

# Constellation

Project Progress Report – January 2021 to June 2021



Constellation Partners



UNIVERSITY OF STRATHCLYDE  
POWER NETWORKS  
DEMONSTRATION CENTRE

**SIEMENS**  
*Ingenuity for life*



## Contents

1.	Executive summary .....	3
1.1	Project background .....	3
1.1.1	Situation .....	3
1.1.2	Complication .....	3
1.1.3	Solution .....	4
1.2	Project progress .....	6
1.3	Risks and issues .....	7
2.	Project Manager's report.....	7
2.1	Workstream 1 – Software & Cyber Security Requirements, Design and Development .....	10
2.2	Workstream 2 – Functional Requirements, Design, Development and Hardware Specification .....	12
2.3	Workstream 3 – Trials & Analysis .....	14
2.4	Workstream 4 – Open Innovation Competition .....	16
2.5	Workstream 5 – Academic Insight & Future Governance.....	17
2.6	Workstream 6 – Learnings & Dissemination.....	18
3.	Business case update .....	19
4.	Progress against plan .....	21
4.1	Detailed progress in the reporting period.....	22
4.2	Identification and management of issues .....	22
4.3	Key achievements and notable events in the reporting period are shown below:.....	23
4.4	Look-ahead to next reporting period .....	23
5.	Progress against budget .....	23
6.	Project bank account .....	23
7.	Project Deliverables .....	23
8.	Data access details .....	25
9.	Learning outcomes .....	26
10.	Intellectual Property Rights (IPR).....	26
11.	Risk management .....	27
12.	Accuracy assurance statement.....	32
13.	Material change information.....	32
14.	Other information .....	32

## 1. Executive summary

### 1.1 Project background

#### 1.1.1 Situation

The energy industry is at the heart of the UK's journey to Net Zero as more consumers shift their behaviour and increase their reliance on electricity. Consumers will depend on electricity to heat, eat and move, in addition to keeping the lights on. It is therefore essential to increase the whole electricity system's resilience. UK Power Networks is keenly aware that we must do this cost effectively to ensure the impact on energy bills is kept to a minimum.

To facilitate Net Zero at the lowest cost to consumers, electricity network operators:

- Have developed sophisticated and powerful central capabilities, such as Advanced Distribution Management Systems (ADMS) and Active Network Management (ANM); and
- Will employ smart services such as flexibility to allow quick and efficient connection of more Low Carbon Technologies (LCTs) to the distribution network.

#### 1.1.2 Complication

**Network resilience:** The existing central network management systems deliver significant benefits in terms of the ability to actively control large volumes of demand and generation on the network. However, these systems have limited resilience, specifically in their ability to continue to operate optimally when communication links are unavailable.

Furthermore, as network operators increase their reliance on smart services provided by Distributed Energy Resources (DER), there is a significant future risk to the network resilience. Previously the loss of distributed generation (DG) was of little consequence to the network operation, as it did not provide services in significant volumes to the distribution network. However, as we increase our reliance on DER to provide smart services, the loss of a high proportion of generation at the distribution level could lead to an increase in disconnection events and potentially blackouts. More specifically, UK Power Networks estimate that 2.9GVA<sup>1</sup> of smart services in GB will be at risk of being impacted by loss of communication with central systems or by unnecessary interruption of DER by 2050.

**Network capacity:** The expected increase in DER required to achieve Net Zero will require significant amount of network capacity to be available in specific areas, so our first step is to ensure we fully utilise the existing network capacity. However, DNOs' existing protection systems can limit the available capacity in some instances. Specifically, protection is designed to protect the network from faults, but in specific cases it limits the amount of DG that can be connected. Load blinding is the latest solution which allows the protection to use a pre-calculated power factor to differentiate between network faults and generation/load. This solution is limited by the single static setting which is unsuitable for the changing power flows of the future network. By 2050, this will result in parts of the GB network having an estimated 1.4GVA<sup>1</sup> of unaccessible spare capacity to connect more DER and support our transition to Net Zero due to static protection settings.

---

<sup>1</sup> [https://www.ofgem.gov.uk/system/files/docs/2020/11/constellation\\_nic\\_2020\\_fsp\\_-\\_public\\_27.11.2020\\_0.pdf](https://www.ofgem.gov.uk/system/files/docs/2020/11/constellation_nic_2020_fsp_-_public_27.11.2020_0.pdf)

**Digitalisation:** Existing protection, control and communication functionality within substations are supplied within dedicated hardware and require lengthy installation, commissioning and maintenance processes. The current products are also difficult to integrate and have limited flexibility to adapt their functionality. The Energy Data Taskforce recommend maximising the value of smart digital solutions, rather than solely relying on the mass deployment of equipment. As such, there is a growing need for single hardware containers hosting a number of flexible and easy to implement virtual (software) solutions.

## 1.1.3 Solution

Technology is evolving at a rapid pace and UK Power Networks recognises the opportunities this presents to enhance our resilience and facilitate Net Zero at the lowest cost for consumers. In order to overcome the complications above we will leverage the newest advances in 5G communication and software engineering to enhance our local substations by making them more intelligent, digital, interoperable and enable secure, scalable communication between them.

Constellation achieves this through a flexible and future proofed system for local intelligence working in partnership with the existing central systems. There are two distinct Methods:

- Method 1: Local ANM – Local network optimisation at the substation level to provide resilience to DER operation against loss of communication with the central systems.
  - Whenever the central systems are unable to communicate with our local network assets, the local intelligence will take over optimisation for that specific provider, substation or area. This will enable the network to be operated more optimally, controlling the area locally, compared to curtailing the provider.

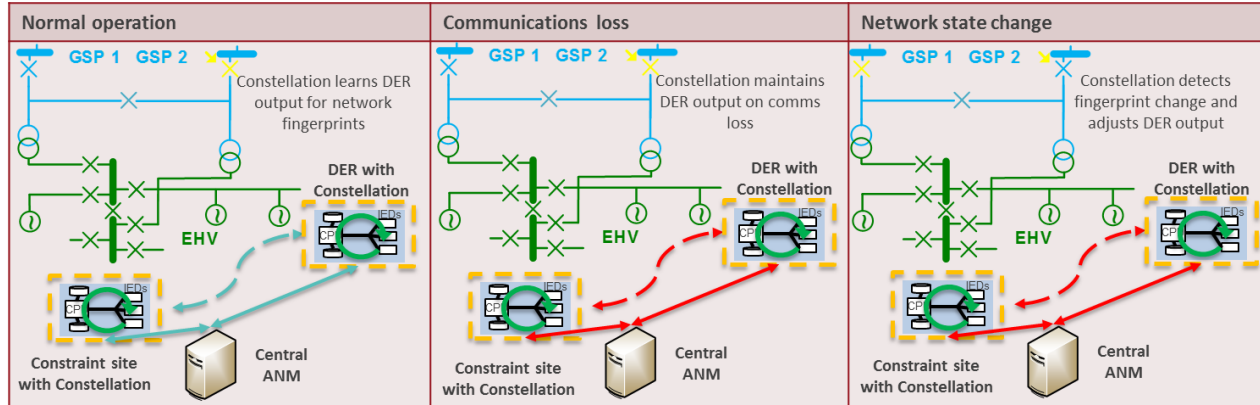


Figure 1 - Local ANM (Method 1) summary diagram

- Method 2: Wide area and adaptive protection:
  - Provide resilience to DG operation against instability events triggering the conventional generator protection. Constellation will develop sophisticated protection algorithms to identify when the DER should disconnect, if events have caused islanded operation. This will rely on low latency communications via 5G slicing.

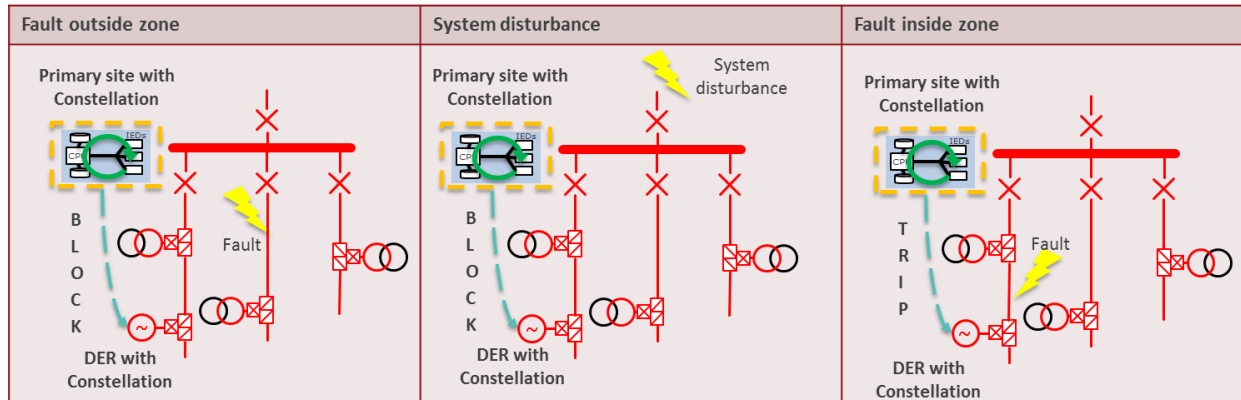


Figure 2 - Wide area protection (Method 2) summary diagram

- Dynamically assessed protection settings and enhanced wide area control to enable more capacity for DER to connect. Constellation will develop the ability to provide real time protection settings from the substation to dynamically validate and modify them. This will allow the load blinding to adapt to the power flows on the network and correctly discriminate between genuine faults and generation/load.

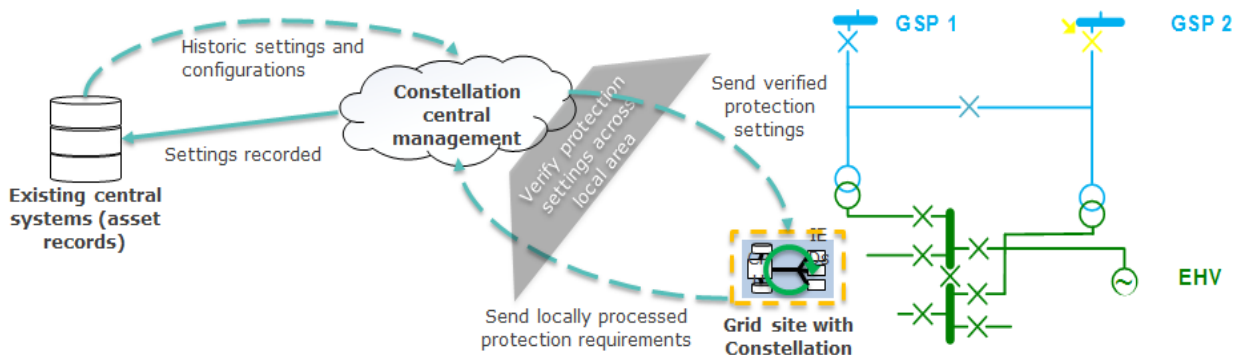


Figure 3 - Adaptive protection settings (Method 2) summary diagram

Constellation is UK Power Networks' newest flagship innovation project which is delivered between 2021 and 2025 in partnership with ABB, GE, Siemens, the Power Network Demonstration Centre (PNDC) and Vodafone and was awarded funding in 2020 by Ofgem as part of the Network Innovation Competition (NIC) funding mechanism.

If proven successful, UK Power Networks estimates that by 2030 the solutions trailed as part of Constellation could save customers in GB £132m in cost efficiencies. The project Methods will also enable carbon savings of 1.9m tCO<sub>2</sub> and will release an additional 1.98GVA of network capacity by 2030 in GB.



### 1.2 Project progress

This Project Progress Report (PPR), the first for Constellation, covers the period between January 2021 to June 2021. This document, together with the next six-monthly report, due to be published in December 2021, will fulfil the reporting requirements of Sections 8.11 – 8.15 of v3.0 of the NIC Governance Document for 2021<sup>2</sup>. The Constellation team prefers to publish PPRs every six months rather than the minimum requirement of annual reporting because the project advances substantially in a six-month period. It is anticipated that other NIC projects and stakeholders would therefore benefit from being informed of the progress and learning on a six-monthly basis. The next reporting period will cover July to December 2021. The general project progress is presented first, and then followed by workstream detail of the progress – starting with workstream 1 and finishing with workstream 6.

To date, good progress has been made and the project is on schedule for delivery aligned to the Project Direction. Over this period, the project has successfully:

- Finalised legal agreements between all Constellation project Partners;
- Initiated the mobilisation of the project teams across all the Partners;
- Kicked-off the project on 28 April 2021 – a week before the planned start date as reported in the Full Submission; and
- Completed initial planning and coordination of activities for the first Project Deliverable.

The focus prior to the kick-off meeting was the negotiation and agreement of the legal and commercial terms across all project Partners. Additionally, the lead project Partner (UK Power Networks) mobilised the delivery team and set up the project control systems and tools which will be used for the management of the project. This has been informed through lessons learned from previous and on-going NIC projects, such as Power Potential and Active Response. Regular progress review, coordination and risk management sessions are now in place to limit risk of slippage. The progress across the six workstreams since the project kick-off (28 April) is detailed below:

- **Workstream 1** is responsible for the specification, design and development of the software, architecture, integration and cyber security aspects across all Constellation elements. This workstream compliments workstream 2 as it will provide input to the hardware requirements. This workstream is on track. UK Power Networks has initiated the planning activities of the key specification and design activities for 2021. Additionally, a number of technical sessions have been carried out to define the integration dependencies for all project Partners. A key achievement in workstream 1 was the finalisation of the methodology to specifying the requirements for the the software, architecture, integration and cyber security.
- **Workstream 2** is responsible for the specification, design and development of the functionality (performance) of all Constellation elements and the equipment which will be trialled. This workstream is on track. This workstream has initiated the drafting of the overall system specifications. These specifications consist of the hardware requirements, the functional (performance) requirements for Method 1 (Local ANM), Method 2 (Wide area and adaptive protection), and the central management system.
- **Workstream 3** is responsible for the design and management of the Constellation trials, which incorporate **off network** trials hosted at the PNDC and **live trials** hosted on the UK Power Networks distribution network. This

<sup>2</sup> [https://www.ofgem.gov.uk/system/files/docs/2017/07/electricity\\_network\\_innovation\\_competition\\_governance\\_document\\_version\\_3.0.pdf](https://www.ofgem.gov.uk/system/files/docs/2017/07/electricity_network_innovation_competition_governance_document_version_3.0.pdf)

workstream is on track. The workstream has so far developed high-level objectives for the trials based on engagement with the project Partners. These objectives will feed into the test requirements definition and the development of the detailed trials design over the next reporting period.

- **Workstream 4** is responsible for running the Open Innovation Competition (OIC), which involves incubating and testing additional methods for deployment on the Constellation platform. The activities related to this work stream start in 2022, so it is currently on track. However, the outcomes of the requirements elicitation phase carried out in 2021 under workstreams 1 and 2 will feed into this workstream.
- **Workstream 5** is responsible for the academic insights and research into the future governance. This workstream will feed into the requirement specification for workstreams 1 and 2. This workstream is on track. The focus of the workstream so far has been on specifying the requirements for the two initial research streams:
  - Adaptive and Loss of Mains (LoM) protection; and
  - Communication and data architecture.

A key achievement was the finalised scope of both research streams and the kick-off of the research itself.

- **Workstream 6** is responsible for the dissemination of the knowledge generated from the project. The workstream is on track. The main activities completed during this reporting period include the completion of the project kick-off meeting involving all project Partners, the submission of an abstract for the CIGRE 2022 Paris session and engagement with members of the PNDC digital substation working group.

### 1.3 Risks and issues

During this reporting period, the project has devised a robust risk management methodology to ensure that risks are raised promptly and mitigation actions are clearly set out with achievable deadlines. To date, none of the risks registered have developed into issues impacting the project's critical path. However, we have highlighted two key risks in section 4.2:

- Technical uncertainty in the initial requirements and design stage of the project due to the novelty of Constellation. This is currently mitigated by coordinating the plan for the upcoming design stage across both internal and external technical experts.
- Risk of not identifying suitable sites in time for our Partners to do any bespoke analysis and design. We are currently working internally to arrange site surveys to provide our Partners with trial site details early in the project.

Since the bid submission, a number of risks have been added to the risk register; all risks are shown in Section 11. Some of these risks have the potential to impact the critical path but suitable mitigations are currently being scoped and agreed. The project team carefully tracks these risks on a frequent basis to ensure that further mitigations can be applied where necessary.

## 2. Project Manager's report

The project made good progress during the reporting period (January – June 2021), focusing on the following areas:

- Finalised the Collaboration Agreement and the individual Project Agreements;
- Initiated the mobilisation of UK Power Networks' project team, including the recruitment of key resources;
- Initiated the mobilisation of the project Partner teams;
- Formally commenced the project;
- Ongoing project planning, which is vital for tracking the effects of changes to workstream plans on the overall Constellation programme and mitigating associated risks; and
- Ongoing engagement with UK Power Networks' stakeholders.

## Legal agreements with project Partners

The Collaboration Agreement sets out the Partners' general obligations to each other under the Constellation project. The specific individual project Partner deliverables and payments are set out in individual Project Agreements, as visualised in Figure 4 below.

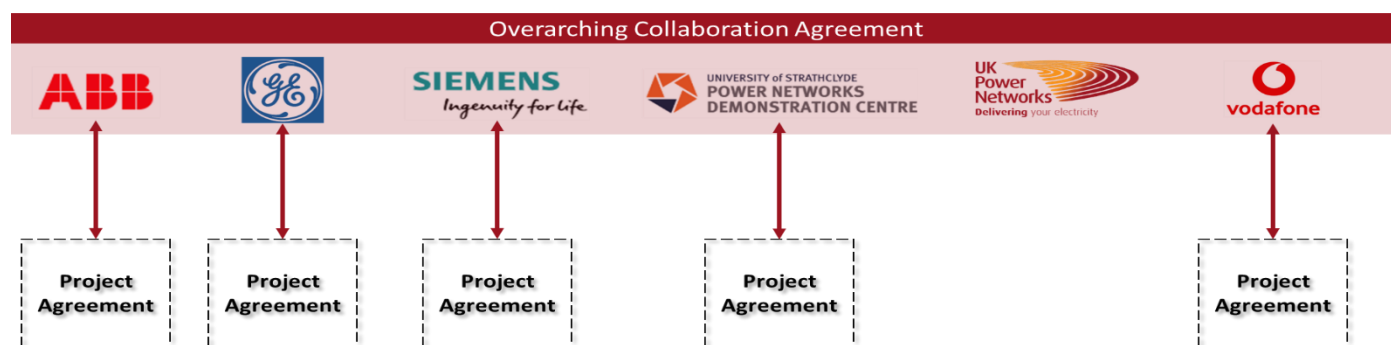


Figure 4 – Constellation's legal framework for consortium of Partners

The legal requirements for collaboration on this NIC project were discussed throughout the development of the bid in 2020. UK Power Networks proactively engaged with all Partners before the funding decision was made, as our previous experience has shown the value of starting legal discussions early.

Between September 2020 and January 2021, all Partners focused their efforts on discussing and agreeing on the general obligations to each other under the Constellation project through a series of dedicated group legal workshops. In February 2021 the Collaboration Agreement was in its final draft and the Partners focused the legal discussion on the individual Project Agreements. In parallel, all Partners secured internal governance approvals and by April 2021 all the contracts were signed in time prior to the project kick-off meeting.

## Resourcing and mobilisation

After the project was awarded funding in December 2020, all project Partners began their internal mobilisation in parallel with the legal discussions. All Partners have established their project teams which will lead the day-to-day delivery within each Partner organisation.

UK Power Networks specifically assembled the core Constellation delivery team, which consists of:



- **Programme Manager** – Constellation is included in UK Power Networks's NIC portfolio. The NIC Programme Manager will be a key decision maker for the project;
- **Project Lead** – A Project Lead has been appointed to the role following successful recruitment. The Project Lead will be responsible for the day-to-day management of the entire Constellation initiative. The Project Lead will also look after workstream 6 unless the successful individual who takes over workstream 1 is sufficient qualified for this role;
- **Project Management Office (PMO)** – The existing Innovation PMO will be providing support to the Project Lead as required;
- **Workstream 1 Lead** – Recruitment in progress;
- **Workstream 2 and 5 Lead** – An experienced Technical Sourcing and Standards engineer within the Asset Management team in UK Power Networks has been appointed the role. This workstream lead will manage the delivery of the technical aspects of the Constellation project, including the academic research; and
- **Workstream 3 and 4 Lead** – An experienced R&D Lead from the Power Networks Demonstration Centre (PNDC) has taken the lead. This workstream lead will manage the delivery of the trials and the Open Innovation Competition (OIC).

The project was planned to begin in May 2021 after the legal agreements were signed. As a result, the mobilisation for workstream 1 and for some of the project Partners will continue into the next reporting period (July to December 2021). It is expected that by the end of Q2 2021 all Partners will have fully mobilised their delivery teams.

### Kick-off meeting

UK Power Networks hosted the project kick-off event for Constellation with all project Partners in attendance on 28 April 2021. Due to the COVID-19 travel restrictions, the session was hosted online via Microsoft Teams and a MURAL digital whiteboard, and 57 stakeholders attended the event. The agenda is shown in Figure 5 below.

The purpose of the event was to bring all the project Partners together and establish a common understanding of the project and everyone's role within it. The session was also to set out the importance of Constellation for Net Zero and the wider industry.

09:00	Welcome	10:45	Q&A
09:10	Constellation and its importance	11:00	Short break
09:50	Q&A	11:05	Collaborative brainstorming
10:00	Short break	11:40	Collaborative planning
10:05	Constellation overview	12:05	Next steps
10:10	Partner introductions	12:15	Event close

Figure 5 - Kick-off meeting agenda

As part of the event, executive representatives from all Partner organisations set out the direction for Constellation and why it is essential we collaborate and successfully deliver the initiative. The working teams then utilised the digital white board on MURAL to introduce themselves and where they are from. As part of this exercise, we collaboratively mapped the wider project team across all Partners on a map. This allowed us to understand our backgrounds and our diversity, which are essential to our collaboration on Constellation.

UK Power Networks conducted a high level planning exercise whereby project Partners could highlight key activities and milestones which would impact their respective scope and deliverables. The output from this exercise can be seen in Figure 6 below. This exercise allowed the project Partners to highlight key dependencies affecting their delivery and enabled the project team to capture any new project risks not already identified in the FSP. Early flagging will allow the project team to manage and mitigate the impact of these risks. Further details on specific risks captured in the project are covered in Section 11 of this PPR.

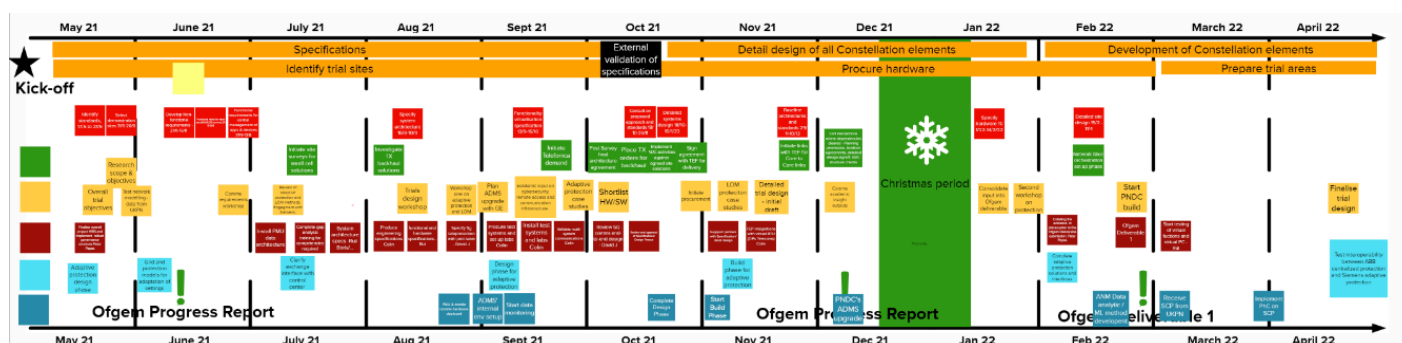


Figure 6 - Output from the high level planning

The kick-off event was essential in engaging with the Constellation stakeholders and establishing a collaborative approach to delivering the project. The event was successful and the feedback from the attendees was that they were motivated, excited and engaged to deliver Constellation.

The following sections present individual workstreams' progress reports. Each workstream's report covers progress made during the reporting period, the challenges encountered, lessons learned and focus areas for the next reporting period. The progress for the workstreams in sections 2.1 to 2.6 is for the first weeks of the project (between May and June 2021), as Constellation kicked off on 28 April.

## 2.1 Workstream 1 – Software & Cyber Security Requirements, Design and Development

Workstream 1 is responsible for the specification, design and development of the software, architecture, integration and cyber security aspects across all Constellation elements. This workstream is delivered in collaboration with ABB, GE and Siemens as they will be designing and developing software solutions for Methods 1 and 2. This workstream is also in collaboration with Vodafone, who will provide the secure site-to-site communication, and PNDC, who will test all Constellation elements.

### Progress during this reporting period

During this reporting period, this workstream focused on the following activities:

- Organising weekly progress meetings to discuss key actions and risks;
- Coordination of the key expertise within UK Power Networks and the project Partners; and
- Planning the delivery of the workstream outputs.

Progress has been made with the drafting of the architecture specifications. These include the software (virtualisation) environment, integration and cyber security requirements. A technical record of the existing (known) high-level requirements will be produced by the Constellation team within the first three months. Over the first month of the project, this workstream developed the approach for specifying the requirements which are necessary prior to the detail design (Figure 7).

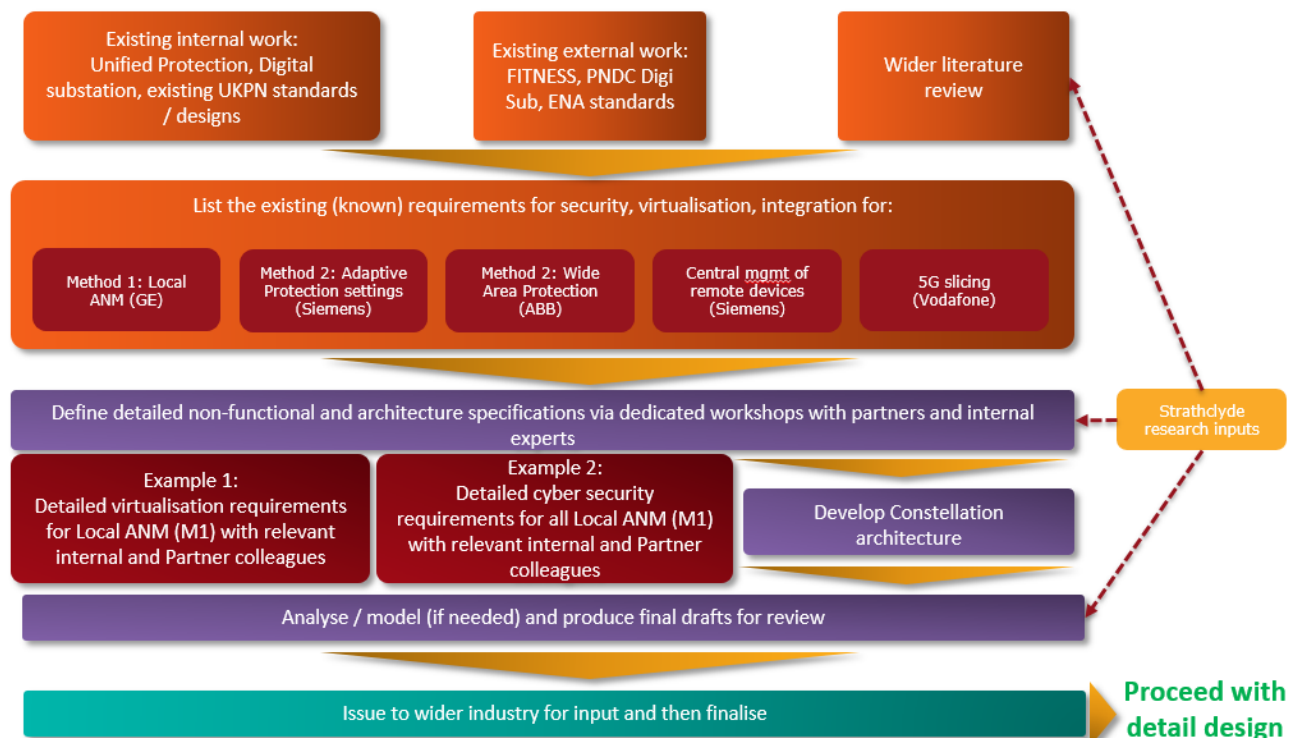


Figure 7 - Approach for the workstream 1 requirements and design

## Challenges and lessons learned

A key part of the early stages of the project is to understand what previous and on-going work can contribute to the requirements and design for Constellation. It is essential that the project Partners collaboratively research all relevant on-going activities in virtualisation, integration and cyber security areas and use the results as a starting point for the initial requirements.

One of the main challenges in the early stages of the project is specifying the requirements for the software (virtualisation) environment. The requirement for this environment is to be suitable for real time protection and control software and to

manage the physical (hardware) resources of the substation computer efficiently and reliably. The real time element of this environment needs to be carefully designed to ensure the correct operation of the Local ANM and the Wide Area Protection.

## Outlook for next reporting period

During the next reporting period this workstream will focus on:

- Specifying the existing (known) software (virtualisation) environment, integration and cyber security requirements;
- Identifying the gaps in requirements and standards which support them;
- Setting up workshops and focus groups with key internal and Partner experts;
- Collaboratively detailing the full requirements for software (virtualisation) environment, integration and cyber security;
- Developing the draft system architecture; and
- Creating the integration plans with key internal systems.

## 2.2 Workstream 2 – Functional Requirements, Design, Development and Hardware Specification

Workstream 2 is responsible for the specification, design and development and agreement of the functionality (performance) of all Constellation elements specifications and the equipment to which will be trialled. The areas covered include:

1. Hardware requirements: in line with IEC 61850-3 and applicable national standards;
2. Method 1 requirements: deployment of local active network management (ANM) functions at the trial sites;
3. Method 2 - wide area protection requirements: islanding prevention and response to voltage and frequency events;
4. Method 2 - adaptive protection requirements: automatic update of protection settings via IEC 61850 data attributes;
5. Method 2 - virtual protection functions requirements: provision of protection functions that run in a virtual platform at the substation PC. The required data attributes and system integration shall be defined too; and
6. Central management system (of remote devices in substations) requirements: provision of a central platform to store and manage a wide range of protection and control data that is continually updated.

## Progress during this reporting period

During this reporting period, the workstream focused on the following activities:

- Organising weekly progress meetings to discuss key actions and risks;
- Coordination of the key expertise within UK Power Networks and the project Partners; and
- Planning the delivery of the workstream outputs.

The work plan for the delivery of functional requirements has been agreed between the Partners. Progress has also been made with the drafting of the overall system specifications. These include the functionality (performance) of all Constellation elements specifications and the equipment to which will be trialled. This document shall include agreeable high-level requirements and a direction towards the detailed specifications for each element of Constellation.

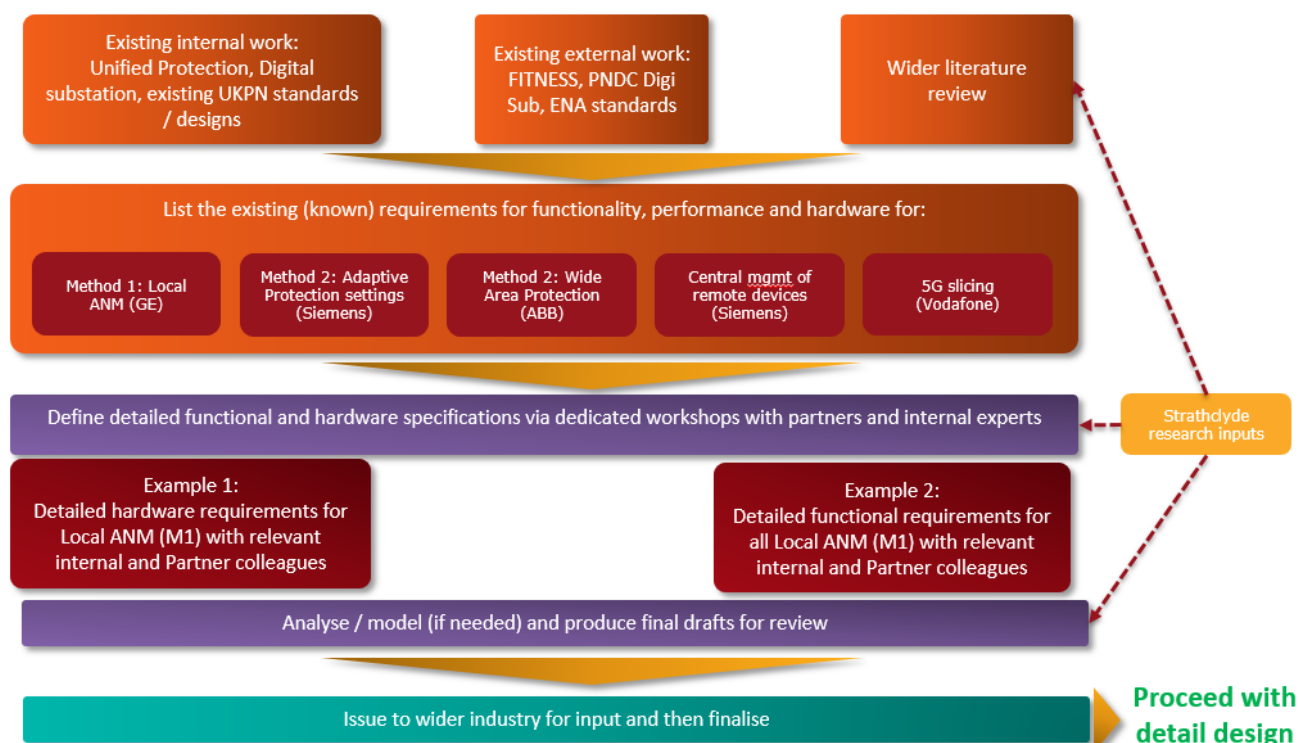


Figure 8 - Approach for workstream 2 requirements and design

## Challenges and lessons learned

The fast evolving technology means that the specifications defined in 2021 need to be flexible and future-proof. This is more relevant for the 5G communications, cyber-security requirements and virtualisation platforms. To ensure the solutions are enduring, early and comprehensive engagement is being made internally and with the Partners.

## Outlook for next reporting period

The initial high-level system specifications are planned to be agreed upon in the next reporting period. Additionally, in the next reporting period the detailed system requirement specifications are planned to be drafted and reviewed.



The next progress report shall report the progress on the following activities:

1. Detailed specifications;
2. Partners' agreement on detailed specifications;
3. Commencement of the detailed design;
4. Identification of suitable trial sites;
5. Trial site preparation plans; and
6. Site equipment procurement process initiation.

## 2.3 Workstream 3 – Trials & Analysis

Workstream 3 is responsible for designing, running and evaluating the outcomes of the Constellation trials. The trials aim to ensure sufficient de-risking of the Constellation Methods is achieved by advancing their TRL and successfully demonstrating their functionality in an operational environment. The trials consist of two complementary phases – **off network** trials hosted at the PNDC and **live trials** on the UK Power Networks distribution network. The iterative nature of the trials process ensures the translation of specifications associated with the Constellation Methods into a set of refined requirements and network management policies and standards for BaU rollout, as illustrated in Figure 9 below.

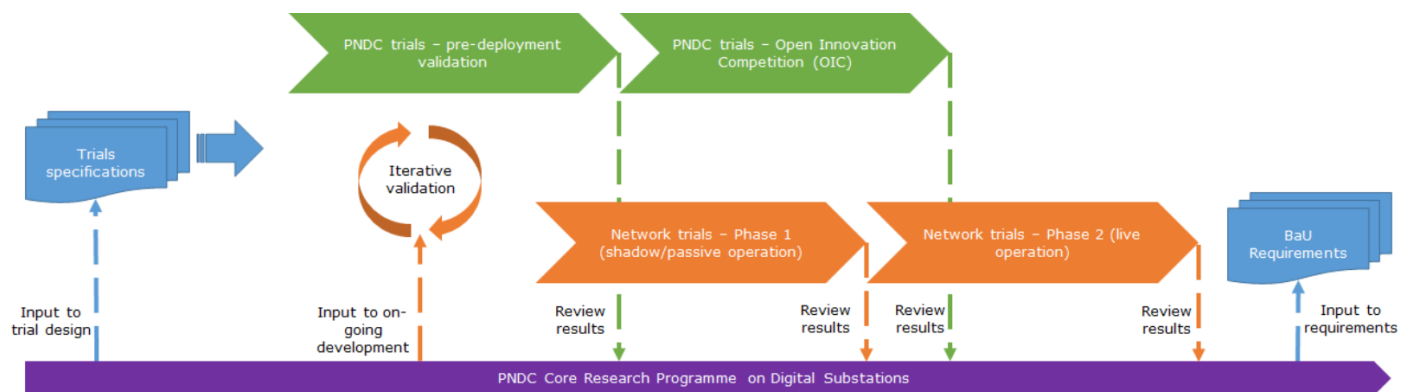


Figure 9 - Constellation trial process

## Progress during this reporting period

A workshop has been organised by the PNDC to elicit some of the trials requirements for the Constellation solution. The workshop was conducted via a Miro virtual whiteboard (as seen in Figure 10) to collect and organise input from the workshop attendees. The workshop was attended by PNDC members, including UK Power Networks, Scottish Power Energy Networks and Scottish and Southern Energy Networks as well as SMEs innovating in this space such as Powerline Tehcnologies, Bellrock Technology, Chronos and Fundamentals. The testing requirements identified during the workshop were structured around the main elements of the Constellation system. These elements include the hardware, the virtualisation (software) environment, the site-to-site communication and central management of remote devices.

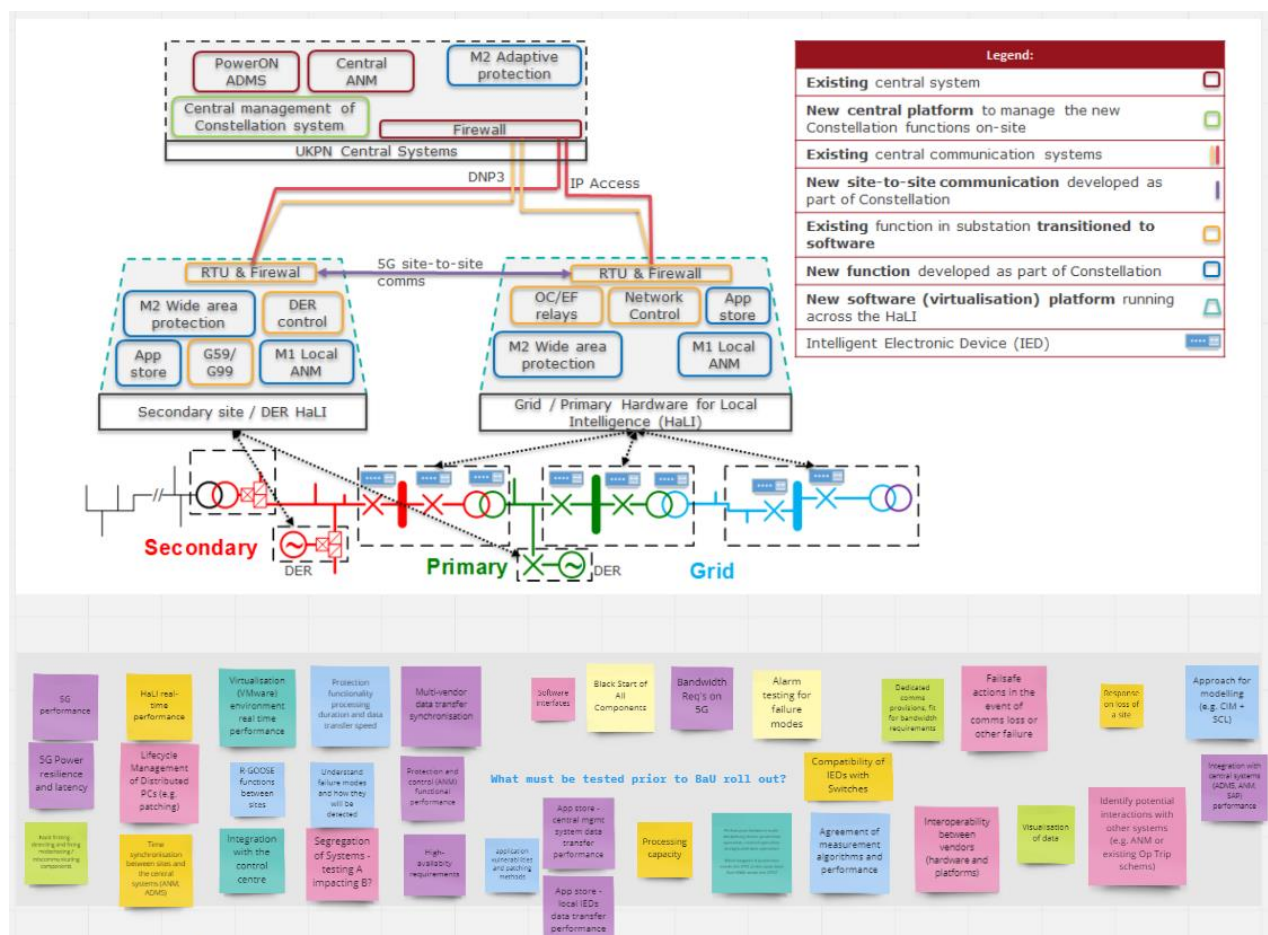


Figure 10 - Workshop notes on Constellation trial requirements

The workstream started developing high-level objectives for the trials based on the engagement with the project Partners to date. These objectives will identify what and how should be tested during PNDC and UK Power Networks trial phases. These will then feed into the test requirements definition and the development of the detailed trials design over the next reporting period.

## Challenges and lessons learned

In this early stage of the project it is important to carry out focused engagement sessions with the project Partners to elicit testing requirements including one-to-one and group workshops related to the constituent elements of the Constellation solution. This will ensure both a deeper and common understanding of the Constellation system such that traceability of requirements can be established for successful trials.

One of the main challenges at the early stages of the project is the identification of the UK Power Networks trial sites. On one hand this dependency may result in some uncertainty in the elicitation of testing requirements for the live trial, but on the other hand this is an opportunity to develop a trials methodology that is applicable to a wide range of sites and is not specific to a single DNO so that the learning outcomes can be scalable to other network operators. Furthermore, the PNDC digital substation working group will be leveraged as a forum to validate the trials methodology across a wider spectrum of end users and potential technology suppliers.

### Outlook for next reporting period

Over the next reporting period, workstream 3 will focus on the following activities:

- Engaging with UK Power Networks, the project Partners and the project Suppliers for the development of testing requirements and trials design through a series of workshops;
- Initiating the design of PNDC trials, which will focus on the functional and non-functional verification of the Constellation Methods and platform as well as the sharing of learning from this phase with the project Partners and PNDC digital substation working group; and
- Commencing the design of UK Power Networks trials. This activity will focus on the site specific aspects of testing including interactions with generator sites. Ultimately, the outcome of the trials will validate the business case assumptions and inform the route to BaU rollout.

### 2.4 Workstream 4 – Open Innovation Competition

Workstream 4 is responsible for the incubation and trial of additional methods (use-cases) that are delivered by third parties and procured from the market in an open competition format.

#### Progress during this reporting period

The workstream activities do not start until 2022. However, in preparation for the kick-off, stakeholder engagement was carried out to identify the use cases that the OIC should prioritise. This is from a list of 17 provisional use cases presented in the Constellation FSP (section 10.4.8, Table 18). The following top three use cases were identified based on an outcome of a vote:

- First: IC03 – **Fault location**, use a high sample rate data recorder at a primary / grid substation to carry out travelling wave fault location for all feeders;
- Second: IC08 – **Network islanding**, The Constellation platform and wide area protection can allow sections of the DNO network to safely island and reconnect and can be deployed at scale;
- Joint third: IC06 – **Voltage control**, use wide area measurements and DER reactive power control to reduce the voltage transients on the network. Integration with secondary on load tap changers is possible when they become common place; and
- Joint third: IC04 – **Future protection**, using a high sample rate data recorder to carry out waveform based local protection algorithms to detect low fault current faults and intermittent issues. Proactive action can be taken to carry out repairs before a feeder trip would traditionally occur.

## Challenges and lessons learned

The workstream activities do not start until 2022.

## Outlook for next reporting period

Although workstream 4 was not planned to start until 2022 (as per the FSP), the following relevant activities will be undertaken over the next reporting period to ensure delivery on time:

- Input in to the requirements and design phases of the project in 2021 to ensure the ability of third parties to implement and trial additional methods as part of the OIC; and
- Design of the trials so that they are not exclusive to Constellation Methods 1 and 2, but rather encompass the general principles of functional and non-functional verification that enable the deployment of additional methods in the future.

## 2.5 Workstream 5 – Academic Insight & Future Governance

Workstream 5 is fundamental in ensuring that Constellation project delivers a future-proof system capable of increasing the electricity system resilience. It is aimed at answering the complex technical, commercial and contractual challenges of distributed network operation. It will be carried out through four investigation packages delivered by academic researchers and validated across the Project consortium and the PNDC core research programme working group.

### Progress during this reporting period

Two of the academic insight activities have already been kicked-off and are being delivered by the University of Strathclyde, these are:

- **Communication and data architecture:** activities will outline options for resilient and secure communication architectures required for the Constellation Methods. In addition, requirements for site-to-site communications, and the configuration and management of virtualisation of the Constellation Methods will be considered; and
- **Adaptive and loss of mains protection:** activities will focus on the systematic evaluation of the operation of these protection schemes to understand their performance envelope and inform the requirements and design phases of Method 2. Furthermore, this work will provide a wider perspective on possible protection solutions which can be implemented using a Constellation system.

During this reporting period, the objectives and scope of work for the aforementioned academic insight activities are being developed and after that, the literature review phase of these activities will commence.

## Challenges and lessons learned

No specific challenges or lessons learned to be reported on at this early stage of the project.



## Outlook for next reporting period

By the end of the next reporting period, the bulk of the two research activities will have been completed. The main activities will involve:

- Joint workshops between project Partners to discuss requirements, refine assumptions and disseminate outcomes;
- Modelling and Methods evaluation activities; and
- Production of technical reports presenting the outcomes of research activities with focus on input in to the requirements and design phases of the project and provision of a longer-term recommendations to support the scalability and longevity of the Constellation solution.

## 2.6 Workstream 6 – Learnings & Dissemination

Workstream 6 is responsible for the dissemination of the knowledge generated from the project. The project has a comprehensive knowledge dissemination plan in place that is outlined in the roadmap in Figure 11.

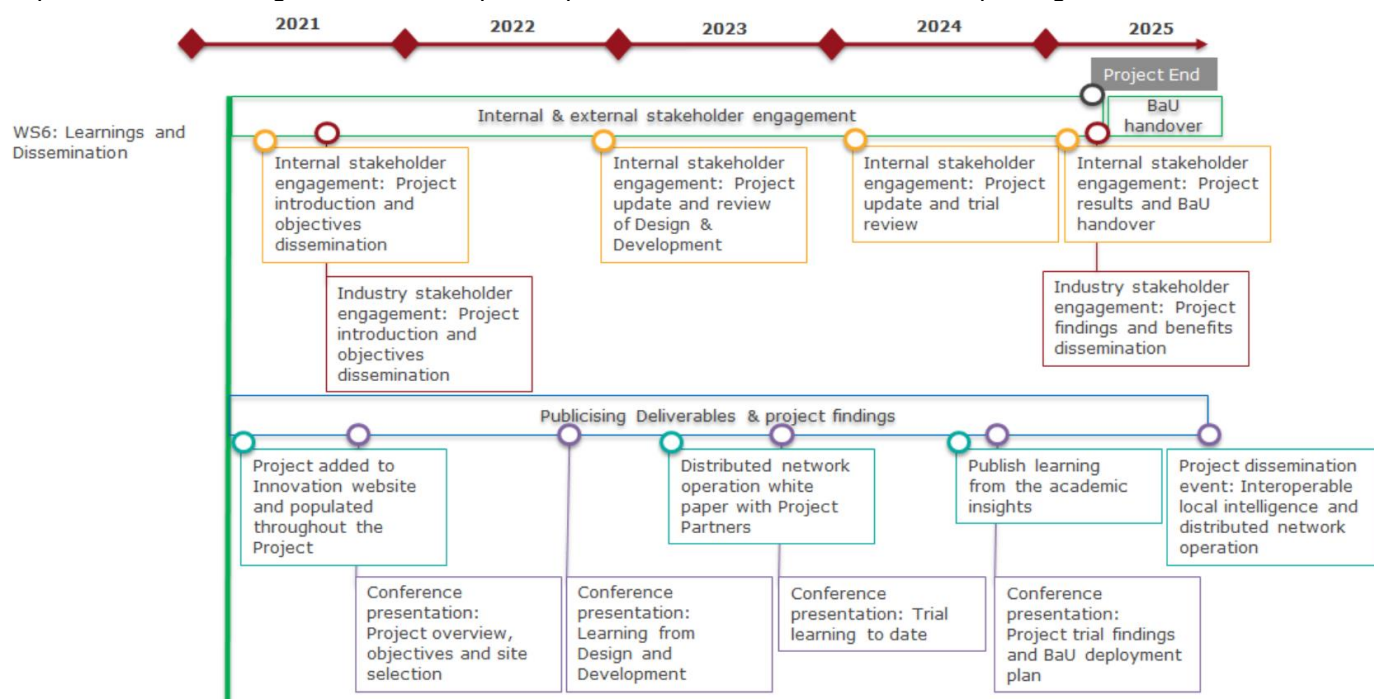


Figure 11 - Constellation knowledge dissemination roadmap

## Progress during this reporting period



The following key activities have been carried out:

- Project kick-off involving all project Partners. This is part of a continuous process to achieve a common understanding of project goals and Partner responsibilities.
- A PNDC digital substation working group workshop has been carried out focusing on the requirements for the Constellation trials. The workshop participants represented a wide spectrum of stakeholders, particularly from network operators and suppliers;
- An abstract for the CIGRE 2022 Paris session has been submitted to the CIGRE UK National Committee for consideration. This paper focuses on the lessons learned so far from the trials of centralised protection and control schemes in the UK Power Networks network, which paves the way to the implementation of the Constellation solution and Methods. This will be the first in a series of conference publications to disseminate the work related to digital substations carried out by the Partners; and
- UK Power Networks and the PNDC are currently in contact with CIGRE B5 and IEEE working groups looking into virtualisation and future digital substation architectures. These will be key forums for disseminating the work to an international audience and learning from experts in this field.

### Challenges and lessons learned

The key challenge with the kick-off meeting was ensuring all Partners had agreed to the Collaboration Agreement and had approved their individual Project Agreements prior to the project launch. As such, the project team had to closely plan and monitor the progress of the legal activities.

The project team learned that utilising collaborative digital tools (like MURAL) is essential to ensure engagement in group sessions during times when we cannot meet with our stakeholders in person. The digital whiteboard worked well with over 40 participants to allow us to brainstorm together and collaborate effectively.

### Outlook for next reporting period

Over the next reporting period, the project dissemination activities will ramp up to increase awareness of the project objectives and latest learning. Some of the key activities include:

- Regular PNDC digital substation working group updates and workshops; and
- Presentation at the ENIC conference.

## 3. Business case update

The project team has not discovered any new information that affects the business case. Consequently, the business case remains consistent with the Constellation FSP.

Figure 12 shows the costs and gross benefits, as well as the net expected benefits of Constellation when rolled out across GB, split between the two different cost and benefit categories. The left side of the graph shows the costs, while the right side shows the benefits.

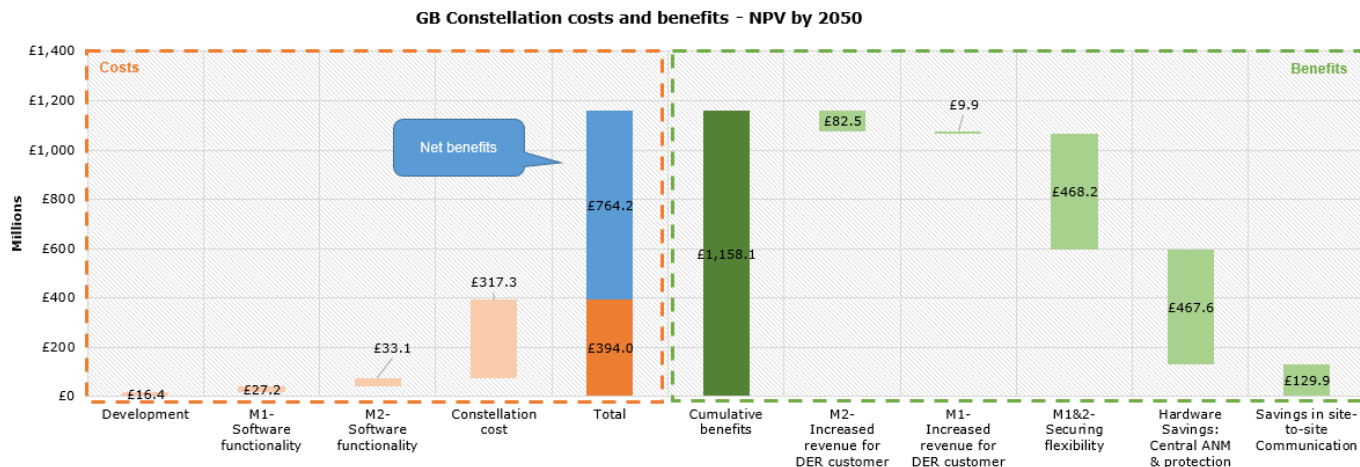


Figure 12 - Forecasted financial benefits in GB by 2050

# Constellation

Project Progress Report – January to June 2021

## 4. Progress against plan

Figure 13 shows the high-level project plan for Constellation. The project remains on track to achieve the Deliverables by the dates shown below. In the next few sections the project team describe the progress of more specific items in the detailed project plan.

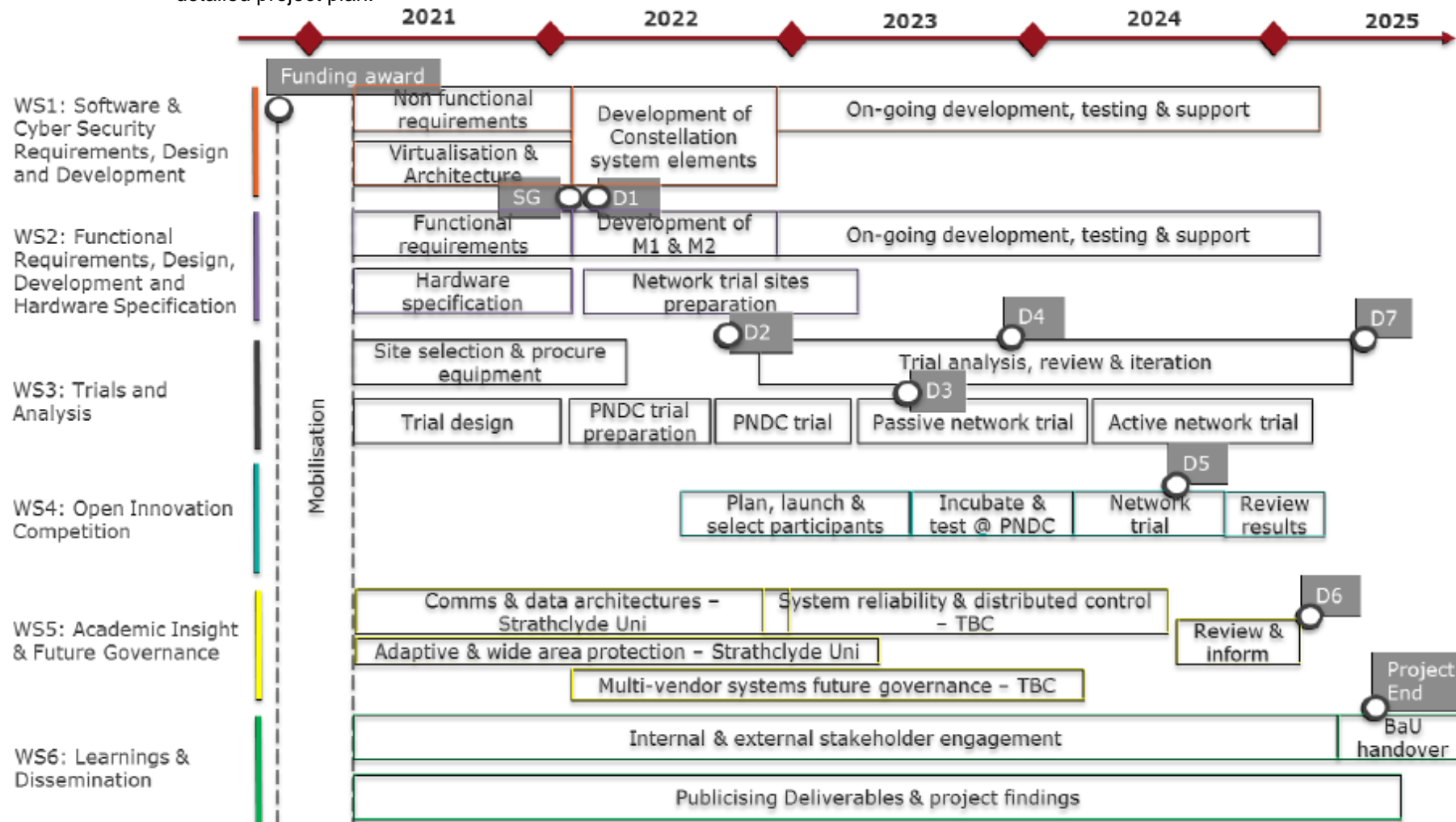


Figure 13 - High-level Project plan

## 4.1 Detailed progress in the reporting period

Overall progress to date is in line with the high-level project plan submitted in the FSP. The PNDC trial remains on track to start in Q4 2022. A summary of tasks that were started in the reporting period is given in the table below, together with their status at the end of the period.

Table 1 – Summary of tasks started in this reporting period

Task description	Workstream	Status at end of period
Finalise Collaboration Agreement		Completed
Finalise Project Partner Agreements		Completed
Mobilise delivery teams		In progress
Develop baseline plan		Completed
Plan, organise and carry out the kick-off event		Completed
Organise progress review and risk review sessions	1 and 2	Completed
Prepare requirement specification approach	1 and 2	Completed
Detail the high-level requirements for Methods 1 and 2	2	In progress
Detail the high-level requirements for the hardware, software environment and 5G site-to-site communication	1 and 2	In progress
Develop the high level architecture	1	In progress
Identify suitable sites and survey them	2	In progress
Specify and kick-off the academic research	1, 2, 3 and 5	Completed
Identify the trial design requirements	3	In progress
Procure the project Suppliers		In progress
Complete the first Project Progress Report		Completed

## 4.2 Identification and management of issues

The project team recognises the importance of robust risk management methodologies for any project, but more specifically for complex innovation projects. Due to the nature of these projects, it is likely that certain risks might impact the overall project activities. A full list of project risks identified for Constellation is provided in Section 11. While no issues have been identified at this stage, some risks could develop into issues if they are not mitigated in the next period. However, two risks have been identified as likely to occur and are presented below:

- Technical uncertainty risk – this is due to the novelty of the Constellation solutions. The project team are currently investigating suitable mitigations which, once agreed and approved, will be put in place to ensure the risk does not materialise (or reduce its impact if it does).
- Trial site selection risk – this is a planning and coordination risk which has been identified to impact the development and deployment of the 5G site-to-site communication between substations. To manage this risk UK Power Networks is in close communication with Vodafone, who are responsible for the 5G element of the project, to ensure they can get early access to the likely trial site locations. Vodafone will survey the likely trial

sites before UK Power Networks finalise them. This will enable Vodafone to proceed with the planning and design while the trial sites are being finalised.

### 4.3 Key achievements and notable events in the reporting period are shown below:

- Collaboration Agreement and all Project Partner Agreements are signed;
- Project kick-off meeting held;
- Baseline project plan developed; and
- The approach to developing the requirements and design is finalised.

### 4.4 Look-ahead to next reporting period

The following major tasks and milestones are planned for the next reporting period:

- Specification of the high-level Constellation requirements;
- Specification of the draft detailed requirements for Local ANM (M1);
- Specification of the draft detailed requirements for Wide area and adaptive protection (M2);
- Specification of the draft detailed requirements for the central management system;
- Specification of the draft detailed requirements for the 5G site-to-site communication;
- Specification of the draft detailed requirements for hardware;
- Development of the draft architecture for Constellation;
- Development of the draft overarching trial objectives;
- Progress on the trial site identification and selection; and
- Progress on the two streams of the academic research.

## 5. Progress against budget

This section is provided in the Confidential Appendix A.

## 6. Project bank account

This section is provided in the Confidential Appendix A.

## 7. Project Deliverables

This section provides an overview of progress against each of the deliverables set out in the Project Direction. The text describes progress on the evidence for each Deliverable.



Table 2 – Constellation Deliverables

Ref	Project Deliverable	Deadline	Evidence	Progress
1	Details of the system design and architecture for protection and control on a substation with local intelligence	28/02/22	(WS1 and WS2) Report on the system design of Constellation and the associated architecture for communication, protection and control across Methods 1 and 2	This deliverable is on track. The project team have begun specifying the high level requirements which will enable the design and architecture for Methods 1 and 2
2	Description of the trial design and site selection criteria process for Methods 1 and 2	31/08/22	(WS1 and WS2) Report containing: <ul style="list-style-type: none"> <li>• A description of the trial site selection criteria process for each phase of the network trials; and</li> <li>• Details of the trial requirements for the demonstration of each element of Constellation</li> </ul>	This deliverable is on track. The project team have begun reviewing potential trial sites and is currently investigating the site drawings and access details. The PNDC are also working closely with the Partners to specify the trial requirements.
3	Initial learning from off-network PNDC trial, and learning from development and virtualisation of Methods 1 and 2	30/06/23	(WS1, WS2 and WS3) Report containing: <ul style="list-style-type: none"> <li>• Details of the key learning from the design and development of Methods 1 and 2;</li> <li>• Details of learnings from design of 5G slicing; and</li> <li>• Testing preparation and early lessons from the off-network testing</li> </ul>	The deliverable remains on track, however no progress is due in this reporting period, aligned with the programme.
4	Review and insights following site installation and learning from mid trial passive network demonstration	30/11/23	(WS2 and WS3) Report containing: <ul style="list-style-type: none"> <li>• Key lessons from site installation process at DER sites and primary/grid substations; and</li> <li>• Early learning from the passive network demonstration</li> </ul>	The deliverable remains on track, however no progress is due in this reporting period, aligned with the programme.

Ref	Project Deliverable	Deadline	Evidence	Progress
5	Learning from the Open Innovation Competition (OIC)	31/07/24	(WS3) Report containing key learning on the OIC use case prioritisation, participant selection and incubation process	The deliverable remains on track, however no progress is due in this reporting period, aligned with the programme.
6	Learning from academic insights and the governance required to prepare for the future world of distributed network operation	28/02/25	(WS7) Report containing analysis by the academic partner on the opportunities, risks and barriers to full distributed and interoperable future network operation	This deliverable is on track. The project team and the University of Strathclyde have launched two of the four research streams.
7	Analysis and presentation of findings from the trials and plan for BaU deployment	30/09/25	(WS3) Report containing findings from the trials and appraisal of the business case including key learning and plan for BaU deployment	The deliverable remains on track, however no progress is due in this reporting period, aligned with the programme.
<b>[Note this is a common Project Deliverable to be included by all Network Licensees as drafted below]</b>				
N/A	Comply with knowledge transfer requirements of the Governance Document.	End of Project	<ol style="list-style-type: none"> <li>1. Annual Project Progress Reports which comply with the requirements of the Governance Document.</li> <li>2. Completed Close Down Report which complies with the requirements of the Governance Document.</li> <li>3. Evidence of attendance and participation in the Annual Conference as described in the Governance Document.</li> </ol>	First Project Progress Report is completed (UK Power Networks have elected to submit a report every six months)

## 8. Data access details

To view the full Innovation Data Sharing Policy, please visit UK Power Networks' website here: <https://innovation.ukpowernetworks.co.uk/wp-content/uploads/2019/11/UKPN-Innovation-Data-Sharing-Policy-7-Nov-19.pdf>

UK Power Networks recognises that innovation projects may produce network and consumption data, and that this data may be useful to others. This data may be shared with interested parties wherever it is practicable and legally permissible to do so and it is in the interest of GB electricity customers. In accordance with the Innovation Data Sharing Policy, published in 2019, UK Power Networks aims to make available all non-personal, non-confidential/non-sensitive data on request, so that interested parties can benefit from this data.

## 9. Learning outcomes

The project team recognises the importance of 'best in class' learning and dissemination. Specific lessons learned regarding each of the workstreams are captured in the workstream progress reports. As the project started in May 2021, there are no final materials which are available for dissemination as of yet. In the next reporting period, the project team will publish the report for Deliverable 1. This will be made publicly available on the UK Power Networks Innovation website.

## 10. Intellectual Property Rights (IPR)

As Constellation started in May 2021, this section lists any relevant IPR that is forecast to be registered in the next reporting period.

Table 3 – IPR forecast for next reporting period

IPR description	Owner	Type
Constellation requirement specifications	UK Power Networks	Relevant foreground IP

## 11. Risk management

This section lists the risks highlighted in the FSP plus any other risks that have arisen in the reporting period. The project team has described how we are managing the risks we have highlighted and how we are learning from the management of these risks. Risks 1-23 are captured in the FSP. We identified Risks 22-47 during the first six months since the funding was awarded (and first month of the project delivery). The project continues to monitor risks and issues on a monthly basis, at a 'deep-dive' risk management meeting. At this meeting, risk impacts and mitigation plans are updated.

Table 4 – Risk register

RISK & ISSUE LOG														
ID	Risk / Issue	Status	Description	Impact	Risk Probability	Risk Impact	Risk Score	Mitigation / Planned Actions	Mitigated Probability	Mitigated Impact	Mitigated Score	Owner	Last updated	Date Closed
R13	Risk	Open	Integration of equipment and systems is not achievable or is more difficult/takes longer than expected	Project incurs delays or cannot proceed	4	5	20	- Collaborative requirements gathering and design process is undertaken to ensure integration elements are understood - Prepare key systems to be ready for integration, while detail design is taking place	3	3	9	WS1 Lead	24/05/2021	
R26	Risk	Open	Internal expertise is not available to support	The project will not deliver all of the intended outcomes to the expected quality or will be delayed	4	5	20	- Work closely with internal stakeholders to clarify expected input and secure support - Plan the work to align with resourcing needs	3	3	9	Project Manager	24/05/2021	
R43	Risk	Open	5G service needs to be resilient to power failures to be used for protection / SCADA	The project will not deliver all of the intended outcomes and will not be accepted to BAU	4	5	20	- Specify the requirements for protection and control - Design the trial with Vodafone and PNDC to demonstrate the resilience of the 5G service	3	3	9	WS3 Lead	24/05/2021	
R44	Risk	Open	Not all stakeholders are kept up to date with project results and progress	Project is delayed and may not be accepted into BAU	5	4	20	- Stakeholders are identified and engagement approach is specified - Frequent and clear communication with stakeholders is carried out throughout the project	3	3	9	Project Manager	24/05/2021	
R47	Risk	Open	Negative sequence and zero sequence data is not available	Project is delayed and/or requires re-scoping	4	5	20	- Understand the specific network parameters which are required for M1 and M2 - Understand if we can leverage existing ADMS capabilities to provide - Last resort is to manually identify and load the required parameters	3	3	9	WS2 Lead	24/05/2021	
R9	Risk	Open	Suitable sites for the demonstration of the solution are not available	Trials cannot proceed	4	5	20	- Undertook early research and identified two potential network areas, of which two are proposed in the bid - Ensure value can be derived from the off-network testing	2	2	4	WS2 Lead	24/05/2021	
R10	Risk	Open	Unavoidable changes are made to key personnel on the project	Possible delays to the project	4	4	16	- Comprehensive project documentation is maintained to reduce the impact of any staff changes that may occur. - Ensure knowledge sharing is undertaken across the project team to avoid single point of failure	3	3	9	Project Manager	24/05/2021	
R12	Risk	Open	IPR requirements deter some innovation competition entrants	Limited outcomes from innovation competition element	4	4	16	- Ensure early publication and full explanation of IPR requirements to ensure entrant buy-in to project requirements	2	3	6	WS4 Lead	24/05/2021	

R34	Risk	Open	Not enough resource to carry out integration	Project is delayed and/or requires re-scoping	4	4	16	- Plan key resource requirements and availability - Understand resource requirements and plan alternative ways of securing the necessary expertise	3	4	12	WS1 Lead	24/05/2021	
R39	Risk	Open	Project and BAU not sufficiently coordinated to transition into BAU	Limited outcomes from the trials	4	4	16	- Keep the BAU owners and stakeholders engaged and updated - Ensure the products meet the BAU requirements or there are plans in place to meet the BAU requirements	2	2	4	Project Manager	24/05/2021	
R41	Risk	Open	There is no appropriate data management in place to support the increased volumes of data	Project is delayed and may not be accepted into BAU	4	4	16	- Specify the data management requirements early - Agree specific data management plans before the trials with the relevant business stakeholders	2	3	6	WS3 Lead	24/05/2021	
R23	Risk	Open	The DER operators in the trial areas do not wish to participate in trials	Trial results are of lower quality and potentially insufficient to inform BaU roll-out	4	4	16	- Engaged with DER operators in the provisional trial areas - Ensured minimal effort and impact on DER operation during trial	1	3	3	Project Manager	24/05/2021	
R1	Risk	Open	COVID-19 restrictions continue and impact project activities	Cannot hold face-face meetings slowing design process and de-prioritised site work (non-essential)	3	5	15	- Contingency built in and a price review stage gate included at the end of detail design. This will allow costs to be re-negotiated after the architecture and design has completed. - Engage provider on fixed priced contract rather than time and materials	2	3	6	Project Manager	24/05/2021	
R2	Risk	Open	Architecture and system build costs are significantly higher than anticipated at FSP costing stage	Project overspend requiring additional partner contributions and/or change request for reduction in project scope	3	5	15	- Contingency built in and a price review stage gate included at the end of detail design. This will allow costs to be re-negotiated after the architecture and design has completed. - Engage provider on fixed priced contract rather than time and materials	2	4	8	Project Manager	24/05/2021	
R6	Risk	Open	Suitable innovation competition entrants cannot be found	Project is delayed and/or requires re-scoping	3	5	15	- Leverage PNDC core research programme contacts - Leverage the R&D connections and experience of all partners	3	3	9	Procurement	24/05/2021	
R7	Risk	Closed	Failure to agree Project contracts between UKPN and Project Partners	Project cannot proceed	3	5	15	- All partners have agreed in principle to NIC terms - Negotiation of collaboration agreement between all partners to begin after FSP submission - long lead in between project award and work start to allow time for negotiations	1	4	4	Project Manager	30/04/2021	30/04/2021
R24	Risk	Open	Requirements and specifications are not clear or design cannot be approved	Goods and services are of lower quality and fail to deliver the benefits	3	5	15	- Leverage expertise from consortium of Partners to ensure clear requirements and design - Work out the requirements and design collaboratively in workshops / focus groups - Have a staged approach to specifying the requirements	2	3	6	Project Manager	24/05/2021	
R25	Risk	Open	Activities on the critical path are delayed or stopped	Key milestones and deliverables are delayed	3	5	15	- Frequent progress review sessions in place across all Partners - Frequent coordination sessions in place across all Partners - A robust project plan is developed and it is validated and updated closely	2	3	6	Project Manager	24/05/2021	



R27	Risk	Open	Single point of failure in resourcing	Project is delayed and/or requires re-scoping	3	5	15	- Ensure there is clear and structured documentation to enable handovers - Plan the work to align with the resourcing needs	3	4	12	Project Manager	24/05/2021	
R31	Risk	Open	Substation PC is not powerful enough to support the virtualised protection and control	The project will not deliver all of the intended outcomes	3	5	15	- Align virtualisation standards with BAU - Align substation design and IP addressing with BAU - Collaborate with Partners to understand hardware requirements for the software they are developing	2	4	8	Project Manager	24/05/2021	
R35	Risk	Open	No suitable expertise for testing and integration	The project will not deliver all of the intended outcomes	3	5	15	- Understand the testing and integration requirements early - Plan how the necessary testing and integration skills are made available in time for the Project	2	4	8	WS1 Lead	24/05/2021	
R40	Risk	Open	There is a cyber security breach	Network is rendered open to cyber attack	3	5	15	- Specify robust cyber security requirements - Compliance with cyber security requirements - Develop a suitable cyber security breach response plan	3	3	9	WS1 Lead	24/05/2021	
R45	Risk	Open	Conflicting interactions with other systems (DERMS, Distributed Restart, etc)	Project is delayed and/or requires re-scoping	3	5	15	- Constellation elements integration and interactions with other systems are specified early - Key interactions with other systems are planned and tested during the project	3	3	9	Project Manager	24/05/2021	
R21	Risk	Open	5G coverage is not available in the trial areas in time for the trials	Project is delayed and/or requires re-scoping	3	5	15	- Contingency budget to account for the installation of small 5G cells in the trial areas - Vodafone to leverage relationship with infrastructure operator (Telefonica) in the trial areas to ensure coverage is delivered in time for the trials	2	2	4	WS2 Lead	24/05/2021	
R3	Risk	Open	Some elements of the technical solution are not achievable to the desired specification within the project timescale and budget	The project will not deliver all of the intended outcomes	3	4	12	- Ensure requirements and solution design is realistic after the detail design stage. - Continuously and quickly adapt to changing requirements, with iteration loops built into the project plan throughout the development. - Regularly progress following UKPN established project control methods	3	3	9	Project Manager	24/05/2021	
R4	Risk	Open	Methods do not deliver the anticipated benefits	Lower than anticipated value delivered	3	4	12	- Regularly revise business case to update expected method costs and expected benefits	3	3	9	Project Manager	24/05/2021	
R5	Risk	Open	Project Partner/Supplier performance is not adequate	Outcomes are delayed, with potential overspend. This may also require a change in partner/supplier as an interim step.	3	4	12	- Ensure shared responsibility for deliverables - Incentivise partner/supplier for success - Ensure tendering/onboarding process focuses on critical project elements	2	3	6	Procurement	24/05/2021	
R17	Risk	Open	Insufficient innovation competition entrants who meet the entry/procurement requirements	Project is delayed and/or requires re-scoping, limited outcomes from innovation competition	3	4	12	- Leverage partner experience in R&D incubation - Identified over 15 use-cases for participants to work on	2	3	6	WS4 Lead	24/05/2021	

R18	Risk	Open	Insufficient availability of quality training data for machine learning to enable solution to be accurate and effective on the network	Accuracy of algorithm decision making is not assured	4	3	12	- Using simulation early, and ramp up level of autonomous operation throughout the duration of the tests as data is built up - Get PMU data from trial sites early in the project	3	3	9	WS2 Lead	24/05/2021	
R20	Risk	Open	The selected hardware is not suitable for the time-critical operation of Methods 1 and 2	The project will not deliver all of the intended outcomes	3	4	12	- Equipment was selected based on its ability to perform the required functionality - Sufficient risk budget to ensure equipment scope change can be absorbed	2	3	6	WS2 Lead	24/05/2021	
R22	Risk	Open	The virtualisation approach is not suitable for real time protection & control applications	Project is delayed and/or requires re-scoping	3	4	12	- Carried out investigation to select a flexible approach which can deliver the capabilities - Included in project risk budget which will be governed with a stage gate at the end of detail design (Jan 2022)	3	3	9	WS1 Lead	24/05/2021	
R29	Risk	Open	Unable to recruit suitable / sufficient resource for the project	Project is delayed and/or requires re-scoping	3	4	12	- Carry out robust recruitment to ensure expertise is on-board - Plan a suitable "plan B" alternative to secure the expertise required	2	3	6	Project Manager	24/05/2021	
R32	Risk	Open	Other connectons / build at trial sites impact project	Project is delayed and/or requires re-scoping	3	4	12	- Understand the expected development activities in the trial areas - Coordinate trial preparation with the other on-going activities	2	2	4	Project Manager	24/05/2021	
R33	Risk	Open	Delays caused by extended procurement processes	Project is delayed and/or requires re-scoping	4	3	12	- Provide Procurement with early visibility of required procurement activities - Plan sufficient time to carry out all procurement activities	2	2	4	Project Manager	24/05/2021	
R38	Risk	Open	Integrating multi-vendor IEC61850 is harder than anticipated	Project is delayed and/or requires re-scoping	3	4	12	- Secure the expertise from the consortium of Partners to ensure the requirements and design are achievable - The Partners revise the design and the products / services if necessary	2	3	6	Project Manager	24/05/2021	
R46	Risk	Open	NG equivalent model for impedances and other network parameters is challenging to obtain	Project is delayed and/or requires re-scoping	3	4	12	- Understand the specific network parameters which are required for M1 and M2 - Plan how these can be provided to the Partners	3	3	9	WS2 Lead	24/05/2021	
R8	Risk	Open	A partner/supplier may withdraw from the project	Partner/supplier must be replaced or project descope	2	5	10	- Ensure all partners/suppliers are engaged and involved throughout the project - Previous engagement with wider industry provides confidence there are a number of potential organisations who can deliver some project aspects	2	4	8	Project Manager	24/05/2021	
R14	Risk	Open	Solution has unintended impact on the network causing failure, underperformance, and/or customer equipment failure	Loss of supply, damage to customers' equipment	2	5	10	- Equipment is fully tested off-network - Sufficient time is included in project plan to resolve any issues fully and re-test - No equipment will be deployed on the network into an active trial before it has successfully passed FAT and SAT	1	5	5	WS3 Lead	24/05/2021	

R15	Risk	Open	Catastrophic failure of equipment causes network damage and/or injury	Network equipment is damaged, injury is caused	2	5	10	- Solution consists of mainly software components and the hardware ones cannot fail explosively (substation PC, routers & switches) - Failure Mode and Effects Analysis is undertaken to ensure such failures are anticipated and designed out	1	4	4	Project Manager	24/05/2021	
R16	Risk	Open	IT security standards are not met	Network is rendered open to cyber attack	2	5	10	- OT integration testing is included in the PNDC trial scope - Ensure full engagement with IT security team throughout the project - Key UKPN security requirements need to be fulfilled before the system is commissioned to our network - Ensure test plan encompasses all relevant IT security tests	2	4	8	WS1 Lead	24/05/2021	
R28	Risk	Open	The designs of the project Methods are not innovative	Lower than anticipated value delivered and potentially project is closed	2	5	10	- Collaborate closely with all Partners to ensure novel aspects of scope remain in the design - Review on-going work in the industry to identify if anyone else has demonstrated key Constellation elements	1	4	4	Project Manager	24/05/2021	
R30	Risk	Open	Someone else develop a product which makes Constellation obsolete	Project is stopped or re-scoped	2	5	10	- Review on-going work in the industry to identify if anyone else has demonstrated key Constellation elements	1	3	3	Project Manager	24/05/2021	
R37	Risk	Open	Project Partners/Suppliers do not pass the FAT	Project is delayed and/or requires re-scoping	2	5	10	- Work closely with the Partners/Suppliers during the design and development - Build in sufficient time to re-iterate the design and development	2	3	6	Project Manager	24/05/2021	
R42	Risk	Open	The Open Innovation Competition products break some of the other project elements	Project is delayed and may not be accepted into BAU	2	5	10	- Ensure sufficient testing at PNDC before adoption into the DNO network - Specify what separation is required for all OIC products to ensure safe operation of other systems	1	2	2	WS4 Lead	24/05/2021	
R11	Risk	Open	The specification and procurement of the equipment takes longer than expected	Possible delays to the project	3	3	9	- Ensure timescales on the project are realistic and have built-in contingency for high risk elements - Undertake regular reviews during high risk and critical project activities	3	2	6	Project Manager	24/05/2021	
R19	Risk	Open	Length of trial period is not sufficient to collate all representative data	Trial is insufficiently representative of potential scenarios with which the solution may be required to cope	3	3	9	- Significant time allocated for testing on the network - Off-network testing to simulate various network scenarios	1	3	3	WS3 Lead	24/05/2021	
R36	Risk	Open	Testing scenarios cannot be replicated accurately across the different elements in the project	Limited outcomes from the trials	2	4	8	- Prepare a robust trial plan and specify the testing scenarios	1	3	3	WS3 Lead	24/05/2021	

## 12. Accuracy assurance statement

The project has implemented a project governance structure as outlined in our innovation policies and procedures that effectively and efficiently manages the project and all its products. All information produced and held by the project is reviewed and updated when required to ensure quality and accuracy. This report has gone through an internal project review and a further review within UK Power Networks to ensure the accuracy of information.

We hereby confirm that this report represents a true, complete and accurate statement on the progress of the Constellation project in its first six-month reporting period and an accurate view of our understanding of the activities for the next reporting period.



Signed .....

09/06/2021

Date .....

Suleman Alli  
Director of Customer Service, Strategy, Regulation & IS  
UK Power Networks

## 13. Material change information

No material changes have been encountered during this reporting period and none are foreseen for the next reporting period.

## 14. Other information

Currently there is no other information to report to Ofgem.