[redacted]Circuit Breaker Programme - OFGEM Justification Paper	
Name of Scheme/Programme	1. Strathaven 275kV ([redacted]control scheme replacement) 2. Strathaven 400kV (Mech replacement) 3. Newarthill 275kV ([redacted]control scheme replacement / civil asset condition)
Primary Investment Driver	Asset Health (Lead asset – Circuit Breakers)
Scheme reference/ mechanism or category	1. SPNLT2087 / Circuit Breaker (Strathaven 275kV) 2. SPNLT2088/ Circuit Breaker (Strathaven 400kV) 3. SPNLT2089/ Circuit Breaker (Newarthill 275kV)
Output references/type	NLRT2SP2087/ Lead NLRT2SP2088/ Lead NLRT2SP2089/ Lead
Cost	1. £ 0.369 m (SPNLT2087) 2. £ 0.368 m (SPNLT2088) 3. £ 0.234 m (SPNLT2089)
Delivery Year	1. SPNLT2087 – 2024 2. SPNLT2088 - 2024 3. SPNLT2089 - 2025
Reporting Table	C0.7 / C2.2a_CI / C2.2a_AP / C2.3 / C2.4b / C2.5 / C2.5a
Outputs included in RIIO T1 Business Plan	No

Issue Date	Issue No	Amendment Details
July 2019	Issue 1	First issue of document
December 2019	Issue 2	Gross cost, NPV, Monetised Risk, Long Term Risk Benefit values, delivery year and future pathways – Net zero text updated.

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1 Introduction

First generation pneumatic and hydraulic mechanism SF_6 circuit-breakers have provided reliable service since their installation began in the mid-1980s. However, the mechanisms are now proving to be unreliable and intervention is required. The issues and solutions differ by circuit-breaker model and so interventions are considered on this basis.

[redacted]275kV [redacted]and 400kV [redacted]circuit-breakers are a model where significant unreliability issues have been experienced and intervention is required to ensure ongoing operation. This is mainly due to ancillary control system being comprised of 1970s electronic components that are failing in service. The support provided by the OEM is now limited to "grey" spares from recovered plant, but these suffer from the same aged failure mechanisms and do not guarantee any firm life extension

The proposed solutions reviewed are either the replacement or refurbishment of [redacted]circuit-breakers. The programme will take place at three sites during the RIIO-T2 period, prioritised by the unreliability of existing circuit-breakers and according to the availability of system access.

- Circuit breaker addition / activities : 7 units (Total between all schemes listed here)
- Circuit breakers disposed: 4 units (Total between all schemes listed in this paper)

Note the above volumes are the total of all the schemes listed in this paper. Please refer to section 5 for the individual breakdown.

2 Background Information

There has been an ongoing performance issue with the control cabinets of the [redacted]type (400kV and 275kV). The failure mode is the failure of the control module, leaving the CB unable to operate. In the past this has been managed through a control of recovered spares. However due to the age and type of the components these are now no longer supported or manufactured.

The [redacted]Gas Circuit Breakers have an ongoing issue with electronic component failure that renders the CB inoperable. These electronic control modules are now obsolete and unsupported by the OEM due to the age of the electronics. The OEM ([redacted]has identified this issue and has developed a solution with NGET that replaces the current control system and replaces it with a modern, fully supported control mechanism. However, the cost of the refurbishment is comparable to the cost of a new 275kV circuit-breaker but with a higher cost differential at 400kV.

Following investigation into the problematic electronic control systems and the short supply of unsupported components intervention is required to ensure that the assets can perform until the end of its design life.

[redacted]CB Sites
Strathaven 275kV – 3 units
Newarthill 275kV – 1 unit
Strathaven 400kV – 3 units

Table 1 - [redacted]CB Sites

275kV [redacted]Circuit Breakers at Strathaven and Newarthill also have an ongoing issue of gas leaks which has been taken into consideration for the final intervention option selected.

Please find below the details of the circuit breakers identified for intervention.

SPEN corporate asset ID	Asset Description	Manufacturer	Model	Year of manufacture	EoL	Monetised risk
14241069	STHA275GCBL25	[redacted]	[redacted]275KV GCB TRANS	1992	9.72450	£ 298,576.92
14241070	STHA275GCBL55	[redacted]	[redacted]275KV GCB TRANS	1992	9.72450	£ 298,576.92
14241074	STHA275GCBL75	[redacted]	[redacted]275KV GCB TRANS	1992	9.72450	£ 74,791.37
14210009	NEAR275GCBS10	[redacted]	[redacted]275KV GCB TRANS	1996	9.40346	£213,824.10
14212242	STHA400GCBX405	[redacted]	[redacted]400KV GCB TRANS	1996	11.96862	£712,951.98
14211299	STHA400GCBX500	[redacted]	[redacted]400KV GCB TRANS	1993	9.72450	£300,414.24
14211328	STHA400GCBX705	[redacted]	[redacted]400KV GCB TRANS	1993	9.72450	£317,205.29

Table 2 Identified [redacted]/ [redacted]Circuit Breaker Refurbishments

The EOL and risk values are those at the end of the RIIO-T2 period without intervention.

3 Optioneering

A summary of the options considered for interventions were as follows:

3.1 Strathaven 275kV and Newarthill 275kV ss – [redacted]275kV GCB

	Option	Status	Reason for rejection
Baseline	Investment deferred to RIIO T3: Scope of works similar to option 1	Proposed	-
1	Replacement with SF6 circuit breaker in RIIO T2	Proposed	-
2	Refurbishment in RIIO T2	Rejected	The 275kV [redacted]Gas Circuit Breakers have an ongoing issue with electronic component failure that renders the CB inoperable. Further these have also had issues with gas leaks in the past. Refurbishment of these 275V Circuit Breakers is not feasible commercially mainly due to the high cost of refurbishment when compared to replacement.

3.2 Strathaven 400kV – [redacted]400kV GCB

	Option	Status	Reason for rejection
Baseline	Replace in RIIO T3: Scope of works similar to option 2	Proposed	-
1	Refurbishment in RIIO-T2	Proposed	-
2	Replacement in RIIO-T2	Proposed	-

4 Detailed Analysis

4.1 Options considered: Strathaven 275kV and Newarthill 275kV ss [redacted]units

The options considered for intervention for [redacted]CB sites were as follows:

- Baseline –Replacement in RIIO-T3
- Option 1 –Replacement in RIIO-T2

Baseline –Replacement in RIIO-T3:

The option to defer intervention was considered but following results from the condition assessment and the presence of the failure mode affecting operability it was discounted and the option of replacing the unit in RIIO T2 is considered as the preferred option.

Option 1 - Replacement in RIIO-T2:

Replacing the 275kV [redacted]circuit breaker has been considered and is the most technically / commercially feasible option for the 275kV units. This installs new units, which reduces the SFs leakage rate and promotes a more sustainable solution. Note that 275kV SF6 circuit breakers have been considered as 275kV non-SF_6 AIS circuit-breakers are not yet available and it is expected that this will be the case at least until the end of RIIO-T2.

4.2 Options considered: Strathaven 400kV ss [redacted]units

The options considered for intervention for [redacted]CB sites were as follows:

- Baseline – Replacement in RIIO-T3
- Option 1 –Refurbishment in RIIO-T2
- Option 2 –Replacement in RIIO-T2

Baseline –Replacement in RIIO-T3:

The option to defer intervention was considered but following results from the condition assessment and the presence of the failure mode affecting operability it was discounted. CBA results also support this view.

Option 1 – Refurbishment in RIIO-T2:

Refurbishment of [redacted]and [redacted]CBs components ensure that the circuit breaker is operable for its design life.

The high cost of replacing the Circuit Breakers makes refurbishment cost effective option and is preferred.

Option 2 - Replacement in RIIO-T2:

Replacing the entire 400kV circuit breaker is not a commercially feasible option and not preferred.

4.3 Selected Option

- **275kV [redacted]CBs: Option 1** – Issues associated with availability of spares, and the nominal cost difference between replacement and refurbishment, makes replacement a viable option. The CBA results also support this.

- **400kV [redacted]CBs: Option 1** – Refurbishing the circuit breakers is a commercially and technically viable option and is preferred over replacement.

4.4 CBA Outputs

The CBA results are detailed below

4.4.1 Strathaven 275kV [redacted]CB

Options	Proposal	NPV £m
Baseline	Investment deferred to RIIO T3: Scope of works similar to option 1	£ 28.57
1	Replacement with SF6 circuit breaker in RIIO T2	£ 31.78

The CBA for the 275kV [redacted]supports the proposed investment strategy of replacing the complete CB.

4.4.2 Strathaven 400kV [redacted]CB

Options	Proposal	NPV £m
Baseline	Replacement in RIIO-T3	£ 43.83
1	Refurbishment in RIIO-T2	£ 48.15
2	Replacement in RIIO-T2	£ 50.36

The CBA for the 400kV [redacted]supports the replacement of the complete CB.

However the increased costs to deliver a 400kV CB change are not justified and the refurbishment option is proposed.

4.4.3 Newarthill 275kV [redacted]CB

Options	Proposal	NPV £m
Baseline	Investment deferred to RIIO T3: Scope of works similar to option 1	£ 9.65
1	Replacement with SF6 circuit breaker in RIIO T2	£ 10.63

The CBA for the 275kV [redacted]supports the proposed investment strategy of replacing the complete CB.

4.5 Environment & Sustainability

The SPT sustainability approach is to prioritise reuse, then refurbish and then replace. Replacements are proposed where there is a clear economical case.

SPT proposes to commence replacement of SF_6 as an insulating and interruption medium where possible. At present, the technology for non-SF_6 at 275kV and 400kV in CB is not commercially or technically viable and is not expected to be until at least the end of RIIO-T2. However should this position change, options to use alternatives will be considered.

4.6 Innovation

Innovation is a key component to deliver developments in all aspects of work. While the technology used in the project will be standard with a proven track record, SPEN will look to use innovate ways of project delivery and installation to deliver the programme.

5 Conclusion

Different options for the management of the condition issues associated with [redacted]275kV and 400kV circuit-breakers have been presented and reviewed in detail. The technical analysis and the outcome of the CBA support the replacement and refurbishment of the circuit-breakers in the RIIO-T2 period.

For the 275kV [redacted]the proposal is to replace circuit-breakers.

For the 400kV [redacted]the proposal is to refurbish the circuit-breakers, as the increased costs to deliver a 400kV CB change for a minimal NPV gain are not justified.

Please find details of investment below:

Scheme name	Project cost (£ m)	Delivery year	Declared output	Lifetime risk benefit (Lr£m)
Strathaven 275kV ([redacted] control scheme replacement)	0.369	2024	Asset addition/ activity: 3 units Asset disposal: 3 units	£ 31.86
Newarthill 275kV ([redacted] control scheme replacement / civil asset condition)	0.234	2025	Asset addition/ activity: 1 unit Asset disposal: 1 unit	£ 10.76
Strathaven 400kV (Mech replacement)	0.368	2024	Asset addition/ activity: 3 units	£ 33.78

6 Future Pathways – Net Zero

6.1 Primary Economic Driver

The primary driver for this investment is asset condition and risk. The investment does not have a strong reliance on environmental benefits.

6.2 Payback Periods

The CBA indicates that a positive NPV results in all assessment periods (10, 20, 30 & 45 years) which is consistent with the lifetime of the intervention. Consumers benefit from reduced network risk immediately on completion of the project.

6.3 Pathways and End Points

The network capacity and capability that result from the proposed option has been tested against and has been found to be consistent with the network requirements determined from the ETYS and NOA processes. Additionally, the proposed option is consistent with the site-specific capacity requirements from SPT's Energy Scenarios.

6.4 Asset Stranding Risks

Electricity generation, demand and system transfers are forecast to increase under all scenarios. The stranding risk is therefore considered to be very low.

6.5 Sensitivity to Carbon Prices

Carbon price sensitivities have been applied using the higher case CBA template. The CBA outcome is influenced by losses and is sensitive to carbon prices.

6.6 Future Asset Utilisation

It has been assessed that the preferred option is consistent with the future generation and demand scenarios and that the risk of stranding is very low.

6.7 Whole Systems Benefits

Whole system benefits have been considered as part of this proposal. The capacity and capability of the preferred option is consistent with the provision of whole system solutions.

7 Outputs included in RIIO T1 Plans

N/A