

## NIA Project Registration and PEA Document

### Date of Submission

Feb 2023

### Project Reference Number

NIA2\_NGESO047

## Project Registration

### Project Title

Distributed ReStart – Redhouse Live Trial

### Project Reference Number

NIA2\_NGESO047

### Project Licensee(s)

National Energy System Operator

### Project Start

February 2023

### Project Duration

0 years and 11 months

### Nominated Project Contact(s)

Michael Kenny, Julie Balch

### Project Budget

£500,000.00

## Summary

The Distributed Restart NIC project is exploring how Distributed Energy Resources (DERs) can be used to restore power in the event of a total or partial shutdown of the GB Electricity Network. Current approaches rely on large power stations and interconnectors but, as the UK moves to cleaner and more decentralised energy, new options must be developed, leading to reductions in both cost and carbon emissions.

Two live trials have been completed at Galloway and Chapelcross Grid Supply Points (GPSs). This follow-on NIA project will support an additional live trial at Redhouse GSP to demonstrate the use of a battery energy storage system (BESS) with grid-forming technology to restart the network and use of a prototype Distribution Restoration Zone Controller (DRZC) to stabilise and maintain the power island within voltage and frequency limits.

## Third Party Collaborators

GSIMiddle Balbeggie Ltd

Bolshan Renewables Ltd

## Nominated Contact Email Address(es)

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## Problem Being Solved

Currently there are four types of organisations involved in Electricity System Restoration (ESR), formerly known as 'Black Start': National Grid Electricity System Operator (ESO), ESR providers, Transmission Owners, and Distribution Network Operators. Each organisation receives instructions and implements its part of restoration plans using a resilient and secure private telecommunications network (OPTEL). However, the electricity system has transformed, driven by decarbonisation, decentralisation and digitisation.

ESR services need to evolve in line with this and support the continued transition to a low-carbon, decentralised future. This project is determining how Distributed Energy Resources (DER) can contribute more fully to ESR. This requires an entirely new and more complex approach to restoration, which has not been achieved anywhere in the world. As a result, there are a number of technical, commercial, regulatory, and operational risks that need to be worked through and mitigated before transition into Business as Usual (BAU).

Restoration costs have risen steadily in recent years as the costs associated with keeping large generators on standby have risen. The ESO will continue to procure Restoration services as economically and efficiently as it can. Creating a collaborative and comprehensive solution between the ESO and DNOs now, to allow DER to participate in the system restoration market, will bring significant financial benefits to consumers through increased competition and lower costs. This will provide further support for community-led energy schemes and potentially achieve shorter restoration times.

## Method(s)

The method trialled in this NIC project was electricity system restoration from DERs. The project focussed on DERs in the tens of MW range connected at 33 kV. Some larger generators connected at 132 kV already provide restoration services, while smaller DERs would need to be harnessed and coordinated in much greater numbers to have the required impact. It was determined that typical network topologies at 33 kV would allow the establishment of power islands under a 132/33 kV Grid Supply Point (GSP), or Bulk Supply Point (BSP). However, the methods can be adapted and applied to different networks.

To demonstrate this, the project was organised into Workstreams to address each area of risk (technical, commercial, regulatory, and organisational), with each Workstream tasked by Ofgem including three key deliverables as follows:

**Organisation, Systems & Telecoms (OST):** The OST workstream's objective was to develop the process design, communications and systems required to coordinate all parties involved in an electricity restoration service – also known as black start.

The workstream also sought to highlight changes that would be needed across DERs, DNOs, TOs and the NGENSO.

**Power Engineering & Trials (PET):** The PET workstream's objective was to establish the technical requirements for an electricity system restoration service – also known as black start. It did this through:

- Detailed analysis of case studies
- Multiple stages of review and testing
- Demonstrating the service's concept in live trials on SPEN networks.

The PET workstream engaged with DNOs and TOs, as well as other industry stakeholders. It also engaged with DER developers and specialised consultants, including universities and national electrical testing centres.

The workstream drew on learnings from power system analysis of several distribution restoration zone (DRZ) case study networks. Additionally, it worked with a number of suppliers to develop an automation scheme, called a DRZ controller.

**Procurement & Compliance (P&C):** The P&C workstream's objective was to determine how to deliver the electricity system restoration service concept in a way that best served the needs of end-consumers. It did this by:

- Exploring the options and trade-offs between competitive procurement solutions and mandated elements
- Making recommendations on the procurement strategy – aiming to be as open and transparent as possible, while reflecting wider industry discussions on related topics like the distribution system operator (DSO) transition and whole system planning
- Considering necessary changes in codes and regulations

In addition, another key deliverable set by Ofgem was the timely dissemination of all the new knowledge (IPR) generated from the project. This was managed via the **Knowledge & Dissemination Workstream (K&D)**, which has the following deliverables agreed:

- Quarterly Stakeholder Advisory Panel meetings
- Industry engagement at the Energy Innovation Summit (EIS)
- Creation of live trial reports

- Creation of BAU procurement contracts
- Email campaigns to our registered database which has grown to over 840 industry parties
- Project webinars

During the Covid-19 pandemic, the workstream continued to engage with stakeholders by moving its communications channels online and creating podcasts via engagement with industry experts, who were able to interview all project members remotely.

In line with the ENA's ENIP document, the risk rating for the Redhouse Live Trial extension is scored Low:

- TRL Steps = 1 (1 TRL steps Redhouse Live Trial extension TRL 7 – 8)
- Cost = 2 (£500k - £1m)
- Suppliers = 1 (2 suppliers)
- Data Assumptions = 1
- Total = 5 (Low)

## Scope

Several types of DERs were considered in the Distributed ReStart NIC project, to demonstrate that the solution is applicable across technology types and across all of GB. The project focussed on DERs that have reached at least a TRL 4 in the context of providing Restoration services (thermal power stations, small hydro stations, wind farms and small gas or diesel stations) whilst remaining open to considering other technologies. The case studies identified have a mixture of synchronous and non-synchronous generation types, from both dispatchable and intermittent resources, this will provide an opportunity to explore technology options.

This project is designed to deliver tested and proven concepts and frameworks that can be directly implemented into BAU, assuming the concept is technically and economically viable. It will enable a restoration from any DER technology once certain TRL levels are attained.

This follow-on NIA project will support an additional live trial at Redhouse GSP will demonstrate the use of a battery energy storage system (BESS) with grid-forming technology to restart the network and use of a prototype Distribution Restoration Zone Controller (DRZC) to stabilise and maintain the power island within voltage and frequency limits.

## Objective(s)

Following the completion of the second live trial at Chapelcross in July 2022, the project has successfully met all 10 of its original and agreed objectives. These were agreed with Ofgem at the start of the project, and were designated as deliverables in the Project Direction:

### Organisation, Systems & Telecoms (OST):

- Defined the communications requirements for this process including automation via a new DRZC (Deliverable 1).
- Confirmed the new organisational design, roles, and responsibilities (Deliverable 2).
- Demonstrated how the restoration process and joint action would work in practice between the Electricity System Operator (ESO), Transmission Owners (TOs), Distribution Network Operators (DNOs), and Distributed Energy Resources (DERs) via desk-top exercises (Deliverable 3).

### Power Engineering & Trials (PET):

- Defined the technical capabilities required to enable a feasible Distribution Restoration Zone (DRZ) (Deliverables 4 and 5).
- The Live Trials at Galloway and Chapelcross demonstrated the use of different technology types to prove successful energisation (Deliverable 6).
- In partnership with the Organisational, Systems and Telecoms (OST) workstream, we defined, developed and factory-tested a prototype Distribution Restoration Zone Controller (DRZC).

### Procurement & Compliance (P&C):

- Defined the approach and process to procure services from DER providers (Deliverable 7).
- This was demonstrated via our procurement test event (Deliverable 8)
- Facilitated distribution restoration through ongoing industry code changes (Deliverable 9).

Ofgem Deliverable 10 is designated as the Project Closedown report, which is in the process of final development ahead of the formal closedown of the project in October 2023.

In addition, the project has progressed further than the original project plan with the inclusion of the build and test of a Distribution Restoration Zone Controller (DRZC) prototype that allows for automation (with control room engineer direction) of the creation and stabilisation of a local power island.

We have also requested a further extension to the project to 31 October 2023 (with a proportionate addition to our funding via this NIA request) to deliver a third live trial at the RedhouseGSP. This will involve use of a battery energy storage system (BESS) with grid-forming technology to restart the network and use of the prototype DRZC to stabilise and maintain the power island within voltage and frequency limits. The project plan now includes two new trial aims, split across three distinct phases over a two-week test period from 29th May – 9th June 2023:

### **Phase 1**

Deliver Phase 1 proving grid forming capability of Distributed Battery Energy Storage System (On 3rd party network only).

### **Phase 2**

Deliver Phase 2 proving grid forming capability of BESS and ability energise both 33kV and 132kV transformers / network.

### **Additional Goals (Phase 3):**

- Include Middle Balbeggie Solar farm within tests to demonstrate ability of multiple DER to contribute to islanded grid.
- Implement DRZC control of island to demonstrate ability to simply respond to disturbances or have complete control of island.

## **Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)**

This ENA Consumer Vulnerability Impact Assessment Tool has identified this project as having a positive impact on consumers in vulnerable situations. This project is expected to benefit all electricity consumers, including those in vulnerable situations by enabling DNO's to meet or exceed the new ESRS requirements, by restoring services to 60% of customers within 24 hours, or 100% within 5 days of a partial or full shutdown on the GB electricity network.

## **Success Criteria**

The original aims, objectives, and success criteria defined at the bid submission stage, were to consider as many different types of DERs as feasible to demonstrate that the solution is applicable across technology types and across all Great Britain.

The project focused on DERs that have reached TRL 4-8 in the context of providing electricity system restoration services. The case studies identified for the resulting live trials, had a mixture of synchronous and non-synchronous generation types, from both dispatchable and intermittent resources, and this provided an opportunity to explore technology options.

This project was designed to deliver tested and proven concepts and frameworks that can be implemented into BAU, assuming the specific implementation is technically and economically viable, and the outcomes of the project demonstrate that this has been achieved in a way that goes beyond the original aims and objectives. Thus, the project has exceeded the original success criteria.

All required Ofgem deliverables have now been met and the project has delivered enhanced value and learning through the innovative development of the DRZC concept and the additional live trial at Redhouse planned for June 2023. In terms of success criteria, this will be measured across two Phases as detailed in Section 2.4 above.

### **Phase 1 – successful manual restoration of the Redhouse GSP by:**

- Proving grid forming capability of Distributed Battery Energy Storage System (On 3rd party network only).
- Proving grid forming capability of BESS and ability energise both 33kV and 132kV transformers / network.

### **Phase 2 – successful automated restoration of the Redhouse GSP by:**

- Implement DRZC control of stable power island to demonstrate ability to simply respond to disturbances or have complete control of island.
- Include Middle Balbeggie Solar farm within tests to demonstrate ability of multiple DER to contribute to islanded grid.

## **Project Partners and External Funding**

The existing Distributed Restart project is NIC funded at a level of Ofgem provided £10.3 million of the project's total budget of £11.7 million, with the balance of £1.4 million contributed by the partners:

- ESO: £879,580
- SPEN: £289,510
- TNEI: £122,400

The Ofgem NIC funding included a contingency amount of £584,540K, which has been included in the forecast spend of £2.1M for the upcoming Redhouse Live Trial.

A further estimated £500,000 of NIA funding is requested to support the delivery of the Redhouse Live Trial.

## Potential for New Learning

The Distributed Restart project is at a key stage in its delivery, with two of three live trials having completed ([trial announcement October 2020](#)).

The Distributed Restart project has overcome a number of the significant technical and trial site provider readiness challenges. Given the strategic importance of what the project is demonstrating, the ESO, Scottish Power Energy Networks and TNEI are committed to delivering the full scope of the extended project. A successful rollout could save consumers over £145M by 2050 and reduce CO2 by up to 810,000 tonnes through avoiding warming of conventional generation.

This request for NIA funding to support the additional live trial at Redhouse will enable this project to deliver additional value, proven BESS ability to act as an Anchor Generator, plus automation to TRL 8/9 of the ability of new technology, combined with renewable Distribution Generation to restart the GB network and comply with the new ESRS standard.

Following completion of the Redhouse live trial in June 2023, the Power Engineering and Trials (PET) Workstream lead will compile the final PET Part 3 Report, and this will be communicated and published on the project website, for industry to access.

## Scale of Project

This project has developed and demonstrated the power engineering and trials, organisational systems, and the procurement and regulatory requirements to accelerate the provision of ESR services from DERs into BAU. Case studies have been developed on real network locations to prioritise, analyse, plan and test proposals. A key success factor for innovation projects is industry engagement, learning and buy-in. This continues to take place through engagement and consultation, as well as through participation of DER owners/operators in case studies, and through a Stakeholder Advisory Panel.

The **Development phase** identified the viable options for de-centralised restoration, then progressed on to the detailed design necessary to support testing and future roll-out. The following aspects of the method will be developed:

- Methods to assess DER and network capability and potential for ESR for specific distribution network locations.
- Recommendations for adaptations of DER and distribution networks to facilitate ESR safely and economically.
- Coordination and control solutions to ensure appropriate levels of resilience, efficiency and restoration times along with clear definition of roles and responsibilities.
- Procurement and regulatory frameworks, including contract design and proposals for any changes to codes, standards, licences and funding arrangements.

The project initially focused on the technical viability of the proposed method, in the case studies across GB. This included assessment of power systems behaviour and the options for communications and coordination of ESR. This early work confirmed the need for further Development and Demonstration of DER and network performance, new processes and tools for organisational coordination, and an appropriate commercial framework.

The **Demonstration phase** planned and carried out testing of the designed solutions. This phase covered both practical testing on live power systems and process exercising (through desktop exercises) to enable the designed solutions to be tested in an appropriate and safe environment. Where incremental improvements were identified, they were incorporated into the final proposed solutions. This phase was able to demonstrate that the designed options:

- Provide credible technical solutions for the provision of ESR services from DERs, and that the requirements for ESR are met by each DER type.
- Can be implemented in a ESR situation using an appropriate process for coordination and control of DER as part of the GB restoration solution.
- Can be validated and tested, by developing a thorough and robust planning process for provider assessment and risk mitigation.
- Produce a framework for a viable service, demonstrated through desktop exercises and an industry consultation to assess market suitability and product appetite.

As the project nears completion, the focus is increasingly on implementation into BAU. The Power Engineering & Trials work stream has produced guidance notes and supporting materials to facilitate future assessment and testing of ESR from DER across GB. The Organisational & Systems work stream has defined how the Power Island will be coordinated and managed, with functional specifications for the systems and telecommunications for parties and roles that would be directly involved in restoration in different areas. The Procurement & Regulation work stream has finalised a competitive procurement approach and contractual terms to be used by ESO, DNOs and DERs. The regulatory aspects have subsequently been transferred out of the project and proposals forwarded by ESO into the wider industry, e.g., the proposing of code changes.

For the Redhouse live trial in May/June 2023, the additional scale will cover:

### Phase 1

Successful manual restoration of the Redhouse GSP by:

1. Proving grid forming capability of Distributed Battery Energy Storage System (on 3rd party network only).
2. Proving grid forming capability of BESS and ability energise both 33kV and 132kV transformers / network.

### Phase 2

Successful automated restoration of the Redhouse GSP by:

1. Implement DRZC control of stable power island to demonstrate ability to simply respond to disturbances or have complete control of island.
2. Include Middle Balbeggie Solar farm within tests to demonstrate ability of multiple DER to contribute to islanded grid.

An extension of this project through NIA funding, is the only way that the ESR from DER method can be implemented both quickly and at a very large scale. As the concept is innovative and inherently risky, funding through BAU would be done in a much more sporadic way, and only once individual areas of work have been suitably de-risked for the end consumer and shareholders.

The envisaged cost of the live trial (£2.1M) is countered against the foreseen benefits to the consumer as detailed above. The ESO believes, as does Ofgem in their response to the Material Change Request dated December 9th, 2022, that the inclusion of this additional live trial, funded via NIA, will provide significant benefits to consumers and industry, at economies of scale that would not be possible with starting a separate NIA project from scratch.

## Technology Readiness at Start

TRL7 Inactive Commissioning

## Technology Readiness at End

TRL8 Active Commissioning

## Geographical Area

The Live Trial will take place at two locations, both in the Redhouse GSP, North of Kirkcaldy, Scotland, and the applicable DNO is Scottish Power Distribution (SPD):

1. The South Redhouse ESS comprising a 16.0MW battery energy storage facility on land beside Redhouse electricity substation, Heatherywood Road, Kirkcaldy, Fife, KY1 3NW.
2. A solar generating facility at Easter Balbeggie, Kirkcaldy, Fife KY1 3NS with a total installed capacity of 4,997.480 kWp.

The Funding Licensees, as well as the two participants (DER's) involved in the live trial as follows:

- National Grid Electricity System Operator (ESO)
- SP Energy Networks (SPEN)
- Bolshan Renewables Ltd
- GSII Middle Balbeggie Ltd

## Revenue Allowed for the RIIO Settlement

None

## Indicative Total NIA Project Expenditure

With the project extension to October 31st, 2023, the total project budget and contingency have been utilised (with Ofgem's written permission) to initiate the live trial. An additional £500,000 of NIA funding has been requested to support the delivery of Redhouse live trial and form a contingency fund.

## Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

### Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

#### How the Project has the potential to facilitate the energy system transition:

As mentioned, this project supports the electricity industry's transformation and, by enabling access to new sources of ESR capability, has the potential to deliver significant benefits to consumers. The project has developed a robust methodology to ensure the project delivers value for the consumer, and industry participants are supportive and engaged

Without this project, incremental changes would be made to systems and processes to demonstrate value to other DERs to encourage participation and changes to their respective systems and processes, rather than at the scale and speed of a collaborative wholesale solution that is made possible through the NIC/NIA mechanisms.

#### How the Project has potential to benefit consumer in vulnerable situations:

N/A

### Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

#### Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

N/A

#### Please provide a calculation of the expected benefits the Solution

The project scope spans the initial research stages (feasibility & viability), design & development, as well as extensive demonstration that the ESR concept using DER is now a possibility and can be tendered for in the commercial & regulatory framework that supports the ESRS.

In terms of expected benefits, the original 2018 Cost-Benefit Analysis (CBA) calculated an NPV of up to £115m, leading to an 80kT CO<sub>2</sub>e reduction per annum (2025-2032). The carbon benefits are significant, totalling 0.81 MT CO<sub>2</sub>e by 2050. An update to the CBA, based on interim project learning, has resulted in an increased NPV of £145m.

#### Please provide an estimate of how replicable the Method is across GB

System restoration has always been a complex process and the distributed restoration concept developed and demonstrated in this project is more complex than conventional methods due to the greater number of parties involved and application of technologies not previously used in this way. The physical components and knowledge required to implement the method are detailed in our project deliverables, with our [Final Findings and Proposals for Electricity System Restoration from DERs](#) report providing a summary of and route into all project learning, for all relevant stakeholders and future participants in distributed restoration.

Changes in equipment and new operating processes will be required by DNOs and participating DERs and the distribution networks. However, in the near term at least, distribution restoration zones will be implemented through the process of the ESO tendering for services and prompting a collaborative process of DNOs and DERs working through feasibility studies and design of potential solutions. Replication of the project outcomes will therefore be achieved through this collaboration with the ESO, who will be able to guide and support other parties in the required technical, organisational, and commercial changes.

As per the NIC governance, the intellectual property generated in the project has been shared openly in our project deliverables. Like other power system applications, implementation of a distribution restoration zone will rely upon intellectual property held by others, for example in the design and operation of specific DERs, the protection relays used on networks, or the telecoms networks essential to wide area monitoring and control.

One significant outcome of the project is the proposed use of a Distribution Restoration Zone Controller (DRZC) to provide a degree of automation that would accelerate the restoration process, reduce the burden on DNO control engineers, and enable the use of a wider range of DERs. The project took an innovative approach to the design of a DRZC, engaging four separate solution providers to produce designs and then deriving a generic set of functional requirements. The four individual designs are described in reports published on the project website, available to all. However, the generic requirement specifications developed through the project mean that DNOs are free to use whatever solutions provider they wish to choose and are not limited to those who have been directly involved in the project. This approach has provided access to the intellectual property generated in the project.

### **Please provide an outline of the costs of rolling out the Method across GB.**

For the reasons outlined above, it is currently not possible to outline roll-out costs, due to the many variables at play. However, the Closedown report from the original project scope, published at the end of January 2023, details all known 'Cost Categories', which offer guidance to industry to assist DERs and DNOs as they assess likely locations for establishing DRZs ahead of the 2025 'go-live' date.

### **Requirement 3 / 1**

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

- A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).
- A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)
- A specific novel operational practice directly related to the operation of the Network Licensees system
- A specific novel commercial arrangement

RIIO-2 Projects

- A specific piece of new equipment (including monitoring, control and communications systems and software)
- A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven
- A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)
- A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology
- A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution
- A specific novel commercial arrangement

### **Specific Requirements 4 / 2a**

#### **Please explain how the learning that will be generated could be used by the relevant Network Licensees**

Extensive technical details of network modifications that DNOs and DERs will need to make, to implement a successful distributed restoration service on their Assets, have been published. Section 2.0 of our [Final Findings Report](#) gives a detailed overview of the key technical findings and recommendations that have been derived from the successful live trials at Galloway and Chapelcross, as well as extensive information from the various network studies. The key findings for Network Licensees are summarised below:

In the transition to BAU, it will be necessary for all DRZ participants to tackle the technical challenges identified in our project analysis and live trials. This will be driven by the process of the ESO tendering for new restoration services and working with the DNOs and DERs to assess viability and define workable DRZs.



DER owners will need to determine what service they are able to provide:

- Anchor DER – Each DRZ requires an “anchor” DER, a key requisite is having grid-forming capability.
- Top-up services – To supplement the technical capability of the anchor generator, stabilise or grow (connect more demand or network to) the DRZ, additional DER resources may be required. The requirements are defined in terms of “top-up services” (such as fast MW control, short circuit level) and in themselves are technology agnostic.

The key technical issues to be considered by DNOs, which may require investment on the network to allow it to form part of a DRZ, include:

- 33 kV network earthing – existing earthing schemes must be evaluated to identify changes required to ensure safe operation, especially during initial start-up of the anchor generator and resynchronisation of the power island with the wider system.
- Network protection – existing protection functions and settings within the proposed DRZ must be reviewed to ensure safe operation throughout the restoration process, which may require the use of different settings during the early stages when fault levels are at their lowest. Many modern protection relays have group settings functionality that allows different settings to be used but the details of how this would be implemented in each DRZ would need to be assessed.
- Switchgear capability – studies should be performed to assess risks of transient recovery voltage (TRV) for fault and normal switching operations (together with the associated phenomena of reignitions for vacuum interrupter circuit breakers); the capacitive breaking capacity of switchgear should also be considered. To overcome the technical and human resource constraints associated with establishing and maintaining a DRZ, the DNO may have to implement automation in the form of a DRZ controller (DRZC). This will primarily be required if either of the following “top-up services” are required:
  - Fast MW control – This enables the block load pickup (BLPU) capability of the anchor DER to be enhanced (its ability to pick up instantaneous blocks of demand) to make a viable restoration strategy (e.g. pick up primary [33/11 kV] substations in a single step). The DRZC is truly innovative in requiring sub-second control of DER to achieve this (to maintain acceptable frequency levels). This DRZC function is called fast balancing.
  - Energy MWhs are required to enhance the capacity of the anchor DER to restore demand. The DRZC will control the additional DER to ensure the generation/load balance is such that the frequency is kept within limits. This DRZC function is called slow balancing.

The live trials have provided learning that will inform the transition to BAU, highlighting key issues like:

- the level of transient voltages and currents in an islanded network
- transformer energisation and techniques to mitigate associated generator tripping
- switchgear and network reactive loading capability
- the accuracy of system modelling
- the benefits of live assurance testing.

The new learning generated by the completion of the Redhouse Live Trial in June 2023, will be made available in full to industry and, other Network Licensees internationally. Networks (as well as non-Network Licensees, such as Generators wishing to participate in Distributed Restoration) will be able to access all the findings related to asynchronous generation (such as BESS) used as an Anchor Generator or Top-Up-Service, in terms of cost categories, generator and network protection settings, additional equipment needing to be installed etc.

**Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)**

N/A

**Is the default IPR position being applied?**

Yes

## **Project Eligibility Assessment Part 2**

### **Not lead to unnecessary duplication**

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

**Please demonstrate below that no unnecessary duplication will occur as a result of the Project.**

There is no duplication of the work being delivered by Distributed ReStart and the proposed Redhouse Live Trial.

**If applicable, justify why you are undertaking a Project similar to those being carried out by any other**

## Network Licensees.

N/A

## Additional Governance And Document Upload

### Please identify why the project is innovative and has not been tried before

The ESO is always looking for new ways of doing things to improve system operability, discharge licence obligations and ultimately support consumers, for example the recent addition of interconnectors to the Black Start market framework. Interconnectors fit neatly within the current framework as they are a large transmission-connected asset and are well understood. The ability to control, instruct and despatch these providers on the transmission network is already in existence, so the actions required to develop the service from this “new” technology focused on the assessment of the capability of the technology and its impact on restoration.

This project aims to put in place a wholesale, systematic change which is system and process driven to enable contribution from, and coordination of, a far greater number of embedded providers. It aims to achieve this at significant pace, ready for GB-wide rollout. For it to be successful, it requires involvement and commitment from the entire industry, and resources to be in place that are not currently aligned for System and Network Operators to deliver.

This project is a world-first as restarting the distribution and, subsequently, the transmission network up to Supergrid (400Kv) level (using Asynchronous Distributed Energy Resources, such as a combination of a BESS in conjunction with a Solar farm) on the scale of this Live Trial, has, to the best of our knowledge, not been attempted anywhere in the world.

### Relevant Foreground IPR

All the workstreams have delivered reports that fully satisfy the Project Direction from Ofgem. These have been published on the Key documents webpage of the [Distributed ReStart website: Distributed ReStart | National Grid ESO](#). The final PET Report (Part 3) will also be published on the project website at the end of October 2023.

More detail on the relevant foreground IPR can be found in section 5.3, page 34 of the original [NIC Submission Document](#).

### Data Access Details

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

1. A request for information via the Smarter Networks Portal at <https://smarter.energynetworks.org>, to contact select a project and click ‘Contact Lead Network’. National Grid ESO already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
2. Via our Innovation website at <https://www.nationalgrideso.com/future-energy/innovation>.
3. Via our managed mailbox [innovation@nationalgrideso.com](mailto:innovation@nationalgrideso.com).

Details on the terms on which such data will be made available by National Grid ESO can be found in our publicly available “Data sharing policy relating to NIC/NIA projects” at <https://www.nationalgrideso.com/document/168191/download>.

### Please identify why the Network Licensees will not fund the project as part of its business and usual activities

ESR technical requirements for DER such as block loading, reactive power absorption and inertia capabilities may vary for different network characteristics and the local DER technology mix. Also, energising from the distribution network may require system adaptations. Only by demonstrating through live system trials along with thorough investigation and analysis, will learnings about technical capabilities, options for networks, and how to de-risk and implement this approach in business as usual be generated. Thus, there is a clear need to de-risk by trialing proposed solutions in a live, network environment, together with proving the organisational, systems and telecoms requirements and a new, innovative commercial framework arrangement and appropriate code changes for a BAU roll-out to succeed.

### Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

- The TRL of the overall DER capability was relatively low (between 3-5). Therefore, innovation funding is more suitable for exploring the project's potential and increasing the TRL through proof-of-concept prototype tools before transferring into subsequent development.
- Ofgem have determined internally that NIA funding is their preferred funding option to cover of the utilisation of the project contingency. An example of unforeseen costs could come from finalisation of the two Participation Agreements, whereby the providers

ask for additional/unforeseen costs to be covered and agreed.

- Extending this project to accommodate the Redhouse Live Trial with NIA funding will ensure that the project findings can be shared more widely with other interested Network Licensees.

**This project has been approved by a senior member of staff**

Yes