Distributed ReStart

Energy restoration for tomorrow

Project progress report – Redacted version June 2020

In partnership with:

tnei

SP ENERGY NETWORKS

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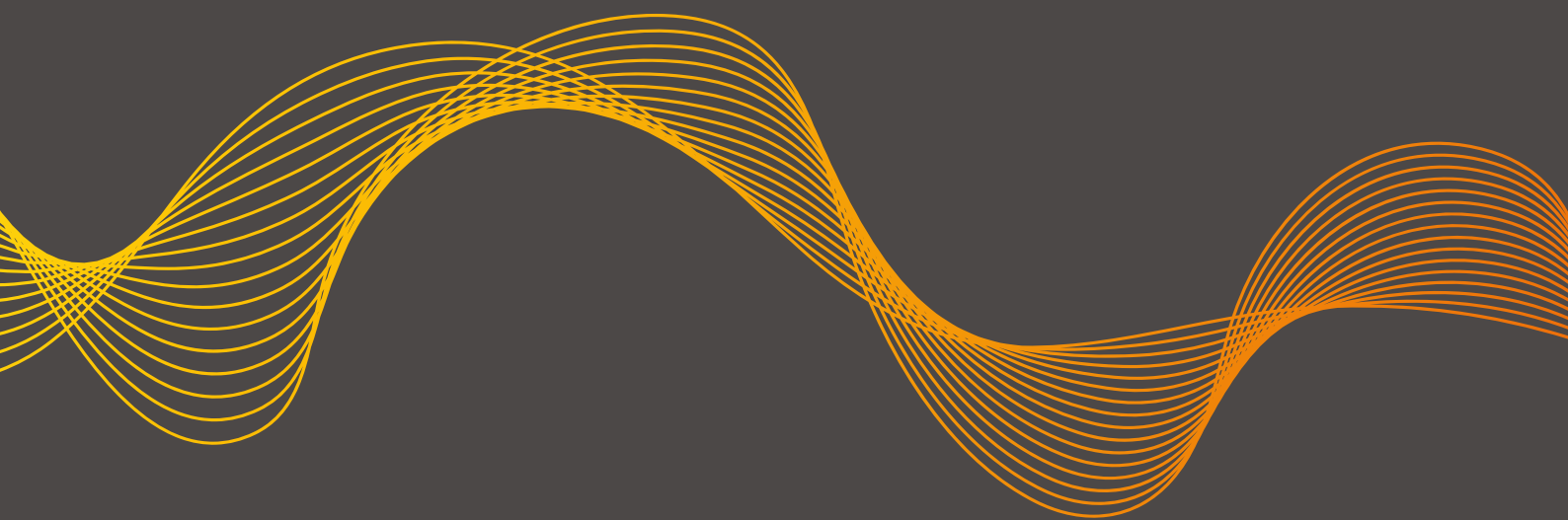

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Project overview

The Distributed ReStart project is a partnership between National Grid Electricity System Operator (NGESO), SP Energy Networks (SPEN) and TNEI (a specialist energy consultancy) that has been awarded £10.3 million of Network Innovation Competition (NIC) funding.

The project is exploring how distributed energy resources (DER) can be used to restore power in the highly unlikely event of a total or partial shutdown of the National Electricity Transmission System. Past and current approaches rely on large power stations but as the UK moves to cleaner and more decentralised energy, new options must be developed. The enormous growth in DER presents an opportunity to develop a radically different approach to system restoration. Greater diversity in Black Start provision will improve resilience and increase competition leading to reductions in both cost and carbon emissions. However, there are significant technical, organisational and commercial challenges to address.

The project is tackling these challenges in a three-year programme (Jan 2019 – Mar 2022) that aims to develop and demonstrate new approaches, with initial procurement of Black Start service from DER from mid-2022 if deemed feasible and cost effective. Case studies on the SP Distribution (SPD) and SP Manweb (SPM) networks will be used to explore options then design and test solutions through a combination of detailed off-line analysis; stakeholder engagement and industry consultation; desktop exercises; and real-life trials of the re-energisation process.

Project description

The project is made up of five workstreams. The project direction and knowledge dissemination workstreams cover the effective management of the project and ensure stakeholders are considered and communicated with throughout all project deliverables. The other three workstreams cover the wide range of issues to enable Black Start services from DER:

- The organisational systems and telecoms (OST) workstream is considering the DER-based restoration process in terms of the different roles, responsibilities and relationships needed across the industry to implement at scale. It is developing requirements for information systems and telecommunications, recognising the need for resilience and the challenges of coordinating Black Start across a large number of parties. Proposed processes and working methods are being created, building on the models illustrated in the Viability Report produced in November 2019.
- The Power Engineering and Trials (PET) workstream is concerned with assessing the capability of GB distribution networks and installed DER to deliver an effective restoration service. It will identify the technical requirements that should apply on an enduring basis. This will be done through detailed analysis of the case studies and progression through multiple stages of review. It will be tested through demonstration of the Black Start from DER concept in 'live trials' on SPEN networks.
- The Procurement and Compliance (P&C) workstream will address the best way to deliver the concept for customers. It will explore the options and trade-offs between competitive procurement solutions and mandated elements. It uses a strategic process to develop fit for purpose commercial solutions that are open and transparent, stakeholder endorsed, and designed end-to-end with the commercial objectives of the project and workstream in mind. It will feed into business as usual activities to make changes as necessary in codes and regulations.

Keep up to date and find all other project reports at: **https://www.nationalgrideso.com/innovation/projects/distributed-restart**

Executive summary

This report provides a six-monthly progress review for the Distributed ReStart Network Innovation Competition Project. Through this, it is demonstrated that Distributed ReStart is currently on schedule, on benefit and under budget.

Project direction

A monthly cycle of project management processes has allowed effective risk and schedule management (inclusive of mitigating Covid-19 impacts). Overall, this means the project remains on track to achieve its successful delivery criteria requirements in a timely manner, whilst remaining under budget, and on benefit.

A key workstream deliverable has been a tender to support cross-workstream automation requirements. This has introduced greater value to the consumer but has introduced delays compared with the single source route. Therefore, a supplementary report due for delivery in December has been agreed with Ofgem and the steering committee to share these outputs.

Power engineering and trials

The power engineering and trials (PET) workstream is currently working on the production of two reports detailing a comprehensive assessment of the power engineering aspects of Black Start from DER. The first report, due in July 2020, will primarily focus on the output of the system studies (undertaken by TNEI), but will also include other relevant factors such as the issues associated with connecting grid-following and grid-forming converter-based DER. The second report, due in December 2020, will focus on the application of automation to the restoration from DER process in the form of a generic specification for a Distributed ReStart zone controller (DRZC), and will also include further details of the proposed live trials.

Organisational systems and telecommunications

The organisational systems and telecommunications (OST) workstream is continuing to develop operational telecommunication requirements, inclusive of cyber security assessment and organisational models through capturing extensive stakeholder input from across the industry. As a result, the workstream is on track to deliver its design stage report in October.

In addition, system automation options and associated telecommunication requirements are being developed through the DRZC design work and will be included in the December cross-workstream publication.

Procurement and compliance

Commercial and procurement options are under development with an ongoing stakeholder consultation process to capture industry views on routes to market for a DER service. In addition, a codes review is ongoing based on power engineering and organisational findings to date. As a result, the workstream is on track to deliver the report in October.

Knowledge dissemination

The knowledge dissemination workstream has delivered extensive stakeholder engagement support for all workstreams, including delivery of a Distributed ReStart conference with over 100 attendees. As a result of Covid-19, many conferences and events the project was due to attend have been cancelled or postponed. This has caused a change in workstream emphasis towards online solutions, leading to ongoing development of a virtual event.

Project governance

This project meets all governance requirements for a Network Innovation Competition project in line with the “Electricity Network Innovation Competition Governance document.”

The project confirms: no intellectual property has been generated to date which has not been publicly shared; all data is either publicly available on our webpage or available on request to our mailbox: **ReStart@nationalgrideso.com**; there are no material changes to project plans or outcomes from the bid submission stage; and every effort has been made to ensure the contents of this report are accurate.

Peter Chandler
Distributed ReStart Project Lead

Project direction

Project delivery is highly dependent upon ensuring alignment between all workstreams, maintaining a clear direction, and a project management office to hold the team to account. The project direction function delivers against these goals.

Key controls

The project direction workstream has established and maintained a consistent approach to project management through a cycle of project controls, including:

- monthly cost reporting from all partner companies contained in a centrally available system and detailed as far as possible against workstreams, cost categories and companies;
- monthly finance surgeries to analyse costs incurred, verify their category allocation and review forecast costs;
- monthly project management board meetings to provide a view of key performance indicators and an option for escalation;
- monthly steering committee updates to senior leadership from all partner companies to scrutinise performance and action escalations;
- weekly whole project calls to address actions, update risks, update and mitigate any Covid-19 risks and promote awareness of whole project outputs;
- fortnightly workstream-lead calls to ensure alignment of all workstreams, supported by two senior engineers providing a design architect function.

This is considered sufficient control to enable delivery and manage spend, progress, risks and issues.

Key challenges

In order to provide the greatest value to the consumer and progress a variety of technical implementation options, the project has conducted a tender for an automated Distributed ReStart zone controller (DRZC).

Using this process allowed the project to review proposals from seven leading industry developers, of which four met both technical and economic criteria with novel approaches proposed. By progressing with four options, the project will be able to make cost effective and technically optimal decisions on further project development, facilitate competition in post-project roll-out and enable the development of technology agnostic requirements.

However, the more complex contractual and procurement processes associated with a tender have caused delays compared with the single source route. For this reason, the project will deliver the outcomes of these front-end engineering designs as part of a second requirements document in December.

The project has managed the Covid-19 impacts through using an additional risk log and introducing deputy functions across every role. As a result, most risks have been downgraded over-time with no issues experienced.

Plan and progress

The project is on track to meet all the delivery criteria for 2020 from the bid document. In addition to these project deliverable milestones, a supplementary requirements document will be published in December containing additional information linked to design stage outcomes and including outputs of the DRZC design. This will incorporate elements from power engineering and trials and telecommunications and systems.

Financial performance

All workstreams, Ofgem cost categories and partner companies remain under budget without impacting on deliverables. Budget outperformance is currently met through a leaner resourcing structure and effective utilisation of external resources. Furthermore, extensive stakeholder engagement has opened project opportunities for low or no cost delivery of some required inputs.

Underspend to date enables development of DRZC concept(s) and further cyber security analysis but will continue to be closely monitored to demonstrate project value.

Quality assurance

The project has established a stakeholder advisory panel consisting of independent experts from across the industry to scrutinise the outputs of the project. This panel provides independent quality assurance and raises points for investigation in later outputs. Furthermore, webinars are hosted after each deliverable publication to enable public commentary on outputs. A full record of this review process is available on our webpage: **https://www.nationalgrideso.com/innovation/projects/distributed-restart**

Power engineering and trials

The technical capability to deliver a Black Start using DERs is assessed through the power engineering and trials workstream. The outcome will be detailed technical specifications supported by live trials in 2021.

Workstream summary

The power engineering and trials workstream is currently in the latter stages of the development stage of the project, with the output at this stage being a report providing an assessment of the power engineering aspects of Black Start from DER (due to complete in July 2020). Given the volume of work that has been undertaken in this area, it is now proposed to also issue a supplementary report (in December 2020).

The workstream is on track to deliver a technical assessment of Black Start from DER on 31 July 2020.

The 'Assessment of power engineering aspects of Black Start from DER: Part 1' report (July 2020) will primarily focus on the outputs of the power system studies undertaken by TNEI. Additional relevant technical studies will also be summarised, including protection assessments carried out on two of the case studies and reports detailing the issues associated with connecting grid-following converter-connected DER (as per existing wind farms, solar farms and battery installations) to a weak network. Moreover, a report will be summarised, considering to what extent in the future a grid-forming converter could deliver the same benefit as a synchronous generator in terms of being the 'anchor' generator (such technology is at the development stage at present). Relevant project updates will also be given, including the latest proposals for live trials, an overview of the automation systems being considered, and an update to the Issues Register produced in the PET Viability Report (July 2019).

The 'Assessment of power engineering aspects of Black Start from DER: Part 2' report (December 2020) will primarily focus on providing a generic functional specification for a DRZC. Additionally, the report will include proposed functional requirements for DER to provide Black Start services, real time digital simulation (RTDS) analysis of restoration scenarios (carried out by The National HVDC Centre), proposed future testing requirements, a summary of costs to implement Black Start from DER, and an update to the live trial proposals.

The second report will be issued during the early stages of the demonstration stage of the project and will lay the foundation for the live trials, and developing final functional and testing proposals for Black Start from DER.

Key workstream findings

Case studies

In order to 'flesh out' the exact requirements to enable Black Start from DER, at this stage, three of the ten case studies have been selected for further detailed analysis. These have been chosen as they provide a variety of types of synchronous anchor generation (the generator which will initially energise the network) in order that any critical differing technical characteristics can be identified and modelled. Two of the networks are in the SPD area, Chapelcross and Galloway Region, and the third is in the SPM area, Legacy. Additional case studies will be utilised as required to provide learning applicable on a GB-wide basis.

A schematic of the Chapelcross case study is given in figure 1.1. This shows the initial 33kV Distributed ReStart zone (DRZ) which will be established, and the potential options for energising the wider network. All these stages will be studied to determine the technical requirements and feasibility.

Restoration strategies

For the three selected case studies, stage by stage restoration plans have been developed. The purpose of these is to identify the extent of network energisation that can be achieved from the anchor and additional DER (e.g. wind, solar and batteries), and the optimal strategies for achieving this. The options include the sequential switching of circuits, simultaneous energisation of multiple circuits, establishing 33kV power islands, and energising up to higher voltages (132kV, 275kV or 400kV).

Power system studies

Based on the case study restoration strategies, power system studies are currently being undertaken to assess what options are technically viable and identify the associated technical capability of the DER and the challenges. The studies include steady state load flow, dynamic, and electromagnetic transient (EMT) studies.

Network protection

One of the major network issues is the ability of the existing protection systems to detect and clear a fault given the relatively low fault level when the network is supplied from DER only. As such, protection assessment studies are in progress, on the three selected case study networks, to identify the extent of the protection changes which may be required, and possible solutions (e.g. new relays may be required with additional settings to be implemented during a Black Start).

Distributed Restoration zone controller

The PET Viability Report (July 2019) identified that establishing, growing, maintaining and restoring a distribution power island at distribution level is likely to require some level of automation for the process to be technically and operationally viable. The project has introduced the concept of a DRZC to describe the system(s) that will enable monitoring, control and coordination of a range of DER, and network resources to provide Black Start services.

Our approach has been to engage four technology companies with expertise in related areas such as active network management (ANM) or microgrids to develop their own DRZC functional specifications, with associated reports on communications and interface requirements. From these, a generic functional specification will be developed, leading to a vendor neutral set of requirements for roll-out across GB. A prototype of the DRZC may be commissioned and tested in later stages of the project.

Live trials

In the three selected case studies, the project is currently working with the DERs and Distribution Network Operators (DNOs) to ascertain the DER and network modifications required, and develop suitable live trial testing programmes.

To reduce the overall project risk, case study live trials will be split into at least two stages. The first is intended to prove the ability of an anchor generator to operate in island mode and provide data to validate the power system modelling. The second stage, and any further stages, will be to prove the ability to establish and maintain a stable power island and energise up to the transmission network. These tests may include the installation of automation which has been developed (i.e. a prototype DRZC).

Conclusions

Many work packages are currently in progress with a view to informing the next PET report in July 2020. This will include a detailed analysis of networks and DER to provide proposals on the relevant technical aspects of providing a Black Start service from DER.

The project will continue to use a 'learn by demonstration' approach to produce and refine technical parameters into a functional specification.

Workstream delivery

The Distributed ReStart workstream is on track to deliver two reports in July and December which will meet the design stage delivery criteria outlined in table 1.1.

Table 1.1
Successful delivery criteria for the PET design stage

Delivery criteria	Status	Action
Detailed assessment of the power engineering aspects of Black Start from DER.	Ongoing	Multiple work packages have been commissioned, including protection studies, DER capability assessments and RTDS studies.
Examples of power engineering through case studies, including firm live trial proposals.	Ongoing	Three case studies have been selected, with non-disclosure agreements entered into by the relevant DERs, allowing live trials to be developed.
Support of conclusions through power system studies.	Ongoing	TNEI have developed a number of restoration scenarios, for the three selected case studies, on which they are carrying out the relevant steady state, dynamic and transient power system studies.
Enable the steering group and DERs to make informed live trial decisions.	Internal review	The content of the reports, including live trial proposal updates, will allow the steering group to make an informed decision on what live testing to progress.
Use a stakeholder-led approach.	Ongoing	Stakeholder review is prioritised across all workstreams.

Workstream technical challenges

A summary of the biggest challenges expected to be resolved through the design stage of the PET workstream is given in table 1.2.

Table 1.2
Key PET workstream challenges and mitigating actions

Challenge	Current supporting activities
Develop a viable restoration plan for DER to energise the distribution and transmission networks.	TNEI have developed multiple restoration plans for each of the three selected case studies and will carry out the full range of required system studies to determine which options are technically viable.
Understand the limitations associated with connecting converter-connected resources (e.g. wind farms, batteries and solar farms) onto a weak network (low fault level resulting in larger frequency and voltage variations).	Strathclyde University has been commissioned to produce five reports looking into all relevant aspects of connecting converter-based DER alongside a single anchor (synchronous) generator.
Low fault level leading to inadequate protection.	Detailed studies have been commissioned to identify the specific generator and network protection requirements when operating in island mode.
Low system inertia. Maintaining the generation/load balance with intermittent resources.	Work is being undertaken to identify a functional design specification for a DRZ controller to overcome the technical challenges of co-ordinating multiple resources in a low inertia system.
Ensuring that the Black Start from DER solution does not preclude future technologies from participating or playing a larger part in the service.	Work packages have been commissioned with Iberdrola Middle East and The National HVDC Centre to consider the issues, and technical solution, if the anchor generator was replaced with a grid-forming converter DER.

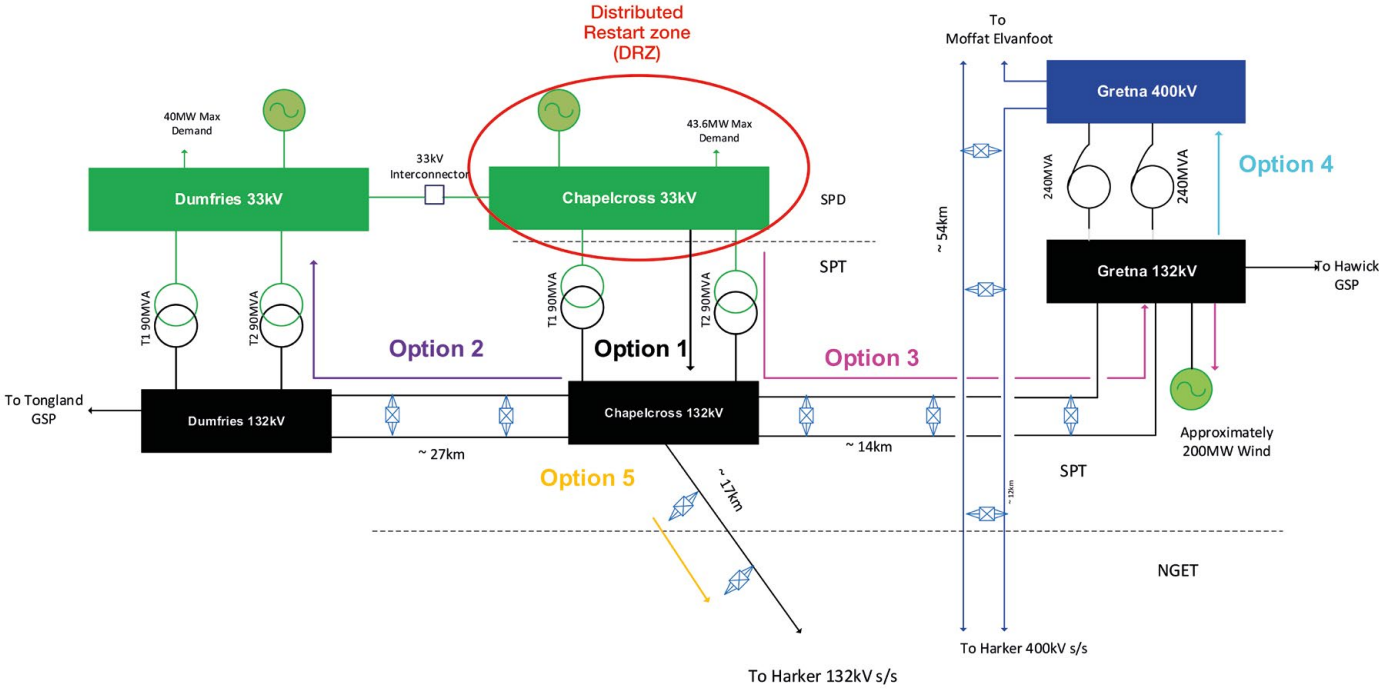
Workstream plan

Table 1.3
Workstream delivery plan for PET

Activities	Target date
TNEI system studies complete	May 2020
ARCADIS protection study complete (Chapelcross case study)	June 2020
Strathclyde University – Assessment of connecting grid-following converters (5 reports)	June 2020
Iberdrola Middle East – Review of using grid-forming converter-connected DER as an anchor generator	June 2020
The National HVDC Centre – RTDS analysis of selected case study restoration scenarios	August 2020
DRZC functional specifications (four vendor reports)	September 2020

Figure 1.1
Distributed ReStart zone (DRZ) schematic

Chapelcross case study



Organisational systems and telecommunications

Delivering the restoration process will be dependent upon the capabilities of the organisations involved: their teams, processes, systems and secure operational telecommunications. These areas are being developed through the organisational systems and telecommunications workstream.

Workstream summary

The organisational systems and telecommunications workstream (OST) is currently in the design stage of the project. The next output being the design stage report "Proposal of the Black Start from DER Process" (SDR2), providing further details on the organisational design options, processes and draft functional specifications for Operational Telecommunications (OT). This report is due to be published in October 2020. In addition to this report, the OST workstream will support delivery of the December publication detailing the OT and systems requirements which stem from ongoing DRZC work.

The workstream is on track to deliver its design stage report by 2 October 2020.

By the end of this workstream in September 2021, it is anticipated that the project will have tested and refined the proposals made in SDR2 through extensive stakeholder engagement, including desktop exercises, and offline tests of systems and hardware.

Key workstream findings

Appropriate organisational structures, allocation of roles and responsibilities, systems and resilient operational telecommunications are essential for delivery of a Black Start service.

In the initial stage of Distributed ReStart, OST conducted a high-level analysis of the Black Start participants, focusing on the capabilities of Distribution Network Operators (DNOs), Transmission Owners (TOs) and the Electricity System Operator (NGESO) and considering the impact on distributed energy resources (DER).

In this design stage, OST is focusing on development of processes, functional specifications for secure, resilient Operational Telecommunications, and requirements for automation and systems to ensure that we meet our design criteria of familiarity, flexibility and end-to-end resilience.

Organisations

Four organisational models were developed in the feasibility stage, considering the Black Start control entity as either the NGESO or DNOs and the automation extremes of fully automatic and fully manual. The key finding is each model will require some degree of organisational change. To better understand the impact of these changes, both NGESO led and DNO manual processes have been developed and are undergoing risk analysis and industry consultation, allowing identification of potential bottlenecks in the process and measures, such as automation, to be targeted at the most appropriate points.

Operational telecommunications

The existing Black Start processes rely heavily on TO-owned, highly resilient dedicated Operational Telecommunications, which enable Black Start communications between the NGESO, TOs, DNOs and service providers (mainly transmission-connected generators). Introducing DER into the Black Start process requires the involvement of many more stakeholders, both in terms of number and type. These new Black Start participants use a large variety of Operational Telecommunication technologies, with varying levels of resilience.

A high-level review of the current options for Operational Telecommunications (satellite, fibre optic cable, microwave radio, private LTE, mobile network (4G/5G), private radio, Openreach ethernet services, Openreach fibre to the premise and Openreach fibre to the cabinet options) has been conducted and the **relative merits of each approach outlined in the OST viability report**.

OST is now focusing on understanding the detailed OT requirements of each organisational model; the impact of any changes; and the development of a draft functional specification. The criteria considered critical for design include:

- minimum or/and maximum speed
- minimum or/and maximum accepted network latency
- network bandwidth/circuit number
- independent power resilience
- separation
- telecommunication device requirements on electrical sites
- cyber requirements
- redundancy.

Stakeholder engagement continues to refine the functional specification and ensures alignment with other existing and developing communications standards across the industry.

Table 1.4
Key focus areas identified through the organisational analysis

Category	Organisation	Automated NGESO control	Manual NGESO control	Automated DNO control	Manual DNO control
Control staff	NGESO	A	R	G	G
	DNOs	A	A	A	R
Organisational impact analysis showed that without automation significant additional resource would be needed for both control party options. Therefore, automation options for distribution management systems (DMS) and energy management systems (EMS) are undergoing assessment in parallel with the development of an automated controller for restoration zones.					
Training processes	DNOs	A	A	A	R
The key issue from the viability stage for training requirements is that under all scenarios DNOs would need additional training regarding power island control, particularly with regards to balancing and frequency. Consultation on processes which have been developed will refine the training requirements across all entities involved in Black Start.					
Supplementary criteria	Meets Black Start needs	A	R	G	A
	Ease of roll-out	R	A	R	A
	Alignment with wider industry change	R	A	A	A
No single model currently exists for the distribution system operator (DSO). Therefore, the project has progressed both NGESO and DNO control models through to the design stage to align with wider network changes. The workstream is continually engaging with the Strategic Telecommunications Group (STG) and the ENA Open Networks project to keep abreast of these wider changes.					

Operational systems

During the feasibility stage, the project reviewed the existing systems key to Black Start. For example, the energy management systems currently provided to DNOs, TOs and NGESO. Visibility, familiarity and interoperability are key criteria for developing the Distributed ReStart system requirements. System needs will also depend on the organisational models and processes brought forwards and will, in turn, influence the technical requirements for operational telecommunications.

Ongoing consideration will be given to the elements of processes most suitable for EMS automation and the controller functions being investigated through the power engineering analysis.

Conclusions

The key findings to date are that familiarity, flexibility and resilience are essential requirements for all proposals.

Workstream delivery

The organisational systems and telecommunications workstream is on track to deliver according to the design stage delivery criteria outlined in table 1.5.

Table 1.5
Successful delivery criteria for the OST design stage

Delivery criteria	Status	Action
A process map with task allocations.	External review	Currently undergoing external consultation to refine process maps.
Organisational structures including roles and responsibilities.	Internal review	Process maps include responsibilities. Detailed organisational structures will follow the external engagement.
Requirements for system or tools with initial outline design concepts.	External review	DRZ controller initial design work commissioned. Ongoing review of DMS/EMS automation options. External stakeholder engagement commenced.
Telecommunications functional requirements.	External review	Currently undergoing external consultation to refine functional telecommunications requirements.
Use a stakeholder-led approach.	Ongoing	Stakeholder review is prioritised across all workstreams.

Workstream technical challenges

A key output of the viability report was to identify the significant challenges which need to be addressed through the design stage and assess the possible impact. Table 1.6 summarises these and the current activities the workstream is undertaking to ensure they are appropriately answered.

Table 1.6
Challenges for the OST workstream

Challenge	Current supporting activities
Wider industry changes could impact on systems and Black Start participants' responsibilities.	Continual engagement with wider industry projects and initiatives including Strategic Telecoms Group (STG), ENA Open Networks and Europe Utility Technology Council (EUTC).
An increased number of stakeholders will have significant impact on the delivery of resilient, secure OT.	During the design stage, the types of OT technologies available, the communications interfaces and OT requirements will be developed. Requirements will be specifically in a technology agnostic manner.
DERs do not currently participate in Black Start so new processes and training will be required.	Where appropriate, process design will seek to minimise impacts on all parties based on the baseline assessment conducted in the viability report.
Provision of secure end-to-end OT.	Risks and options will be discussed in the design stage report. Wider network telecoms changes will consider resilience including cyber, physical and power.

Workstream plan

The high-level delivery plan for the design stage of OST is provided in the table below.

Table 1.7
Organisational systems and telecommunications design stage plan

Activities	Target date
OT Risk Assessment	July 2020
Stakeholder engagement for draft OT functional specification and process maps, including alignment with other projects and industry changes e.g. ENA Open Networks project, and applicability across GB	July 2020
Assessment of changes needed to current organisational structures (NGESO, DNO, DER) to facilitate Distributed ReStart	September 2020
Assessment of viability of OT technologies to deliver requirements	October 2020
Assessment of use of automated systems vs additional personnel	October 2020
Deliverable 2: Report published	October 2020
Supplementary DRZ requirements report	December 2020
Assessment of current and required cyber principles	October 2020

Anticipated change requirements

The key identified requirement for investment from the organisational systems and telecommunications workstream is resilient operational telecommunications between control centres, DER sites, and network control points.

However, it can be seen from the organisational impact assessment that there is a requirement for greater levels of training for operators and an automated system to facilitate faster restoration with fewer resources. Cost assessment will be used to judge what elements of the process to automate.

Procurement and compliance

A key aspect of this project is to develop a viable route to market, that ensures value for end consumers through transparency, competition and increased participation. The aim of the workstream is to develop a fit-for-purpose, stakeholder endorsed, end-to-end process, that meets the commercial objectives of the project.

Workstream summary

The procurement and compliance (P&C) workstream is due to move into the refine stage after delivery of the design stage report.

The workstream is on track to deliver its design stage report by 2 October 2020.

The longer-term goals of the workstream are to develop a proposal for the procurement process and commercial structures that create a route to market for a future Black Start service from DER. This will be supported through proposing code change requirements as part of normal processes. It is intended that this will be validated using extensive stakeholder engagement.

Additional resource has been recruited to support the procurement and compliance workstream.

Workstream findings

The proposed overall objectives of the code change and procurement methodology are to provide:

- increased competition
- reduced barriers to entry
- increased transparency
- financial value for the end consumer
- accelerated restoration times
- a functional route to market for new service.

In order to achieve this, we are developing commercial options which may enable service delivery. These will be refined through industry consultation and further technical findings. This will inform the contract and procurement design to ensure greatest value is provided to the consumer.

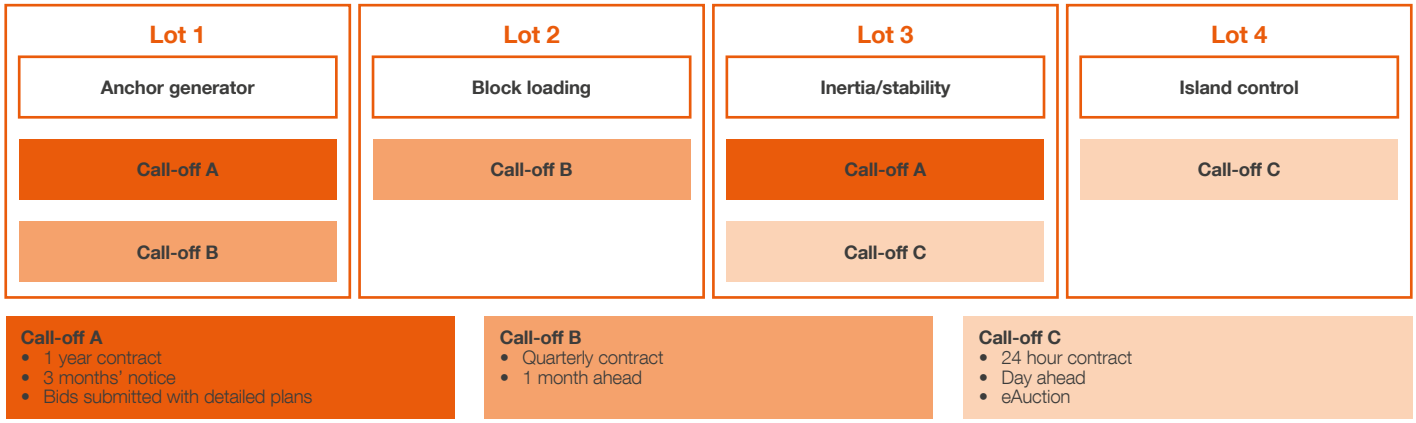
Procurement

The existing principles of Black Start procurement remain relevant to the DER restoration approach and will guide the design stage consultations:

- a clear and transparent service requirement;
- enablement of competition and;
- a reduction or removal of barriers to entry.

To enable this, overall project deliverables across power engineering, systems and telecommunications design are aiming to develop functional technical requirements. Outputs from the power engineering and trials and organisational systems and telecommunications workstreams, such as network investment costs and telecommunication systems costs, are critical inputs to enable understanding of the service's cost base and development of commercial and procurement approaches. It is possible that there may be a requirement for more than one solution, to access a wider range of participants or to access different types of services. If the technical requirements could be split into component parts of a 'full' Black Start service, it could reduce overall costs and reduce barriers to entry.

Figure 1.2
An example of how this structure could work is provided below (Lots are illustrative only).



Through industry consultation, procurement design will investigate the appropriateness of specific timescales for purchase and the overall impact this will have on supplier participation. In addition, opportunities for streamlining the existing contractual process will be considered to reduce complexity which is a current barrier to entry.

Codes

An initial review of the codes has established which changes may be required to facilitate a bottom-up restoration strategy. Table 1.8 shows a summary of the code change requirements identified. Ongoing work will create code change proposals based on this analysis which will be developed through the standard change mechanisms.

Table 1.8
Anticipated impact of the Distributed ReStart project on network codes.
(R – some change requirements, A – minor change requirements, G – no change requirements)

Code	Change requirement
BSC	Changes made to reflect greater involvement of DERs and DNOs during restoration.
CUSC	Potential changes dependent upon the procurement mechanisms used.
DCUSA	Potential changes dependent upon the procurement mechanisms used.
Distribution code	Additional detail could be added to DOC9 or adequate signposting to grid code may be appropriate.
ESQCR	The earthing policy from this documentation could lead to an un-earthed power island below 132kV without review.
G5	Minor alteration or relaxation under restoration scenarios may be appropriate.
G91	This could include clearer requirements for telecommunications resilience of DERs in the event of power outages.
G99	Clauses relating to island operation, protection, frequency response and fault ride through may be subject to change or derogations for a Black Start restoration scenario.
Grid code	Principally inclusion of new parties in specific roles and responsibilities across OC5, OC9 and BC2.9.
P2	No changes required.
P28	Minor alteration or relaxation under restoration scenarios may be appropriate.
P29	Minor alteration or relaxation under restoration scenarios may be appropriate.
SQSS	No changes required.
STC	An adaption could include all relevant participants, or an equivalent distribution equivalent document could be created.

Conclusions

Since the publication of the first procurement & compliance workstream report in November 2019, the project has been developing material and a plan for industry consultation on commercial and codified options for service delivery. This will be used to refine the procurement strategy and methodology options identified in the initial report.

In addition, refinement of code change work is being progressed through NGESO and DNO code change teams to enable compliance of the service and allow procurement processes to start after the project is completed.

Workstream delivery

Functional requirements

Table 1.9 outlines the 2020 procurement and compliance workstream report's objectives and the sections in which these are addressed. A copy of the full procurement and compliance report can be downloaded from the Distributed ReStart webpage:
https://www.nationalgrideso.com/document/156221/download

Table 1.9
Successful delivery criteria for P&C functional requirements report

Delivery criteria	Status	Action
Draft procurement design.	Under development	The project will begin to develop procurement/ commercial approaches.
Draft contractual arrangements.	Under development	The project will begin to develop contractual approaches.
Regulatory and funding arrangements.	External legal review	Legal advice being sought on organisational models' impact on licence requirements.
Required changes to codes and licence requirements.	Under development	Refinement of required code changes is in progress.
Use a stakeholder-led approach.	Ongoing	Stakeholder review is prioritised across all workstreams.

Delivery challenges

There are a number of key challenges for the workstream.

- There is a dependency on technical outputs for drafting of contract terms. This risk to timelines is being managed carefully through whole project planning.
- There is an impact or delay of stakeholder engagement due to Covid-19. The quality of outputs from engagement could be impacted because of the lack of face-to-face opportunities.

Workstream plan

Table 1.10
Procurement and compliance design stage plan

Activities	Target date
Industry stakeholder engagement.	On-going
Fundamental project assumptions about future service agreed to enable commercial development.	June 2020
Refinement of elements of the strategy process with industry.	July 2020
Use of feedback and input from engagement to develop and then refine initiatives and strategies which meet the commercial objectives.	July 2020
Conduct a thorough review of interdependencies between codes and define the proposed changes following this and industry engagement.	July 2020
Writing up findings.	August 2020

Anticipated change requirements

Any licence condition or code change requirements will continue to be determined throughout the design stage. A summary of likely code change requirements is provided in table 1.8.

The commercial contracts and structures will be developed subject to dependencies over the course of the project.

Knowledge dissemination

All workstreams have relied on a stakeholder-led approach to uncovering challenges, establishing existing capabilities and developing future options. This approach has been facilitated through the knowledge dissemination workstream.

Figure 1.3
Artwork from the project conference depicting all major topics discussed and detailing the interdependencies with wider industry developments and projects.

Awareness activities

Everyone is impacted by Black Start, from consumers through to directly contracted parties. For this reason, the project ensures it delivers content in accessible formats which require no prior knowledge.

On our webpage you will find an animation, high-level description of project outputs and the project infographic explaining current and potential future Black Start processes.

(https://www.nationalgrideso.com/innovation/projects/distributed-restart)

General engagement activities

We have an active distribution list of over 480 registered interested parties and use this as a channel to engage with people globally through 'lightbulb moment' email updates; sharing pertinent project information and news; webinars discussing specific project deliverables or challenges; and by promoting attendance at specific industry events.

Examples of industry events attended are shown in table 1.11.

Table 1.11
General engagement activities

Event	Value unlocked
Utility Week Live 21–22 May 2019	Engagement with broad industry stakeholders has established relationships which have directly impacted on project outputs.
Distributed ReStart Webinar 9 August 2019	Knowledge share with over 100 interested parties reaching a broad audience allowing international engagement.
Power Responsive Summer Conference 26 June 2019	Engagement with demand side response stakeholders.
Customer Connection Seminars 1 October 2019 5 November 2019	Engagement with stakeholders seeking new electricity system connections.
Electricity Ops Forum 23 October 2019	Engagement with current NGESO customers with a specific focus on commercial performance of balancing services.
LCNI Conference 30–31 October 2019	Project engagement with audience with a specific interest in lower carbon innovation projects.
Networks News Article 6 November 2019	Wide reaching news article targeted at those interested in utility networks in the UK.
Distributed ReStart Webinar on OST and P&C outputs 8 January 2020	Knowledge share with over 100 interested people specifically sharing key outputs from the viability stage publications.
Distributed ReStart Conference 2020 30 January 2020	A conference focused on project outputs and wider industry concerns related to the project, including presentations from the steering committee and multiple guest speakers.
Speaker at Future Networks 25 February 2020	Engagement with broad industry stakeholders specifically interested in the future of energy networks.

Targeted engagement and input

The project has taken part in extensive targeted industry consultation, including membership of working groups and hosting workshops. This allows direct input to project deliverables, drawing on knowledge of subject matter experts, inclusive of rigorous challenge.

Table 1.12
Table of specific industry consultation activities

Event	Value unlocked
Strategic Telecoms Group Ongoing collaboration	Ongoing working group. Direct input and challenge to the telecommunications functional requirements, ensuring representative views from across industry.
CIGRE – Denmark 4 June – 6 June 2019	International level working and best practice sharing.
JRC Seminar – Enabling the Smart Grid 11 September 2019	Inputs to telecommunication options for Distributed ReStart and awareness of wider network changes.

Table 1.12 continued
Table of specific industry consultation activities

Event	Value unlocked
Networks Round Tables 12 September 2019	Specific Black Start industry experts (from both TOs and DNOs) were invited and provided significant input into procurement, codes, organisations and operational telecoms. The outputs of this session can be viewed here: **https://www.nationalgrideso.com/document/153861/download**
Stakeholder Advisory Panel 18 September 2019 13 January 2020 27 May 2020	An industry working group has been established to hold the project to account. The outputs of the first session can be viewed here: **https://www.nationalgrideso.com/document/153856/download**
CIGRE – Canada 23 – 24 October 2019	Membership of an international working group on power system restoration. A full day of presentations directly relevant to the project. A full day workshop developing a technical brochure intended to provide international guidance.
Electra Link Conference 5 November 2019	This conference provided a vision on future data acquisition and convergence for a low carbon, decentralised world.
Green Generators Group 12 December 2019	Cornwall Insight Working Group with targeted engagement with DERs with a renewable focus.
Flexibility Forum 18 December 2019	Cornwall Insight Working Group with targeted engagement with providers with a flexibility focus.
EPRI Workshop 23 June 2020	International knowledge share through the Electric Power Research institution.
CIGRE Paper accepted	A project publication will be included in the CIGRE and CIRED 2020 conferences, providing a further channel for expert review.
CIRED Paper accepted	
Knowledge sharing with Resilience as a Service NIC project Ongoing collaboration	Ongoing engagement in line with agreement with OFGEM. Now a member of the project stakeholder advisory panel.
ENA Open Networks (WS1A and WS1B) Ongoing collaboration	Ongoing feedback and presentations including a dedicated OST workstream presentation to ensure project alignment with NGESO and DSO developments.
EUTC knowledge share Ongoing collaboration	Article on OST developments in the EUTC April newsletter with ongoing operational telecommunications input based on Europe-wide developments.
Imperial College and SMPN Networks engagement	Monthly calls on operational telecommunications and cyber security.
E3CC conference March 2020	Attendance at conference, due to present on 19 November 2020 (pending further Covid-19 developments).
BEAMA Ongoing collaboration	Ongoing engagement with the UK trade association for manufacturers and providers of energy infrastructure technologies and systems.

Planned future engagement

Throughout the design stage of the project, stakeholder input will be key to building on existing knowledge and ensuring an inclusive solution. The team commits to continue attending and hosting events throughout 2020. Table 1.13 details our planned engagement but this will be continually revised and added to throughout the project. In addition to these scheduled events the project will host workshops targeted at battery energy storage operators, network operators and DERs across 2020 to input directly on project activities.

We have taken into consideration the impact of Covid-19 upon the project and its ability to interact in open forums. We have developed a virtual event to ensure we continue to offer opportunities for knowledge sharing and one-on-one interactions. For the remainder of this year we assume we will not be attending any further public events. Our marketing strategy has now moved to a more agile approach.

Table 1.13
Planned stakeholder events

Event	Date
Utility Week Live	Currently on hold
Attending CIRED conference	Currently on hold
Attending CIGRE conference	Currently on hold
Attending LCNI	Currently on hold
Distributed ReStart virtual event	A series of project podcasts/webinars starting 30 June 2020
Stakeholder Advisory Panel	Ongoing via teleconferencing
Strategic telecommunications group	Ongoing via teleconferencing
CIGRE Black Start working group	Ongoing via teleconferencing

Knowledge sharing

As a project team it is important to us that all stakeholders are listened to and the knowledge gained from an interaction is passed onto everyone. If this report has prompted any questions of your own, email us at **ReStart@nationalgrideso.com**

Project governance

Data access

Every effort is made to disseminate all project learnings through our webpage:

https://www.nationalgrideso.com/innovation/projects/distributed-restart

Should any further information be required, such as access to raw data, this may be requested, subject to conditions on background IP. This request should be sent to:

ReStart@nationalgrideso.com

Intellectual property

No specific intellectual property has been developed which has not been shared openly in reports at this point in time.

DRZC contracts are structured so that respective companies background intellectual property is protected but the project can share findings on microgrid structures for Black Start.

Material changes

No material changes have been made to deliverables or budgets within the reporting period.

Accuracy statement

The contents of this document are accurate and representative of our current project progress as of 30/06/20.

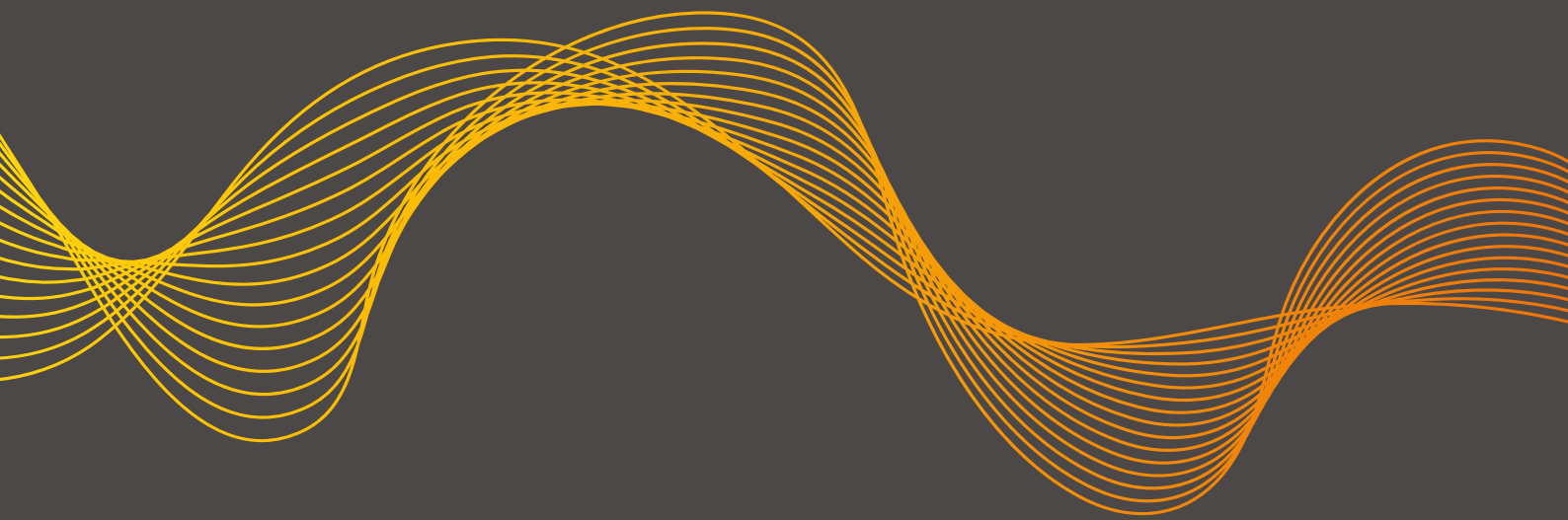
Peter Chandler
Distributed ReStart Project Lead

Appendix 1: RAID log

ID	Risk description and impact	Deliverable impacted	Mitigation actions and contingency	Status
1	Project tasks not completed in a timely manner.	Project direction	We have produced a project plan which is under continual review from workstream-leads with consistent governance and reporting to the project direction workstream.	Risk
2	Critical staff leave NGESO, SPEN or TNEI. This could result in project delays due to loss of expertise.	Project direction	Knowledge of, and responsibility for, the project will not rest with one person through a well-designed team structure. Ensure that documentation and guidance exists to assist anyone joining the project team. A thorough handover process for individual roles will be in place.	Risk
3	The eventual organisational and systems design restricts capability to a limited number of DNO areas. This could reduce project benefits.	Organisational systems and telecoms	Expected modifications to case study networks to facilitate testing of Black Start from DERs have been included in the project budget. During the development stage, we will assess the technical suitability of the case study networks. A key criterion for progression to online testing will be the cost of network modifications required.	Risk
4	Roles and responsibilities may be difficult to effectively split and DSO transition adds uncertainty.	Project direction	Joint discussions across workstreams and forward planning to manage the risk.	Risk
5	Live testing of DER generator equipment could lead to suspension of the project due to safety concerns.	Power engineering and trials	We will thoroughly design and plan specific procedures before carrying out live testing, including individual risk assessments for each test to ensure that risks are carefully managed and mitigated.	Risk
6	Lack of DER commitment to participating in live trials, this could lead to not being able to carry out the live trials.	Project direction	Early engagement in managing the contract agreement and gaining signatures to ensure DER commitment to live trials; early engagement with the necessary legal teams will ensure the right support levels are in place.	Risk
7	Delays to preparation and installation for offline and online trials. This could result in project delays.	Power engineering and trials	Early findings following stage 1 of the PET report will determine the level of reliance required on third parties, early engagement right from the start also helps manage the risk of any delays.	Risk
8	Procurement timescales may be longer than expected. This could result in project delays.	Power engineering and trials, procurement and compliance	The procurement process will begin as early as possible. Apart from the procurement of DER services for testing, there is limited procurement of other products or services. Design for contracting of DER for testing will start being developed during stage 1 – development.	Risk
9	Numbers of control engineers required due to complexity in power islands is not practical for existing relevant system operators.	Organisational systems and telecoms	This is an options risk, relevant to any options considered during the lifespan of the project.	Risk
10	Organisational, technical, procurement and regulatory proposals do not align. This could reduce project benefits.	Project direction	Design Architects are included in the project team to align outcomes across various workstreams, including workstream-lead weekly meetings, which support the mitigation against this risk. This is based on learning from previous innovation projects and NIC Governance Guidelines.	Risk

ID	Risk description and impact	Deliverable impacted	Mitigation actions and contingency	Status
11	Partner companies may not maintain/provide resource at planned levels. This could result in project delays.	Project direction	All partner companies have a nominated Project Management function to ensure internal resourcing remains at the required levels to meet deliverables.	Risk
12	Roles and skillsets required for DER are challenging to resource.	Organisational systems and telecoms	Optioneering will determine the skillsets and will need to be managed carefully.	Risk
13	High cost of providing sufficient resilience in telecoms means focusing on a small number of large resources, limiting involvement of smaller DERs.	Organisational systems and telecoms/ Procurement and compliance	Identified as a dependency. Outputs from the OST workstream will influence how associated services can be procured.	Depen-dency
14	High dependency on external work, projects and technical developments.	Organisational systems and telecoms	Black Start Standard – requirement on telecoms resilience is dependent on how long the telecoms network can operate without power. Mitigating action: develop a register to turn this dependency into a benefit and draw on work already produced. Work closely with the BAU Black Start team to understand how the standard will affect Black Start from DER.	Depen-dency
15	Black Start Task Group – roll-out of Black Start resilience.	Project direction	Roll-out of Black Start Standard is a dependency for telecoms resilience requirements (PDM2 deliverable).	Depen-dency
16	Procurement and compliance is heavily dependent on outputs from workstreams 2 and 3.	Procurement and compliance	The outputs of workstreams 2 & 3 need to be agreed and signed off prior to the design of a procurement solution. Mitigating action: consider the procurement impact in conjunction with the PET and OST workstream outputs, reciprocal dependency.	Risk
17	Workstream 4 – Code Specialist.	Procurement and compliance	There is a need for short-term resource for Codes Specialist (~1 year or less in post). Mitigating action: alternative methods should be provided by both SPEN and NGESO to resource against the requirement; this could include tendering to consultancy companies.	Closed – roles are now resourced through BAU functions
18	Project milestone 8 could need re-planning.	Procurement and compliance	There is a risk that the structure of the PDM 8 deliverable is unrealistic due to the PET PDM 4 deliverable – timings of the delivery have a conflict.	Risk
19	Cyber security.	All	Cyber security is a key aspect of resilience across the full project – it is not mentioned specifically in the BID, this may incur additional cost and effort – scope creep.	Risk
20	Feasibility and design tender.	Power engineering and trials/ Organisational systems and telecoms	There is a risk that the microgrid consultancy tender timeline does not meet the requirements of the PET PDM 5 deliverable. Mitigating action is to split this into a supplementary December deliverable.	Risk
21	Live trials costs.	Power engineering and trials/ Project direction	There is a risk that without the detailed costing for the live trials, forecasting is not as accurate as required. Mitigating action: continual updates to our working forecasts.	Risk

Covid-19 risk register					
Risk category	**Description**	**Proximity**	**Risk response categories**	**Action/mitigation**	**Risk status**
Delivery	There is a risk that due to the Covid-19 virus key resources may be diverted off the project to deliver business critical activities.	Short term	Green	Monitor and track availability of key project members – reduced lockdown measures.	Open
Delivery	There is a risk that the Distributed ReStart project could be paused during the Covid-19 virus.	Short term	Green	Lockdown measures eased – project continues to be green, delivery on track.	Open
Planning	There is a risk that Distributed ReStart will have a material change if the project is delayed or paused.	Short term	Green	Lockdown measures eased – project continues to be green, delivery on track.	Open
Planning	There is a risk that key personnel get Covid-19.	Short term	Green	Lockdown measures eased – project continues to be green, delivery on track – no project member infected.	Open
Global Procurement	There is a risk that the DRZ tender is delayed due to delays in signing the contracts. Delays in agreeing the IP and liability outlined in the schedules.	Medium term	Amber	Delivery split – second report in December, contracts signed with four suppliers and POs processed.	Open
Planning	Risk of live trials being delayed or being much harder to organise due to Covid-19 related actions by DER owners/operators.	Medium term	Amber	Consider re-planning of deliverables. Covid-19 restrictions could continue for many more months so could delay trials.	Open
Planning	Risk of 3rd party contractors/ companies not being able to complete scheduled work packages in agreed time for reports.	Medium term	Amber	Consider re-planning of deliverables. Covid-19 restrictions could continue for many more months so could delay trials.	Open
Finance	Financial implications in cancelling and rescheduling all engagement activities pertaining to the project.	Medium term	Amber	All events/conferences have been cancelled – UWL preparation refunded, UWL attendance fee under review – virtual event replacement.	Open
Planning	People wishing to take annual leave over the summer holidays.	Medium term	Amber	Needs to be monitored.	Open
Report	Timelines – stakeholder engagement could reduce the quality of the outputs for P&C.	Medium term	Amber	Needs to be monitored.	Open



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