Annual Progress Report

The Power Potential Project

January – December 2020

Contents

Executive Summary

This report provides a summary of progress across all project workstreams from January 2020 to mid-December 2020. Power Potential has now delivered technical trials of automated voltage control services from DER (Distributed Energy Resources) to National Grid Electricity System Operator (ESO), enabled by UK Power Networks.

This year, the project brought its systems through a series of test phases and live upgrades, commissioned five DER for the services, and delivered individual Mandatory Trials of the voltage control service for five DER with DERMS (Distributed Energy Resources Management System). System readiness and DER readiness (commissioning and Mandatory Trials) were the two critical items in the Go/No Go criteria to start the Wave 1 Optional Technical Trials. This 24/7 trial phase began in October and has demonstrated end-end service delivery of the automated voltage control service. DER have been paid for their participation under the settlement process developed for the project.

During this year, the COVID-19 pandemic has had a material impact on Power Potential trials continuing as originally envisaged. This was principally due to the impact on stopping, then slowing, the works by customers and UK Power Networks to commission the participating DER. One DER was commissioned prior to the first lockdown and the fifth was commissioned in December 2020. A change in approach was also developed for remote delivery of Mandatory Technical Trials, and to deliver a common version of the DERMS software able to support both the Wave 1 and Wave 2 trials with only minor reconfiguration and upgrade in between. The DERMS software for the main trial phases went live in September 2020 and the integration with National Grid ESO's systems completed in October 2020.

The proposed approach agreed in April 2020 with the project's steering committee members (National Grid ESO and UK Power Networks) was to extend the timescale of the project, without alteration of the trial structure, scope or financial commitment to DER. The trial timescale has been extended to end March 2021, with reporting expected to complete by the end of July 2021. The timescale changes were reflected in a material change request to Ofgem in November 2020.

Over the past months, the Mandatory Technical Trials and Wave 1 Optional Technical Trials have provided important technical and operational learning for DER, National Grid ESO, UK Power Networks and the DERMS developer (ZIV Automation). Trial experience has informed multiple amendments and improvements to systems – to the National Grid Platform for Ancillary Services (PAS) system, to the DERMS, to the DER contractual limits and supporting infrastructure. The trials have provided operational experience to DER, to both partners' control rooms and to numerous support functions. In combination, we have delivered an operable and supportable system for the Wave 2 Market Trials, consistent with the service delivery timescales in the original design and explored site-specific issues with individual DER performance.

Table 1: Power Potential trials calendar

DER Commissioning & Wave 1 Mandatory Trials	March – November 2020: Ran first remote Mandatory Trials (MT) in June with the initial commissioned DER, develop process and DERMS for subsequent MT Once COVID-19 restrictions lifted on site work, we commissioned and ran Mandatory Trials for the rest of the DER.		
Wave 1 Technical Trials	Started 14 October 2020 (Three DER initially)	Finished: 10 December 2020	Eight weeks, then reconfigure
Wave 2 Market Trials	~7 January 2021	Finish 31 March 2021	~12 weeks

Project Manager's Report

This year has seen the project progressing into live demonstration in stages, with significant activities being delivered within the technical, commercial, business process and trials workstreams, supported by project management activity.

As notified to Ofgem in April 2020, project delivery was significantly affected by COVID-19 restrictions, with a material impact on Power Potential trials continuing as originally envisaged, particularly affecting site commissioning. One DER was commissioned in the first half of the year (before lockdown restrictions) with commissioning activities for the rest of DER being re-started at the end of July. The commercial team has continued to manage the commercial proposition, adapted to the new delivery dates and has continued to manage the DER customer experience throughout the project.

This has an impact on the SDRC reports and the project end date. Therefore, the project changed the plan delivery timelines (but not the delivery scope) to manage this situation. In order to preserve the duration of Wave 1 Optional and Wave 2 Market trials, in April 2020, the start of Optional and Market trials were frozen until at least 1 September 2020, and the trial timescales were extended to at least March 2021, with the project end date extended to at least May 2021. According to this new timeline, testing and integration activities were refocused and it has been decided to conduct Wave 1 Optional and Wave 2 Market trials with a single version of the DERMS software, in order to minimise disruption.

The Wave 1 Optional Technical Trials began on 14 October 2020 – this was six weeks later than the 1 September date envisaged as reasonable endeavours in April 2020 during our COVID-19 re-plan. With the customer commissioned prior to lockdown, multiple attempts and two DERMS system upgrades were required to complete the first live Mandatory Trial in August 2020. Due to site restrictions, the second customer was fully commissioned in August 2020. The DERMS upgrade for the Wave 1 and Wave 2 trials completed test and was upgraded to live in September, and by mid-October. We had three customers through commissioning and Mandatory Trial, so once a final PAS-DERMS connection issue was resolved on 12 October, trials began. One additional DER were brought into trials during Wave 1, with a further DER expected to complete its Mandatory Trial after Wave 1.

As a result of the six-week delay, the project adjusted the duration of the Wave 1 Technical Trials from 12 to 8 weeks. The project team, partners and participating DER have shown great commitment to deliver the learning from this project and bring us into the end-end trials stage.

Wave 1 Optional Technical Trials are an end-end validation of the system (PAS-DERMS-PowerOn-RTU-DER). DER have been available and delivering the voltage control service on a daily basis through these trials. Learnings from the initial weeks have led to the development and application of software changes in PAS and DERMS, changes in limits agreed with DER, changes at DER and configuration modifications in PowerOn and RTU. These address challenges with visibility of utilisation of the service to National Grid ESO Control room, consistency of PAS-DERMS data exchange without manual intervention, keeping the DER constantly in voltage control mode, and data traffic volumes on the UK Power Networks infrastructure.

These changes were applied progressively over October and November, with the final set of these changes being applied after completion of the Wave 1 trials in December. The full impacts are currently under review, but we are confident that changes will allow us to have consistent high availability of the systems and service (from DER, UK Power Networks and National Grid ESO perspectives) in the final weeks of Wave 1 and in our Wave 2 trials.

Project delivery is structured into five workstreams:

- Technical (WS1)
- Commercial (WS2)
- Business processes (WS3)
- Trials (WS4)
- Project management (WS0)

Progress in project delivery workstreams is described in the following sections.

1. Workstream 1: Technical

Detailed information on the delivered technical solution and was covered in SDRC 9.4 at the end of 2019, but this section provides an updated overview of progress to date.

Overview of the DERMS solution

The DERMS solution was fully implemented for Wave 1 and Wave 2 Optional Technical Trials by September 2020 with a configuration of the DERMS system to achieve trial goals.

This configuration of the DERMS was reviewed in early 2020 to reduce any further delays to trials by reducing the scope of the final go-live deployment to focus on bid requirements rather than the more ambitious requirements of the detailed design. This eliminated dependencies on external factors such as the availability of a high-quality Common Information Model (CIM) of the network to support a dynamic load-flow calculation. These features can be added later as necessary (post-trial) when the dependencies have been eliminated.

Customer readiness and system/infrastructure readiness and integration have continued to present substantial and complex challenges this year. The project team has been focused on technical delivery, preparing and bringing live a DERMS version (16.7) to allow the execution of Mandatory Trials. In parallel, it has continued with testing and integration activities for Wave 1 and 2. This includes the connection to the PAS system and other critical external interfaces such as PowerOn and National Grid ESO IEMS data. The team has also completed the FAT (Factory Acceptance Testing) of the DERMS software for Wave 2 trials. Post-FAT, with DERMS version 18.1 and 18.2, the team completed regression testing, integration activities and defect debugging to take the systems live.

This year, the project brought its systems through a series of test phases and live upgrades and fulfilled the following goals:

1. Commissioned five DER for the services, with a RTU workaround having been implemented for the fifth DER
2. Delivered individual Mandatory Trials of the voltage control service for the DER
3. System readiness (Upgrades to the DERMS and PAS systems on live)
4. Having achieved system readiness and three DER ready, started Wave 1 Technical Trials in October and demonstrating end-to-end service delivery of the automated voltage control service.
5. Three out of five DER have so far received payments for their participation under the settlement process developed for the project.

The project team worked closely with the DER and National Grid ESO to minimise the impact of the COVID-19 pandemic. COVID-19 slowed down the overall progress increasing the elapsed time for readiness and participation of DER. The first DER commissioned prior to the first lockdown in March followed by four more DER commissioned between August and November.

The current version of DERMS software delivering Wave 1 Optional trials is 18.2.4. Two further technical patch upgrades are planned – one during Wave 1 Optional Technical Trials and one further before DERMS is configured for Wave 2 Market Trials.

The DERMS solution for Wave 1 Optional Technical Trials is intended to demonstrate the same infrastructure, interfaces and despatch functionality of the full DERMS detailed design, but without the network modelling or the load flow functionalities. The full detailed design of the DERMS solution remains as a reference document for the project. For the Wave 2 Market Trials, the Interim DERMS solution is now supplemented by the Wave 2 commercial functions, active power service and predictor (see FAT scope explanation).

Delivery of the active power service from PAS was descoped from delivery in March 2020 (exceeding bid requirements). The revised approach was agreed to support a limited duration trial

of a few hours which would demonstrate technical delivery of an active power service DERMS-DER with liaison between National Grid ESO and UK Power Networks control rooms to request dispatch. The commercial interface and settlement to DER was unchanged.

The final Go-live system architecture is shown below.

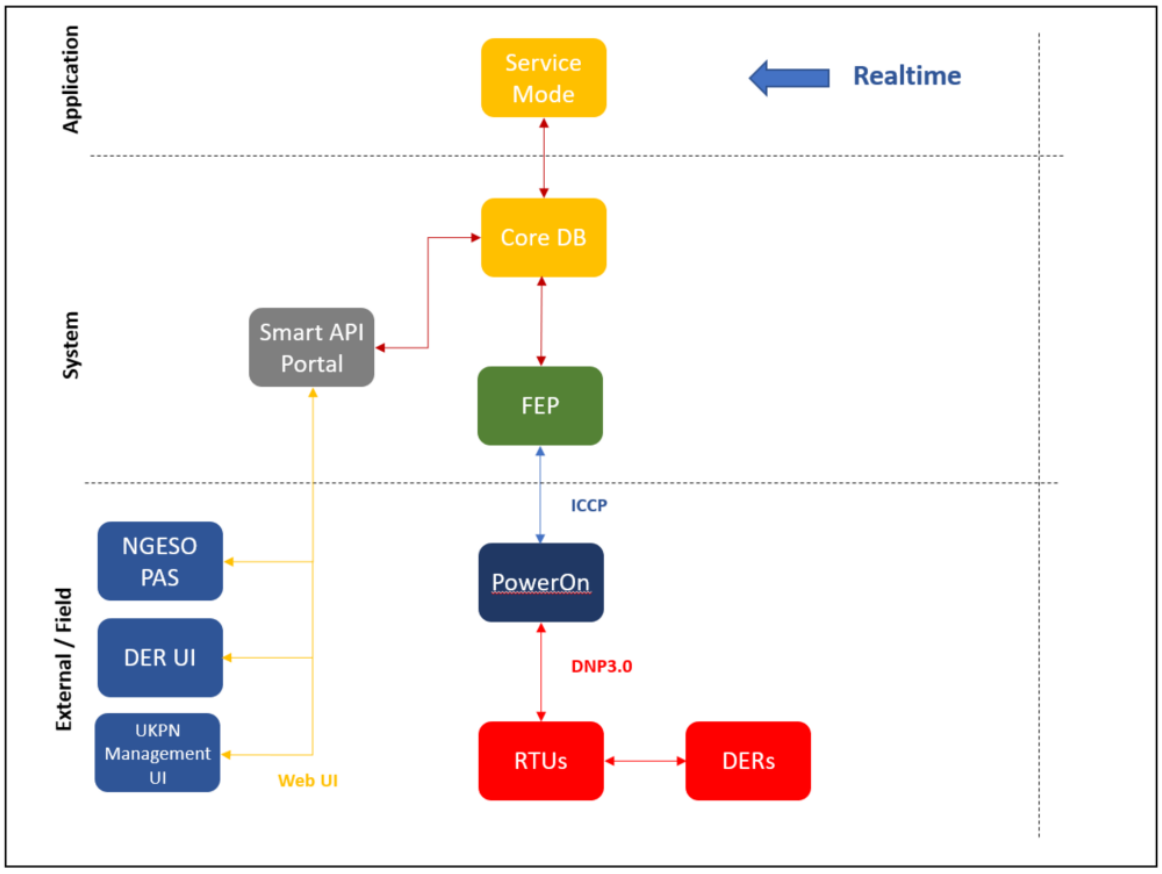


Figure 1: The final Go-live system architecture

Core DB	DERMS core database
FEP	Front end protocol
PAS	Platform for Ancillary Services
PowerOn	UK Power Networks' network management system
RTU	Remote Terminal Unit
UI	User Interface (for DER and UK Power Networks to interface with DERMS)

Technical Deliverables

The technical delivery team at UK Power Networks has worked closely with National Grid ESO technical teams (for PAS and for DERMS testing) and third-party providers (ZIV Automation, CGI, TCS, Silversands, SI, Team Zen, Cyient and GE). Together the teams have progressed the development, implementation and integration of the key components of the Power Potential solution as defined in the Architecture Design Document to deliver all the outcomes in this period.

UK Power Networks changed its delivery approach for Power Potential in January 2020, after the first go-live of the first version of DERMS in December 2019. This brought Power Potential systems into a combined delivery and support approach with UK Power Networks' Active Network Management projects and RTU development strategy. This was in recognition that Power Potential systems are part of the overall DSO transition strategy, commonalities in technical delivery approach integrating with a new PowerOn-RTU-DER communications and visibility. Both projects were also being delivered by overlapping support functions across UK Power Networks (smart grid team, innovation, operational telecoms, control engineers, control system infrastructure, control system automation, outage planning, contracts and settlement).

Delivery of this project has a significant element of information systems setup, interface and associated fault-finding, requiring specialist external skill sets, and providing great learning for future service support and delivery.

Key technical progress achieved during this period includes:

- Completion of testing of DERMS version to support DER commissioning, promoted to production
- Commissioning of first DER to DERMS
- Completion of testing for DERMS version to support Mandatory Trials, including forward-testing of aspects required for later trial stages, including successful completion of PAS to DERMS testing
- Upgrade of live DERMS to support Mandatory Trials, and to provide DER access to DERMS for registration and familiarisation ahead of Optional Trials
- Successful FAT completion of new DERMS version to support Wave 1 Optional Trials and Wave 2 Trials
    - Reactive power cost curves – demonstrating how commercial inputs from DER are input and processed by DERMS, provided to PAS, and that the DER user interfaces and commercial logic meet the project's commercial and contractual requirements
    - Active Power service – DER and DERMS screens
    - Predictor (demand and generation forecast by DERMS based on weather inputs)
    - Future Availability (day ahead and real-time)
    - Import and management by DERMS of an example CIM network model by DERMS
    - Regression test of Wave 1 functionality
- Releases 18.1 and 18.2 tested successfully for Optional and Market Trials (functional, non-functional and UAT testing)
- DERMS v18.2 (18.2.4) promoted to live in production in September 2020, including manual failover between two UK Power Networks sites, ready for Optional Trials

Wave 1 Optional trials started on 14 October with three DER participating currently. Another DER joined the Trials in late November.

In mid-December at the end of the eight week Wave 1 Optional Trials, there is a planned upgrade to the DERMS software for issues arising in trials (see workstream 4), handling additional communications failure scenarios, and residual minor defects relating to Wave 2.

COVID-19 has had an impact on delivery timescales with all work by all teams having been carried out largely remotely for the eight months (late March – November). The exception being any site work required for commissioning, which restarted in June.

The pace of the development and testing has all significantly increased within the last eight months despite COVID-19 pandemic through a systematic approach and efficient collaboration with National Grid ESO and ZIV Automation.

More certainty around delivery dates has been achieved, but risk still exists due to the fast pace now required to meet trial dates and remaining COVID-19 risks.

Testing

Figure 2 below provides a high-level overview of the system test approach. This process was carried out for incrementally and with regression each stage of the DERMS delivery (commissioning, Mandatory Trials, Wave 1, Wave 2), with FATs for the Mandatory Trials and Wave 1, and for the Wave 2 systems.

Objective	DERMS components work separately & together	DERMS satisfies functional requirements	DERMS installed correctly	Interfaces are designed & working correctly	Power Potential solution satisfies requirements	Sign-off by National Grid ESO & UK Power Networks control engineers	Power Potential solution performance, security, reliability
Teams Involved	ZIV Automation	National Grid ESO & UK Power Networks project teams	UK Power Networks IT team	National Grid ESO & UK Power Networks IT teams	National Grid ESO & UK Power Networks project teams, DER	National Grid ESO & UK Power Networks business stakeholders	National Grid ESO & UK Power Networks IT teams

Figure 2: System testing stages

Testing has continued during the current period in line with the initial proposed testing approach.

A greater rigour and improved test management has been introduced along with a more effective approach to the management of a wide collection of diverse resources across UK Power Networks, National Grid ESO and third parties. This has accelerated testing and the deployment of DERMS versions.

DER commissioning preparation

The first DER to be commissioned to a live DERMS platform was undertaken in March 2020, just prior to lockdown (live integration and dispatch tests in February 2020, and commissioning on 16 March 2020). Commissioning proves DERMS-DER live control and dispatch, proving both normal and failure modes, based on manual instruction from DERMS and PowerOn to that specific DER by UK Power Networks. This was successfully completed, with some elements of performance review carried over to Mandatory Trial.

Following the lifting of COVID-19 restrictions, UK Power Networks restarted its site preparation works for commissioning in June 2020. At one site, an additional RTU was fitted to avoid disruption to blackstart capabilities. By the end of July, of the five DER sites, four were fully-ready for commissioning from the perspective of customer works (one site delayed due to COVID-19 restriction on international travel for controller installation). UK Power Networks' site works were fully complete in August 2020.

Site preparation works (operational telecoms work) involved installing a live upgrade to the RTU logic developed for the Power Potential project, to enable the signal exchange and control of the

DER by DERMS via PowerOn (logic passed additional FAT test in February 2020 prior to the first live commissioning). However, the site works also included installation of several crucial peripheral items – processor, switch, serial to Ethernet converter, return data from Power Quality Meter to the RTU and create a ‘tag’ in the PI logging system.

Customer site works include installation of a power plant controller programmed to comply with the DER interface schedule, and installation of cable between the controller and RTU.

During this period, detailed commissioning and capability testing specifications have been developed and used. A Commissioning Test Requirement, Commissioning Procedure and Commissioning Test Form were adopted by UK Power Networks, and incrementally updated. A Commissioning Quality Plan has also been produced to ensure all commissioning activates from DERMS, through PowerOn to RTU/Customer can be managed in a coordinated and consistent way.

The project anticipates publishing a report on its learning from the commissioning activity, in addition to the SDRC 9.7 report on trials learning.

2. Workstream 2: Commercial

The commercial workstream continues to be responsible for the design and development of a route to market for DER to deliver reactive power and active power services to National Grid ESO. The workstream reviews the contractual arrangements as well as the commercial implementation in the DERMS Wave 2 solution and is responsible for managing and learning from the customer experience through the project.

Following the signing of contracts with five DER in 2019, this phase continues to engage with both trial participants and other interested DER. We were open to recruit additional DER participants to ensure that the trials contain enough volume to maximise learnings from this innovative service, whilst preparing all other participants for the trial to ensure readiness but closed this in September 2020.

A summary of the updates and progress made in 2020 is covered in this section and includes:

- Regional Market Advisory Panel meetings
    - Wave 2 methodology
- The updated trial timeframe, documentation and commercial proposition
    - Wave 3
- Updates to the Market Procedures (trial timeframe, commercial proposition, active power)
- Continued DER engagement (confirmed trial participants and potential future participants post-trial)
- Customer readiness work
- Update from academic partners

Regional Market Advisory Panel (RMAP) Updates

The project team continues to host quarterly RMAP meetings and publishes the minutes on the project website.

- Quarter 1 – 12 February 2020
- Quarter 2 – 29 April 2020
- Quarter 3 – 29 July 2020
- Quarter 4 – 6 January 2021 (planned)

At the 11 December 2019 RMAP meeting, DER requested regular updates on project progress that they could share with their wider business. The team created a DER newsletter template which included some regular sections such as updates, objectives, look back/look ahead. The first issue also included an overview of the project so DER could share this with their internal stakeholders to understand the main deliverables and benefits of the project. There has been 23 newsletters issued to date over 2020 (as of 8 December). In addition to updates on project progress, commissioning, DERMS, user guides, Wave 3 and active power services (as described in future sections), updates were provided in the following areas:

- **Aggregator consultation** – The project team shared the feasibility study for the design of an aggregator interface to DERMS. The dispatch of services using an aggregator interface is not part of the trial however it is one of the learning objectives from the project. Therefore, the project has now conducted a feasibility study that provides an assessment of available

methods and potential design considerations to develop a DER aggregator interface in the context of this project's requirements. The outcome of the feasibility study was summarised and presented in the "DER Aggregator Interface to DERMS – Feasibility Study", shared with RMAP members and interested stakeholders This document is not intended to be a design specification but will act as a reference to inform potential future implementation and design considerations of an aggregator interface after the project. The feasibility study was shared with interested stakeholders on the 1 May 2020 and feedback sought from them. A follow-up event is being planned, linked to UK Power Networks' work in other projects on the development of an aggregator interface/API.

- **Wave 2 calculation methodology** – The project team shared the work in developing the assessment and nomination process for Wave 2. The project team set out the main considerations and principles during Wave 2 and the need to work around a fixed budget by using a Target Average Cost. Further information is available on the project's website.

- **National Grid ESO data share on reactive power** – The project participants were made aware of the new voltage information including regional data showing the synchronisation costs in accessing reactive power services. The project team explained the process undertaken a few days after the purchase by National Grid ESO control engineers, to tag actions across potentially multiple benefits such as voltage, stability and upward/downward regulation. Project participants were informed of the actual monthly reports available on the National Grid ESO website and how these could be used to inform their pricing decisions.

The updated trial timeframe, documentation and commercial proposition

Market Procedures

The revised trial calendar timeline has been included in an updated Market Procedures document available on the project website. Further technical assessment considerations on how the trials were amended are provided in the Workstream 4: Trials section of this report.

Updates to the Market Procedures included adjustments to the Wave 1 participation payment thresholds which allow participants to access up to the £45,000 participation fee based on their availability for the service. These thresholds have been adjusted to reflect the reduced Wave 1 duration while maintaining the level of payment against a reduced number of availability hours from DER.

For Wave 2, the only change made was to move the start of the Wave 2 trials from November to December, the commitment to run the trial for 1,800 hours remained, ensuring DER retained the same opportunity to 'test the market'.

The project's steering committee took a decision not to proceed with the Wave 3 trials. This decision was shared with project participants on 29 July 2020 at the Regional Market Advisory Panel meeting. Further details on the decision can be found here in the minutes of that session. The decision to not proceed with Wave 3 allowed the project to focus on the core deliverables from the original bid without potentially compromising the learning opportunity in Wave 2. This allowed clarity and focus to deliver the central elements of the bid within the remaining project timeframe. Whilst it presented value to both DER and project learning, Wave 3 was not specified as part of the original project direction and at this stage could compromise delivery of the earlier waves. It was also expected to lead to increased project cost on top of the current project overspend.

The details of the active power competitive bidding calendar will be confirmed following further consideration and confirmation from our Steering Committee of the form of the active power trials. Changes have also been made to the active power service, where the number of hours available to DER participating in the active power service have been reduced. Further details of this change are discussed in Workstream 1 section. The active power service windows will be during the Wave 2 trials in 2021.

Participation Payments Letter

After each participating DER successfully completes the DER Commissioning Test and Mandatory Technical Trial, the DER will be issued with the Participation Payments Letter. The letter guarantees access to the participation payment and has also been updated to include the revised thresholds, in lieu of an update to the DER Framework Agreement. The letter was also used to review the P-Q envelope and service parameters submitted by the DER in the DER Framework Agreement, adjusting the technical assumptions to match those actually delivered during commissioning.

As DER five was not ready to join the Wave 1 trials period, there was no opportunity for them to make the first milestone of >373 hours of availability and to receive the first participation payment milestone of £36k.

A number of other documents have been updated this year; DER Interface Schedule, DER test specification, DER Technical Requirements and Guidance on Wave 1 mandatory technical trials.

Recruitment and continued engagement

The project team continues to engage with key stakeholders through the Regional Market Advisory Panel meetings and participants ahead of and during the trials in 2020. Five DER have signed both a 'DER Framework Agreement' and a 'Variation Agreement relating to a Connection Agreement' to indicate their intention to participate in the Power Potential trials.

The engagement process has ensured that trial participants are kept up to date and are involved/consulted on the progress of developing the trial. The engagement process is led jointly by UK Power Networks and National Grid ESO. Both parties have utilised existing relationships with providers within the trial region, through the Business Development and Balancing and Revenue Services team within National Grid ESO, and the Stakeholder Engagement and Connection teams at UK Power Networks.

At the end of September 2020, the project team were approached by a potential new entrant. The 10MW solar farm which was connected at 33kV was at the preliminary stage, checking project viability and drafting a business case to get owner buy in. The project team developed a costed step-by-step plan of how we could bring the site on-board and into the trial at the Wave 1-2 transition phase. The recruitment process includes the need for a network assessment to check the allowable reactive range at the DER point of connection and a software variation to the DERMS to include the new site, and to make a change to DERMS. The overall assessment did not give us the confidence that we could complete the integration testing, commissioning and Mandatory Technical Trial in time for the start of Wave 2. It also alluded to a risk to the timescale for the whole project to progress to Wave 2. We referred the issue to our project's steering committee for a decision on the risk and additional funding to enable further participation. Based on that steer, we therefore with regret, explained the assessment results to the enquirer, noted the interest and subscribed the interested parties to our mailing list to remain updated on how the project progresses.

We continue to engage with DER in the region, and the project team is still regularly being approached with enquiries about participation (four in 2020). We provide information about the project since maintaining stakeholder interest is key to adoption post trials should the project be developed into a BAU solution.

Whilst we continue to engage with interested parties the project has ceased recruitment of further participants. This decision was taken by the project's steering committee in September 2020 on the basis that it would incur significant additional project cost and the risk that the onboarding work required for a new provider could not have been completed in time to have them ready for Wave 2. Aspects of the trial would also need to be halted to accommodate new providers which put the project timescales for Wave 2 at risk. The project has however continued to engage with these

providers keeping the providing information as requested and regular updates through project communications.

Engineering Recommendation G99 came into effect on 27 April 2019, which brought significant new requirements for generation of all sizes, including having the ability for reactive power capability. Customer recruitment would likely be easier for new connections in the future as generators will already have capability to deliver reactive power and therefore, voltage control.

Customer site-readiness

Customer readiness to participate in the commissioning activity includes:

- installation of the communications cable that joins the DER site controller to the UK Power Networks RTU
- DER controller DNP3 compliant and programmed with the DER Interface Schedule signals

Each participant has installed the communications cable and programmed their DNP3 module to meet the DER Interface Schedule specification, with the timescale for one participant impacted by COVID-19, due to the module being developed and programmed outside of the UK and travel restrictions on the delivery team.

The UK Power Networks' Technical Integration Lead has supported DER with the review of DNP3 simulation results. By checking the DER programme, the integration lead was able to spot mismatches in signal value types and rectify before the planned communication test.

The UK Power Networks' DER Relationship Manager led the scheduling of the integration testing and commissioning activities, lining up both UK Power Networks resources (commissioning engineer, telecoms engineer, control engineer and the DERMS driver) and DER availability. The commissioning activity was split out to two separate days. Day one involved the communication check between the UK Power Networks RTU and the DER controller, completing a 'ping' test to confirm the two devices could see and speak to one another. The testing then moved onto signal exchange testing, where all the signals stipulated in the DER Interface Schedule were checked and verified. Day two, took the DER through the DER Test Specification document which includes integration, capability and performance tests from DER <> RTU <> PowerOn <> DERMS and the final commissioning checks such as failsafe.

By October 2020, three of the participants had successfully completed the commissioning activity. DER four was delayed by the impact of COVID-19 as their DNP3 module was built and programmed outside of the UK and their company had followed government guidelines and restricted travel. DER four successfully completed commissioning 5 November. DER five experienced an issue with implementing two of the mandatory readback signals stipulated in the DER Interface Schedule. The project team was conscious of the risk of the DER not being able to join Wave 1 in time to reach the first milestone payment and so UK Power Networks investigated and implemented a workaround for the missing signals into the RTU logic. DER five successfully completed integration testing 17 November, commissioning on 1 December and their Mandatory Technical Trial on 2 December 2020.

Two of the five participants signed up to deliver the Reactive and Active Power services. It was the project's original intention to complete active power testing within both the commissioning phase and the Mandatory Technical Trial. This activity was moved to be incorporated within the commissioning phase only, to reduce the number of times DER were instructed to change their active power instruction as this could impact other revenue opportunities for the DER. The change saved both time and money without a reduction in learning relative to bid requirements.

DER access to DERMS

DER need to access the DERMS via its web interface for Wave 1 Optional Technical Trials, to provide their availability and the expected operating level per settlement period for the service.

UK Power Networks' DER Relationship Manager ensured accounts were created and usernames, passwords were shared. A DERMS user guide was also created, incorporating screen shots to walk DER through each of the dashboards. DER were given access to the DERMS release 16.7 on the production environment on 26 June. In order to access the DERMS, each user was required to register for Multi-Factor Authentication, which provides protection to ensure only authorised users can access the DERMS web interface. Twenty-nine users submitted requests for access, made up of read-only and write access permissions.

As of 20 July, seven users had completed the registration. The UK Power Networks DER Relationship Manager, provided timely reminders to encourage users to complete their registration, and then to familiarise with the system. The reminders highlighted the days remaining until Day Ahead data would be needed to be entered into the DERMS web interface to participate in the Optional Technical Trials. Additional support by way of user specific webinars were also offered. By mid-August, 16 users had completed their registration with support, with at least two write users per organisation.

DER were initially given access to the Wave 1 dashboards which were needed for the Optional Technical Trial. To prepare DER for participating in the Wave 2, Market Trials, the pre-production environment was made available for familiarisation late-November. DER were also sent an updated DERMS user guide, reflecting the new dashboards and functionality introduced in Wave 2.

Academia: Imperial College work

Engagement with the academic partners from Imperial College London has progressed this year to cover the task of "Validation of the Power Potential trials". This is the final task to be completed from Imperial College's scoped work, to review the DERMS commercial calculations during Wave 2. An initial meeting was held in March 2020 between UK Power Networks, National Grid ESO, Imperial College and ZIV Automation representatives to define the case studies to be analysed in this report. Imperial College has produced a document to capture the objectives and scope of the work, both at day-ahead and real-time timescales, and data input needed for the different case scenarios. Imperial College is also in contact with ZIV Automation to get the initial network data and other DERMS values needed for the analysis. A final report is expected in January 2021.

3. Workstream 3: Business processes

National Grid ESO

Preparations for the trials have continued with business processes developed for the key elements of National Grid ESO's operation during service delivery. The trial design developed by the commercial workstream and trials delivery workstream identifies a series of trial waves, each of which will necessitate different business processes and work instructions to be developed and agreed with training for the affected business functions. Business processes have been developed for the different areas summarised in Table 2 and detailed work instructions/standard operating procedures are being prepared for each wave of trials.

Table 2: National Grid ESO Process changes adopted for the Power Potential trials

National Grid ESO Process changes adopted for the Power Potential trials		
Theme	**Purpose**	**Description**
Network data (IEMS)	To ensure DERMS receives 400kV measurements	Support from Control System Support is in place and ICCP connection has been validated.
Dispatch (Wave 1 and Wave 2)	To define Control Room responsibilities during Wave 1 and Wave 2	Business procedure has been established for the Wave 1 reactive power trials. Business procedure for Wave 2 has been finalised. Control room personnel are trained for Wave 1. Weekly advice/guidance for control room personnel for Wave 1 trials is in place [1] Agreement in place to conduct active power trials for a limited time duration; specific times to be defined. Engagement with planning teams for notification of outages that impact Power Potential DER and planned network splits is in place.
Nomination (Wave 2)	To establish the approach to nominate the service required in response to the system need	Assessment logic for Wave 2 according to Target Average Cost (TAC) has been revised. Assessment process has been established and tested. Commercial procedure in place for Structuring and Optimisation Team to undertake daily nomination process during Wave 2.
PAS (Wave 1 and Wave 2)	To ensure visibility and dispatch of the Power Potential reactive power service	Development of PAS system for Wave 1 and Wave 2 trials is completed. Project access to PAS data recordings (for tenders, dispatch and RTM) is completed. PAS deployment into the control room has been completed. Project considering further PAS-DERMS testing in advance of Wave 2 to mitigate any issues with the new data exchange requirements.
Settlements (Wave 1 and Wave 2)	To establish how payments for services delivered will be reconciled with the service accepted by National Grid ESO and the service delivered.	High level processes agreed. Standard Operating Procedure for Wave 1 is complete. Standard Operating procedure for Wave 2 is complete.

[1] During Wave 1, National Grid ESO define the PAS instructions for the current week, based on the outcomes of the previous week e.g. adjusting parameters to facilitate achieving more reactive power absorption overnight

Next steps

Further details of business readiness for trials is provided in the SDRC 9.4 report.

In addition, the project team has identified the main business process steps and changes that need to occur to be able to transition the service into Business As Usual. This also involves understanding the interaction with future market changes and any ongoing work within the ESO (e.g. stability pathfinders). The outcomes of this work will be outlined in the SDRC 9.6 report which will be published at the end of the project.

UK Power Networks

The processes for signing customers up to the service and for settlement were created in 2019 and outlined in last year's SDRC 9.4 and the Annual Summary Report December 2019.

The only additions in 2020 have been setting up new customer identifiers in each partner's financial systems to enable the settlement between National Grid ESO and UK Power Networks, and implementation of an approach to raise purchase orders to the DER using the 'self-bill' approach defined by the project. This allows the project to pay participating DER based on their service delivery according to the trial contract, without requiring the DER to submit invoices.

The processes were successfully implemented to make trial payments in the final months of 2020, initially for the payment for active power testing during commissioning, then the first Wave 1 Optional Trials payments.

The rest of this section describes the Hypercare Service Design infrastructure created by UK Power Networks to provide support during trials and DER familiarisation activities.

Hypercare Service Design Overview

A Service Design Document and 'Knowledge Based Article' describe in detail the processes in operation to support Mandatory and Optional Trials, consistent with UK Power Networks' approach to support of other live systems.

Support for the Power Potential solution commissioning, mandatory and optional trials is in the form of a Hypercare support model. UK Power Networks/National Grid ESO and DER users contact the Hypercare 'desk' to raise incidents or requests after first checking the Self Service FAQ Alfresco site. There is a DER Single Point of Contact (SPOC) for business/commercial related calls and a UK Power Networks/National Grid ESO SPOC for internal user technical calls. When calls are received by the DER or UK Power Networks/National Grid ESO SPOC they will be logged into the RQM incident management system. If the incident/request is business related the DER SPOC will resolve it directly or work with the project Team to resolve it and notify resolution back to the user.

If the incident is an internal UK Power Networks/National Grid ESO technical call the UK Power Networks/National Grid ESO SPOC will capture and manage the call, handing off to the relevant resolver group if required to resolve the incident. The incident will then be investigated and resolved by the Resolver Group and on resolution notified back to the UK Power Networks/National Grid ESO SPOC who will confirm resolution with the user who raised incident.

Any password reset or remote access calls relating to the DERMS Web Interface are made directly to the UK Power Networks IT Service Desk who will be the single point of contact for resolving these requests/issues on the spot, in line with standard IT Service Desk service support process.

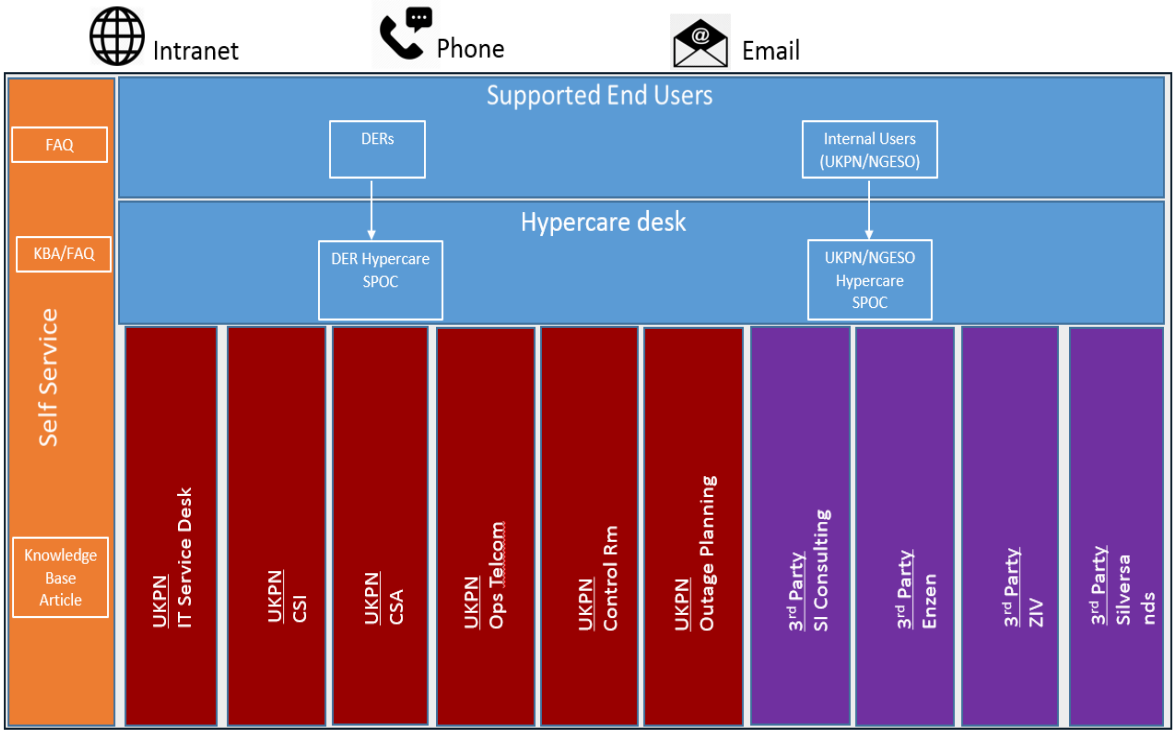


Figure 3: Target Operating Model – Control Systems Infrastructure (CSI) and Control Systems Automation (CSA)

The above target operating model and the Incident Management Flow (see figure 4) were implemented in May 2020 when the Hypercare Desk became the primary contact point for all DER and UK Power Networks/National Grid ESO users. Hypercare Desk triages calls based on its ability to resolve and level of knowledge gained during operation of the Trials. If the Hypercare desk cannot resolve the call it is passed to the appropriate resolver via a template email and managed to resolution by the Hypercare Desk. If the performance measure is likely to breach, there is an escalation process. Weekly hypercare issues triage has been held during the Wave 1 Optional Trials.

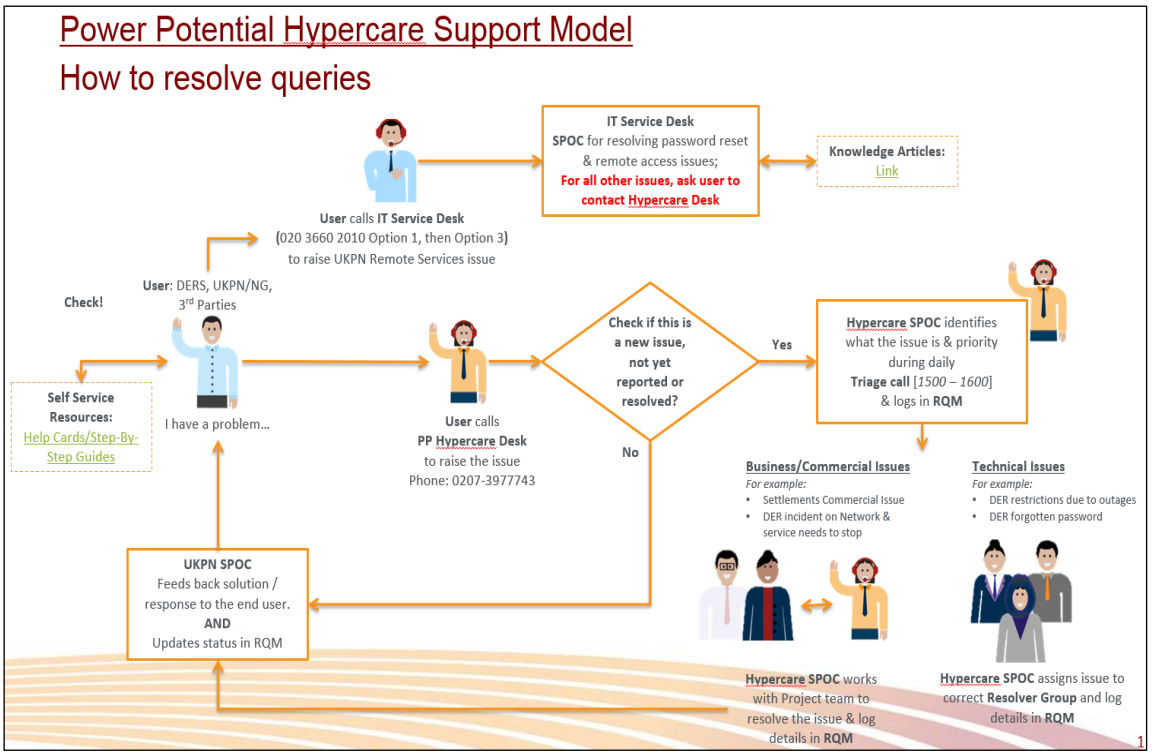


Figure 4: Incident Management Process Flow

4. Workstream 4: Trials Delivery

Power Potential has moved forward significantly since the last Annual Summary Report in December 2019. Despite the COVID-19 pandemic, five DER have completed commissioning and Mandatory Technical Trials and the project has progressed into Wave 1 Optional Trials on 14 October 2020.

Technical Trial Stages: Commissioning, Mandatory, Optional

Considerable learning and experience is already being gathered during this first wave of Power Potential trials and will be captured in the SDRC 9.6 report in 2021.

Overall, five DER have now completed commissioning. The four DER which have completed the mandatory technical trials and who have moved into Wave 1 Optional Trials, have participlated according to their declared availability and on a nearly continuous basis. There have been numerous learning points from each activity, which are recorded by UK Power Networks in a Trials Learning Log, shared with National Grid ESO, and which will be used to inform future activities and Business as Usual services.

Preparations for trials included a UK Power Networks “Network Operating Procedure” being created for liaison between UK Power Networks Control Room and National Grid ESO, along with business procedures for data capture, analysis and reporting.

During the Commissioning process, an integration test is carried out between the customer and a UK Power Networks Operational Telecoms engineer, to ensure the communications between the DER RTU, PowerOn and DERMS have been set up correctly. This strategy was developed early in the commissioning phase to identify and correct any issues ahead of the main Commissioning activity. This includes a variety of tests, which have been developed to prove the functionality of the complete end-to-end solution from the UK Power Networks perspective. This process is a collaboration across multiple teams at UK Power Networks and the customer. If a DER can be shown to successfully respond to signals from PowerOn, and then to signals from DERMS, then it will be classed as commissioned and ready for participation in the next stages of trials. Once it is marked as Commissioned a control engineer will then activate the required data points in the PI logging system for this DER to ensure all required data is captured.

There are three main parts to the Mandatory Technical Trial, which every DER must go through before it is able to take part in the Optional Trials. The first is to measure the response of DERMS and the DER to a sudden simulated step change in the 400kV voltage, and the second is to measure the response to a simulated slow change in the 400kV voltage. The final test measures the response of DERMS and the DER to changes in the simulated 400kV target voltage set point. In each case, the expected response is calculated taking into account the network conditions. These are then compared to the measured responses and if the DER has met the required outputs, it will be passed. The purpose of these tests is to mimic the conditions in which the DER will have to respond in the later trials and ensures the DER is able to adequately do so, as per the technical requirements which were set out prior to the beginning of trials.

In addition to commissioning and the mandatory technical trial, the DER must also pass a capability test. This test measures the speed at which the DER can provide the full lag response and the full lead response. For a DER to meet the technical requirements for participating in these trials, it must be able to provide 90% of its full response in two seconds, and 100% in five seconds. In some occasions some of these tests had to be carried out multiple times, as there were changes required to some part of the setup for data exchange or capture. This represents additional learning points for all parties involved.

Once a DER has passed all the above, it is able to enter the Optional Trials phase. Over the period of the Wave 1 Optional Trial, three DER were able to operate near continuously when available for V service and provide voltage services to the transmission network. Control engineers from National Grid ESO were able to test this from their PAS system and call on the DER in the trial to provide

reactive power and therefore voltage support. This has been successful and is monitored weekly through joint sessions between the UK Power Networks and National Grid ESO delivery teams.

Throughout the trials, there has been a daily collection and review of data. This process has been automated using open-source software such as Python and Plotly to interrogate the UK Power Networks PI data store. This data is used to monitor the activity from DERMS and the response from each of the participating DER, as well as identifying any potential anomalies or irregularities.

In addition, data from National Grid ESO has been provided to allow detailed analysis of the trial results. Data from PAS system (dispatch service information and system voltage set point) alongside the data historian results (voltages on super grid), this allows the project team to have a full picture of what is happening during the trials in the end to end process, from National Grid ESO to DER via the distribution network.

So far, most of the learning is on system performance and we are still working to gain positive learning on dynamic voltage service as such.

Data analysis is vital and an important part of the trial process, not only for project partners, but also for the generators to allow them to be ready for dynamic service in the future.

Mandatory Trials delivery

For much of the year, COVID-19 restrictions have impacted significantly on project progress. The execution of Mandatory Trials was no longer possible from a UK Power Networks' control room location due to site access restrictions. In this context, the Trials delivery team devoted significant effort to create the right procedures to allow the remote execution of Mandatory Trials. This included the preparation of several dry-run sessions to get confidence in the processes, while co-ordinating remotely with UK Power Networks' control room personnel.

A Mandatory Trials procedure document was created together with updated Mandatory Trials test specifications to record data. This complemented the existing Mandatory Trials guidelines with the main project agreements to execute trials. An external version of the updated Mandatory Trials guidelines can be found on the Power Potential website.

Starting in July 2020, a series of Mandatory Trials were carried out to demonstrate the DER being dispatched into voltage control mode from DERMS, based on DER availability and GSP instructions. A solar plant was the first to complete Mandatory Technical Trials successfully on 12 August. This followed two unsuccessful attempts on 14 July, where testing was abandoned due to a customer comms failure, and on 16 July due to issues arising with DERMS relating to the scaling of the voltage droop settings and software update speeds.

A battery was then commissioned on 6 August and successfully completed Mandatory Trials on 7 September. This was followed by a windfarm, which completed Mandatory Trials on 24 September.

With three DER fully commissioned and having completed Mandatory Technical Trials, the steering committee agreed Wave 1 Optional Trials, which commenced with service availabilities submitted on 14 October 2020 and provision of voltage control service on 15 October.

Since then, a further DER, a windfarm has completed commissioning and Mandatory Trials and is now participating in Wave 1 Optional Trials. An additional battery had completed one component of the Mandatory Trial at the time of writing this report.

Trial Schedule

The full trials calendar was published in the updated Market Procedures in October 2020.

- Wave 1 (Optional trial) start 14 October – 10 December 2020 (eight weeks)
- Wave 2 (Commercial trial) 14 December – 20 December 2020 (one week)
- Christmas break 21 December – 3 January 2021 (two weeks)

• Wave 2 (Commercial trial) 4 January – 28 March 2021 (12 weeks)

The Wave 1 trials run 24/7 including at the weekends. Availability and expected operating level for the start of the optional trial must be submitted by 2pm on the day-ahead. The optional trial ran from 14 October 2020 to 10 December 2020, with the submission of DER availability and expected operating level by 2pm each day. DER were able to earn participation payments for Wave 1 based on hours available between the service delivery start and end times in the table below.

Available market hours for the Wave 2 reactive power trials are for full trading days starting at 23:00 (11pm). Active power trials will run in specific service windows during Wave 2.

Wave 2 Trials, which are designed to test the commercial operation of the DER, will start after completion of the DERMS upgrade mentioned in the previous section; the Wave 2 dates shown in Table 3 below are due to be revised.

Table 3: Power Potential trial schedule (Wave 2 to be revised)

Trial Phase	DER submit bids by	Service Delivery Start Date/Time	Service Delivery End Date/Time
Wave 1 Optional	Wed 13-Oct-2020 14:00	Thur14-Oct-2020 11:00	Tue 10-Dec-2020 11:00
Reconfigure to Wave 2 and give DER access		Tue 10-Dec-2020 11:00	Mon 14-Dec-2020 14:00
Wave 2 (Reactive Commercial Trials)	Mon 14-Dec-2020 14:00	Mon 14-Dec-2020 23:00	Sun 20-Dec-2020 23:00
Wave 2 (Reactive Commercial Trials)	Mon 4-Jan-2021 14:00	Mon 4-Jan-2021 23:00	Sun 28-Mar-2021 23:00

Transmission service context

Voltage control, in both a static and dynamic method has become increasingly important to National Grid ESO as System Operator for the Transmission System. Constraints take many forms of the network (thermal/stability/voltage), and these issues have been more acutely seen with an evolving power system. In recent years the decrease in large, Grid Code compliant generators and the increase of smaller, asynchronous, generators which are often renewable has created a much less predictable energy landscape. This has led to a more dynamic system, with rapidly changing flows, accompanied with less network reinforcement, more economic transmission system. There is now a greater requirement for more automatic voltage support for post fault scenarios to prevent voltage collapse and excessive voltage step change.

The South-East Coast of the UK transmission network is unique owing to a few factors. Firstly, it is unusual to have the quantity of generation and demand on a single double circuit route over 250km between Hampshire and Kent. There is approx. 3GWs of HVDC interconnectors, with a further 1GW being commissioned soon. This is accompanied by the more recent addition of three large windfarms. There is also a large penetration of DER from renewable sources (Wind & Solar).

As a result, the flows on this part of the network are both high and change rapidly. A securable fault as per SQSS design can result in some 5.5GW of generation and 2GW of demand connected via the remaining other end of the double circuit some 250km away, leading to a complex requirement for both thermal and voltage stability as well as voltage step change issues. This is currently managed by transmission connected generation, GSP based ARS/ATCC/AVC schemes, an intertripping scheme to the HVDC interconnectors and a fleet of reactive equipment (notably the new DRCs built to accommodate greater European interconnection).

Due to the speed of action required to avoid these issues, the required voltage service is technically demanding, and hence real time operational trials were essential to understand performance and value.

Transmission service trial learnings so far

The optional trials ran for an initial period of eight weeks. The target utilisation for each DER was aimed to be no more than 20% on average in accordance with each DER who had available submissions. As such the initial National Grid ESO instructions into PAS were focused around establishing the required control parameters to achieve this (GSP deadband and droop). This has been a challenging period with new operational tools, including the period of clock-change which has a large impact on the overall shape of the demand curve and influences the UK to Europe interconnector flows. The autumn months are also associated with greater wind speeds and storms affecting the local generation mix.

The National Grid ESO Electricity National Control Centre (ENCC) has been very supportive in integration of the new activities into the daily control routine. Additionally, they have given constructive feedback regarding the implementation of a new service which included offline training (self-serve from videos and user guides) due to the ongoing segregation of control personnel from normal training environments due to COVID-19.

It should be noted that PAS has undergone improvements and patches to overcome issues and this has been made more complicated by the Power Potential functionality within PAS sitting amongst other operationally live market tools. There have been some circumstances in which the PAS system has not been able to instruct the service (PAS outages, clock change, DERMS communication error to PAS requiring manual override). However, from a DERMS and DER perspective, we have identified workarounds, so we have not needed to interrupt the trial in any of these situations. Availability of PAS is more critical in Wave 2, but PAS outages can be planned in future outside critical windows. The remaining issues are being addressed by system changes, so will not affect the Wave 2 trials and future service delivery. Updates were also made to the PAS system in mid-November to give National Grid ESO Control Engineers clear visibility of service utilisation.

Wave 1 Optional Trial experience

The output of the optional trial so far have yielded varied results. Based on the trial experience, and number of changes have been made to the system and its configuration. The trial analysis thus requires us to consider the operating modes used in PAS, DERMS and DER control operation at that time.

1. Settings of the control parameters in PAS (GSP deadband and droop) and changes to the PAS system (as described in the previous section over the first six weeks).
2. Agreeing changes with DER in the active power limits for the reactive power service in the first week.

   Improvements have been made to the DERMS software configuration as issues were found, and the contractual limits for the DER were adjusted for practical reasons. For example, a solar farm which was providing reactive power at night required a slightly negative active power lower limit to be able to provide reactive power. This is because they import a small amount of active power at night, when they are not generating active power themselves.
3. Adjusting the recalculation and update frequency of DERMS setpoints during service delivery. In the initial trial period to 29 October, the DERMS calculations up to the 29 October were fast – recalculated every 5s. During the Wave 1 Optional Trials, the UK Power Networks' Control Systems and Automation team reported an issue with the huge volume of data traffic flowing through the control servers to and from DERMS and the DER RTUs. The volume of data traffic was overwhelming the data management process, and therefore required immediate resolution, and as such the DERMS simulator was slowed down to 10

min refresh rate recalculation intervals whilst a solution was developed in a DERMS upgrade to reduce the volume of outbound traffic.

This slowing of the system reduced DER rapid Mvar oscillations that were seen across all three DER for large kV set point changes, it has not resolved this issue entirely. Additionally, the current slower DERMS calculation prevents full dynamic response to the transmission system, where the dynamic response from end to end should be less than 30 seconds (time required for transformer tap changer operation).

4. Upgrade to DERMS after the Wave 1 trials (December or early January, after submission of this report) including the following three functional changes
    1. Implementation of a deadband on the voltage setpoint – reducing data volumes to allow the recalculation frequency to return to 5s. After much analysis, it was determined that a 0.1% dead band on how DERMS sends voltage set points would reduce the volume of outbound data flow. This could reduce the data flow from the DERMS to PowerOn by over 85%. We have also explored reductions in inbound data traffic from RTU to DERMS e.g. disabling data not required for DERMS, and a change was made in the measurements at the RTU.
    2. Reduce the frequency of limit issue. A further part of the change reduces the frequency of reactive power limits sent to each DER site. In the initial design, these limits were updated if the DER active power level changed so that DER was operating with a different reactive power range. However, the control logic required DERMS to receive a 'readback' of these new limits from site in order to keep the DER in service. Particularly for customers with rapidly changing limits, this could cause the DER to fall out of service. A change has been made to only send limits to site relating to the maximum allowed reactive range and require readbacks of those at the start of the combined implementation of these changes in the DERMS upgrade, so the full impact is currently under review.
    3. Previously DERMS has issued kV setpoints to each DER such that the difference between the setpoint and real-time voltage indicates the expected additional reactive power demand from the DER. We identified that DER have interpreted this delta as the total power demand required, making their individual responses incomparable unless using the same method. DERMS will have new options after the upgrade to calculate kV setpoints consistent with each DER interpretation, it is believed that this difference has led to DER outputs contrary to the expected kV setpoint and will address our concerns with DER oscillations and delivered range.

The DERMS upgrade also addresses multiple issues affecting support of the service (reducing manual intervention requirements). Overall, we are confident that changes from the upgrade will allow us to have consistent high availability of the systems and service (from DER, UK Power Networks and National Grid ESO perspectives) and subject to successful patch release, we will consider opportunities and times for gaining relevant learning from optional trials, before the start of market trials.

So far there have two parts to this trial with two different DERMS recalculation/refresh rate speeds, in addition to the other changes implemented. It is hoped that the implementation of a third operating mode for DERMS after its upgrade will resolve both the traffic issue and raise the speed of end to end service back to within dynamic timescales. It is predicted however this change will again have a significant impact of the DER outputs and response. This will require testing and analysis.

We have and continue to learn a lot about the challenges between integrating different and varied generators and their control systems into a transmission facing service. To this end, we will continue to evaluate the dynamic response with DER that we have in the trials.

5. Business Case Update

The business case has not been updated in 2020 and remains as reported in detail within the SDRC 9.5 Cost Benefit Analysis report in 2019. As notified to Ofgem in November 2018, the SDRC 9.5 report was submitted in March 2019 to Ofgem, but its publication is being withheld until the project's commercial trials are completed to avoid distorting participant behaviour during these trials. The SDRC9.5 report provides a view following the cost benefit analysis completed by the University of Cambridge on the Power Potential project. The University of Cambridge completed analysis on the benefit of the project within the trial region, formed by four GSPs. Replication studies were then conducted to determine where else the project has the capability to add value.

Following the trials there is expected to be a short review of the CBA with bid and accepted prices containing updates to actual/forecast DER volumes to understand how this impacts the potential project benefits. An appendix with these findings will be included in SRDC 9.6 in 2021 (Trials Report).

6. Project Against Plan

The project has made progress significant progress with the DERMS software operational on the live system, with DER commissioning and Mandatory Trials having begun. The hypercare and support approach for trials has been implemented. The key milestones achieved are set out in Table 4.

Table 4: Key Milestones

MILESTONE	Date
DERMS 16.5 live to support DER Commissioning	Feb 20
First DER commissioned	Mar 20
DERMS 16.7 Live to support Mandatory trials	Jun 20
FAT complete (18 to support Optimal Trials and Wave 2 Trials)	Jul 20
PAS to DERMS National Grid ESO E2E Integration Tests (16.7)	Apr 20
DERMS 18.1 testing for Optional and Market Trials complete	Jul 20
DER commissioning (3 sites)	Sep 20
UAT (DERMS 18.2.4) complete	Aug 20
DERMS 18.2.4 live in production (Optional and Market Trials)	Sep 20
Optional Trial Start	Oct 20

A material change request letter was submitted to Ofgem on 9 November 2020, requesting access to the project contingency, changing the project end-date to 31 December 2021, and setting out the timing of the remaining Successful Delivery Rewards Criteria (SDRC) reports. These have been revised to reflect the updated project delivery plan and the revised delivery dates are summarised in Table 5 below, notified to Ofgem in April 2020 and contained in 9 November material change request sent to Ofgem.

Table 5: Revised schedule for the remaining SDRC reports

	SDRC 9.5	SDRC 9.6	SDRC 9.7
Title	Cost Benefit Analysis	Trial Phase Report	DSO risk-reward framework for providing wider system services
Original submission date	31 December 2018	31 December 2019	31 December 2019
Revised submission date	7 May 2021	30 April 2021	15 May 2021

7. Successful Delivery Reward Criteria

Table 6: Status of the project's Successful Delivery Reward Criteria (SDRC)

SDRC	Progress
SDRC 9.1: Technical High-Level Design The high-level design of the technical solution and high-level business processes which will operate the solution. Evidence: • Alternative design options considered and selection criteria • High level design specification • Functional design document • High level business processes • Review of anticipated synergies and conflicts	Completed and submitted on time. Published on time.
SDRC 9.2: Commercial and Detailed Technical Design **Stage Gate 1** – The agreed detailed technical design (Partner/s, National Grid, UK Power Networks, Customers) and Commercial Framework for the trial. Evidence: • Stakeholder consultation findings • Functional Specification Documents • Finalised Commercial Framework • Detailed Business Processes	Completed and submitted on time. Published on time.

SDRC	Progress
SDRC9.3: Commercial Tendering Process Report and Finalised Trials Approach **Stage Gate 2** – Outline the learnings from the tendering rounds for the reactive power services and the engagement on the active power services. Based on this process and the trials approach, to advise which customers will be utilised during each trial phase and the forecasted effectiveness. Evidence: • Report on tendering approach, including technical and contractual requirements for participation, barriers to entry and measures to alleviate these • Proposed commercial framework and interaction with SO and DNO incentives • Review of technologies and volumes under contract • Initial forecasts of availability and utilisation volumes • Signed commercial contracts • Trials Approach and Methodology	This SDRC was delivered and published on time as planned by National Grid ESO, interpreting 'signed commercial contracts' as requiring signing of the inter-operator agreement between National Grid ESO and UK Power Networks and as described in the SDRC. The agreed inter-operator contract was further revised after the SDRC was submitted, in line with final format of the framework agreement with DER providers.
SDRC9.4: Customer Readiness Report and Performance of the Technical Solution in a Controlled Environment **Stage Gate 3 –** Update on the effort required to ready customers to take part in the trial (technical, business processes, etc.) and the performance of the technical solution in a controlled environment and expected performances in the live environment. Evidence: • Test Report – End to End Testing Business Change Implementation Report • Customer Readiness Assessment • Technical Solution – GO / NO-GO Criteria Results • Customer and Business – GO / NO-GO Criteria Results	This SDRC delivery date was revised to 30 November 2019. Published on time.

SDRC	Progress
SDRC9.5: Cost Benefit Analysis Analysis assessing the financial case for the trial to date and for extending the approach into the future Evidence: Detailed assessment of the costs and benefits of TDI 2.0, to include: • analysis of the net benefit of extending the trial into the future (using Ofgem's CBA framework), replication study assessing the viability of, and case for, extending TDI 2.0 to other DNOs and for providing a wider set of services	Completed and submitted on time for the revised delivery date of 31 March 2019, based on theoretical analysis from the University of Cambridge before the trial. This cannot be published due to the risk of distorting participants' bids during the trial. Thus, we have not published the report at this time. We will update the SDRC 9.5 report in 2021 with additional learning from the trial (accepted bid prices and volumes, and latest view of the delivery and support costs of the technical solution). We propose this updated version of the SDRC 9.5 with the CBA will be following completion of the project trials in 2021, accompanying the SDRC 9.6 trials report to be submitted 7 May 2021.
SDRC 9.6: Trial Phase Reports **Stage Gate 6** – Trials Report The completion of the trials in line with customer agreements and review of the performance of the trial; the closure of the project (potentially moving into BAU) in line with customer agreements Evidence: • Trials Phase Report including adequacy of contracted volumes to meet requirement, availability/reliability of DER and control system, accuracy of sensitivity and accuracy forecasting, evidence of competitive bidding, evidence of conflicts • Report summarising the financials of each party (subject to DER commercial confidentiality), and in particular the costs incurred by the DNO, the uplift applied to DER bids, and hence the net revenue that the DNO receives • Assessment of scheme design and operation to cover how well it worked, where conflicts arose, and how the governance arrangements performed • Plan for transitioning trial participants into enduring solution	This SDRC report has been rescheduled, to 30 April 2021. Detailed planning for trial delivery continues including ensuring that business processes are developed and reviewed, responsibilities assigned and training scheduled. Early discussions have taken place to define the report outline and ensure the bid learning criteria will be evaluated consistently with the data gathered during trials.

SDRC	Progress
SDRC 9.7: DSO risk-reward framework for providing wider system services A paper describing the incentive framework used for the project and recommendations for an enduring incentive framework for an active DSO Evidence • Analysis of the costs, risks and revenues for the services included in the trial • Assessment of mechanism used within the trial and comparison against alternative incentive mechanisms • Assessment of the applicability of these incentive schemes to a DSO providing a broader set of system services and interaction with the wider SO incentives	This SDRC report has been rescheduled to 15 May 2021. Early discussions are underway to review the potential options and how the pros and cons of these can be further developed through the learning generated by the project trials.

8. Data Access Details

Interested parties can access any network and consumption data gathered because of this project in accordance with National Grid ESO's published policy. UK Power Networks follows a similar innovation data-sharing policy.

9. Learning outcomes

Dissemination activity from the Power Potential project has continued throughout this reporting period to keep raising awareness and the profile of the project and encourage trial participation with key stakeholders and audiences within the industry. Engagement with DER and aggregators has been critical to successful delivery of the projects' trials and overall project objectives.

The projects' engagement strategy continues to communicate the key benefits that the Power Potential service will bring, including:

- making a material contribution to voltage control and constraint management on the National Electricity Transmission System
- providing an additional revenue opportunity for DER
- gathering evidence on the level consumer savings that could be achieved through adoption of the Power potential approach following the trials.

The engagement process has ensured that potential DER being targeted for participation in the trial are kept up to date and are involved/consulted on the progress of developing the trials. The engagement process is led jointly by UK Power Networks and National Grid ESO. Both parties have continued to utilise existing relationships with providers within the trial region, through the Business Development and Contracts and Settlements team within National Grid ESO. The key channels used in this reporting period are listed below in External Engagement.

Project website

Maintaining a good website is one of the best ways to promote an activity. To ensure the project is connecting with its stakeholders, the project website has been updated regularly. On the project website, users can learn about the project at a high level or find more technical detail using the sign posted tabs, such as finding out about requirements for participation in the project or learning about the DERMS platform. The website hosts all the relevant documents the DER need to learn about participation requirements, or complete to take part. To make the site user friendly and help

navigation, the website now includes signposted document folders. A direct link has been added to the website which means users can request to join the mailing list.

The project website includes an 'events and news' section, which allows stakeholders to follow the project's external engagement activities. A dedicated email address (box.PowerPotential1@nationalgrid.com) appears at the top of the page, allowing for further questions or queries to be submitted directly to the team.

As the project trials begin, and as the project publishes results and more guidance for interested parties, the project team will be able to track the number of visitors to the website. This will help the project team understand how many visitors are reading the project material and give them an indication as to the levels of interest in participating.

Website statistics for last 12 months for the project webpage. Note that this data excludes webpage visitors from within the National Grid and National Grid ESO network:

Table 7: Website analytics

Page Hits	4,959
Visitors	4,360
Downloads	1,968
Average time on page	5 minutes 53 seconds

External engagement

The project has participated in the following events:

- **CIGRE webinar on 4 March 2020**

  Representatives from both National Grid ESO and UK Power Networks participated in a one-hour webinar organised by CIGRE UK to explain the project approach to trials that the project is following. A copy of the presentation can be found here.

- **New Energy Infrastructure2020 Virtual Conference on 25 March 2020**

  Dr Biljana Stojkovska discussed Power Potential on her presentation 'Integrating distributed energy resources to the grid' in the New Energy Infrastructure virtual conference held in March. Details of this conference can be found here.

- **CMS & NERA on 5 May 2020**

  UK Power Networks presented on Flexibility services and Power Potential to this law firm and economic consultant.

- **Teach-in session with Ofgem on 8 of July 2020**

  Representatives from both National Grid ESO and UK Power Networks hosted a two-hour Power Potential teach-in session with Ofgem, including a demo of the DERMS software from ZIV Automation. Over 10 attendees from Ofgem participated in this meeting and some of the topics presented included:

  - System integration and DER readiness/commissioning
  - Update on delays due to COVID-19 and revised timelines
  - Interactions with wider National Grid ESO work
  - Further considerations for an enduring ESO/DNO solution
  - Similarities and difference between PP and the 'Distributed Restart' project

- **International CIGRE 2020 e-session on 24 August – 3 September 2020**

  The project has a paper accepted for the CIGRE 2020 conference, which this year was conducted virtually as an e-session. The title of the paper is 'ESO/DSO coordination for reactive power services from DER in the UK's Power Potential innovation project: initial trial results' and a presentation of the main findings. Further details on this conference can be found here.

- **Energy Networks Innovation Conference (ENIC) on 8/9 of December 2020**

  The Energy Networks Innovation Conference 2020, formerly the Low Carbon Networks & Innovation Conference (LCNI), will be a free interactive virtual conference this year and was held on 8/9 December 2020. On the 8 December Dr Biljana Stojkovska and Dr Rita Shaw presented on Power Potential (preparation for trials and initial trial results).

Publications

The National Grid ESO and UK Power Networks press release were picked up in nine trade publications for the start of the live trials and the National Grid ESO website.

UK Power Networks, 21 October 2020 World-first renewable energy market trial hits major milestone

National Grid ESO, 22 October 2020 World-first renewable energy market trial hits major milestone

Table 8: Publication List October 2020 – 'Starts Live Trial'

Publication	Date	Headline / Link	Source Country	Reach Value (number of readers)
Utility Week	21/10/2020	ESO and UKPN trial distributed reactive power service	United Kingdom	3,000
Current-News.co.uk	22/10/2020	Ambitious' UKPN reactive power market project hits new milestone with live trial	United Kingdom	30,000
RocketNews	22/10/2020	Power Potential starts live trial | Renewable Energy – Energy Digital – Energy News, Magazine and Website	Canada	30,000
Energy Digital	22/10/2020	Power Potential starts live trial	United States	30,000
Electrical Contracting News	22/10/2020	World-first renewable energy market trial hits major milestone	United Kingdom	500
Energy Digital 2019	22/10/2020	Power Potential starts live trial		7,500
TendersInfo	26/10/2020	United Kingdom: World-first renewable energy market trial hits major milestone	India	30,000
PV Magazine	27/10/2020	UK utility trials 'world first' renewables-friendly energy market	Germany	175,000
Osborne Clarke	30/10/2020	The Energy Transition | Net zero and RIIO-2, Tesla's Virtual Power Plant and Ofgem's State of the Market Report	United Kingdom	30,000

Industry awards

No awards entries were submitted for the project during this period.

Conference publications

- **Article from Cambridge University in the Applied Energy Journal**

  Cambridge University, one of the project academic partners, has published a journal article in the Applied Energy Journal with the title 'Reactive power procurement: A review of current trends'. The article discusses some of the main findings in their research conducted within the scope of this project. The link to this publication can be found here.

Figure 5: Reactive power procurement-A review of current trends

- **Article featured in the Energy Industry Times publication for May-June 2020**

  An article on how 'Batteries react to network needs' was featured in the May-June 2020 edition of The Energy Industry Times publication, discussing how embedded batteries can be controlled to support the grid. The link to this publication can be found here.

Figure 6: Batteries react to network needs

Fortnightly newsletter to project stakeholders

At the end of 2019, the project issued the first newsletter update to the main project stakeholders. This has been established as regular project communication occurring every two weeks, to update DER and other RMAP participants on the projects latest progress.

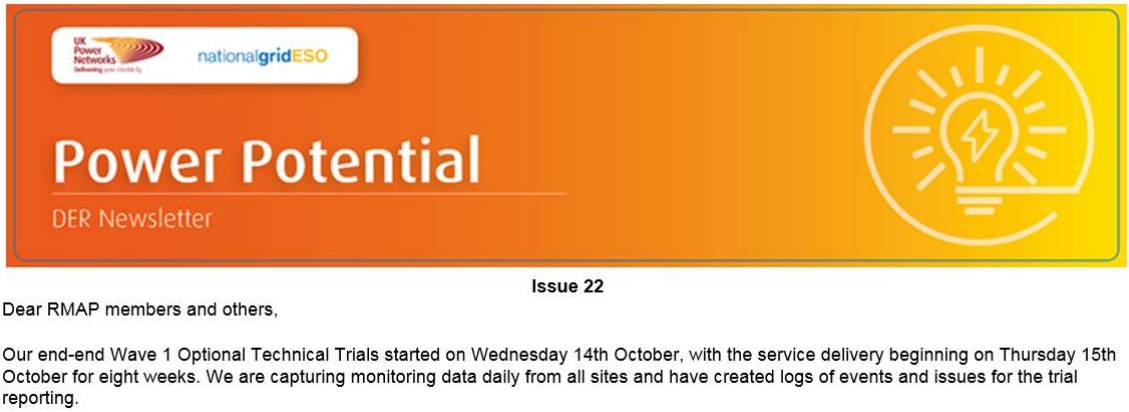


Figure 7: First newsletter updates to main project stakeholders

Monthly Newsletter to UK Power Networks' internal stakeholders

Since February 2020, Power Potential has featured in several of the monthly internal newsletters (>100 recipients) and design authority meetings (~20 key stakeholders). This is recognition that Power Potential is part of business change being delivered through the company's Active Network Management project.

Social media

Where the project has enjoyed any significant progress, these have been shared internally and externally (Figure 8) to enhance the profile of the project. Posts below linked to the 'World-first renewable energy market trial hits major milestone'.

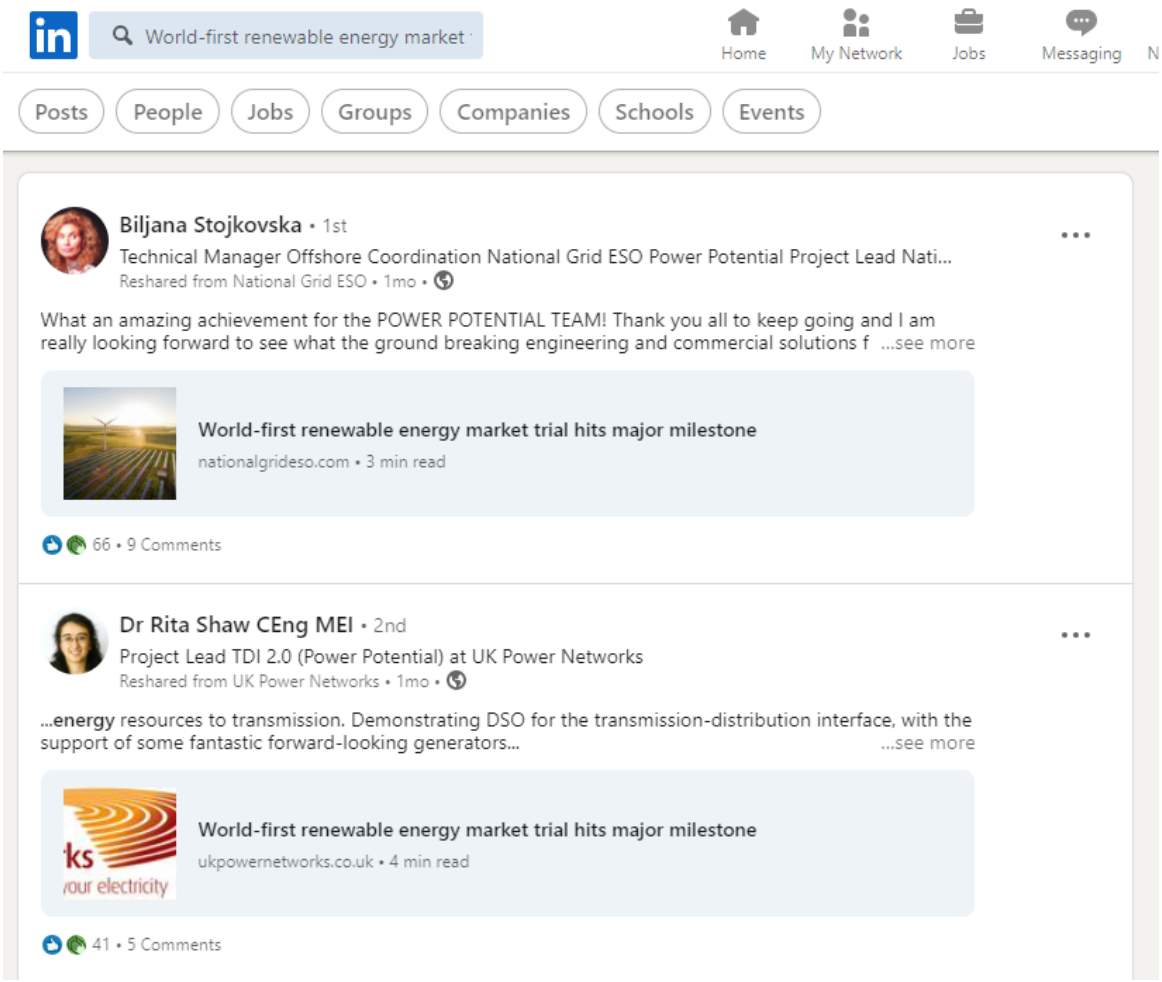


Figure 8: LinkedIn visibility of Start of Trials

10.IPR

To meet the requirements to publish Intellectual Property (IP) developed within this project, National Grid ESO and UK Power Networks notify the project manager promptly after identifying any joint result that it believes to be patentable or capable of protection by any other similar registered IPR.

National Grid ESO or UK Power Networks may apply for any number of patents or other protection in the respect of the joint results. Such applications may be filed in the name of National Grid ESO and UK Power Networks and their employees may be named as inventors or co-inventors in any such patent application. Up to 30 November 2020, the following IPR has been generated:

Table 9: IPR up to 30 November 2020

Workstream	IP description	IPR Owner
WS1	TDI 2.0 solution requirement specification document	UK Power Networks
WS1/2	DER Operating Characteristics document	National Grid ESO and UK Power Networks
Project	Project Handbook	National Grid ESO and UK Power Networks
WS1/2	Use cases Definition	National Grid ESO and UK Power Networks
WS2	Communication and DER Engagement Plan	National Grid ESO and UK Power Networks
WS1/2/3	SDRC 9.1 report	National Grid ESO and UK Power Networks
WS1/2	Functional and non-functional requirements for TDI 2.0 technology solution	National Grid ESO and UK Power Networks
WS1/2/3	SDRC 9.2 report	National Grid ESO and UK Power Networks
WS1/2/3	SDRC 9.3 – Commercial Tendering Process Report and Finalised Trials Approach	National Grid ESO and UK Power Networks
WS1	Detailed Design for the DERMS Solution	ZIV, UK Power Networks and National Grid ESO
WS1/2	SDRC 9.5 Cost Benefit Analysis Report	National Grid, UK Power Networks and Cambridge University
WS1	Power Potential Test Strategy	UK Power Networks
WS1/2/3	SDRC 9.4 Customer Readiness Report and Performance of the Technical Solution in a Controlled Environment	National Grid ESO and UK Power Networks
WS4	Mandatory Trials guideline document	National Grid ESO and UK Power Networks
WS4	Optional Trials guideline document	National Grid ESO and UK Power Networks
WS4	Mandatory Trials procedure document	National Grid ESO and UK Power Networks

Workstream	IP description	IPR Owner
WS4	Mandatory Trials test specifications	National Grid ESO and UK Power Networks
WS1	Power Potential commissioning requirements and procedure	UK Power Networks
WS1/WS2	DERMS DER web interface user guide	UK Power Networks

The following IP is forecast to be generated in the next reporting period:

Table 10: IP forecasted to be generated in the next reporting period

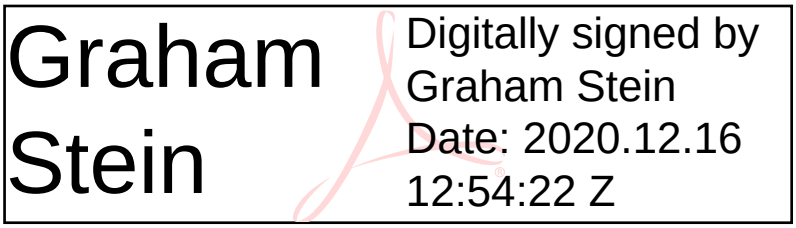
Workstream	IP description	IPR Owner
WS4	SDRC9.6 – Trials Report	National Grid ESO and UK Power Networks
WS2/3	SDRC 9.7 – DSO risk-reward framework for providing wider system services	National Grid ESO and UK Power Networks
WS1	Learning from DER commissioning for Power Potential	UK Power Networks

11.Risk Management

A robust project structure and governance process means that any potential issues or changes that could affect project delivery are identified quickly and actions are put in place to resolve them. The risk register is attached as Appendix A.

12.Accuracy Assurance Statement

This progress report has been produced in agreement with the entire project hierarchy. The report has been written and reviewed by all project partners. The report has been approved by **Graham Stein, Senior Manager of Network Operability at National Grid ESO**. Every effort has been made to ensure all information in the report is true and accurate.



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Appendices

Appendix 1: Risk Register

Two risk tables are presented below:

1. Table 11: Status of risks from the original bid document
2. Table 12: Additional risks identified and managed during project delivery

Table 11: Status of risks identified in the original bid submission

Risk #	Area/theme	Risk & Impact description	Mitigation/Update	Status
1	General	Final funding not awarded.	Funding secured.	Closed
2	General	Significant changes to South East Coast network make the TDi2.0 solution no longer suitable.	Future developments and scenarios considered and the solution continues to be relevant.	Green
3		Number not used.		
4	General	Insufficient resources allocated to the project.	Project plan developed and actively managed. Partners committed to resourcing delivery of key project milestones. Contingency fund overseen by Steering Committee.	Closed
5	General	Loss of key staff delays delivery.	Ensure project handbook and file sharing systems are in place and ongoing engagement with team managers across both partners.	Green
6	Technical	Technical limitation of ICCP interoperability between National Grid ESO and UK Power Networks cannot deliver required data transfer causing delay.	Detailed analysis undertaken of options and Steering Committee has closed this risk, agreeing use of web services.	Closed
7	Technical	Specification of the technical solution is insufficient to deliver requirements.	Specification developed with subject matter experts from across both project partners to ensure that it is fit for purpose.	Closed
8	Technical	Control system fails to perform leading to unsatisfactory trial results.	Control system to be subject to performance testing using benchmarking or simulations under various operating conditions.	Closed
9	Technical	Interoperability issues may delay response and reduce ability to control the system.	Agreed common standards for components and interface protocols.	Amber
10	Commercial	Risk that five DER/40 Mvar volume will not be recruited and commissioned in time for the trials	Ongoing engagement has enhanced the commercial proposition and increased the value of the payments to DER budget for the trials.	Closed
11	Commercial	Volume and price risk associated with each DER's sensitivity to transmission constraint it is being asked to alleviate.	Payments to DER fund in place and value increased to bolster commercial proposition.	Closed

Table 12: Additional risks identified and managed since bid submission

Risk #	Area/theme	Risk & Impact description	Mitigation/Update	Status
12	General	Ways of working at each partner creating silos.	Progress made to develop productive way of working across partners.	Closed
13	General	Project is disjointed.	Project handbook developed, weekly cross-partner workstream meetings and monthly steering committees established.	Closed
14	Finance	Budget not agreed between partners.	Budget split between partners agreed.	Closed
15	Technical	CIM integration takes longer, delaying project	Revised project delivery plan agreed with interim approach to reduce delays to trials.	Closed
16	Commercial	Delay in producing detailed workstream plan risk project delay.	Detailed project plan in place with dependencies mapped to other workstreams.	Closed
17	Technical	Risk that SDRC9.1 scope definition is compromised and not delivered in full.	SDRC9.1 delivered on time and to scope/quality.	Closed
18	Technical	CIM Export too costly or cannot be delivered.	Budget for costs has been agreed. Delivery plan rescheduled to allow more time for CIM Export delivery without delaying trials.	Closed
19	Technical	SDRC9.1 not delivered on time as regulatory and business review takes longer than anticipated.	Parallel reviews with National Grid ESO and UK Power Networks' management/regulatory teams. Delivered on time and to scope/quality.	Closed
20	Commercial	The project does not have a joint communication plan for the projects participants.	National Grid ESO and UK Power Networks carrying out joint engagement and weekly meetings ensure good co-ordination. Communications and engagement plan produced, and the plan has been approved by National Grid ESO's and UK Power Networks' communication teams.	Closed

Risk #	Area/theme	Risk & Impact description	Mitigation/Update	Status
20a	Commercial	Risk that aggregators see UK Power Networks as a competitor	Engagement with DER to clarify roles and responsibilities of partners, including through published documentation. Ongoing consideration of this risk to progress though discussion on migration to business as usual for the SDRC9.6 report.	Green
21	Commercial	Risk of rushed procurement before agreement of proposed solution.	Technical solution requirements and design completed before publication of the Framework Agreement and Market Procedures documents for DER to participate in the trials. Procurement of service is now planned for day ahead, rather than a year in advance, therefore agreed to close this risk.	Closed
22	Commercial	Resourcing delivery of TDI 2.0 and RDP projects at same time.	Resourcing between the two initiatives has been resolved.	Closed
23	Commercial	Misalignment of TDI 2.0 and RDP deliverables.	Liaison between the two initiatives is well established. Technical, commercial and PMO linkages in place.	Closed
24	Commercial	Provision of services by DER to National Grid via UK Power Networks is insufficient to measure impact at GSP	40 Mvar combined volume of DER participating in the trials has been set as a goal by the Steering Committee, to ensure sufficient volume to measure impact.	Closed
25	Commercial	Insufficient recruitment of DER for the project trials.	DER recruitment on going, with positive response to published Framework Agreement and Market Procedure.	Closed
26	Technical	There is a risk that analogue values polled from RTUs may reflect inaccurate values.	UK Power Networks analysis undertaken of bad data and engagement with Asset Management team to agree a way forward. Action to refresh the PowerOn system with correct lines data from planning tool underway. Ongoing risk to keep under review.	Closed
27	Technical	There is a risk that tap changer control in both SGTs and Grid (distribution) transformers is not adequate for the project.	Evidence within available information demonstrates that this is not critical for minimum viable product but will be considered for next stage.	Closed
28	Technical	There is a risk that the time delay in measurements of parameters of the 400kV system to the DERMS is too long.	Data transfer via ICCP links National Grid ESO -PowerOn-DERMS on pre-production and live system indicated data transfer in around 1ms, plus 1s buffer	Green

Risk #	Area/theme	Risk & Impact description	Mitigation/Update	Status
29	Technical	There is a risk that the time delay in an instruction sent to the DER from DERMS is too long (more than 10 seconds).	Remains under review in live trials – communications latency latency <10s, but live system temporarily slowed from 10s to 20min instruction interval due to data traffic intervals. Deadband applied to DERMS voltage setpoint to enable instruction interval to be reduced	Green
30	Technical	There is a risk that the intensity and duration of WS1 activity needs more NG SME input than budgeted for	January 2019 – Steering Committee approved additional resource from contingency budget to cover National Grid ESO costs.	Green
31	Commercial	There is a risk that the commercial proposition is not compelling enough to persuade DER and Aggregators to participate in the project.	Risk closed as adequately covered by Risk 9 Webinar held 21 September 2017 and concerns captured. 1-2-1s to be proactively sought. Guidance to be adapted and published online.	Closed
32	Technical	There is a risk that the IS Vendor (ZIV Automation) cannot deliver the detailed design and build of the solution envisioned by the project team.	Risk ongoing and to be reviewed regularly. Walk-through of revised detailed design for the interim solution is complete. Full solution design agreed. Progress is being made, but not fully resolved yet. Final DERMS upgrade to be delivered December 2020 ahead of Wave 2 trials.	Amber
33	Technical and Commercial	There is a risk of insufficient sharing of data between the project partners.	To be kept under review and within consideration of regulatory requirements. Wave 2 market reporting requirements still being specified, December 2020	Amber
34	Commercial	Adding secondary optimisation may impede delivery of the project's Minimum Viable Product (MVP).	Agreed that secondary optimisation is out of scope for the project's MVP, whilst agreeing to explore options for inclusion without detriment to MVP.	Closed
35	Business readiness	There is a risk of delay if workstream 3 leads are not identified and mobilised in time.	Workstream leads confirmed and delivery plans included within project plan.	Closed
36	Robust plan	There is a risk that the project plan is not effectively driving delivery.	Re-planning underway following delays to delivery and ongoing revision of logic of critical dependencies. Material change request to Ofgem submitted November 2020.	Amber

Risk #	Area/theme	Risk & Impact description	Mitigation/Update	Status
37	Commercial	There is a risk that DER will be deterred by the uncertainty regarding how trials will work during 2019/20.	Four participants now in trials at end November 2020 and commissioning of fifth participant underway.	Closed
38	Commercial	There is a risk that we do not have enough budget to deliver the success criteria for DER recruitment.	Criteria met. Steering Committee approved revising the level of contingency allocated to boosting payments to trial participants, reflecting the latest forecast participation level. Publication of the commercial proposition for the trials has been well received.	Closed
39	Commercial	There is a risk that the RMAP advocates a different approach to that planned within the trials.	Engage RMAP on developing approach and consider their feedback in finalising the project's approach. Framework Agreement and Market Procedure now published.	Closed
40	Technical	There is a risk that the IS architecture elements of the detailed design cannot be agreed.	Architecture has been signed off.	Closed
41	Technical	There is a risk that the testing schedule risks delay in delivering SDRC9.4 and the start date for trials.	Review testing requirements for SDRC9.4 (i.e. testing in controlled environment). Align plan with proposed trial design (start dates).	Closed
42	Technical	There is a risk that the project approach to large embedded generators is not agreed.	Steering Committee agreed to engage large embedded generators to gauge their interest. MW despatch to remain under ENCC control. Mvars despatch to be considered through DERMS.	Closed
43	Technical	There is a risk of not having proper Transmission and Distribution data to develop DERMS solution.	Detailed plan developed and progress is being tracked through the project's Technical Question governance approach (Reference "TQ8"). The Technical question approach is used to raise and track resolution of outstanding technical design issues.	Closed
44	Technical	There is a risk that PAS-DERMS interface delivery increases project costs or risks.	Plan and costs agreed for this activity.	Amber
45	Commercial	There is a risk that SDRC9.3 is not delivered in full and on time.	Delivered on time and to quality/scope.	Closed

Risk #	Area/theme	Risk & Impact description	Mitigation/Update	Status
46	Commercial	There is a risk of not having clear idea about the interface for Aggregators.	Steering Committee agreed that aggregator approach cannot now be pursued through the available project timescale and budget.	Closed
47	Commercial	There is a risk that the project will incur costs without securing trial results data and insight (if the trials are cancelled after DER complete commissioning tests).	Raised at 24 May 2018 Steering Committee and risk accepted in order to bolster commercial proposition to DER participants.	Green
48	Technical	There is a risk that ANM in the project area affects performance or on-time delivery of DERMS.	Commitment by ANM project to fund any relevant costs. System delivered with close co-operation with UK Power Networks' ANM project to share labour resources	Closed
49	Technical	There is a risk that the GE CIM export may not be fully tested and may not be compatible with ZIV algorithms/or delay in providing the export.	Project delivery plan rescheduled to minimise delay to the trials caused by delay in CIM Export readiness. Initial GE CIM export accepted and transformed by ZIV in March 2019. IS transfer solution delivered in December 2019 to transfer multiple CIM extracts, and FAT test of CIM import completed in July 2020. January 2020 decision to proceed with live trials without daily CIM import – project identified inclusion would have required data correction activity for whole SPN licence area rather than local to each DER	Closed
50	Technical	There is a risk that DERMS produces inaccurate results due to poor quality data.	See risks 51 and 52.	Closed
51	Technical	There is a risk that DERMS produces inaccurate results due to incorrect inputs. (Data quality – transducers).	More accurate power quality metering data utilised at each DER. Data risks reviewed in order to reframe them more effectively.	Closed

Risk #	Area/theme	Risk & Impact description	Mitigation/Update	Status
52	Technical	There is a risk that DERMS produces inaccurate results due to incorrect inputs (data quality – PowerOn).	Data correction and state estimation solutions for network/SCADA data has been investigated, did not need to be implemented for trial, forms part of offline learning. Trial could be delivered based on use of just GSP and DER data with static network model. 1) Key aspects of PowerOn operational model have been updated from PowerFactory (planning model) 2) Missing directional data in PowerOn would in future addressed as part of state estimation.	Closed
53	Technical	There is a risk that the intensity of activity proposed during build/test in 2018 cannot be fully resourced by the available team.	Additional UK Power Networks resource secured for testing and integration.	Closed
54	General	There is a risk that SDRC9.4 delivery is delayed by technical, commercial and/or business readiness.	Delivered on time and to quality/scope.	Closed
55	Technical	There is a risk that the PowerOn upgrade (version number PowerOn Advantage (POA) 6.4.1) will be delayed, including functionality that DERMS requires to get automatic update of the CIM network model.	Priority – liaise with GE and UK Power Networks control room to determine scale of delay, implications of running DERMS before the POA 6.4.1. Upgrade to PowerOn. To investigate whether it may be possible to manually update the CIM model on monthly basis. Update – POA upgrade delivered July 2019.	Closed
56	Technical	There is a risk that no mobile controllers will be available for use in the test lab and this part of the solution will not be used or tested until SIT starts in February 2019.	Mobile controller purchased, therefore risk is closed. Also five customer DER controllers were brought to lab for testing.	Closed
57	General	There is a risk of SDRC9.5 not being delivered on time and with the required scope and quality.	SDRC9.5 delivered on time and to quality/scope. Notified Ofgem of the need to delay publication until completion of the project trials to avoid distorting commercial behaviour of participants during the trials	Green

Risk #	Area/theme	Risk & Impact description	Mitigation/Update	Status
58	General	There is a risk of the 12-monthly report not being delivered on time and with the required scope and quality.	Plan for drafting, review and approval agreed.	Green
59	Communication	There is a risk that insufficient planning and focus result in a poor 30 October 2018 Showcase event.	Plan agreed and Tracked. Success event delivered.	Closed
60	Commercial	Risk that migration to BAU will be delayed due to the requirement for different commercial arrangements.	New commercial arrangements would be required post-trial. Wave 3 was cancelled – no firm BAU plans. Work underway to develop detailed plan for migrating participants to an enduring solution once the trials finish in 2021. This includes mapping what different approaches might be required for BAU (versus those in the trial), to minimise delay. Also acknowledge to all stakeholders that this is an innovation project and there is an underlying risk that the project may not be successful.	Red
61	Technical	There is a risk that implementation of new Volt Select 400kV SCADA points from National Grid ESO into UK Power Networks' systems is not successfully completed.	The design was progressed through the project's Technical Question governance approach (reference to this risk is "TQ4") and was delivered in 2019. The Technical question approach is used to raise and track resolution of outstanding technical design issues.	Closed
62	Technical	There is a risk that PAS testing does not meet project objectives on time/in full that ensure nomination, dispatch and settlement functionalities within DERMS.	Discussion held with ZIV and National Grid ESO to agree PAS testing strategy after process definitions are closed (i.e. paper walkthrough meetings). PAS-DERMS pre-production connectivity proven end August 2019. PAS-DERMS business logic testing still to be scheduled.	Closed
63	Not in use			
64	Not in use			
65	Technical	There is a risk that in real time the DER technical availability volume of the reactive power service is inaccurate.	Likelihood and impact deemed low given volume in trial. Mitigation include % of plant in service available signal in list of mandatory signals. Need a process to utilise this in future.	Green

Risk #	Area/theme	Risk & Impact description	Mitigation/Update	Status
66	Business processes	Risk that the WS3 plan does not adequately cover the risks associated with the Staged Delivery approach.	National Grid ESO and UK Power Networks teams have revised WS3 plans for interim and full solution and migration to BAU and appraised the risks for each of these.	Green
67	Trials	There is a risk that the project risks during the trial delivery phase are not fully documented.	To be developed by the Trial manager at each partner before trial delivery.	Amber
68	Business readiness	There is a risk that the new Power Potential service software and displays may not be installed in the Control Room in time for the trials.	Included within Control Room calendar for 2019.	Green
69	Business readiness	Risk that the detailed documentation for despatch is not ready on time.	Project lead and despatch lead to walk-through WS3 requirements for interim, full and fall-back manual solutions.	Closed
70	Business readiness	Risk that control room personnel are not trained to use the Power Potential service in time.	Training has begun and further training will be scheduled before each phase of trials.	Green
71	Business readiness	Risk that the business procedure and detailed documentation for nomination is not ready in time.	To revise plan for WS3 nomination to reflect staged Delivery plan.	Closed
72	Business readiness	Risk that nomination personnel are not trained to use the Power Potential service in time.	To revise plan for WS3 nomination to reflect staged Delivery plan.	Closed
73	Business readiness	Risk that the business procedure and detailed documentation for settlement is not ready in time.	Active power and Wave 1 trials paid in 2020. Some difficulties with payment timescales from National Grid ESO to UK Power Networks – now resolved. Business procedure agreed, Standard Operating Procedure developed. Wave 2 settlement to be delivered in 2021	Green
74	Business readiness	Risk that settlement personnel are not trained to use the Power Potential service in time.	Finance support trained.	Green

Risk #	Area/theme	Risk & Impact description	Mitigation/Update	Status
75	Business readiness	The testing and training manual for PAS are not ready in time.	PAS team at National Grid ESO to schedule time to develop training manual and delivery training for operational teams for the trials.	Closed
76	Commercial	There is a risk that the active power service being trialled under Power Potential will not align with future EU regulation (TERRE).	Commercial analyst has investigated the commercial requirements for the Trans European Replacement Reserve Exchange project (TERRE) in order to map against the project approach and establish if there is an issue and how to address. Project TERRE is delayed	Closed
77	Commercial	There is a risk that the methodology to test DER capability strays beyond the specification currently drafted in DER Technical requirements	Test specification now written. UK Power Networks committed to only test requirements set out in the DER Requirements. National Grid ESO reviewed the test specification.	Closed
78	Commercial	There is a risk that DER are deterred from involvement in the project due to inconsistent messages from the project team.	FAQs in place as well as agreeing key messages and approaches in 1-2-1s beforehand.	Closed
79	Trials	There is a risk that the trials do not give enough data to provide an adequate conclusion of trial success.	The duration of trials, the number of DER participants and their reactive power capability have all been carefully considered to ensure sufficient data can be captured during the trials.	Green
80	Trials	There is a risk that generator dispatch impacts trial length or data to determine trial success.	Pre-trial training and monitoring activity during the trials will seek to ensure despatch are fully briefed on the trial service approach and encouraged to deploy the service, where appropriate.	Closed
81	Technical	There is a risk that DER effectiveness for prolonged impacts on voltage is nullified by tap changers (identified from customer's test).	1. Share DER list with Outage Planning and request that taps locked in place where applicable during trials. 2. Discuss design decision with National Grid ESO and then with customer. 3. Plan to program tap changer optimisation in ZIVs algorithm for BAU.	Green

Risk #	Area/theme	Risk & Impact description	Mitigation/Update	Status
82	Technical	Risk of trial delay when migrating from the interim technical solution to the full solution (Wave 1 to Wave 2)	Focused Wave 2 on commercial extension as core bid requirement, rather than demonstrating CIM-based load flows (beyond bid requirement). Wave 2 FAT completed, final defects on pre-prod being addressed, reconfiguration of installed software to Wave 2 version expected to be a few hours.	Amber
83	Technical	There is a risk that the project solution may not be compliant with the Electricity Balancing Guidelines (EBGL) for December 2019.	Reviewed whether existing PAS solution for EBGL for the PAS-STOR delivery is also appropriate for Power Potential	Closed
84	Trials	Risk of lack of resource from requirements and nomination to deliver the Wave 2 trials.	Colleague identified at National Grid ESO to lead on requirements and nomination	Closed
85	Technical	Risk on co-ordination of specific point testing for communications.	Plan to have one test environment for each of the pre-production and production set-up of the technical solution	Closed
86	Technical	Risk of delay if GE fail to deliver RTU Logic on time.	Detailed planning with GE to ensure tracking against key delivery dates	Closed
87	Trials	Risk that trials take place at time that historically has low service requirements	Review trial calendar and implications on likely operational scenarios occurring.	Green
88	Technical	Risk that test platform resource to commission not available on time	Delivery rescheduled with test resource allocated.	Green
89	Commercial	Risk of delays to DER signing Framework Agreement and variation to Connection Agreement	FAQs developed to address common questions and ongoing stakeholder engagement to close out queries	Green
90	Commercial	Delay in DER studies	Contractor resource in place to facilitate efficient progress of DER studies	Closed
91	Technical	Risk that the SCADA data quality is poor	For trial, data correction algorithm to be applied (see risk 50). For BAU, state estimator approach to be implemented – initial version implemented as described in SDRC 9.4	Closed

Risk #	Area/theme	Risk & Impact description	Mitigation/Update	Status
92	General	Risk of a freeze in system changes during Brexit transition	Corporate contingency planning has established potential two week freeze in system change if a disorderly Brexit takes place.	Amber
93	Financial	Insufficient budget to deliver project due to extended project duration	Steering Committee approved allocation of contingency and business funds to enable delivery of the extended project through to completion and close-down in 2020. Material change request submitted.	Amber
94	Technical	PAS-DERMS interface risks	Delivered – PAS-IIB-DERMS connectivity test completed end August 2019, functional integration tests completed August 2020, live connection established October 2020	Closed
95	Technical	Risk of delay to IIB/ESB solution delivery	Delivered – PAS-IIB-DERMS connectivity test completed end August 2019	Closed
96	Technical	Risk of project not being given high enough priority to mobilise UK Power Networks resource	Continuous monitoring with operational teams and against other projects, including escalation to senior management. Introduced joint programme delivery with ANM project in 2020.	Closed
97	Technical	Risk of Outage Planning activity being delivered late	Risk to Full solution (considering synergies with the UK Power Networks Network Vision project), activity for DERMS Interim Solution already delivered	Closed
98	Technical	Risk of delay in securing release of the User Interface design	DER user interface being design specified in early 2019 for all waves.	Closed
99	Technical	Risk of delays to ICCP readiness	ICCP links delivered summer 2019	Closed
100	Technical	Risk of delays in ICCP-PowerOn-RTU	ICCP-PowerOn-RTU signal integration proven	Closed
101	Commercial	Wave 2 Market Reporting not agreed with DER before Wave 2 trial start	National Grid ESO team to add	Amber
102	Technical	Active Power service not being developed with PAS	Alternative approach for technical trial agreed DERMS-DER with National Grid ESO liaison	Closed

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