Distributed ReStart

Energy restoration for tomorrow

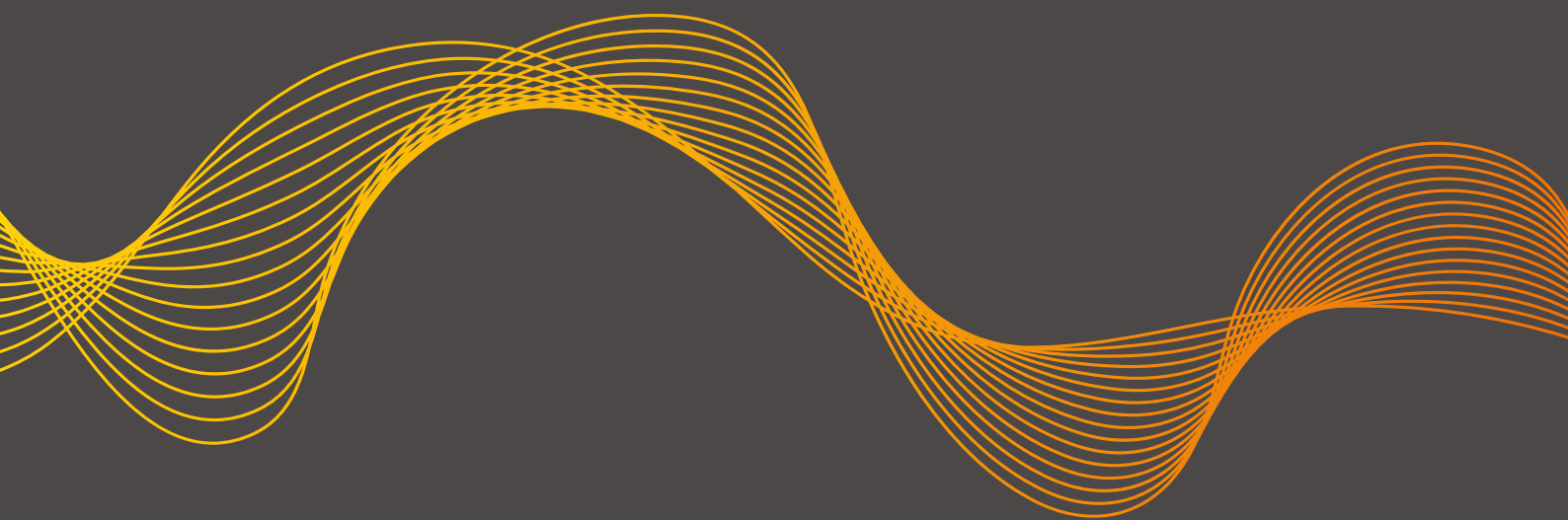
Project progress report December 2019

In partnership with:

tnei

SP ENERGY NETWORKS

nationalgridESO



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Project overview

The Distributed ReStart project is a partnership between National Grid Electricity System Operator (ESO), 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 work streams cover the effective management of the project and ensure stakeholders are considered and communicated with throughout all project deliverables. The other three work streams cover the wide range of issues to enable Black Start services from DER:

- The Organisational Systems & Telecoms (OST) work stream 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 will specify the 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 will be tested in the project through desktop exercises involving a range of stakeholders.
- The Power Engineering and Trials (PET) work stream 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 & 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

There are appropriate controls in place for the management of deliverable schedule, deliverable cost and risks to benefits. Through a cycle of monthly governance processes the project management office monitors, supports and reports against these criteria.

Overall, the project has delivered all objectives from the NIC bid on schedule. The overall project cost is below budget across all cost categories, companies and workstreams. The overall project business case has not been updated as there are not currently any identified requirements or risks to benefits which were not present at the planning stage. Therefore, expected savings for consumers remain £115m by 2050.

Power Engineering and Trials

The Power Engineering and Trials workstream has produced a report titled "Viability of Black Start from DERs." This report details: choice of case studies and options for network re-energisation, initial proposals for the functional testing requirements and the potential for roll-out across GB. From this analysis, it is found that no insurmountable power engineering challenges are yet identified which act as blockers to Black Start from DER.

Organisational Systems and Telecommunications

The Organisational Systems and Telecommunications workstream has produced a report titled "organisational systems and telecommunications viability." This report includes: a resilience assessment of telecommunications, a resilience assessment of systems, and a capability assessment of organisational structures. In addition, it draws out key areas of focus for the design stage. From this analysis, it is found that there are no identified organisational, systems or operational telecommunications blockers to delivering Distributed ReStart.

Procurement and Compliance

The Procurement and Compliance workstream have produced a report titled "Functional requirements for Procurement and Compliance." This report sets out the strategy for developing commercial structures and considers gaps and blockers in industry codes to enable the service. This enables us to consider possible future Black Start service structures using DERs and draw insights regarding options for delivery of a commercial solution.

The second major objective of the report was to review the relevant codes and licences to identify any elements that could present an obstacle for the implementation of a future Black Start service from DER. The review of the codes did not highlight any insurmountable barriers.

Knowledge dissemination

All workstreams have taken a stakeholder-led approach to project delivery, facilitated by the Knowledge Dissemination workstream. A range of tools are used for engagement from wide reaching activities intended for interest and awareness to direct partnership with companies for the purpose of output delivery. The project has over 400 directly registered interested parties, has attended over 14 events, hosted 2 webinars and established a stakeholder advisory panel.

Every effort is made to disseminate all project learnings through our webpage:
https://www.nationalgrideso.com/innovation/projects/distributed-restart

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.

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 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.
- Fortnightly whole project calls to address actions, update risks and promote awareness of whole project outputs.
- Weekly 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

Ensuring value for the consumer remains the project's foremost criteria. Therefore, there is a need for rigorous and competitive procurement exercises for all high cost deliverables. Specifically, with regards to live trials, this may be a challenge due to the intended timescales. However, bringing forwards key activities is expected to mitigate risks to the deliverable timelines. In addition, an ambitious expedited trials plan will provide a model for subsequent procurement and builds contingency time into SDR 6, "Demonstration of Black Start from DER".

Issues

Resourcing of an full time employee (FTE) for the codes specialist role has not been possible. For this reason, Project Direction completed a competitive exercise to deliver this work in time for Procurement and Compliance Functional Requirements through consultants.

Plan and progress

Project Direction is responsible for scrutinising and aligning the plans of all workstreams, inclusive of further resource allocation where needed. As a result of effective project management and workstream management, all deliverables detailed in the NIC submission documentation have been met on time. Individual workstream plans are detailed in the sections below.

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.

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 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

Business case update

There is no change to the base case cost-benefit analysis of the project, therefore benefits continue to be estimated at £115m by 2050.

No currently identified requirements from any workstream are understood to be excessive compared with the initial assumptions. Therefore, no further review is needed at this stage. A second cost-benefit analysis is planned as part of the design stage of the project after greater certainty is created around cost of implementation, using live trial costs and all identified system requirements.

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 physical demonstrations through live trials in 2021.

Workstream summary

The Power Engineering and Trials workstream is currently in the design stage of the project, having successfully delivered its viability paper on 29 July. Table 1.1 summarises the outputs of this paper with the key finding:

No insurmountable power engineering challenges are yet identified which act as a blocker to Black Start from DER.

The design stage of the project will look to build on the work done in the initial viability report and develop detailed technical solutions on how DER may be used for Black Start services. This will include assessing the capability and requirements of the DER, the DNO networks and the application of automation to aid the restoration process. As part of this, comprehensive power system studies will be undertaken, and all the technical issues highlighted in the viability report addressed. Moreover, the scope and requirements for live trials on the network will be developed. Work is currently ongoing against this stage with intentions to deliver a report on the outcomes in July 2020.

The workstream will conclude with a demonstration phase in which physical live trials will be used to validate the technical solutions proposed and provide a model for future Black Start testing. These live trials will be used to create the functional requirements which can be met by any combination of technologies proven capable in the future.

Key workstream findings

The Power Engineering and Trials workstream has identified the essential case study criteria (minimum technical capability of the DER to initiate Black Start restoration) as a generator capable of providing an independent voltage source. Currently, on DNO networks, this is limited to synchronous generators. These have been classified as 'anchor' generators and were considered if they were connected at 33kV or 11kV transforming directly to 132kV. The project was based on 10 case studies (sample areas of DNO networks) which met this criteria and also had additional DER connected (wind farms, solar and batteries). The generators in these case studies cover many generation types inclusive of: hydro, wind, biomass, energy from waste, solar and combined heat and power. Furthermore, they represent a range of network types, allowing the solution to be applicable across GB.

This workstream has established that existing synchronous generators will need additional capability to provide Black Start services (e.g. auxiliary power to self-start, frequency control to be commissioned), the DNO networks will need works to be undertaken (e.g. a revision of protection settings and 33kV earthing systems) and innovative control and automation will need to be considered to overcome some of the technical challenges (e.g block load pick-up) and reduce the human resource required to maintain stable power islands.

Workstream delivery

The Power Engineering and Trials workstream has delivered its first paper "The Viability of Black Start from DER" (SDR 4) in a timely manner and this report delivers against all objectives from bid documentation.

The full Power Engineering and Trials viability report can be found on the Distributed ReStart webpage: **https://www.nationalgrideso.com/document/149961/download**

Table 1.1
Successful delivery criteria for PET viability report

Successful delivery criteria	Report sections which address this point
Choice of case studies and options for network re-energisation in each case	Case study criteria and selection (Report sections 2.1–2.5)
Initial proposals for the functional testing requirements to apply for Black Start from DERs	Initial proposals for functional and testing requirements (Report sections: 4.1–4.5)
The potential for roll-out across GB	Assessment of Black Start from DER viability (Report Sections: 3.1–3.8) The potential for roll-out of the method across GB (Report Sections: 5.1–5.6)
Use a stakeholder-led approach	Industry engagement (Report sections: 1.1, 5.2, 5.3, Appendix D)

The outcome of the design stage (due to complete on 31 July 2020) will be a report titled "The Technical and Financial Proposals for Demonstration."

This report will address the following:

- Detailed assessment of the power engineering aspects of Black Start from DER.
- Examples of power engineering through case studies, including firm live trial proposals.
- Support of conclusions through power system studies.
- Enable Steering Group and DERs to make informed live trial decisions.
- Use a stakeholder-led approach.

To achieve these aims, the following work has been conducted since August 2019:

Case studies

To enable a detailed technical assessment to be undertaken, four of the ten case studies have been selected for further study. These have been chosen to provide a variety of anchor generation (steam, hydro and gas), which have different characteristics and will need to be modelled separately. In addition, the case studies provide the opportunity to study the integration of wind, solar and battery generation. Three of the networks are in the SPD area – Chapelcross, Galloway Region and Glenrothes Region – and one in the SPM area, Legacy.

Anchor generators

Engagement with anchor generator owners in the case studies has commenced to obtain detailed information on their technical capability, and the resilience of their existing sites. From this dynamic power system, models of the generators are being developed to accurately assess their capability for restoration tasks such as picking up load (known as the block load pick-up). In addition, the requirements to make each generator self-starting is being assessed, along with providing the necessary technical capability (e.g. frequency and voltage control).

DNO networks

Detailed protection studies have been commissioned to identify the exact requirements for protection changes that will be required within a case study were it to operate as a distribution island. For example, which protections will require the settings to be changed (and what would those settings be) and where would additional protections be required. From this, a detailed inventory of the protection changes will be provided.

Distribution ReStart zone (DRZ) controller

The PET viability report identified that some form of control and automation would be required to overcome the technical challenges of operating a power island with multiple DER resources (including intermittent) and the resource constraints (e.g. control engineers) to make the service viable. A detailed specification has been produced for the required functionality of the controller, and engagement is ongoing with multiple technology companies in relation to providing a full functional design specification for a potential DRZ controller.

Restoration strategies

Work has commenced on detailing restoration strategies for the case studies. Options such as sequential switching in of circuits are considered as well as simultaneously switching multiple circuits. In addition, multiple options have been developed for restoring demand at a primary (33/11kV) substation. Once full restoration options have been developed, system studies will be undertaken to identify the viable and optimal strategies.

System studies

Work has commenced to identify the range of steady state, dynamic and transient studies that will need to be undertaken to ensure that the restoration strategies for each case study have been adequately assessed to prove if they are technically viable. Detailed models of the anchor generators (including boiler dynamics) are being developed.

Live trials

Work has also commenced in assessing the suitability of the case studies for live trials (e.g. locations to connect load banks), and what technical capability will require to be proven by a live trial (e.g it is likely the block load pick-up capability of the different anchor generator types will require validation by a live trial).

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
Matching the technical capability of the anchor generator (e.g minimum stable load required, block load capability) with the ability to restore the DNO network.	The operating capability of the anchor generators is being assessed in detail and restoration strategies are being developed to cater, where possible, for the specific capability. In addition, consideration is given to the use of equipment such as a load bank, and automation to provide fast switching, where required to overcome generation/network limitations.
No earth reference at 33kV when it is disconnected from the higher voltage network.	Consideration of the most economic means of provision for a new earth reference point, likely to be an earthing transformer at the DER connected busbar.
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.	Works will be 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.

Workstream plan

Table 1.3
PET workstream plan

Activities	Target date
Power system studies (4 case studies)	Q2 2020
Protection studies (4 case studies)	Q2 2020
DRZ controller – functional design specification	Q3 2020

Anticipated change requirements

Based upon current findings, the project has proposed the introduction of several changes to infrastructure and operational processes as detailed below. These investment requirements are not currently understood to be so onerous that they affect project benefits. However, a full cost benefit update will be part of the design stage project deliverables.

It is currently expected that the following infrastructure will be required:

- Back-up generation for DER auxiliaries.
- Flexible demand, for trials this will be a load bank and suitable controller to protect the anchor generator, but the enduring solution may use different mechanisms.
- Voltage and frequency control enabling works for DER.
- Power System Synchronising Breakers may be needed.
- An earthing transformer will be required for minimum safety standards.

Organisational Systems and Telecommunications

Capability to deliver the restoration process will be dependent upon the organisations involved; the systems they use; and the availability and resilience of telecommunications. This will be developed through the Organisational Systems and Telecommunications workstream.

Workstream summary

The Organisational Systems and Telecommunications workstream delivered its first paper "organisational systems and telecommunications viability assessment" (SDR 1) on 08/11/2019 in line with the bid document requirements.

The report's key findings are:

There are no identified organisational, systems or operational telecommunications blockers to delivering Distributed ReStart.

This report identifies that the key themes during the design phase should be familiarity, resilience and flexibility. The design stage outputs (described later in this section) will cumulate in the next report "A Design for Process, Control Systems and Resilient Telecommunications," (SDR 2). By the end of this workstream in September 2021, it is anticipated that the project will have tested and refined the proposals made in SDR 2 through desktop exercises, and offline tests of systems and hardware.

Key workstream findings

Organisational analysis

Through workshops and bilateral meetings with Black Start stakeholders, the capabilities and skillsets of existing Black Start participants were reviewed and a set of organisational structure models developed to assess potential future requirements. These models represent a discrete set of options for control of Black Start and levels of automation.

These models allow the project to consult on and understand possible change requirements to meet the project objectives, whilst remaining flexible enough to take account of other industry changes.

Systems and telecommunications viability

For telecommunications, a broad range of suitable technologies have been identified that could meet the end-to-end voice and data requirements needed to facilitate Distributed ReStart. It is anticipated that the outcomes of the telecommunications analysis will be a functional specification that may be met by a range of technologies and allow flexibility for future developments.

Workstream delivery

Organisational systems and telecommunications viability

Table 1.4 outlines the delivery criteria for the organisational systems and telecommunications viability assessment and the report sections which address each objective.

The full organisational systems and telecommunications viability report can be found on the Distributed ReStart webpage:
https://www.nationalgrideso.com/document/156216/download

Table 1.4
Successful delivery criteria for OST viability report

Successful delivery criteria	Report sections which address this point
Resilience assessment of telecommunications	Operational telecommunications (Report sections: 10, 11, 12) Telecommunications case study (Report section: 15)
Resilience and capability assessment of systems	Systems option analysis (Report sections: 13 and 14)
Capability assessment of organisational structures and skills	Organisations (Report sections: 6, 7, 8, 9)
Identify key areas of focus for the design stage	Next steps (Report section: 17) Telecommunications option analysis (Report section: 12) Organisational models (Report sections: 8 and 9)
Use a stakeholder-led approach	Industry engagement (Report section: 3)

A design for process, control systems and resilient telecommunications

The outcome of the design stage (due to complete on 2/10/2020) will be a report titled "A Design for Process, Control Systems and Resilient Telecommunications". This next report will deliver the following:

- A process map with task allocations.
- Organisational structures, including roles and responsibilities.
- Requirements for system or tools with initial outline design concepts.
- Telecommunications functional requirements.

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 1.5 summarises these and the current activities the workstream is undertaking to ensure they are appropriately answered.

Table 1.5
Challenges for the OST workstream

Challenge	Current supporting activities
Wider industry changes will impact significantly on available people, systems and responsibilities	Continual engagement with wider innovation projects, ongoing strategic telecoms outputs and focus on ENA DSO worlds. Progressing with multiple models to allow synergy.
An increased number of stakeholders will impact significantly on telecoms requirements	The design stage will review the communications interfaces and requirements.
An increased number of stakeholders could impact on cyber security	Cyber security is treated as a project deliverable for the design stage as another requirement for resilience.
DERs do not currently participate in Black Start so there is an initial cost with establishing processes and training	Process design will seek to minimise impacts on all parties based on the baseline assessment conducted in the viability report.
Whole system telecommunications resilience requirements	As part of the strategic telecoms group, this project will learn and influence wider network telecoms changes to 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 1.6
Organisational systems and telecommunications design stage plan

Activities	Target date
Compare models with operational telecommunications	Q3 2020
Further engagement with all stakeholders	ongoing
Align with evolving DSO/DNO developments	Q2 2020
Applicability across GB	Q2 2020
Develop desktop exercises for each organisational model	Q3 2020
Draft organisational requirements	Q3 2020
Process map	Q3 2020
Develop draft telecommunications requirements/ specification	Q3 2020
Telecommunications options	Q3 2020
Cost-benefit analysis	Q3 2020
Define existing capability and possible manufacturers for any automation requirements through stakeholder engagement	Q3 2020
Cyber policies	Q2 2020
Development of cyber principles	Q3 2020
Report writing	Q4 2020

Anticipated change requirements

The key identified requirement for investment from the 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 potentially an automated system to facilitate faster restoration with fewer resources. Cost assessment will be used to judge the most efficient components 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 workstream has delivered its first paper "Procurement and Compliance functional requirements" (SDR 7) within the planned timeframe from bid documentation.

The key findings of this report are:

The commercial structures and procurement process should be developed and refined through a strategic process to ensure they are fit for purpose and stakeholder endorsed.

The review of codes did not highlight any insurmountable challenges.

Within the report, we have reviewed a number of inputs to the strategic process, including outputs of the PET and OST workstreams, current Black Start processes, methodologies, and current and forecast spend positions; and have used commercial analysis tools to help us understand the current structures. This enables us to draw insights regarding what may need to change to deliver a successful and appropriate commercial solution.

The second major objective of the report was to review the relevant codes and licences to identify any elements that could present an obstacle for the implementation of a future Black Start service from DER.

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.

Workstream findings

The report outlines considerations for the design of a future Black Start service from DER. These are summarised in 'commercial insights' later in this project progress report. The code review has not identified any significant barriers. However, challenges will exist in incorporating new participants into clauses which refer to existing specified stakeholders and general interdependencies across the multiple codes.

Workstream delivery

Functional requirements

Table 1.7 outlines the report's objectives and the sections in which these are addressed. A download of the full Procurement and Compliance report can be found on the Distributed ReStart webpage.
https://www.nationalgrideso.com/document/156221/download

Table 1.7
Successful delivery criteria for Procurement and Compliance functional requirements report

Successful delivery criteria	Report sections which address this point
Procurement options and selection criteria	Procurement (Section 2) Strategy development (Section 4)
Commercial design	Commercial design (Section 3) Developing options (Section 5)
Gaps and blockers in code licences to enable the service	Review of codes (Section 7) Horizon scan – codes (Section 8)
Use a stakeholder-led approach	Approach to engagement (Section 1.4) Horizon scan – commercial (Section 6)

Outline of contract terms and regulatory arrangements

The outputs of the design stage will be to consider "Contract terms and regulatory arrangements" (SDR 8). The aim of this stage is to outline a design of the procurement process and contractual arrangements. This is expected to include:

- procurement design and contractual arrangements
- regulatory and funding arrangements
- required changes to codes and licence conditions
- use of a stakeholder-led approach.

Delivery challenges

There are two key challenges for the workstream:

- To manage the shortfall for a codes specialist. This will be mitigated through recruitment or outsourcing.
- The dependency on technical outputs for drafting of contract terms. This risk to timelines is being managed carefully through whole project planning.

Workstream plan

Table 1.8
Procurement and Compliance design stage plan

Deliverable	Target date
Engagement plan for phase 2	December 2019
Cross-workstream planning	December 2019
Assess component groupings	February 2020
Industry challenge and review of strategy process for procurement and commercial	April 2020
Refine inputs	April 2020
Develop initiatives	April 2020
Begin to refine initiatives	June 2020
Propose implementation plan	October 2020
Development of proposals for code changes	April 2020
Review and refinement with industry	June 2020
Begin implementation process for code changes	December 2020
Iterate horizon scan	October 2020
Phase two report	October 2020

Commercial insights and change requirements

The Procurement and Compliance workstream used its report as a chance to review considerations for the contractual design stage in the format of insights. These will guide the commercial design stage and procurement contractual terms.

- The project should create technical requirements which are functional and transparent.
- There is an opportunity to improve value for the end consumer through transparency of procurement process, consideration of options which improve liquidity and splitting technical requirements where possible.
- There is an opportunity to maximise service provider participation and take advantage of demand elasticity by procuring over a range of timeframes and closer to real time and designing a more streamlined end to end contractual process.
- There is a need for a review of the feasibility process to reflect the larger number of providers expected to form a single service plan and the high interdependency which may be placed on multiple DERs.
- There is a need to continue to protect consumers against exposure to risk of non-delivery, late delivery by providers or lack of capability, potentially leveraging commercial mechanisms to achieve this.
- The project should consider opportunities for self-assessment whilst still ensuring service minimum standards are met, potentially utilising commercial penalties as a mechanism for this.

- Consideration should be given to assurance processes which enable national and regional standards. This will become particularly important if the obligations for assurance or procurement are shared across multiple entities.
- The project should continue to prioritise cost transparency.
- The project should consider how integrated systems could support achievement of overall project objectives, including more accurate operational monitoring, more accurate data preventative performance monitoring, and data accessibility to enable provider self-servicing.
- There is a need for the project to investigate options for funding wider infrastructure requirements of this new service inclusive of changes to network assets, control systems and resilient operational telecommunications with a mind to balance capital costs, market liquidity and competition.
- The project should view systems holistically, considering integration and interaction between control systems and procurement platforms to maximise liquidity and competition and promote provider self-servicing.
- There is a need to consider the impact on liquidity and competition when looking at automatic control options, the entity (or entities) responsible for procurement and assurance, the size of a distribution network restoration zone, and the number of DERs considered for a single plan.
- Where possible, technical requirements should be split into component parts and the timeframes over which these are procured varied.
- There is a requirement to balance wider infrastructure capital investment and the improved liquidity and competition which results from lower barriers to entry.

Code insights and change requirements

None of the code change requirements are considered insurmountable. However, based on current analysis:

- There may be a requirement for Grid Code terminology changes in specific clauses relating to roles and responsibilities, particularly in OC5, OC9 and BC2.9.
- System Operator – Transmission Owner Code (STC) and System Operator – Transmission Owner Code process (STCP) 06-1 may need to be adapted to include all relevant participants (DNO, DSO, etc).
- To enable power island synchronisation more detail could be provided in the appropriate clauses within Distribution Operator Code (DOC) 9.
- The earthing policy within the Electricity Safety, Quality, and Continuity Regulations (ESQCR) could pose a risk in a distribution power island. This will likely require asset changes.
- A number of potential issues are found in Engineering Recommendations (EREC) G99. Several clauses relating to island operation, protection, frequency response and fault ride-through may be subject to change, or derogations provided for a Black Start and restoration scenario.
- Relaxation of certain conditions during a restoration scenario are likely to be required in P28, P29 and G5.
- Changes in the Connection and Use of Systems Code (CUSC) and Distribution Connection and Use of Systems Code (DCUSCA) may be needed to facilitate procurement for Distributed ReStart.
- Changes in the Balancing and Settlement Code (BSC) may be required across multiple sections to reflect the greater involvement and role of DERs and the distribution network operator during restoration.
- It is recommended that the Grid Code and ER91 include clearer requirements for telecoms resilience of Black Start DERs in the event of power outages.

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.

Key outcomes

The project recognises the value that stakeholder engagement brings at every level, from broad awareness to actively supporting with the delivery of outputs. Figure 1.1 shows our general approach to engagement with description of the project's high-level actions.

Figure 1.1
Our approach to stakeholder engagement

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)**

Furthermore, attendance at Utility Week Live is an example of a wider industry event which we attended in May 2019 and plan to attend in May 2020.

General engagement activities

We have an active distribution list of over 400 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 promoting attendance at specific industry events.

Examples of industry events attended are shown in table 1.9.

Table 1.9
General engagement activities

Event	Value unlocked
Utility Week Live 21–22 May 2019	Engagement with broad industry stakeholders, 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.

Targeted engagement and input

In addition to general engagement, the project has taken part in extensive targeted industry consultation. Inclusive of 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 and genuine review.

Table 1.10
Targeted Engagement Activities

Event	Value unlocked
Strategic Telecoms Group 7 August 2019 13 September 2019 8 October 2019 28 October 2019 11 November 2019 28 November 2019	Ongoing working group. Direct input and challenge to the telecommunications options reviewed in SDR 1 "organisational systems and telecommunications Viability", expectation of continued input and alignment activities across all deliverables.
Cigré – Denmark 4–6 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.
Networks Round Tables 12 September 2019	Specific Black Start industry experts invited from TOs and DNOs who 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	An industry working group established to hold the project to account. The outputs of the first session can be viewed here: **https://www.nationalgrideso.com/document/153856/download**
Cigré – 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.
ElectraLink: Central Solutions for a Fast-Evolving Utilities Industry 5 November 2019	This conference provided a vision on future data acquisition and convergence for a low carbon, decentralised world.
Speaking at Green Generators Group 12 December	Targeted engagement with DERs with a renewable focus.
Flexibility forum 18 December 2019	Cornwall Insights working group with representatives from various DERs.

Figure 1.2
The project team at Utility Week Live 2019 – meet us there at Utility Week Live 2020!

Figure 1.3
Distributed ReStart collaborates with international level research into power system restoration from DER at Cigré Canada

Figure 1.4
Project Lead Peter Chandler presents at LCNI

Figure 1.5
Representation from TOs, DNOs, iDNOs and various operational telecommunications experts for our networks round table event

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 1.11 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 operators, network operators and DERs across 2020 to input directly to project outputs.

Table 1.11
List of stakeholder events

Event	Date
End of year Distributed ReStart newsletter	2 January 2020
Distributed ReStart webinar on OST and P&C outputs	8 January 2020
Distributed ReStart stakeholder advisory panel	13 January 2020
Cigré 2020 Conference Paper Submission	20 January 2020
Hosting Distributed ReStart Annual Conference	30 January 2020
Speaking at Future Networks 2020	25 February 2020
Conference paper submission to CIRED	16 March 2020
Utility Week Live	19 May 2020
Attending CIRED conference	4 June 2020
Attending CIGRE conference	24 August 2020
Attending LCNI	3 November 2020
Stakeholder Advisory Panel	Ongoing
Strategic telecommunications group	Ongoing
Cigré Black Start working group	Ongoing

Horizon scanning

A key element of our engagement strategy is to utilise and align with ongoing whole system changes across the industry.

The DSO transition is a key dependency of this project. The range of proposed organisational models and engagement with ENA Open Networks ensures continued alignment with the possible futures, delivering benefits from whole system thinking.

The project looks to facilitate the System Operator's ambition of carbon-free operation by 2025 and support wider initiatives around net zero by 2050. Continued engagement with renewables through the green generators group and wider innovation projects detailed will allow the project to maximise the potential of these technologies and influence their capability for service functional requirements.

With this in mind, we have identified projects which are potentially impactful and will continue to monitor outputs, contribute or engage with them across the whole project lifecycle as appropriate. However, as a project team, we are always keen to learn, if you are aware of a project we should be following which is not on this, list please contact us at: **ReStart@nationalgrideso.com**

List of relevant projects

Resilience as a Service – SSE

Network Islanding Investigation – WPD

Distributed Generation Cybersecurity Connection Guidance – BEIS

European Emergency Restoration Network Code – NGESO, DNOs, TOs, SGUs

System Restoration Plan (SRP) and System Defence Plan (SDP) – NGESO, DNOs, TOs, SGUs

Black Start Tender Process – NGESO

Strategic Telecoms Group (ENSTG) – ENA facilitated, includes DNOs, JRC, NGESO

ENA Open Networks project – ENA facilitated, includes DNOs, NGESO

ENA Cyber Security Task Group – ENA members, E3C members, BEIS, NCSC, Ofgem (associate)

BAU Black Start Workshops – NGESO, TOs, DNOs

Black Start Strategy – NGESO

Black Start from Non-Traditional Generation Technologies – NGESO, SPEN, TNEI

DSO Position Paper – Ofgem

Open letter consultation on approach to setting the next electricity distribution price control – Ofgem

Power Potential – NGESO, UKPN

Electricity Flexibility and Forecasting System – WPD

Testing Coordinated DSO-ESO Procurement and Dispatch – NGESO

Demonstration of virtual synchronous machine control of a battery system – NGESO

Residential Response – NGESO

Short term Inertia Forecast – NGESO

Frequency response auction trial – NGESO

Virtual Stat-Com – WPD

A holistic intelligent control system for flexible technologies – SPEN

Micro resilience – NPG

The Planning Data Exchange System between Network Licensees to Enable a Smarter Grid – NPG

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. In the appendix, you will find our project Q&A tracker for all recently asked or currently open questions. 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.

Material changes

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

Accuracy statement

This progress report has been produced in agreement with the entire project hierarchy. The report has been reviewed by all project partners. The report has been approved by the Distributed ReStart, Steering Committee and by Roisin Quinn the Project Sponsor. Every effort has been made to ensure all information in the report is true and accurate.

Roisin Quinn

Head of National Control – National Grid Electricity System Operator & Distributed ReStart – Project Sponsor.

Appendix 1: Q&A tracker

You asked…	We answered…
1. Can 'anchor generators' be A-Synchronous? Converter connected technologies which can provide a voltage reference are already available.	We have considered this through our NIA projects **https://www.nationalgrideso.com/document/148201/download** We are continuing to track developments across industry, including trials in GB, and will seek to make functional requirements technology agnostic when capability is demonstrated. With batteries as anchor generators, there is a challenge in their ability to deliver power for a sustained period, which depends on the amount of stored energy.
2. How can A-Synchronous generation regulate frequency?	Different manufacturers use different approaches to frequency regulation using converter-connected sources so there isn't a defined solution we intend to use. For the purpose of the project, a crucial factor is whether the converter is 'grid forming' rather than 'grid following'.
3. Can batteries be used for 'stacking' different restoration services? What possible services can batteries provide for restoration?	Batteries are very flexible resources that if configured appropriately might deliver a range of different services essential to the restoration process. This could include self-starting ability and a range of fast dynamic responses and slower steady-state control of voltage and frequency. Means of procuring this capability and functional requirements for it will be developed through the design stage of this project.
4. Is switchgear on distribution networks rated for operation during Black Start conditions?	The network conditions during Black Start introduce higher risk of phenomena like transient over-voltages or harmonic distortion, which may pose a threat to switchgear or other assets and these risks are being assessed. However, given that short circuit levels will be very low during the early stages of restoration, the switchgear rating, in terms of its current-carrying capability, is not expected to be a problem.
5. How do we synchronise power islands on the distribution networks? Will we need to install Power System Synchronising relays everywhere? The Power System Sync issue may also extend to installation of VTs.	It is expected that new system synchronising relays, and associated measurement equipment, may have to be installed at locations identified as potential synchronisation points. The most economic means of providing this will be reviewed by the project in the design and refine stages.

You asked…	We answered…
6. Switching of flexible demand and network demand to provide stable DER loading will be complex, requiring automation. Why can't network demand be used for initial block loading?	The challenge is in the load block sizes that can be achieved in practice and with high confidence. So-called 'cold load pick-up' introduces greater uncertainty and risk when switching in normal demands that have been off supply for extended periods. The size of load blocks that can be switched depends on the prevalence of circuit breakers on the network, and there is an impact on restoration timescales if more switching actions are necessary. In some circumstances, analysis may determine that network demand on its own provides enough flexibility and control. Where it does not, additional flexibility must be provided, which might be done using a controlled load bank, a battery or other resources – if deemed cost effective. Within the project trials, we will not interrupt supplies to domestic customers. Therefore, we see a role for controllable load banks for proof of concept in the live trials.
7. What network models are being used for study analysis?	Most analysis will use the normal network models used for other studies of the distribution and transmission networks. It may be necessary to extend, supplement or otherwise amend the network models for specific types of studies, particularly those requiring electromagnetic transient type modelling. It will also be necessary to add suitable representations of DER dynamic behaviour.
8. What other services will be required for energising and growing power islands on distribution networks? Have we considered flywheels and synchronous compensators?	We are open to all solutions that are practical and cost effective, possibilities for providing this may stem from stability or voltage pathfinder projects which we are monitoring as a team. Given that Black Start is a very low probability event, the emphasis must be on using the resources that are there anyway. Synchronous compensators and flywheels would provide additional dynamic reactive compensation, inertia and improved frequency response, and additional short circuit level if installed in an area undergoing DER-based restoration, and if it was practical to re-energise them in very weak network conditions.
9. How will protection work during Black Start from DER? Does the project need to engage with the accelerated loss of mains change programme? Will ROCOF settings need to be changed to accommodate our Black Start from DER proposals?	The project is at too early a stage to recommend settings that might be implemented in the current loss of mains change programme. Rate of change of frequency (ROCOF) is clearly a risk in very low inertia power islands and we may conclude that ROCOF relays need to be disabled during the early stages of restoration. This forms a part of our more general review of protection. Early findings are that it may be necessary to change a number of different protection settings, on the network and DER, before commencing the restoration process. This preparatory step will be an important part of the process. The project is also considering what changes in codes or what derogations may be necessary to facilitate this.
10. How will emissions from energy from waste/fossil-fuelled DERs be dealt with?	We are aware that operating combustion-based resources at lower than normal operating points may have an adverse impact on emissions, which may breach the normal limits imposed on some DER. Where this adverse impact cannot be avoided, we will explore with the environmental authorities what scope there is to relax emissions limits during Black Start, noting that it is a very low probability event, of short duration, and of critical importance to societal wellbeing and public safety. This issue is not specific to DER and must be dealt with when large or medium combustion plant is contracted for a Black Start service.

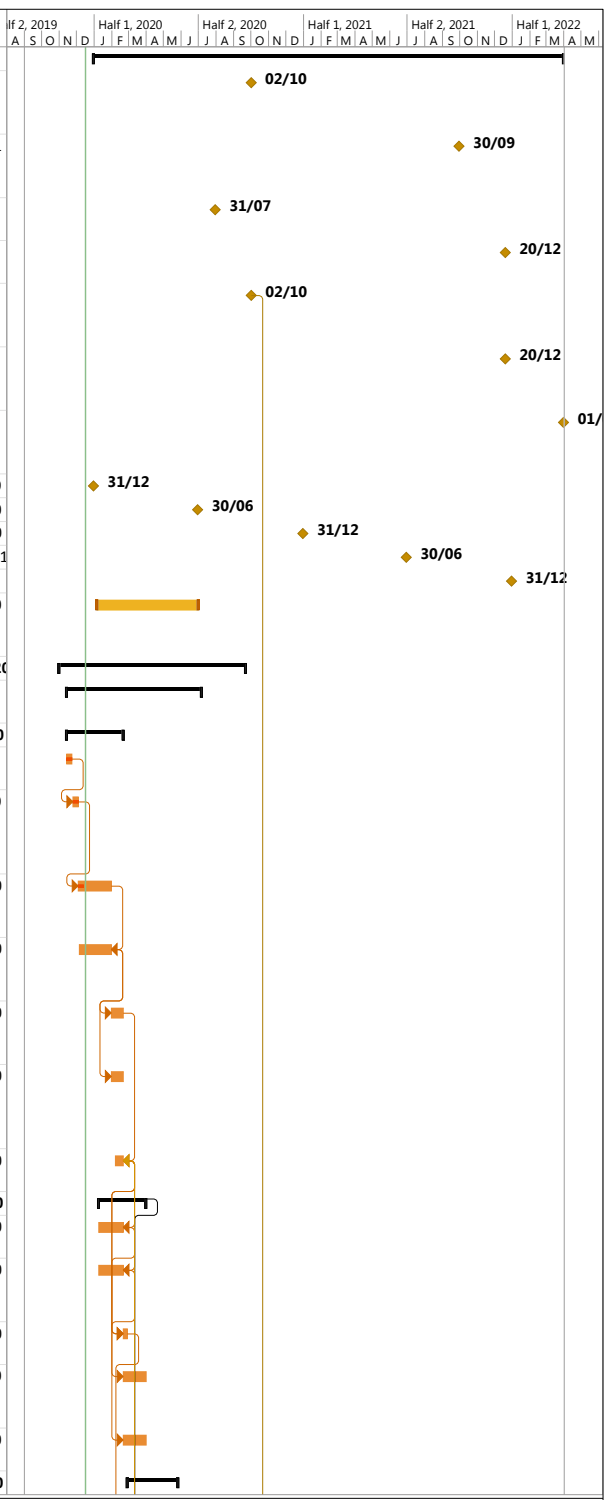
Appendix 2: RAID log

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 National Grid ESO, 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 due to a well-designed team structure. Ensure that documentation and guidance exists to assist anyone joining 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 phase, 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 to DER generator equipment could lead to suspension of the project due to safety concerns.	Power engineering and trails	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 in 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 for 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 trails	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 time scales may be longer than expected.	Power engineering and trails, 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 Phase 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 high 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 and 3 outputs 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 a Code 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.	Risk
18	Project milestone 8 could need re-planning.	Procurement and compliance	There is a risk that the structure of the PDM8 deliverable is unrealistic due to the PET PDM 4 deliverable – timings of the delivery have a conflict across the other workstreams.	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 trails/ 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.	Risk
21	Live trials costs.	Power engineering and trails/ Project direction	There is a risk that without the detail costing for the live trials, forecasting is not as accurate as required. Mitigating action: PET workstream to provide best view of estimated costs.	Risk

Appendix 3: Whole project plan

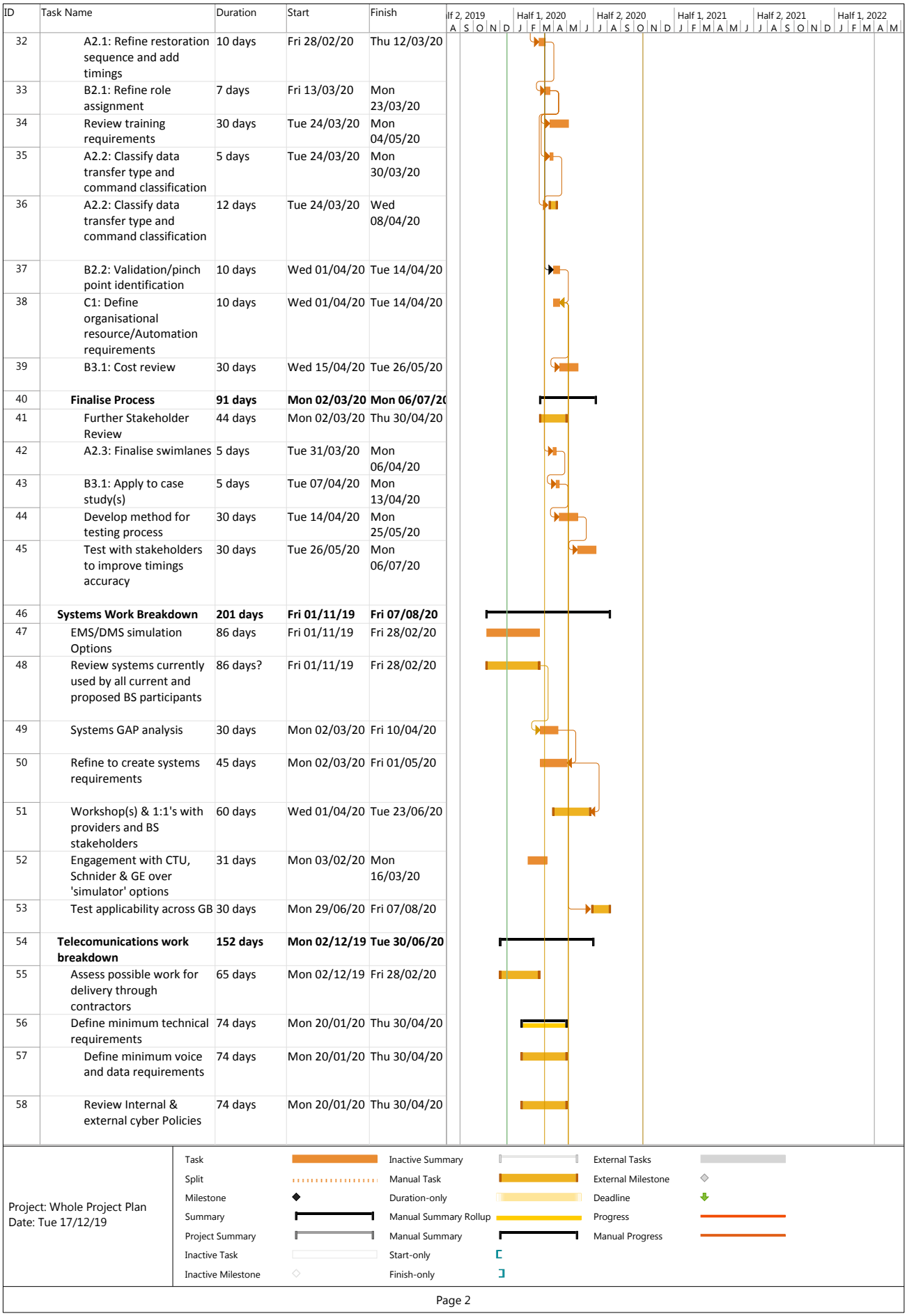
ID	Task Name	Duration	Start	Finish
1	**Project Deadlines**	**588 days**	**Tue 31/12/19**	**Fri 01/04/22**
2	OST SDR2: Design of Process, Roles and Requirements	0 days	Fri 02/10/20	Fri 02/10/20
3	OST SDR3: Refine the organisational, systems and telecoms	0 days	Thu 30/09/21	Thu 30/09/21
4	PET SDR5: Technical and Financial Proposals	0 days	Fri 31/07/20	Fri 31/07/20
5	PET SDR6: Demonstration of BSfDER	0 days	Mon 20/12/21	Mon 20/12/21
6	P&C SDR8: High level outline of contract & regulation	0 days	Fri 02/10/20	Fri 02/10/20
7	P&C SDR9: Final version of generic procurement terms	0 days	Mon 20/12/21	Mon 20/12/21
8	PD: SDR10: Final proposals for functional and testing requirements	0 days	Fri 01/04/22	Fri 01/04/22
9	PD: PPR Dec 2019	0 days	Tue 31/12/19	Tue 31/12/19
10	PD: PPR Jun 2020	0 days	Tue 30/06/20	Tue 30/06/20
11	PD: PPR Dec 2020	0 days	Thu 31/12/20	Thu 31/12/20
12	PD: PPR Jun 2021	0 days	Wed 30/06/21	Wed 30/06/21
13	PD: PPR Dec 2021	0 days	Fri 31/12/21	Fri 31/12/21
14	**Develop draft functional technical requirements across all workstreams**	127 days	Mon 06/01/20	Tue 30/06/20
15	**OST D2**	**232 days**	**Fri 01/11/19**	**Mon 21/09/20**
16	**Organisational Work Breakdown**	**168 days**	**Thu 14/11/19**	**Mon 06/07/20**
17	**Draft Process**	**71 days**	**Thu 14/11/19**	**Thu 20/02/20**
18	A1.1: Gather Inputs	7 days	Thu 14/11/19	Fri 22/11/19
19	A1.2 Align switching programme and guidance with LJRP structure	7 days	Mon 25/11/19	Tue 03/12/19
20	A1.3:Create a set of process steps for ESO and DNO led	42 days	Wed 04/12/19	Thu 30/01/20
21	A1.4:Assign roles for DNO led and ESO led model	40 days	Fri 06/12/19	Thu 30/01/20
22	A1.5: Classify type of interaction and approximate timings	15 days	Fri 31/01/20	Thu 20/02/20
23	A1.5: Review telecomunications and systems requirements	15 days	Fri 31/01/20	Thu 20/02/20
24	A1.6: Draft process created	10 days	Fri 07/02/20	Thu 20/02/20
25	**Stakeholder Review**	**59 days**	**Thu 09/01/20**	**Tue 31/03/20**
26	B1: Review with ENA on worlds	31 days	Thu 09/01/20	Thu 20/02/20
27	A1.8 Validation with BAU, PET & P&C	31 days	Thu 09/01/20	Thu 20/02/20
28	A1.9: Make changes based on review	5 days	Fri 21/02/20	Thu 27/02/20
29	A1.10: Black Start Participant review and input	28 days	Fri 21/02/20	Tue 31/03/20
30	Descision on models progressed	28 days	Fri 21/02/20	Tue 31/03/20
31	**Refine Process**	**63 days**	**Fri 28/02/20**	**Tue 26/05/20**



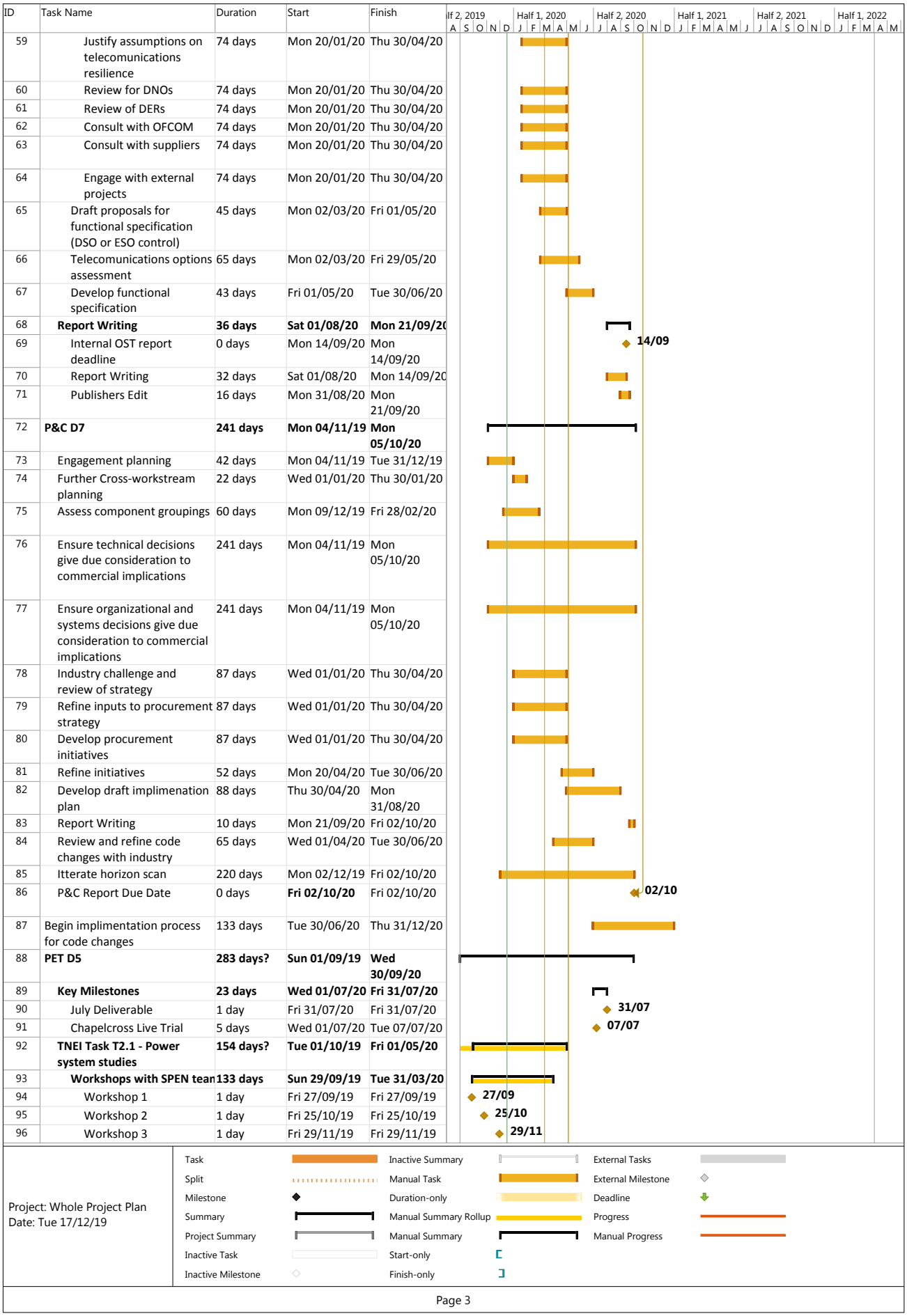
Project: Whole Project Plan
Date: Tue 17/12/19

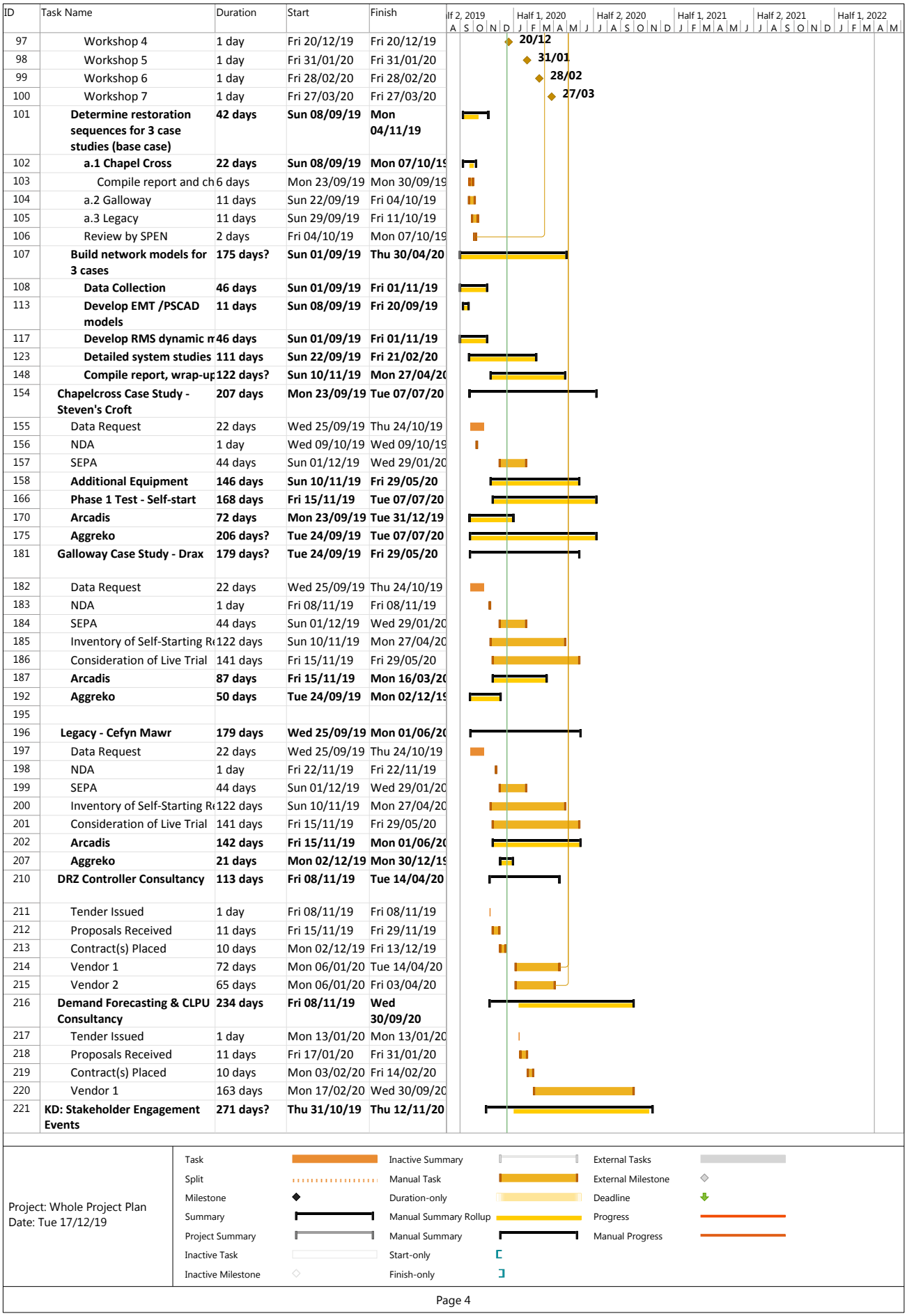
Task	Inactive Summary	External Tasks	
Split	Manual Task	External Milestone	
Milestone	Duration-only	Deadline	
Summary	Manual Summary Rollup	Progress	
Project Summary	Manual Summary	Manual Progress	
Inactive Task	Start-only		
Inactive Milestone	Finish-only		

Page 1



ID	Task Name	Duration	Start	Finish
32	A2.1: Refine restoration sequence and add timings	10 days	Fri 28/02/20	Thu 12/03/20
33	B2.1: Refine role assignment	7 days	Fri 13/03/20	Mon 23/03/20
34	Review training requirements	30 days	Tue 24/03/20	Mon 04/05/20
35	A2.2: Classify data transfer type and command classification	5 days	Tue 24/03/20	Mon 30/03/20
36	A2.2: Classify data transfer type and command classification	12 days	Tue 24/03/20	Wed 08/04/20
37	B2.2: Validation/pinch point identification	10 days	Wed 01/04/20	Tue 14/04/20
38	C1: Define organisational resource/Automation requirements	10 days	Wed 01/04/20	Tue 14/04/20
39	B3.1: Cost review	30 days	Wed 15/04/20	Tue 26/05/20
40	**Finalise Process**	**91 days**	**Mon 02/03/20**	**Mon 06/07/20**
41	Further Stakeholder Review	44 days	Mon 02/03/20	Thu 30/04/20
42	A2.3: Finalise swimlanes	5 days	Tue 31/03/20	Mon 06/04/20
43	B3.1: Apply to case study(s)	5 days	Tue 07/04/20	Mon 13/04/20
44	Develop method for testing process	30 days	Tue 14/04/20	Mon 25/05/20
45	Test with stakeholders to improve timings accuracy	30 days	Tue 26/05/20	Mon 06/07/20
46	**Systems Work Breakdown**	**201 days**	**Fri 01/11/19**	**Fri 07/08/20**
47	EMS/DMS simulation Options	86 days	Fri 01/11/19	Fri 28/02/20
48	Review systems currently used by all current and proposed BS participants	86 days?	Fri 01/11/19	Fri 28/02/20
49	Systems GAP analysis	30 days	Mon 02/03/20	Fri 10/04/20
50	Refine to create systems requirements	45 days	Mon 02/03/20	Fri 01/05/20
51	Workshop(s) & 1:1's with providers and BS stakeholders	60 days	Wed 01/04/20	Tue 23/06/20
52	Engagement with CTU, Schnider & GE over 'simulator' options	31 days	Mon 03/02/20	Mon 16/03/20
53	Test applicability across GB	30 days	Mon 29/06/20	Fri 07/08/20
54	**Telecomunications work breakdown**	**152 days**	**Mon 02/12/19**	**Tue 30/06/20**
55	Assess possible work for delivery through contractors	65 days	Mon 02/12/19	Fri 28/02/20
56	Define minimum technical requirements	74 days	Mon 20/01/20	Thu 30/04/20
57	Define minimum voice and data requirements	74 days	Mon 20/01/20	Thu 30/04/20
58	Review Internal & external cyber Policies	74 days	Mon 20/01/20	Thu 30/04/20


ID
Task Name
Duration
Start
Finish
lf 2, 2019
Half 1, 2020
Half 2, 2020
Half 1, 2021
Half 2, 2021
Half 1, 2022
A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M
59 Justify assumptions on telecomunications resilience 74 days Mon 20/01/20 Thu 30/04/20
60 Review for DNOs 74 days Mon 20/01/20 Thu 30/04/20
61 Review of DERs 74 days Mon 20/01/20 Thu 30/04/20
62 Consult with OFCOM 74 days Mon 20/01/20 Thu 30/04/20
63 Consult with suppliers 74 days Mon 20/01/20 Thu 30/04/20
64 Engage with external projects 74 days Mon 20/01/20 Thu 30/04/20
65 Draft proposals for functional specification (DSO or ESO control) 45 days Mon 02/03/20 Fri 01/05/20
66 Telecomunications options assessment 65 days Mon 02/03/20 Fri 29/05/20
67 Develop functional specification 43 days Fri 01/05/20 Tue 30/06/20
68 Report Writing 36 days Sat 01/08/20 Mon 21/09/20
69 Internal OST report deadline 0 days Mon 14/09/20 Mon 14/09/20
14/09
70 Report Writing 32 days Sat 01/08/20 Mon 14/09/20
71 Publishers Edit 16 days Mon 31/08/20 Mon 21/09/20
72 P&C D7 241 days Mon 04/11/19 Mon 05/10/20
73 Engagement planning 42 days Mon 04/11/19 Tue 31/12/19
74 Further Cross-workstream planning 22 days Wed 01/01/20 Thu 30/01/20
75 Assess component groupings 60 days Mon 09/12/19 Fri 28/02/20
76 Ensure technical decisions give due consideration to commercial implications 241 days Mon 04/11/19 Mon 05/10/20
77 Ensure organizational and systems decisions give due consideration to commercial implications 241 days Mon 04/11/19 Mon 05/10/20
78 Industry challenge and review of strategy 87 days Wed 01/01/20 Thu 30/04/20
79 Refine inputs to procurement strategy 87 days Wed 01/01/20 Thu 30/04/20
80 Develop procurement initiatives 87 days Wed 01/01/20 Thu 30/04/20
81 Refine initiatives 52 days Mon 20/04/20 Tue 30/06/20
82 Develop draft implimenation plan 88 days Thu 30/04/20 Mon 31/08/20
83 Report Writing 10 days Mon 21/09/20 Fri 02/10/20
84 Review and refine code changes with industry 65 days Wed 01/04/20 Tue 30/06/20
85 Itterate horizon scan 220 days Mon 02/12/19 Fri 02/10/20
86 P&C Report Due Date 0 days Fri 02/10/20 Fri 02/10/20
02/10
87 Begin implimentation process for code changes 133 days Tue 30/06/20 Thu 31/12/20
88 PET D5 283 days? Sun 01/09/19 Wed 30/09/20
89 Key Milestones 23 days Wed 01/07/20 Fri 31/07/20
90 July Deliverable 1 day Fri 31/07/20 Fri 31/07/20
31/07
91 Chapelcross Live Trial 5 days Wed 01/07/20 Tue 07/07/20
07/07
92 TNEI Task T2.1 - Power system studies 154 days? Tue 01/10/19 Fri 01/05/20
93 Workshops with SPEN tean 133 days Sun 29/09/19 Tue 31/03/20
94 Workshop 1 1 day Fri 27/09/19 Fri 27/09/19
27/09
95 Workshop 2 1 day Fri 25/10/19 Fri 25/10/19
25/10
96 Workshop 3 1 day Fri 29/11/19 Fri 29/11/19
29/11
Project: Whole Project Plan
Date: Tue 17/12/19
Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress



ID	Task Name	Duration	Start	Finish
97	Workshop 4	1 day	Fri 20/12/19	Fri 20/12/19
98	Workshop 5	1 day	Fri 31/01/20	Fri 31/01/20
99	Workshop 6	1 day	Fri 28/02/20	Fri 28/02/20
100	Workshop 7	1 day	Fri 27/03/20	Fri 27/03/20
101	**Determine restoration sequences for 3 case studies (base case)**	**42 days**	**Sun 08/09/19**	**Mon 04/11/19**
102	**a.1 Chapel Cross**	**22 days**	**Sun 08/09/19**	**Mon 07/10/19**
103	Compile report and ch	6 days	Mon 23/09/19	Mon 30/09/19
104	a.2 Galloway	11 days	Sun 22/09/19	Fri 04/10/19
105	a.3 Legacy	11 days	Sun 29/09/19	Fri 11/10/19
106	Review by SPEN	2 days	Fri 04/10/19	Mon 07/10/19
107	**Build network models for 3 cases**	**175 days?**	**Sun 01/09/19**	**Thu 30/04/20**
108	**Data Collection**	**46 days**	**Sun 01/09/19**	**Fri 01/11/19**
113	**Develop EMT /PSCAD models**	**11 days**	**Sun 08/09/19**	**Fri 20/09/19**
117	**Develop RMS dynamic m**	**46 days**	**Sun 01/09/19**	**Fri 01/11/19**
123	**Detailed system studies**	**111 days**	**Sun 22/09/19**	**Fri 21/02/20**
148	**Compile report, wrap-up**	**122 days?**	**Sun 10/11/19**	**Mon 27/04/20**
154	**Chapelcross Case Study - Steven's Croft**	**207 days**	**Mon 23/09/19**	**Tue 07/07/20**
155	Data Request	22 days	Wed 25/09/19	Thu 24/10/19
156	NDA	1 day	Wed 09/10/19	Wed 09/10/19
157	SEPA	44 days	Sun 01/12/19	Wed 29/01/20
158	**Additional Equipment**	**146 days**	**Sun 10/11/19**	**Fri 29/05/20**
166	**Phase 1 Test - Self-start**	**168 days**	**Fri 15/11/19**	**Tue 07/07/20**
170	**Arcadis**	**72 days**	**Mon 23/09/19**	**Tue 31/12/19**
175	**Aggreko**	**206 days?**	**Tue 24/09/19**	**Tue 07/07/20**
181	**Galloway Case Study - Drax**	**179 days?**	**Tue 24/09/19**	**Fri 29/05/20**
182	Data Request	22 days	Wed 25/09/19	Thu 24/10/19
183	NDA	1 day	Fri 08/11/19	Fri 08/11/19
184	SEPA	44 days	Sun 01/12/19	Wed 29/01/20
185	Inventory of Self-Starting R	122 days	Sun 10/11/19	Mon 27/04/20
186	Consideration of Live Trial	141 days	Fri 15/11/19	Fri 29/05/20
187	**Arcadis**	**87 days**	**Fri 15/11/19**	**Mon 16/03/20**
192	**Aggreko**	**50 days**	**Tue 24/09/19**	**Mon 02/12/19**
195				
196	**Legacy - Cefyn Mawr**	**179 days**	**Wed 25/09/19**	**Mon 01/06/20**
197	Data Request	22 days	Wed 25/09/19	Thu 24/10/19
198	NDA	1 day	Fri 22/11/19	Fri 22/11/19
199	SEPA	44 days	Sun 01/12/19	Wed 29/01/20
200	Inventory of Self-Starting R	122 days	Sun 10/11/19	Mon 27/04/20
201	Consideration of Live Trial	141 days	Fri 15/11/19	Fri 29/05/20
202	**Arcadis**	**142 days**	**Fri 15/11/19**	**Mon 01/06/20**
207	**Aggreko**	**21 days**	**Mon 02/12/19**	**Mon 30/12/19**
210	**DRZ Controller Consultancy**	**113 days**	**Fri 08/11/19**	**Tue 14/04/20**
211	Tender Issued	1 day	Fri 08/11/19	Fri 08/11/19
212	Proposals Received	11 days	Fri 15/11/19	Fri 29/11/19
213	Contract(s) Placed	10 days	Mon 02/12/19	Fri 13/12/19
214	Vendor 1	72 days	Mon 06/01/20	Tue 14/04/20
215	Vendor 2	65 days	Mon 06/01/20	Fri 03/04/20
216	**Demand Forecasting & CLPU Consultancy**	**234 days**	**Fri 08/11/19**	**Wed 30/09/20**
217	Tender Issued	1 day	Mon 13/01/20	Mon 13/01/20
218	Proposals Received	11 days	Fri 17/01/20	Fri 31/01/20
219	Contract(s) Placed	10 days	Mon 03/02/20	Fri 14/02/20
220	Vendor 1	163 days	Mon 17/02/20	Wed 30/09/20
221	**KD: Stakeholder Engagement Events**	**271 days?**	**Thu 31/10/19**	**Thu 12/11/20**

Project: Whole Project Plan
Date: Tue 17/12/19

Task		Inactive Summary		External Tasks	
Split		Manual Task		External Milestone	
Milestone		Duration-only		Deadline	
Summary		Manual Summary Rollup		Progress	
Project Summary		Manual Summary		Manual Progress	
Inactive Task		Start-only			
Inactive Milestone		Finish-only			

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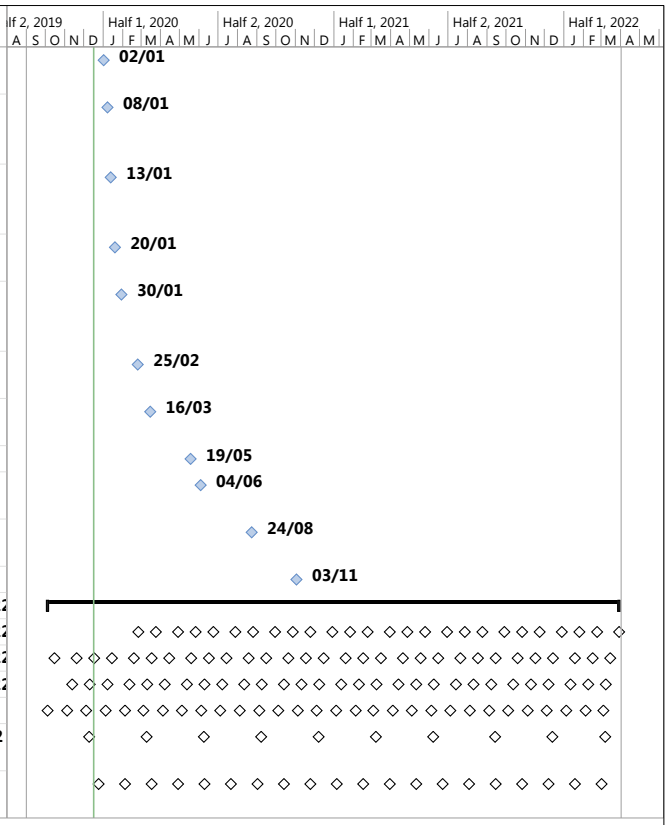
ID	Task Name	Duration	Start	Finish
222	End of year Distributed ReStart newsletter		Thu 02/01/20	
223	Distributed ReStart Webinar on OST and P&C outputs		Wed 08/01/20	
224	Distributed ReStart stakeholder advisory panel		Mon 13/01/20	
225	CIGRE 2020 Conference Paper Submission		Mon 20/01/20	
226	Hosting Distributed ReStart Annual Conference		Thu 30/01/20	
227	Speaking at Future Networks 2020		Tue 25/02/20	
228	Conference paper submission to CIRED		Mon 16/03/20	
229	Utility Week Live		Tue 19/05/20	
230	Attending CIRED conference		Thu 04/06/20	
231	Attending CIGRE conference		Mon 24/08/20	
232	Attending LCNI		Tue 03/11/20	
233	**Project Direction**	**647 days**	**Sat 05/10/19**	**Wed 30/03/22**
234	**Steer-Co**	**545 days**	**Wed 26/02/20**	**Wed 30/03/22**
261	**PMB**	**630 days**	**Wed 16/10/19**	**Wed 16/03/22**
292	**Finance Surgery**	**605 days**	**Wed 13/11/19**	**Wed 09/03/22**
322	**Finance Submission**	**630 days**	**Sat 05/10/19**	**Sat 05/03/22**
353	**Quaterly full team meeting**	**585 days**	**Tue 10/12/19**	**Tue 08/03/22**
364	**Workstream Lead meetings**	**570 days**	**Wed 25/12/19**	**Wed 02/03/22**



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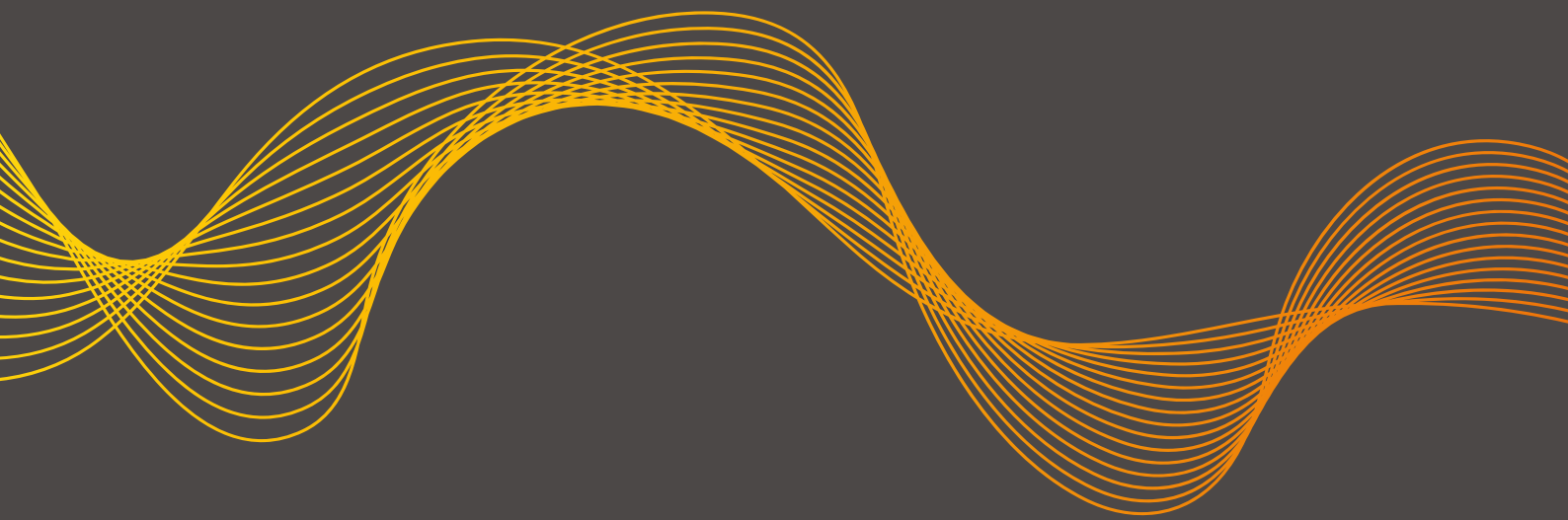
Task		Inactive Summary		External Tasks	
Split		Manual Task		External Milestone	
Milestone		Duration-only		Deadline	
Summary		Manual Summary Rollup		Progress	
Project Summary		Manual Summary		Manual Progress	
Inactive Task		Start-only			
Inactive Milestone		Finish-only			



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