SPNLT20275 Series Compensation Control Scheme Modernisation

Issue 1.0

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SP Energy Networks

RIIO-T3 Series Compensation Control Scheme Modernisation			
Name of Scheme	RIIO-T3 Series Compensation Control Scheme Modernisation		
Investment Driver	Asset Health		
BPDT/Scheme Reference Number	SPNLT20275		
Outputs	• Protection – Protection & Control – Automatic Reactive Switching (ARS)		
Cost	£5.42M		
Delivery Year	2027 - 2031		
Applicable Reporting Tables	5.1_Project_Meta_Data, 7.1_Scheme_C&V_NonLoad_Actuals, 10.2_Asset_ID, 10.3_Site_ID, 11.10_Contractor_Indirect		
Historic Funding interactions	N/A		
Interactive Projects	N/A		
Spend Apportionment	**ET2**	**ET3**	**ET4**
	£0.44M	£4.98M	£0.00M

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1. Introduction

400kV Series Compensation Equipment (SCE) are installed at sites of Moffat, Eccles and Gretna 400kV substations and are utilised to maximise the transfer capacity on both East and West coast 400kV AC circuits crossing the B6 boundary. In an AC transmission system, the maximum active power transferable over a certain power line is inversely proportional to the series reactance of the line.

Therefore, by compensating the series reactance to a certain degree, using a series capacitor, an electrically shorter line is realised and higher active power transfer is achieved. The series capacitor is self-regulated, i.e. its output is directly (without control) proportional to the line current itself, it will also partly balance the voltage drop caused by the transfer reactance. Consequently, the voltage stability of the transmission system is increased. The purpose of SCE is to provide capacitive reactance in series with the circuit reducing angular deviation and voltage drop, thereby increasing the load carrying capability and stability of the circuit. This facilitates the provision of additional transmission capacity and improve system stability between Scotland and England during high power transfers.

Figure 1: Moffat 400kV substation

Figure 2: Eccles 400kV substation

Figure 3 - Gretna 400kV substation

The circuits identified as being affected by work are as follows:

Moffat	Eccles	Gretna
Moffat SC1	Eccles SC1	Gretna SC2
	Eccles SC2	

Table 1 - Identified affected circuits

2. Background Information

This project will replace SCE control components at Moffat, Eccles and Gretna substations.

The Protection and Control scheme for this system was energised at Gretna late 2015, followed by Moffat, Eccles late 2016 and the 2nd Eccles circuit in 2017. Each SCE's duplicated integrated protection and control system (which are [redacted] proprietary design) has two [redacted] and associated equipment (RTU/HMI/ IO modules / GPS etc).

To date 2 x [redacted] CPUs have been replaced due to a bad Ethernet port and faulty serial connections. The [redacted] PAC systems is considered end of life by [redacted] and is no longer supported, replacements can only be provided from remanufactured components. The remanufactured products are OEM Components, tested, upgraded, fully cleaned and re-boxed estimated at £40k each however come with no warranty.

Due to these assets being critical to the operation of the SCE and the failure rate experienced by SPT proactive replacement of these systems is required.

3. Optioneering

This section provides a description of each intervention option and details the key considerations. A summary of each option is described at the end of this section.

The primary aim of this project is the replacement of existing, unsupported SCE control components at Moffat, Eccles and Gretna substations. This is required due to the failure rate of existing components as well as the fact that the manufacturer no longer manufactures or supports them.

Options proposed below apply to all the circuits identified within this Engineering Justification Paper.

3.1. Baseline: Do nothing / Deferral RIIO-T4

This is the same as Option 1, but with the work being carried out during RIIO-T4.

3.2. Option 1: Replace components during RIIO-T3

This option considers replacing all specified SCE control components with new components at Moffat, Eccles and Gretna substations during RIIO-T3.

The following table provides a summary and comparison of the options considered for this project:

Options	Map	Layout of Substation / Connection	Layout of all Route Works	Relevant Survey Works	Narrative Consenting Risks	Narrative Preferred Option	Narrative Rejection
Rejected – Baseline: Do nothing	N/A	N/A	N/A	N/A	N/A	N/A	A 'Do nothing' option has rejected as it is likely that components will fail and they are critical to the function of and affects the availability of the SCE. Components will need to be replaced.
Preferred - Option 1: Replace components during RIIO-T3	N/A	N/A	N/A	N/A	N/A	Replacing all specified SCE components would benefit the system as components with a lower failure rate would be used thereby reducing system downtime. These new components would also benefit from ongoing manufacturer support.	N/A

3.3. Selected Option

Option 1 achieves the main objective of replacing the relevant SCE control components during the RIIO-T3 period, reducing future outages caused by further failure of existing components.

4. Cost

The preferred option will be a single tender to GE as they are the OEM of the SCE control systems installed at Moffat, Eccles and Gretna. To make fundamental changes to the systems, access is required to the intellectual property associated with the design, therefore this could not be delivered by another manufacturer.

4.1. Estimated Total Project Cost

A Business Plan provision and estimated cost of the project is indicated in the following table. These costs include associated Contractor Indirect. To be referred to tables "7.1_Scheme_C&V_NonLoad_Actuals" and "11.10_Contractor_Indirect".

Project costs for Option 1 (preferred) are summarised in the Cost Breakdown below:

Item	Asset	Intervention	Volume	Estimated CAPEX (£m 23/24)
1	Moffat / Eccles / Gretna System	Replacement	8	[redacted]
2	Preliminaries and Site Establishment	-	-	
3	Spares			
4	Risk	-	-	

Expenditure incidence is summarised below:

Estimated CAPEX value per year, £m, 23/24 price base									
Energisation Year	Yr. 2026: CAPEX	Yr. 2027: CAPEX	Yr. 2028: CAPEX	Yr. 2029: CAPEX	Yr. 2030: CAPEX	Yr. 2031: CAPEX	**RIIO-T2 Total: CAPEX**	**RIIO-T3 Total: CAPEX**	**Total: CAPEX**
2027 - 2031	£0.44m	£0.93m	£1.19m	£1.22m	£1.03m	£0.61m	£0.44m	£4.98m	£5.42m

4.2. Regulatory Outputs

The primary asset outputs are identified in table below:

Asset	Voltage	Intervention	Volume	Delivery Year
Protection – Protection & Control – Automatic Reactive Switching (ARS)	-	Replacement	8	2027-2031

5. Deliverability

SPT's project management approach has been applied 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. A dedicated Project Manager will be assigned 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.

5.1. Delivery Schedule (Level 1 Programme)

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. Table below summarises the key milestones within the delivery schedule.

Item	Project Milestone	Estimated Completion Date
1	IP-2	October 2024
2	SCA/ITT Documents	July 2025
3	Tender Process	February 2026
4	IP3 Stage 2	March 2026
5	Commence Site Works	June 2026
6	Complete Site Works	December 2030
7	Estimated Project Close Out	February 2031

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.

5.2. Risk and Mitigation

A Risk Register would be generated collaboratively during the initial design stages to identify any risks, which if realised, could result in deviation from the delivery plan. Mitigation strategies would also be 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. Currently, the top scheme risks are:

- Network access restrictions: Wider issues on the network restricting available capacity. Co-ordinate with OCC to ensure outage plan takes into consideration the impact of delayed outages.
- Asbestos: Unknown asbestos content is available in existing infrastructure within the substation building and foundations. Detailed asbestos survey to be carried out at start of the project. Specialist contractor to be considered for any asbestos removal works.
- Dismantling in close proximity to energised circuits. Requirements of regular proximity outages has the potential of delaying programme: Demolition stages to be planned in advance of actual works.
- Project delays resulting in significant impact on network stability and increase constraint costs substantially.

5.3. 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:

5.3.1. 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.

5.3.2. 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.

5.3.3. 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.

5.3.4. Post Energisation

SPT Projects and SPT Operations 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.

5.4. Environmental and Wayleave Considerations

This section explores environmental and wayleave considerations for the project.

5.4.1. Environmental Planning

Not applicable for this scheme. All works contained within substation footprint.

5.4.2. Wayleave Issues

Not applicable for this scheme. All works contained within substation footprint.

5.4.3. Environmental Sustainability

ENV-01-007 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, working towards a zero carbon emissions target by end of 2050, with interim targets of 15% by 2023 and 80% by 2030 from a baseline of 2013/2014
- 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. Conclusion

The option proposed in this paper will result in the replacement of outdated SCE control components at Moffat, Eccles and Gretna substations with newer, supported components with lower rates of failure.

The replacement of the specified components at these substations would help to avoid further SCE control failures which would lead to less downtime.

Our optioneering approach has considered Whole System solutions in the development of our proposed options with no Whole System outcomes identified.

The options proposed have been reviewed in terms of scope feasibility, cost, timescales and risks, with Option 1 being the proposed option as it takes proactive steps to mitigate issues that may be experienced at a later date due to the involvement of out-of-date components with high rates of failure.

In line with the costs prepared, the proposed scope of works and CBA analysis, Option 1 is the preferred option:

- Scheme Total Cost: £5.42M
- Timing of investment: 2026 - 2031
- Declared outputs: The lead asset outputs are identified in table below:

Asset	Voltage	Intervention	Volume	Delivery Year
Protection – Protection & Control – Automatic Reactive Switching (ARS)	-	Replacement	8	2027-2031

- Price control period of outputs: 2027-2031