgem and also uploaded on the QUEST website.

Project deliverables two and three are due in the next reporting period, shown in Table 7.1 below.

Table 7.1: QUEST project deliverables

Reference	Project Deliverable	Deadline	Evidence	Delivery Status
1	QUEST Initial Report - Use Cases	31/07/2021	Document introducing the Project and detailing the use cases and scenarios.	Submitted to Ofgem on the 30th of July 2021 and also uploaded on to the QUEST website the same day.
2	QUEST System Design and Architecture Lessons Learned	31/12/2021	Document explaining Project progress including the following outputs: • Review of architecture options • Specification for the network models and modelling regime.	On track for submission deadline.

3	QUEST Trials, Design and Specification Report	30/06/2022	Document explaining Project progress including the following outputs: • Functional specification for chosen architecture. • Functional specification for voltage control methodology. • Trial design. • Detailed site design.	On track for submission deadline.
4	QUEST Interim Report - System Design and Technology Build Lessons Learned	30/06/2023	Document detailing Project progress to date including lessons learned from: • QUEST software. development and testing. • Power system model development. • Site installation for the voltage control and ANM equipment.	On track for submission deadline
5	QUEST System Integration Lessons Learned Report	30/12/2023	Document detailing the lessons learned from the installation and commissioning of the QUEST system including system integration and the results of site acceptance testing.	On track for submission deadline.
6	Customer Research Findings Report	31/10/2024	Document detailing the outputs from the customer research.	On track for submission deadline.
7	QUEST Trials and Analysis Report	30/12/2024	Document detailing: • Final results from network trials. • Final results from modelling trials. • Output from the voltage demand relationship research. • Any adaptation required to voltage control methodology.	On track for submission deadline.
8	QUEST Final Report	30/04/2025	Report on the conclusion of the QUEST Project including all the lessons learned and detailing the next steps, including BAU transition.	On track for submission deadline.

9	Comply with knowledge transfer requirements of the Governance Document.	End of Project	Annual Project Progress Reports which comply with the requirements of the Governance Document. Completed Close Down Report which complies with the requirements of the Governance Document. Evidence of attendance and participation in the Annual Conference as described in the Governance Document.	On track for submission deadline.

The current status of the evidence for all project deliverables is shown in Appendix B. Progress against project deliverables and the project plan will continue to be monitored, and if the current forecast for any project deliverable changes, this will be detailed in future project progress reports.

8 LEARNING OUTCOMES

As this is ENWL's sixth large-scale innovation project, the project team has been able to review and apply lessons learnt from previous projects. During this reporting period, much of the work has revolved around project mobilisation, governance, ensuring the correct financial controls are in place, and delivery of the first project deliverable, "QUEST Initial Report - Use Cases". The purpose of the Use Case report was to introduce the QUEST project and then go on to document the selected Use Cases prepared to allow for the QUEST system design and architecture options to be considered in the next phase of the QUEST project.

In the next reporting period, it is expected that further learning will be generated after the submission of the next two project deliverables, "QUEST System Design and Architecture Lessons Learned" due in December 2021 and "QUEST Trials, Design and Specification Report" due in June 2022.

Originally, the voltage demand relationship study was due to commence in January 2021 and be submitted at the end of December 2024. However, the decision was made to start this research in December 2021 because it aligns to other work that is currently in progress. For example, the review of architecture options and the specification for the network models and modelling regime – both feeding into the first deliverable – and the power system development model – feeding into the fourth deliverable. The learning from this work is expected to be evidenced within the next reporting period.

9 INTELLECTUAL PROPERTY RIGHTS (IPR)

ENWL is following the default IPR arrangements. No IPR has been generated or registered during the reporting period. The IPR implications of forthcoming project deliverables are currently being considered and will be reported in the next project progress report.

10 RISK MANAGEMENT

There are currently no uncontrolled risks that could impede the achievement of any of the project deliverables outlined in the project direction, or that could cause the project to deviate from the full submission.

The project risks identified in the QUEST full submission have been migrated into the QUEST delivery risk register, reviewed, and confirmed as still valid. Risks will be monitored on a continuous basis, including the potential risks that were documented in the full submission. Project risks are described in detail in Appendix A.

With the agreement of partner contracts and placement of purchase orders, the mobilisation risk has diminished and is anticipated to be formally closed at the first project steering group.

The placement of purchase orders continues to mitigate the risks of delayed installation.

There is an increased probability that the use of existing monitoring equipment will not take place due to an issue raised by project partner Ricardo. The cost and effort required to re-deploy existing monitoring equipment and implement this into the data handling system is being investigated and evaluated against deploying new equipment. The outcome of this evaluation will be reported in the next reporting period. The impact of this will be reassessed, but at this stage it is not expected to have a negative impact on the project plan or budget.

Changes to date are:

- Project partners have mobilised, and this risk is being reviewed prior to closure.
- The likelihood of utilising existing monitoring equipment has decreased due to an expected increase in effort and cost.

11 CONSISTENCY WITH FULL SUBMISSION

At the end of this reporting period, it can be confirmed that the QUEST project is being undertaken in accordance with the full submission.

12 ACCURACY ASSURANCE STATEMENT

This document has been reviewed by a number of key business stakeholders. The project team and select members of the QUEST project steering group, including a member of the bid development team, have reviewed the report to ensure its accuracy. The narrative has also been peer-reviewed by ENWL's Head of Network Innovation.

The financial information has been produced by the QUEST project manager and the project's finance representative, who review all financial postings to the project each month to ensure they are correctly allocated to the appropriate project activity. The financial information has also been peer reviewed by ENWL's risk, control, and assurance (finance) manager.

Issue of the document has been approved by the Head of Network Innovation.

13 APPENDICES

Appendix A: Status of risks from the full submission

Project Phase /Workstream	Description	Probability	Impact	Mitigating Action	Revised	Revised Impact Score
		Score	Score		Probability	
Project work groups	Not being able to setup share point access where external partners can access is hindering development of the project work with partners	2	4	Looking at other alternatives for creating share point access. Very little support from IT. This has been escalated to DR, who is speaking to TS to help get resolved.	2	4
Customer	There is a risk that customers could be adversely affected by implementation of the holistic voltage control methodology. This risk might result in a breakdown in customer relationship and reputation.	2	3	We will engage with a variety of customers to understand how optimising voltage may affect their operations and identify any special requirements. We will adapt the Method to incorporate the needs of these specific users. To ensure that there is no public or reputational damage to ENWL, QUEST will embed a process to quickly and appropriately manage any customer impacts.	1	3

Trials and Analysis	There is a risk that implementation of the holistic voltage control methodology may have an impact on the network which leads to disruption or outage.	1	5	The holistic voltage control methodology uses a combination of proven techniques. We will run the methodology in open loop to understand the actions it would take before allowing operation on the live network.	1	5
Trials and Analysis	There is a risk that the QUEST software does not perform as intended leading to a requirement for additional resource to carry out debugging/ development.	3	4	We have selected a Project Partner who is familiar with our existing systems and software and whom has appropriate experience and technical expertise to perform this task.	2	4
Technology	There is a risk of increased cost for installation of BSP and Primary AVC schemes due to unforeseen issues such as increased cabling, etc.	3	5	Preliminary site surveys to be conducted.	1	5
Technology	Due to the Covid Pandemic there has being 20% increase on materials	2		ENWL to monitor this price inflation and perhaps reduce the number of OLTC we use in trial.	1	4
Technology	There is a risk of delay in procurement/delivery of OLTC Tansfromers leading to a delay in implementation.	2	4	The plan is order the transformers this years and keep them in storage for when required for installation next year	1	4

Delivery	There is a risk that COVID-19 restrictions will impact Project delivery. This is especially true should we experience a second wave or a regional lockdown. This could have a significant effect due to the location of one of our Partners, potentially causing delays to Project completion.	3	4	Suitable partnership agreements that ensure collaborative working, value for customers' money and achievement of learning objectives in a timely manner have been identified for all Partners. A project initiation document will be issued to the Project Partners to ensure that all parties are ready.	2	3
Mobilisation	There is a risk that the Project Partners are not able to mobilise their resources in time because of other commitments leading to a delay in achieving potential milestones which could have a Project reputational and financial repercussion.	3	4	Suitable partnership agreements that ensure collaborative working, value for customers' money and achievement of learning objectives in a timely manner have been identified for all Partners. A project initiation document will be issued to the Project Partners to ensure that all parties are ready.	2	4
Technology	There is a risk of delay in development/integration of the overarching software, which leads to an overall Project delay.	3	4	We have selected an appropriate Project Partner with relevant experience to deliver this element of the Project and have ensured that the scope of work is clear and deliverable. Regular development meetings will be held to track progress against the plan.	1	4

Technology	There is a risk that the final architecture design may be more complex than originally anticipated leading to an increase in cost and delivery timescales.	3	5	Proposed architecture in bid has been developed using experience of Project Partners.	1	5
Technology	There is a risk that customers may experience an outage during installation of the distribution substation equipment.	2	2	Pre-site surveys to identify suitable means of installation which avoid customer outages whether via backfeeds or generators.	1	2
Technology	There is a risk that there is a need for unforeseen additional work during commissioning, leading to a requirement for additional resource to attend site to fix or replace.	2	4	Pre-installation surveys to identify commissioning requirements.	1	4
Learning dissemination	There is a risk that attendance at events may be low due to other dissemination events/current restrictions preventing attendance. Learning may be inhibited due to stakeholders having different interests and learning styles.	2	3	ENWL will choose dissemination channels optimised to achieve maximum reach and coverage.	1	2
Close Down	There is a risk that new obligations and guidance will be released on key deliverables, such as the Close Down Report leading to a longer preparation and review period required.	3	3	Communication channels from Ofgem will be monitored and any updates to such requirements identified as early as possible.	1	3
OLTC Distribution Procurement	Due to the effects of the pandemic, there has being global increase on the cost plant materials of over 20%.	2	5	QUEST PM / procurement team to monitor this to understand if these increased costs are permanent, or if changes can be made within tests and trials	1	3

				to try and reduce costs.		
Cyber Security	Integration of SGS ANM within ENWL NMS system may have issues to cyber due to security requirements	2	5	SGS and SE to have discussions with ENWL IT team to understand if what cyber security issues may cause issue with system implementation.	2	5

Appendix B: Project deliverables

Ref	Project Deliverable	Deadline	Evidence	Delivery Status
1	QUEST Initial Report - Use Cases	31/07/2021	Document introducing the Project and detailing the use cases and scenarios.	Submitted to Ofgem on 30 July 2021 and uploaded to QUEST website.
2	QUEST System Design and Architecture Lessons Learned	31/12/2021	Document explaining Project progress including the following outputs: • Review of architecture options • Specification for the network models and modelling regime.	On track for submission deadline.
3	QUEST Trials, Design and Specification Report	30/06/2022	Document explaining Project progress including the following outputs: • Functional specification for chosen architecture. • Functional specification for voltage control methodology. • Trial design. • Detailed site design.	On track for submission deadline.
4	QUEST Interim Report - System Design and Technology Build Lessons Learned	30/06/2023	Document detailing Project progress to date including lessons learned from: • QUEST software. development and testing. • Power system model development. • Site installation for the voltage control and ANM equipment.	On track for submission deadline.
5	QUEST System Integration Lessons Learned Report	30/12/2023	Document detailing the lessons learned from the installation and commissioning of the QUEST system including system integration and the results of site acceptance testing.	On track for submission deadline.
6	Customer Research Findings Report	31/10/2024	Document detailing the outputs from the customer research.	On track for submission deadline.

7	QUEST Trials and Analysis Report	30/12/2024	Document detailing: • Final results from network trials. • Final results from modelling trials. • Output from the voltage demand relationship research. • Any adaptation required to voltage control methodology.	On track for submission deadline.
8	QUEST Final Report	30/04/2025	Report on the conclusion of the QUEST Project including all the lessons learned and detailing the next steps, including BaU transition.	On track for submission deadline.
9	Comply with knowledge transfer requirements of the Governance Document.	End of Project	Annual Project Progress Reports which comply with the requirements of the Governance Document. Completed Close Down Report which complies with the requirements of the Governance Document. Evidence of attendance and participation in the Annual Conference as described in the Governance Document.	On track for submission deadline.

Appendix C: Project direction budget

Project direction ref: ENWL / Celsius / 9 December 2021, Annex 1: Project budget

Cost Category	Cost
Labour	
	1,988,643
Equipment	
	563,986
Contractors	
	1,960,565
IT	
	3,339,666
IPR Costs	
	-
Travel & Expenses	
	16,085
Payments to users	
	19,998
Contingency	
	707,511
Decommissioning	
	29,021
Other	
	373,959
Total	8,999,432

£000's Excluding Partner Funding Ofgem Cost Category	
Labour	**177,614**
Labour - Project Management	93,073
Labour - Customer Engagement	6,361
Labour - System Design	67,124
Labour - Implementation	6,963
Labour - Trials & Analysis	-
Labour - BAU Transition	-
Labour - Learning & Dissemination	4,093
Equipment	-
Equipment - Implementation	-
Contractors	**290,034**
Contractors - Project Management	98,420
Contractors - System Design	171,984
Contractors - Implementation	17,740
Contractors - Trials & Analysis	-
Contractors - BAU Transition	-
Contractors - Learning & Dissemination	1,890
Contractors - Customer Engagement	-
IT	**519,310**
IT - System Design	464,300
IT - Implementation	55,011
IT - Trials & Analysis	-
Travel & Expenses	**3,688**
Payments to users	-
Contingency	**43,362**
Decommissioning	-
Other	**73,771**
Other - Project Management	415
Other - Accommodation	19,468
Other - Learning & Dissemination	53,888
Total Project to date	**1,107,779**

Appendix D: Detailed project expenditure

£'000s Excluding Partner Funding Ofgem Cost Category	Spend to date			Total Project		
	Actual	Plan	Variance	Forecast	Plan	Variance
Labour	**180,013**	**177,614**	**(9,362)**	**1,995,616**	**1,988,643**	**(6,973)**
Labour - Project Management	124,346	93,073	(31,273)	374,744	374,743	(0)
Labour - Customer Engagement	4,900	6,361	1,461	215,628	215,628	(0)
Labour - System Design	50,767	67,124	16,357	228,876	228,966	90
Labour - Implementation	-	6,963		808,794	805,312	(3,482)
Labour - Trials & Analysis	-	-	-	310,875	310,875	-
Labour - BAU Transition	-	-	-	27,043	27,043	-
Labour - Learning & Dissemination	-	4,093	4,093	29,657	26,076	(3,581)
Equipment	-	-	-	**563,986**	**563,986**	-
Equipment - Implementation	-	-	-	563,986	563,986	-
Contractors	**294,648**	**290,034**	**(4,614)**	**2,018,261**	**1,960,565**	**(57,696)**
Contractors - Project Management	121,796	98,420	(23,376)	611,581	593,858	(17,723)
Contractors - System Design	129,311	171,984	42,673	246,212	240,972	(5,240)
Contractors - Implementation	43,541	17,740	(25,801)	424,744	427,594	2,850
Contractors - Trials & Analysis	-	-	-	414,282	380,013	(34,269)
Contractors - BAU Transition	-	-	-	155,043	151,729	(3,314)
Contractors - Learning & Dissemination	-	1,890	1,890	84,140	84,140	-
Contractors - Customer Engagement	-	-	-	82,259	82,259	-
IT	**133,156**	**519,310**	**386,154**	**3,371,533**	**3,339,666**	**(31,867)**
IT - System Design	133,156	464,300	331,143	2,798,771	2,772,943	(25,829)
IT - Implementation	-	55,011	55,011	241,453	240,686	(767)
IT - Trials & Analysis	-	-	-	331,309	326,037	(5,272)
Travel & Expenses	-	**3,688**	**3,688**	**16,085**	**16,085**	-
Payments to users	-	-	-	**19,998**	**19,998**	-
Contingency	-	**43,362**	**43,362**	**707,511**	**707,511**	-
Decommissioning	-	-	-	**29,021**	**29,021**	-
Other	**10,775**	**73,771**	**62,996**	**373,958**	**373,959**	**1**
Other - Project Management	-	415	415	38,569	38,569	-
Other - Accommodation	9,116	19,468	10,352	107,865	107,865	0
Other - Learning & Dissemination	1,659	53,888	52,229	227,524	227,524	0
Total	**618,592**	**1,107,779**	**482,224**	**9,095,968**	**8,999,432**	**-96,536**

Appendix E: Project bank account

The bank statement below details all transactions relevant to the project. This includes all receipts and payments associated with the project up to the November 2021 month end reporting period.

LLOYDS BANK

Balance and Transaction Report

07-Dec-2021
11:14:58 AM
Page 17 of 17

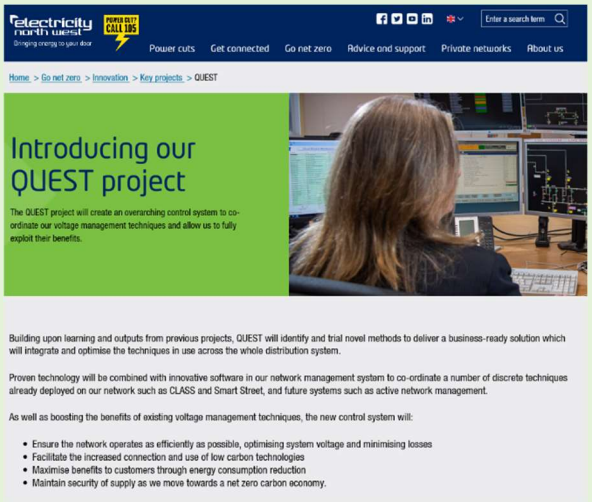
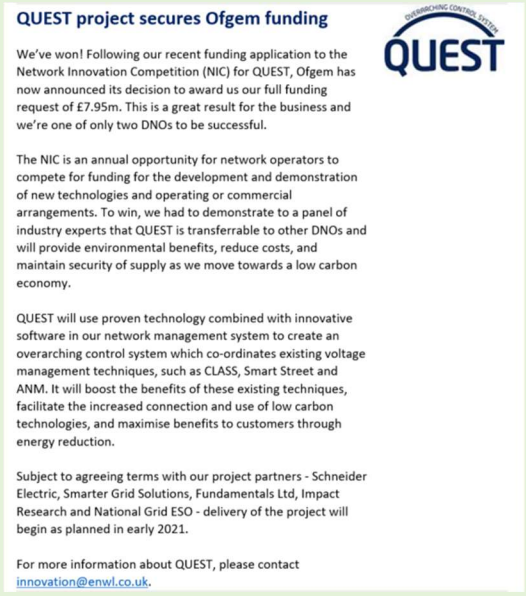
Reporting Period: 06-Dec-2021
Bank Name: Lloyds
Account Number / Name / Currency Code: 308012-21586468 / ELECTRICITY NORTH WEST LIMITED - QUEST / GBP
Closing Ledger Balance As At: 03-Dec-2021 **Closing Ledger:** 6,171,570.32

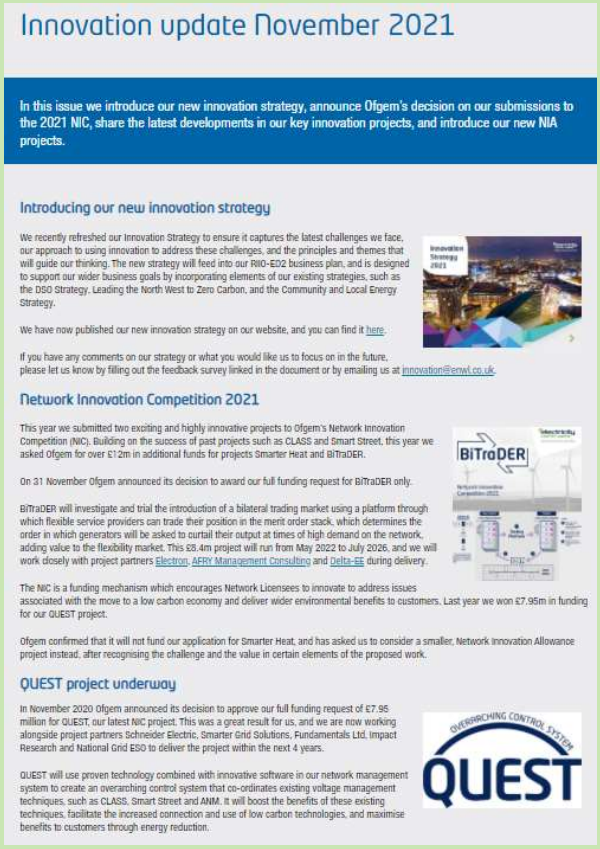
Posting Date	Type	Details		Debits	Credits	Ledger Balance
06-Dec-2021	Inter Account Transfer	1059681794 300002	,TO 02749020	16,089.00		6,155,481.32
06-Dec-2021	Inter Account Transfer	1059682050 300002	,TO 02749020	11,825.93		6,143,655.39
06-Dec-2021	Inter Account Transfer	1059681945 300002	,TO 02749020	24,471.80		6,119,183.59
06-Dec-2021	Inter Account Transfer	1059682316 300002	,TO 02749020	25,620.03		6,093,563.56
06-Dec-2021	Inter Account Transfer	1059681975 300002	,TO 02749020	10,399.27		6,083,164.29
06-Dec-2021	Inter Account Transfer	1059682187 300002	,TO 02749020	163,121.04		5,920,043.25
06-Dec-2021	Inter Account Transfer	1059682248 300002	,TO 02749020	49,071.44		5,870,971.81
06-Dec-2021	Inter Account Transfer	1059682573 300002	,TO 02749020	304,322.29		5,566,649.52
06-Dec-2021	Inter Account Transfer	1059682113 300002	,TO 02749020	13,670.93		5,552,978.59
		Totals		618,591.73		
		End of Report Ledger Balance				5,552,978.59

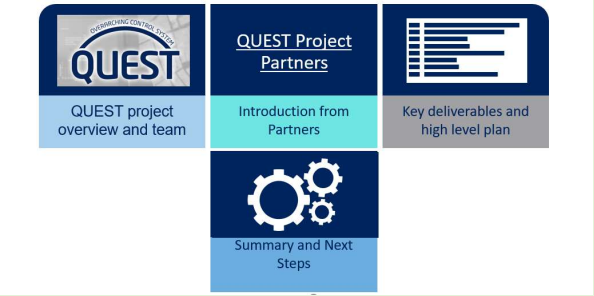
Note:

ENWL's contribution of £891,696 was made into QUEST bank account on the 29th April 2021.

Appendix F: QUEST communications register

Date	Activity	Audience	Evidence
Nov 2020	QUEST webpage created	All stakeholders	Webpage 
Dec 2020	Press release announcing QUEST funding and project description	All stakeholders	Webpage 
Dec 2020	Funding decision announced in Connect, weekly e-bulletin	All ENWL employees	

Date	Activity	Audience	Evidence
Oct 2021	QUEST project video at ENIC 2021 and on website	All stakeholders	YouTube 
Oct 2021	QUEST project ENIC 2021 presentation (available on website)	All stakeholders	Webpage 
Nov 2021	Feature in Innovation Newsletter	All stakeholders on innovation mailing list and visitors to webpage	Webpage 

Date	Activity	Audience	Evidence
May 2021	QUEST Kick-off Meeting Agenda	All project partners and ENWL Project team	
July 2021	QUEST ISG 1 Meeting Agenda	All ENWL QUEST project team and DNO representatives (Northern Power Grid & Western Power Distribution)	

Appendix G: Glossary of terms

Cable	An underground conductor used to distribute electrical power, typically buried directly in the ground or installed in ducts or troughs
Capacity	The amount of power that can be delivered by an asset
Current	The movement of electrons through a conductor, measured in amperes, milliamperes and microamperes
Demand	The amount of electrical energy that is being consumed at any given time
Distribution substation	A substation which contains high voltage (HV) switchgear, an HV/LV transformer, LV switchgear and short length of LV cable(s) and can be either pole- or ground-mounted
Distribution network operator (DNO)	The owner and/or operator of an electricity distribution system and associated assets
Energy Networks Association (ENA)	The industry body funded by GB electricity transmission and distribution licence holders and gas transporter licence holders. It lobbies on common issues in the operating environment, at domestic and European levels, and provides technical services for the benefit of members
High voltage (HV)	Voltages over 1kV up to, but not including, 22kV
NIC	Network Innovation Competition
Low carbon technology (LCT)	A type of technology which operates with substantially fewer carbon emissions than traditional equivalents
Low voltage (LV)	This refers to voltages of 1kV and below
Reinforcement	Network development to relieve an existing network constraint or facilitate new load growth
Deliverable	Successful delivery reward criteria
Substation	A point on the network where voltage transformation occurs
Switchgear	Device for opening and closing electrical circuits
Transformer	Device that changes the network voltage without changing the frequency
NMS	Network Management System

Appendix H: Whitegate GSP Geographical Network Area