Transmission Upgrades – Distribution Restoration Zones

Site Strategy EJP
Version: 1.0
11/12/2024

SP Energy Networks
RIIO-T3 Business Plan

SP Energy Networks

Transmission Upgrade – Distribution Restoration Zones			
Name of Scheme	Transmission Upgrade – Distribution Restoration Zones		
Investment Driver	Wider Works		
NESO Review	NESO Reviewed: No		
BPDT/Scheme Reference Number	SPT200914		
Outputs	Assets CB (Gas Insulated Busbar) (OD) 13 Civils CB (Gas Insulated Busbars) (OD) 13 Assets Disconnector (AIB) 9 Assets Disconnector (AIB) -4 Assets Other Switchgear 15 Assets Other Switchgear -6 Assets Current Transformer (CT) 9 Assets Current Transformer (CT) -3 Civils Platform Creation 500m^2 Assets Voltage Transformer (VT) 3 Assets Shunt Reactor 1 Civils Shunt Reactor 1 Protection Feeder Protection 36 Protection Feeder Protection 32		
Cost	£16.20m		
Delivery Year	2028		
Applicable Reporting Tables	BPDT (Section 5.1 Project Meta Data, Section 6.1 Scheme C&V Load Actuals and Section 11.10 Contractor Indirects)		
Historic Funding interactions	N/A		
Interactive Projects	This submission is in conjunction with the RIIO-ED2 ESRS Re-Opener with OFGEM in June 2025.		
Spend Apportionment	ET2	ET3	ET4
	£5.09m	£11.11m	£0.00m

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1. Executive Summary

Under the new Electricity System Restoration Standard (ESRS), SP Transmission (SPT) and SP Distribution (SPD) have a Grid Code requirement to restore 60% of demand within 24hrs and 100% of demand within 5 days following Black Start.

Part of the SP Energy Networks / SPT strategy (working with ESO) is to achieve this is through Distributed Restoration Zones (DRZs), which would be used in Central, Fife and Dumfries and Galloway, where the customers will be brought back on via embedded generation on the 33kV network. This is based on the learning from Network Innovation Competition (NIC) project Distributed Restart[1]. As part of this process, the network involved has been reviewed from a Black Start perspective to ensure that it can be restored in a safe and controlled manner minimising potential issues.

While most of the work required is on the SPD Network, the proposal requires to use the 132kV Network to grow the DRZ beyond the limits of the SPD 33kV network Interconnection, accessing both more Embedded Generation and more customers/load.

This engineering justification paper (EJP) outlines the works required within the SPT network to enable these DRZs including installation of circuit breakers, point on wave relays and a shunt reactor.

It is anticipated these works will be completed in 2028, with a cost of £16.20m (2023/24).

This EJP is submitted for Ofgem's assessment of needs and cost for approval of baseline allowance within RIIO-T3 plan.

2. Introduction

This EJP provides support for the proposal to allow the delivery of the recently issued Grid Code Modification (GC0156[2]) that requires that all Transmission Owners (TOs) and Distribution Network Owners (DNOs) must be capable of supporting the restoration of 60% of all supplies in 24hrs and 100% within 5 days.

One of the proposed solutions, which has been developed with agreement with the NESO, is the creation of 3 Distribution Restoration Zones (DRZ) within the SPT area. One in Central, one in Fife and one in Dumfries and Galloway.

The DRZ concept was the follow on to the NIC project Distributed Restart where SPEN and the ESO (now NESO) worked together to demonstrate using Low Carbon Technologies such as wind, BESS and solar to re-energise the Grid and supply load.

A DRZ is turning this innovation into a practical, business as usual scheme.

SPEN worked closely with NESO through the Northen Tender process (tender to award Electricity System Restoration (ESR) Response contracts) to identify which potential ESR generators would be suitably placed electrically to develop Distribution Islands. These generators would have to be connected into areas of the network that had local access to the 132kV network and have at least one other generator available as a top up.

[1] Distributed ReStart - SP Energy Networks
[2] Suite of code modifications in relation to the Electricity System Restoration Standard | Ofgem

BI-Monthly meetings were in place to work with NESO to develop a technically deliverable solution that could turn the Distributed Restart NIC project into a business-as-usual activity.

Working through the process with the NESO the 3 DRZs were identified. These three locations were discussed with the NESO as they allowed not only the ESR start and top up services but also access to considerable amounts of other distribution connected generators that could substantially grow the initial islands and restore demand following an ESR event.

This can potentially restore the supplies of 20-25% of SPD's connected customers and will contribute to the overall restoration plan.

This is referred to as Project REPOWER, and this paper covers the SPT element at 132kV.

These DRZs will utilise the large capacity of distribution connected generation to supply the network using the 33kV network. The growth of distribution connected generation over the last 5-10 years has transformed the way the 33kV network operates and this requires it to be part of any system restoration strategy.

To allow the expansion of these zones to increase the reconnected load, the proposal is to use the 132kV network to interconnect the 33kV grid supply points (GSPs) by back energising the 132/33kV grid transformers. This expansion is essential to maximise the possible benefits of the embedded generation within these areas. The potential generation available on any day exceeds the demand these areas have and allows for not just restoration of the local area but potentially supporting any SPT Local Joint Restoration Plan (LJRP) put in place during the restoration to allow the addition of load and / or generation when required.

To allow this, the proposed solution is to install 132kV circuit-breakers (CBs), point on wave (POW) switching relays (and associated voltage transformers (VTs) if required), remote tap change control and a shunt reactor at strategic SPT locations across the 3 DRZs. This will allow the DRZs to be energised and controlled in a safe and co-ordinated way. As the DRZs are using smaller scale generation to re-energise the network, the stability of the system is at a greater risk. The proposed works reduce the risk of a system collapse during the process.

The distribution element of the project will be submitted to Ofgem under the RIIO-ED2 ESR Reopener due in June 2025 which contains the detail of the works on the SPD network assets.

It should be noted that this project is complementary to the Restoration project also included within RIIO-T3 which focusses on supporting system restoration from the transmission network, and both should progress in parallel.

3. Background Information

The traditional, historical plan for partial or complete restoration of the transmission network in SPT's licence area was based on large thermal plant at [redacted] and the ability of [redacted] to provide the initial feed for re-energisation. As the UK has moved to decarbonised forms of energy, the profile of the UK generation has changed with less large thermal plant available and a greater reliance on renewable generation.

With the closure of [redacted] and the associated review of the restoration process, the SPT restoration plan is now reliant on generation being available from the SSEN-T and NGET areas with SPT responsible for creating the transmission corridors to the network interface CBs as per the approved LJRPs.

As part of the ED2 Innovation funding, SPEN, along with other partners including the NESO, successfully demonstrated through the Distributed Restart Project that it was possible to re-energise the distribution and transmission networks from grid forming, inverter driven generation.

Moving innovation into Business as Usual is a key output of any innovation project and SPEN have worked with the NESO to develop three proposed Distributed Restart Zones (DRZ).

The principle is that for each DRZ there is an anchor generator and top-up generator. These are used to start the network through energisation of the 33kV busbars at the anchor GSP and then via the 33kV network bring on load as required. The top-up generator can then provide support through generation or assistance in frequency control provision.

This allows the local network to be energised and restoration of local GSP customers' demand. Additionally in the 3 DRZ areas identified there is a large volume of distribution connected generation that would allow the expansion of the three DRZs through accessing and calling on these non-ESR contracted generators. To allow the growth of these DRZs, the proposal is to use the 132kV network to expand them beyond the localised 33kV GSPs. The control and co-ordination of the generation will be undertaken by a DRZ Controller which will be delivered under the SPD element of this project.

The 132kV network is a transmission voltage asset in Scotland, however not in the rest of GB. The DRZ concept uses the 132kV network in the SPT area to expand the DRZ beyond the 33kV busbar to neighbouring GSPs. This allows access to additional generation and additional load, restoring more customers, but also creates a stronger, more secure network. To allow this to be undertaken requires investment in the 132kV network to allow it to be energised and controlled in a safe and co-ordinated way.

There are 4 parts to the proposal, which are required to allow the DRZ to be extended via the 132kV network.

There is a requirement to install 12 off 132kV CBs at strategic locations across the 132kV networks associated with the 3 DRZs. These CBs will reduce the network path being energised and increase stability on the re-energisation process.

Also, POW switching relays (and associated VTs if required) will require to be installed at strategic locations on the 132kV network. These relays allow the switching transients to be minimised by closing the CBs at the point on the wave which matches the transformers' last known flux state. By matching (as closely as possible) this position the magnetising inrush currents are minimised on switching. This switching was demonstrated under the Distributed Restart trial to reduce the impact on the inverter driven generation sets. When POW switching was not used in the trials the generators tripped. As the intention is for this to be used under a ESR event, then the system must remain stable under the re-energisation process.

Another finding under the Distributed Restart trial was with regard to voltage level set points. The trials demonstrated that having a network target voltage of 0.9pu improved performance of the distribution connected generators, by reducing the capacitive gain on overhead lines (OHL), particularly when energising the 132kV network from small generators at 33kV. To achieve this will require the installation of remote controlled tap changers to allow the modification of voltage set points from the SPD Control Centre.

As the Distributed Restart process re-energises the SPT 132kV network, the distributed generators will require to energise the 132kV OHL and transformers. As well as the magnetising inrush from the transformers, there is also the capacitive element from energising the OHL and cable on the circuits. To counteract this, it is proposed to add a shunt reactor at Stirling GSP. This sits on the longest 132kV line that will be energised, but also allows the Central and Fife DRZs to be synchronised together. This increases the generation and load, but also increases the stability.

These 4 elements of the proposed works support the DRZ in restoring customers and accessing non-ESR contracted generation while reducing the risk of a system collapse during the process of re-energising the network from an ESR event.

4. Optioneering

This section provides a description of the options that were considered to invest in the 132kV network to allow the Distributed Restart schemes to expand beyond the 33kV network limits of the SPD distribution network.

4.1. Baseline – Do Nothing or Delay

A 'Do Nothing' or 'Delay' option is not credible in relation to this project and would be inconsistent with SPT's statutory duties and licence obligations and the recent issue of GC 0156 which requires SPT to enable the return of 60% of connected demand within 24hrs following an ESR event (100% in 5 days). In addition, Ofgem have set a target date of December 2026 to achieve this level of response. Working with the NESO has developed the DRZ option with the contracted anchor and top up generators required to be available to provide the service for November 2026.

4.2. Asset Optioneering

For each of the assets identified in this paper, there has been detailed review of the performance, location and benefits of the investment.

4.2.1. Point on Wave Relay Optioneering

Option No	Description	Commentary	Status
1	Do Nothing - Use of existing Telecontrol only	Use of the existing Telecontrol would put the system at risk on re-energisation as small generators (less than 20MW) attempting to back energise large sections of network and transformer (Grid 132/33kV) magnetising inrush are likely to trip.	Rejected
2	Install POW at all sites and feeders	POW is proven to reduce the switching transients on energisation. Application on all circuits would future proof all and any eventual restoration path. Rolling out to all sites, where they are unlikely to be used or required is an unjustified expense for the project.	Rejected
3	Install POW at Strategic locations	The system configuration and the proposed restoration path has been reviewed and POW relays are to be installed at locations where a grid transformer will be energised (either from 132 or 33kV) or a teed off transformer is present. This will allow the switching and energising transients to be minimised.	Proposed

4.2.2. Remote Tap Change Control Optioneering

Option No	Description	Commentary	Status
1	Do Nothing	Without remote tap change control, the system volts will not be able to be set to 0.9pu by the control engineer at the Operational Control Centre (OCC). This will require a manual intervention at site before any switching can take place. This will add time to any	Rejected

		restoration, is outwith the direct control of OCC and would require resource and management on the day.	
2	Install Remote Tap Change Control (RTCC) at all sites identified under the DRZ proposal	The Installation of RTCC allows the OCC to set up the system remotely, without manual intervention, to 0.9pu which allows a staged, controlled restoration from the distribution network	Proposed

4.2.3. Disconnector Replacement / Circuit Breaker installation Optioneering

Option No	Description	Commentary	Status
1	Do Nothing	The existing disconnectors cannot be used to energise plant and as such would prevent the DRZ from being extended into any sites where a banked transformer exists.	Rejected
2	Replace Disconnectors with CB only	Introduces telecontrol and ability to close to energise assets but removes ability to isolate for any future faults and thereby extends the affected zone until repair can be completed under normal system conditions and puts additional customers at risk of loss of supply.	Rejected
3	Install Disconnecting Circuit Breaker	The footprint of a DCB is comparable to a circuit-breaker allowing replacement in the existing location, retaining disconnector capability to allow local isolation if require. An SF_6-free DCB solution is subject to the SPEN Approvals process. Given the required timescales and lead times, this is not a viable option.	Rejected
4	Install a standard 132kV CB (live tank) and retain/relocate the 132kV disconnector	The standard solution of an SF_6-free 132kV live tank CB and relocation of the 132kV disconnector is the option which achieves the required objectives. This solution has been used historically and can easily be replicated (with site specific considerations)	Proposed

4.2.4. Shunt Reactor Optioneering

Option No	Description	Commentary	Status
1	Do Nothing	Without the shunt reactor, the reactive power generation on energisation of the Westfield-Devonside/Stirling/Bonnybridge 132kV OHL and cable would cause the embedded 33kV Generators to become unstable.	Rejected

2	Install Shunt Reactor at Stirling GSP	The installation of the shunt reactor allows the network to have the OHL and cable reactance compensated and allow the anchor and top up generators to remain stable through the restoration.	Proposed

4.3. Proposed Solution

The recently issued Grid Code Modification (GC0156) states that all TOs and DNOs must enable the restoration of 60% of all supplies in 24hrs and 100% within 5 days.

The 3 proposed DRZs are shown below. The Central and Fife zones are shown on a single page to highlight that these islands can be synchronised once they have been established and are in a steady operating mode (i.e. demand and generation balanced and DRZ controller maintaining voltage and frequency within limits) to extend and secure the islands.

The geographical location of the proposed DRZs can be seen below.

[redacted]

Figure 1: Single Line Diagram of Central and Fife DRZs

[redacted]

Figure 2: Single Line Diagram of Dumfries and Galloway DRZ

For each of the proposed investments the requirements and options considered, along with the proposed solutions are shown below.

4.3.1. Point on Wave Switching

Through the Distributed Restart trials, it was found that POW ensured controlled energisation transformers and thus network stability. Unlike a normal energisation process, where large thermal plant is the source, the DRZ process is based on small, embedded generators (circa 10-40MVA) made up of multiple units starting up the 33kV network and subsequently energising the 132kV network. Through the Distributed Restart trials, it was proven that the use of POW switching successfully reduced the inrush currents associated with OHL/cable and 33/132KV transformer back-energisation.

The POW relays used in the Distributed Restart trial minimised the inrush currents on closing. Unlike standard POW closing, where the 3 poles of the CB are closed individually, in the trial the CBs used (at 132kV and 33kV) were standard with 3 pole ganged closing. However, the effect in using the POW relays with the ganged closing still reduced the inrush and allowed the smaller scale generators to energise the transformers.

Without the POW relays controlling the switching, the inrush currents were of a magnitude that caused the Generator (16MVA BESS in the trial) to trip.

Where required on the network, 32 POW relays are proposed to be installed at the 18 sites below to allow the controlled restoration.

Location	Circuit	Count
Bainsford 33kV	Grid 1 and Grid 2 CBs	2
Bonnybridge 33kV	Cumbernauld No1 and No2 CBs, Drumcross/Bathgate No1 and No2, Bonnybridge GSP No1 and No2	6
Drumcross 132KV	*Grid T1 and Grid T2 132kV CB - New 132kV CBs to be installed*	2
Westfield 33kV	Grid 1 and Grid 2 CBs	2
Westfield 132kV	Mossmorran/Glenniston, Redhouse/Leven 1, Cupar 2/Leven 2	3
Cupar 33kV	Grid 1 CB	1
Leven 132kV	*Grid T2 132kV CB- New 132kV CBs to be installed*	2
Redhouse 132kV	*Grid T1 132kV CB - New 132kV CB to be installed*	1
Kendoon 132kV	Grid 1 CB	1
Carsfad 132kV	Grid 1 CB	1
Earlston 132kV	Grid 1 CB	1
Glenlee 132kV	Grid 1 CB	1
Glenluce 132kV	*Grid T1 and Grid T2 132kV CB - New 132kV CBs to be installed*	2
Tongland 132kV	*Grid T1 and Grid T2 132kV CB - New 132kV CBs to be installed*	2
Tongland 33kV	Grid 2 CB	1
Dumfries 132kV	*Grid T1B 132kV DCB - New 132kV CBs to be installed*	1
Dumfries 33kV	Grid 1 CB	1
Chapelcross 33kV	Grid 1 and Grid 2 CBs	2

4.3.2. Remote Tap Change Control

Again, through the Distributed Restart trials it was found that the energisation from embedded generation to transmission voltages, was more controlled and stable by tapping the grid transformers down to typically 0.9pu to reduce the impact of reactive power demands on OHL and cable energisation.

Where the 33kV generators will be required to back energise the transmission network, RTCC will be required to reduce the system set point at the early stages.

This will require modern AVC relays at the locations below, but also require the ETerra (transmission) and PowerOn (distribution) central control systems to be modified to allow the telecontrol functionality to be used.

As there are 18 sites within the DRZs and the utilisation will be under a system restoration event, then it is required to remove the requirement for manual intervention. This will allow physical resources to be allocated to more critical issues as they develop under the restoration process and allow the control centre to prepare the network for the restoration without being dependent on resource availability.

There are 18 sites across the 3 DRZs where SPT will be required to install RTTC.

Remote Tap Change Scheme Required	
Bainsford GSP	Westfield GSP
Bonnybridge GSP	Drumcross GSP
Cumbernauld GSP	Glenniston GSP
Cupar GSP	Redhouse GSP
Bathgate GSP	Leven GSP
Chapelcross GSP	Glenluce GSP
Kendoon	Dumfries GSP
Carsfad	Tongland GSP and Tongland 132
Earlston	Glenlee

4.3.3. Installation of additional 132kV Circuit Breakers

As discussed previously, the use of remote tap change control and POW switching will allow a secure, controlled restoration process. The controlled staged energisation of the 132kV network, requires the installation of additional 132kV circuit-breakers. The POW switching can only energise one circuit and transformer at a time and as such will require to have teed transformers disconnected.

This is consistent with the current transmission Restoration programme which is unbanking transformers on the strategic 275kV and 400kV networks.

To allow these teed off transformers to be subsequently energised requires a circuit breaker to be installed. This CB will allow the 2nd transformer to be disconnected to allow the energisation of the line and first transformer only. The 2nd transformer will then be energised via closure of the CB. From a normal system operation perspective, to retain the ability to undertake local isolation, the current disconnector and earth switch are required to be retained.

Where a 132kV CB is installed, there may be a requirement for a VT to provide voltage measurements for the POW switching. There is an option to use remote monitoring from a Phasor Measurement Unit as the input to the POW relay which will remove the requirement of a VT. This will be determined on a site-by-site basis.

The 132 kV CBs options reviewed were:

132kV Live or Dead Tank CBs

- These are standard framework CBs available to order (lead times c 75-90 weeks) and a standard installation. They will however require a larger footprint to accommodate a disconnector, earth switch and potentially a VT. To install these will require modifications of the civils and busbar arrangements to allow them to be installed.

132kV Hybrid or DCB

- Hybrid 132kV CBs are currently in service on the SPT network and combine the disconnector and CB into a single unit which can be used to minimise the increase in footprint when replacing a disconnector. These allow the local transformer to be switched in and out via the CB while also retaining the ability to isolate via the disconnector. These are however SF_6 units which will no longer be used where there is a viable SF_6-free alternative. This was rejected based on the SF_6-free alternatives being available.

- There are currently no SF_6-Free 132kV DCBs approved by SPT due to the immaturity of this specialised product. As the name suggests these are circuit-breakers with the functional capability of a disconnector. These can be used to minimise the increase in footprint when replacing a disconnector, allowing the local transformer to be switched in and out while also retaining the ability to provide a point of isolation. At the moment these have been rejected as an option as the costs and timescales for delivery are unclear and there is a viable SF_6 free alternative.

It is proposed to move forward with the live tank to allow a degree of certainty in design and delivery to allow SPT to achieve economic and efficient delivery of the project. The option to install DCBs will be kept under review.

There are 12 CBs to install on the SPT network as part of this project.

Location	Circuit
Drumcross 132KV	Grid 1 and Grid 2
Leven 132kV	Grid 1 and Grid 2
Redhouse 132kV	Grid 1
Glenluce 132kV	Grid 1 and Grid 2 132kV
Tongland 132kV	Grid 1 and Grid 2 132kV
Dumfries 132kV	Grid 132kV
Stirling 132kV	Grid 1 and Grid 2 (depending upon Shunt Reactor connection)

4.3.4. Shunt Reactor

One of the issues with using the 132kV network is the inherent capacitance with energising OHLs and cables. Using the 33kV network connected generators adds reactive demands to these generators, limiting the real power that they can produce.

To counteract this, it is proposed to install a shunt reactor at Stirling GSP, teed off the 132/33KV Transformer to provide a reactive offset to the network demands.

It is proposed to install the reactor at the Stirling site as it is electrically connected to the interconnector between the Central and Fife DRZs. These circuits are more than 55km long, 50km OHL and 5km cable and their energisation will impose a significant reactive demand on the generators employed to undertake the restoration.

The proposed reactor location is the current site of the 33kV Switchgear location at Stirling GSP. The 33kV AIS switchgear is HI5 and planned for replacement during ED2. However, the following locations were also considered and discounted due to practical installation issues.

1. The existing ex-Oil Plant House – rejected due to proximity to existing assets.
2. The site of the Current Generator – rejected –due area not suitable as size requirements for reactor.
3. Access Road to 132kV CSE terminations – this will require working around / moving the cables – rejected due to limited space to re-route cables around proposed reactor size.

5. Proposed Works & Associated Cost

5.1. Project Summary

As discussed above, under the new Electricity System Restoration Standard (ESRS), SPT and SPD have a requirement to enable the restoration of 60% of demand within 24hrs and 100% of demand within 5 days following a partial or total system outage.

Part of the SPEN / SPT strategy (working with the NESO) to achieve this is through Distributed Restoration Zones (DRZs), which would be used in Central, Fife and Dumfries and Galloway, where the customers will be brought back on via embedded generation at 33kV.

As part of this process, the network involved has been reviewed from a system restoration perspective to ensure that it can be restored in a safe and controlled manner minimising potential issues.

While most of the work required is on the SPD network, the proposal requires to use the 132kV network to grow the DRZ beyond the limits of the SPD 33kV network interconnection, accessing both more embedded generation and more customers/load.

By using the 132kV network the 3 DRZs identified within SPD can be significantly expanded to undertake system restoration.

5.2. Project Engineering Works

In the delivery stage work will be prioritised to identify the plant items that will allow the SPT network to be able to support the DRZ if required as quickly as possible. This is particularly important given the lead times of 132kV CBs are currently in excess of 18 months. Given the success of the trials in Dumfries and Galloway and the existing infrastructure is proposed to prioritise the works in this area to make it available as quickly as possible. Elsewhere, the network investment will be planned as per the roll out of the DRZ to ensure consistency and availability in line with each stage.

Pre-Engineering Works

The following list is indicative based on previous experience of such sites and as such should not be read as definitive. Seeking to drive efficiencies throughout the project, any surveys that have been undertaken for the site and are still suitable will be reused. The following surveys will be carried out:

- Topographical survey of the site.
- GPR survey of areas to be excavated to validate approximate locations of buried services.
- Ground bearing capacity checks.
- Geo Environmental Investigation to identify the relevant geotechnical parameters to facilitate the civil engineering design works.
- Earthing Study.
- Insulation Co-ordination Study
- Transport Survey to assess the access of the new equipment.
- Environmental Study.

Point on Wave Relays

For each of the identified locations, a Point on Wave relay will be ordered. The appropriate drawings will be modified to allow the panel modifications and wiring to be undertaken and the scheme tested.

132kV CB Installations

At each of the locations identified there is an in-situ 132kV disconnector. These disconnectors are in place to allow local disconnection and isolation of transformers under both normal and fault conditions.

Under a ESR event, the point POW relays (as mentioned above) can only energise a line and single transformer. Where the transformer is banked, a CB will be required to allow energisation.

As well as the studies above, there will also be a requirement to modify OHL or cable entries to allow the CB to be installed.

On each of the circuits an outage will be required to undertake the civil modifications and new plant installation.

Remote Tap Change Control

This will require modern electronic relays to be procured, and drawings modified to allow their installation, including modifications to the interface with SCADA to allow remote control and telemetry.

Shunt Reactor

The proposal is to install an offline build reactor. The proposed location is that of the existing 33kV Switchboard. The switchboard is to be replaced under ED2 and the project team will liaise will the SPD team to ensure a co-ordinated approach in undertaking the works.

An offline construction means reduced system risk by allowing the construction to be done with both circuits in service.

5.2.1. Estimated Total Project Cost

A Business Plan provision and estimated expenditure incidence of the project is indicated in the following table.

Table 2: Summary of Expenditure Incidence

Energisation Year	Yr. 2026: Direct CAPEX	Yr. 2027: Direct CAPEX	Yr. 2028: Direct CAPEX	RIIO-T2 Total: Direct CAPEX	RIIO-T3 Total: Direct CAPEX	Total: Direct CAPEX
2028	£5.09m	£6.78m	£4.33m	£5.09m	£11.11m	£16.20m

5.2.2. Regulatory Outputs

The primary asset outputs are identified in table below:

Table 3: Primary Asset Outputs

Asset Heading	Asset Category	Asset Sub-Category Primary	Voltage/Rating	Intervention	Volume Measure	Units	Volume	[redacted]
Assets	Circuit Breaker	CB (Gas Insulated Busbar) (OD)	132kV	Addition	Addition	Each	13.00	
Civils	Circuit Breaker	CB (Gas Insulated Busbars) (OD)	132kV	Addition	Addition	Each	13.00	
Assets	Other switchgear	Disconnector (AIB)	132kV	Addition	Addition	Each	9.00	
Assets	Other switchgear	Disconnector (AIB)	132kV	Replacement	Disposal	Each	-4.00	
Assets	Circuit Breaker	Other Switchgear	132kV	Addition	Addition	Each	15.00	
Assets	Circuit Breaker	Other Switchgear	132kV	Replacement	Disposal	Each	-6.00	
Assets	Instrument Transformers	Current Transformer (CT)	132kV	Replacement	Addition	Each	9.00	
Assets	Instrument Transformers	Current Transformer (CT)	132kV	Replacement	Disposal	Each	-3.00	
Civils	Substation platform	Platform Creation	0	Addition	Addition	per m2	500.00	
Assets	Instrument Transformers	Voltage Transformer (VT)	132kV	Addition	Addition	Each	3.00	
Assets	Wound plant	Shunt Reactor	132kV	Addition	Addition	Each	1.00	
Civils	Wound plant	Shunt Reactor	132kV	Addition	Addition	Each	1.00	
Other	Other (Direct)	0	0	0	0	0	0.00	

Protectio n	Protection & Control	Feeder Protection	<=33kV	Addition	Addition	Each	36.00	[redacted]
Protectio n	Protection & Control	Feeder Protection	132kV	Addition	Addition	Each	32.00	
Other	Risk	0	0	0	0	0	0.00	

6. Deliverability

We have applied SPT project management approach to ensure that this project work is delivered safely, and in line with the agreed time, cost and quality commitments. We have a proven track record of delivering essential transmission network upgrade projects and will draw upon this knowledge and experience to effectively manage these works. We have assigned a dedicated Project Manager to the works at every stage who is responsible for overall delivery of the scope and is the primary point of contact for all stakeholders.

6.1. Delivery Schedule

A standard approach has been applied to the planning phase of these works and that will continue for the reporting and the application of processes and controls throughout the lifecycle. The tables below summarises the key milestones within the delivery schedule for Stage 1 of this project.

Table 4: Summary of key milestones for 132kV Circuit Breaker installations

Item	Project Milestone	Estimated Completion Date
1	Glenluce 132kV Grid 1 and Grid 2	June 2026
2	Tongland 132kV Grid 1 and Grid 2	August 2026
3	Dumfries 132kV Grid 1	November 2027
4	Redhouse 132kV Grid 1	March 2027
5	Drumcross 132kV Grid 1 and Grid 2	June 2027
6	Leven 132kV Grid 1 and Grid 2	September 2027
7	Stirling 132kV Grid 1 and Grid 2	December 2028

Table 5: Summary of key milestones for 132kV Point on Wave Relays

Item	Project Milestone	Estimated Completion Date
1	Bainsford GSP Grid T1 and Grid T2 CBs	June 2026
2	Bonnybridge GSP Grid T1 and Grid T2 CBs	July 2026
3	Cumbernauld GSP Grid T1 and Grid T2 CBs	May 2027
4	Bonnybridge 132kV Drumcross/Bathgate No1 and No2	April 2027
5	Drumcross 132KV Grid 1 and Grid 2 132kV CB - New CBs / Hybrid to be installed	To be installed as part of 132kV CB installation.
6	Westfield GSP Grid T1 and Grid T2 CBs	June 2027
7	Westfield 132kV Mossmorran/ Glenniston, Redhouse /Leven1, Cupar/Leven2	July 2027
8	Cupar GSP Grid T1 CB	November 2027
9	Leven GSP Grid T1 and Grid T2 CBs	December 2027
10	Leven 132kV Grid T2 132kV CB- New CB to be installed	To be installed as part of 132kV CB installation.

11	Glenniston GSP Grid T1 and Grid T2 C's	August 2026
12	Kendoon Grid T1 CB	September 2026
13	Carsfad Grid T1 CB	October 2028
14	Earlston Grid T1 CB	February 2028
15	Glenlee Grid T1 CB	March 2027
16	Glenluce 132kV Grid 1 and Grid 2 132kV CB - New CBs to be installed	To be installed as part of 132kV CB installation.
17	Tongland 132kV Grid1 -New CBs to be installed	To be installed as part of 132kV CB installation.
18	Dumfries 132kV Incoming CCT from Tongland- New 132kV CB to be installed	To be installed as part of 132kV CB installation.
19	Dumfries GSP – Grid 1 CB (33kV)	December 2028

Table 6: Summary of key milestones for 132kV Shunt Reactor

Item	Project Milestone	Estimated Completion Date
1	Stirling 132kV Shunt Reactor	December 2028

Table 7: Summary of key milestones for 33kV Remote Tap Change Control

Item	Project Milestone	Estimated Completion Date
1	Bainsford GSP	February 2028
2	Bonnybridge GSP	March 2028
3	Cumbernauld GSP	April 2027
4	Cupar GSP	May 2027
5	Bathgate GSP	June 2027
6	Chapelcross GSP	July 2027
7	Kendoon	June 2026
8	Carsfad	July 2026
9	Earlston	August 2026
10	Westfield GSP	August 2027
11	Cupar GSP	September 2027
12	Glenniston GSP	October 2027
13	Redhouse GSP	November 2027
14	Leven GSP	April 2028
15	Glenluce GSP	September 2026
16	Dumfries GSP	August 2026
17	Tongland GSP	October 2026
18	Glenlee	November 2026

Regular meetings with the Project and Construction Management Teams shall be undertaken to assess the ongoing effectiveness of the Project Management interfaces.

The Project Manager will facilitate internal Project Team Meetings, in which project progress and deliverables will be reviewed and any arising risks or issues will be discussed and addressed.

6.2. Risk and Mitigation

A Project Risk Register was generated collaboratively during the initial project kick-off meeting to identify any risks, which if realised, could result in deviation from the delivery plan. Mitigation strategies have also been developed to manage the risks identified and these will be implemented by the Project Manager. The risk register shall remain a live document and will be updated regularly by the project team. Currently, the top scheme risks are:

- Lead times on plant and protection equipment.
- Coordination with other works at existing sites.

6.3. Quality Management

SPT adopts a "life cycle" approach to Quality Management in major project delivery. Our Management Systems are certified to ISO 9001, ISO 14001 and ISO 45001. Various areas applicable to these standards ensure a quality product is delivered. The significant areas detailed below:

6.3.1. Quality Requirements During Project Development

Any risk or opportunity that may affect the quality of the product are detailed in the Project Risk Register. The suppliers of main equipment may also receive a Factory Acceptance Test Inspection when the asset is being built.

6.4. Quality Requirements in Tenders

Each contract that SPT issues has a standard format. Specifically in relation to quality, this will include a Contractors' Quality Performance Requirement (CQPR). This CQPR represents a specification that details roles and responsibilities for all parties during the works, frequency and format of reporting. It will also specify the document management process to be adhered to during the delivery of the project. In addition to the CQPR, each project has a contract specific Quality Management Plan, detailing the inspection and testing regime for works as well as the records to be maintained.

6.4.1. Monitoring and Measuring During Project Delivery

SPT Projects undertake regular inspections on projects and contractors to monitor and measure compliance with SPT Environmental, Quality and Health and Safety requirements, as detailed in the contract specifications for the work. All inspections are visual, with the person undertaking the inspection ensuring that evidence of the inspection and any actions raised are documented.

The following inspections are completed:

- Quality Inspections (monthly)
- Environmental Inspections (monthly, with weekly review by third party Environmental Clerk of Works)
- Safety Assessments & Contractor Safety Inspection (daily, with full time Site Manager)
- Project Management Tours (monthly)

The scope of audits and Inspections is to determine compliance with:

- Procedures & Guides
- Planned arrangements for ISO 9001, 14001 & 18001
- Legal and other requirements.

6.4.2. Post Energisation

SPT Projects and SPT Operations within SPEN carry out a Defect Liability Period Inspection within the Contract Defect Liability Period with the aim of identifying any defects and rectifying them with the contractors.

6.5. Environmental Sustainability

IMS-01-001 encompasses all activities undertaken within and in support of SP Energy Networks three Licences. This includes operational and business support functions concerned with management of SP Transmission, SP Distribution and associated regulatory and commercial interfaces, products, services and their associated environmental, social and economic impacts. The policy makes the following commitments which shall be respected in any works associated with this scheme.

SP Energy Networks will incorporate environmental, social and economic issues into our business decision-making processes, ensuring compliance with or improvement upon legislative, industry, regulatory and other compliance obligations. We will deliver this by being innovative and demonstrating leadership on the issues which are important to us and our stakeholders, and will:

- Ensure the reliability and availability of our Transmission and Distribution network whilst creating value and delivering competitiveness by increasing efficiency and minimising losses.
- Reduce greenhouse gas emissions in line with our Net Zero Science Based GHG target, which is a target of 90% reduction in GHG emissions by 2035 (TBC) from a 2018/19 baseline.
- Integrate climate change adaptation requirements into our asset management and operations processes to support business resilience and reduce the length and time of service interruptions.
- Consider whole life cycle impacts to reduce our use of resources to sustainable levels, improve the efficiency of our use of energy and water and aim for zero waste.
- Improve land, air and watercourse quality by preventing pollution and contamination and protecting and enhancing biodiversity in our network areas.
- Improve our service to local communities, supporting their economic and social development, protecting vulnerable customers, and respecting human rights.

ENV-04-014 gives specific guidance on the management of incidents with environmental consequence, or potential for environmental consequences, over and above the general requirements for the management of incidents.

6.6. Stakeholder Engagement

SPT is committed to delivering optimal solutions in all the projects we undertake. A key part of this is engaging with relevant stakeholders throughout the project development and delivery process. Stakeholders can include customers, regulatory bodies and other statutory consultees, national and local government, landowners, community groups, and local residents and their representatives (e.g., MPs, MSPs and councillors). Community impacts associated with construction activities are considered at project initiation by completion of a Community Communications Plan, which details the stakeholders relevant to the project, the communication channels that will be used to engage with them, the information that will be provided to and sought from them, and the timescales over which this will happen. It considers any sensitivities that may require increased stakeholder consultation and details specific events that will be held with stakeholders during the development of the project.

As part of this project, SPT will engage with statutory consultees associated with the planning application for these works - the Local Authority, SEPA and Nature Scot - and the third-party landowner.

Due to the location and nature of this project, no particular sensitivities or community impact issues have been identified, but a general level of interest from local representatives has been noted and we will continue to engage with them throughout the project

SPEN have worked closely with NESO in this process to develop a practical / technically feasible solution that will turn an innovation developed solution into a business as usual solution that will be an essential part of any restoration plan.

SPEN continue to work with the NESO in ensuring that licence modifications to allow the SPT 132kV network to be operated as a DNO asset under a System Restoration event. In addition work is being undertaken to ensure that the LJRP's between SPT and SPD capture the works in both to endure that the system restoration is a co-ordinated event.

7. Conclusion

This EJP demonstrates the need to invest in the 132kV network in the Central, Fife and Dumfries and Galloway areas to allow a SPEN response in the event of an ESR incident.

Project REPOWER turns the Distributed Restart Innovation project into a Business as Usual activity. Using the innovation outcomes, SPEN have developed a solution that embraces the Distributed Restart principles and extends them to potentially recover 20-25% of SPD's customers using the existing distribution (<=33kV) connected generators in the event of an ESR Incident.

To allow these numbers to be achieved, there is a requirement to expand the network from outside the local connected Anchor and Top-up generators, and to achieve this requires the use of the 132kV infrastructure in these areas.

Following the innovation outcomes there requires to be 4 main investment projects at strategic sites with the Project POWER targeted DRZs to allow the successful operation if called on.

These are:

- **132kV CBs to be installed** at strategic locations to configure the network so as only one transformer is being energised at once.
- **Remote Tap Change Control schemes to be installed** at the GSPs involved to allow the remote change of voltage set points to 0.9pu to allow a reduced reactive demand on energisation.
- **Point on Wave relays to be installed** at strategic locations. These relays reduce the magnetising inrush currents and increase stability on energisation of transformers.
- **Shunt Reactor to be installed** at Stirling GSP. This will compensate the reactive demand of the 132kV line and cable between Bonnybridge, Stirling, Devonside and Westfield which is energised to make the parallel between the Central and Fife zones.

The main conclusions of this submission are:

- It is necessary to invest in 132kV network in Central, Fife and Dumfries and Galloway to allow the growth and expansion of SPEN's DRZs. The proposed reinforcement scheme plays a vital role in reaching ESRS targets and is aligned with SPT's RIIO-T3 strategic goals.

- The proposed investment is targeted at the sites that are included within the DRZ but optimally located to ensure that any restoration path is secure, stable and reduces the risk to the smaller scale distribution voltage connected generators that are contracted to provide the ESR Anchor and Top-up services.
- This is also supported by the RIIO-ED2 ESR Reopener submission.

This EJP is submitted for Ofgem’s assessment of needs and cost for approval of baseline allowance within RIIO-T3 plan.

8. Appendix A

Maps and Diagrams

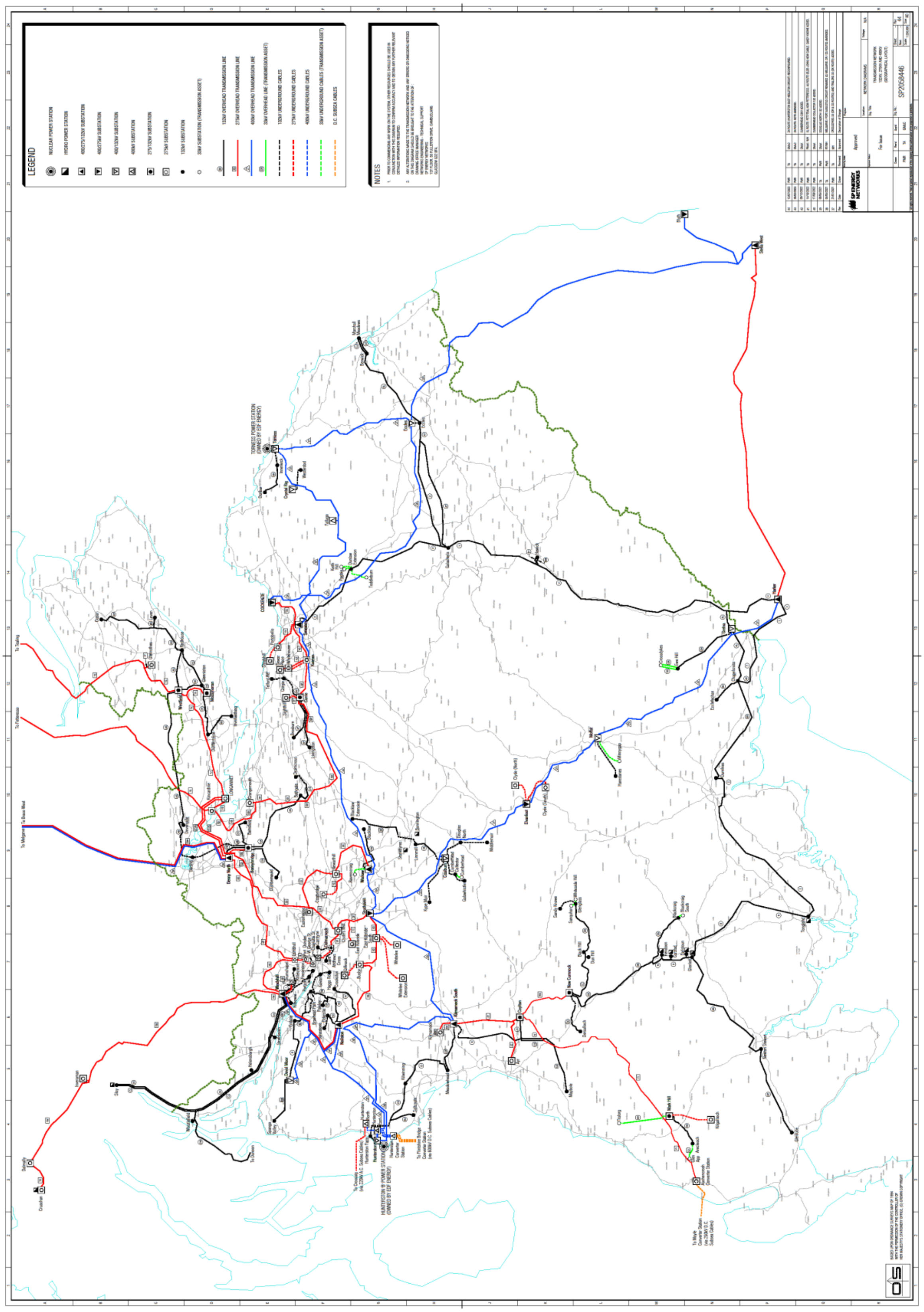

Figure 3 SPT System Diagram

[redacted]

Figure 4 DRZ - Central and Fife

[redacted]

Figure 5 DRZ - Dumfries and Galloway