Scottish & Southern Electricity Networks

RIIO ED2 Engineering Justification Paper (EJP)
Reduction of Losses
Losses - TASS (Project Lean BAU Innovation Roll Out)

Investment Reference No: *5/SSEPD/ENV/LOSSES*

Contents

Table of Figures

Table of Tables

1 Executive Summary

Our ***Environmental Action Plan (EAP) (Annex 13.1)*** sets out our methodology that we propose to undertake during the RIIO-ED2 period in response to increasingly ambitious environmental drivers and stakeholder expectations. Ofgem have introduced a requirement to prepare an EAP as part of our RIIO-ED2 submission and setting a Science Based Target (SBT) is one of these minimum requirements for the EAP.

This paper sets out our plans to implement Transformer Auto Stop Start (TASS) technology to substation transformers to reduce network losses from our primary substations for the RIIO-ED2 period. This is in response to increasingly ambitious environmental drivers and stakeholder expectations, which will significantly reduce Carbon (CO_2) emissions in our SHEPD and SEPD network areas. The primary driver for this scheme is Environmental.

Following optioneering and detailed analysis, as set out in this paper, the proposed scope of works are:

- Implement TASS technology to 134 substations across our SHEPD and SEPD networks.

The cost to deliver the preferred solution is £[redacted] and the works are planned to be completed in 2028.

This scheme delivers the following outputs and benefits:

- Target a reduction in CO_2 emissions of ~ 595.41 tCO_2e.
- Facilitates the efficient, economic, and co-ordinated development of our Distribution Network for Net Zero.

2 Investment Summary Table

Table 1 - Investment Summary

Name of Scheme/Programme	TASS (Project LEAN Roll Out)
Primary Investment Driver	The primary investment driver is the investment required to install TASS - Transformer Auto Stop Start - technology in substations where the criteria for doing so is met. The installation of TASS will act to reduce transformer losses and reduce our CO_2 emissions.
Scheme reference/ mechanism or category	TASS
Output references/type	PCD – EAP Deliverable (S5)
Delivery Year	RIIO-ED2
Reporting Table	CV21 Losses

	E4 Losses Snapshot Annual EAP Report			
Outputs included in RIIO ED1 Business Plan	No			
Cost	£[redacted]			
Spend Apportionment	**Licenced Area**	**ED1 (£m)**	**ED2 (£m)**	**ED3+ (£m)**
	SEPD		£[redacted]	
	SHEPD		£[redacted]	
Delivery Year	RIIO-ED2 (2023 – 2028)			

3 Introduction to the Investment Under Consideration

This Engineering Justification Paper (EJP) introduces the investment under consideration, including a description of the proposed investment and the primary and secondary investment drivers which lead to the need to invest in this innovative technology.

This EJP is intended to inform implementation of the proposed Environmental intervention to reduce network losses from our primary substations, and the primary driver of this EJP focuses on the investment strategy for roll out to Business as Usual (BAU) of Transformer Auto Stop Start (TASS) technology as part of our losses reduction strategy.

3.1 Primary Investment Driver

Ofgem have introduced a requirement to prepare an Environmental Action Plan (EAP) as part of our RIIO-ED2 submission, setting a Science Based Target (SBT) is an Ofgem RIIO-ED2 Minimum Requirement. Failure to set one will mean failure against the Business Plan Incentive assessment.

An SBT is a target that addresses our material carbon impacts that contribute to our Business Carbon Footprint (BCF), the target has to be set against your most recent base year data (2019/20) and has to deliver within 5 to 15 years. We have chosen 2033 as our delivery year.

Our SBT has now been approved by the Science Based Targets Initiative (SBTi). We have selected a 1.5°C SBT by our target year (2033), which means we will need to achieve a 55% absolute reduction from base year (2020) in our Scope 1 & 2 Emissions categories; Losses; Diesel; Road; Fuels other; SF6; and Buildings other fuels.

The reduction of losses is also a minimum requirement for our EAP. The implementation of TASS technology is an innovative solution proven to reduce losses at 33/11kV primary substations.

TASS delivers societal benefits through energy efficiency which reduces costs to customers and equates to lower CO_2 emissions. Implementation of this technology contributes towards our published Losses Strategy to reduce losses on our network, and supports achievement of our SBT.

Our primary investment drivers are as follows:

- **Sustainability** - TASS reduces transformer losses in substations by switching out one of the transformers at times of low demand. On the trial sites, transformer losses were reduced by around 25-30% (~3.5 MWh per month) at each trial site.
- **Reduction of CO_2 emissions** - implementation of TASS and the reduction of losses will also reduce our CO_2 emissions.
- **Affordability** - TASS control boxes are relatively inexpensive to install, the mid-range band for a unit being £[redacted].

- **Manageability** - The aim of the TASS algorithm is to provide the intended automated transformer switching functionality in a safe, efficient and reliable manner. Additionally, the approach developed to identify suitable sites and implement TASS ensures that security of supply and quality of supply are not compromised.

The primary investment drivers to reduce losses correlate to the following Business Plan Data Tables (BPDTs) for RIIO-ED2:

- **CV21 - Losses:** The purpose of this worksheet is to report volumes and costs related to distribution losses. This worksheet is completed where losses management is the primary driver of the investment or action.
- **E4 Losses Snapshot:** The purpose of this worksheet is to collect a snapshot of the types of activities undertaken by DNOs to manage Distribution Losses. Standard Licence Condition (SLC) 49 - Electricity Distribution Losses Management Obligation and Distribution Losses Strategy paragraph 49.9(b) requires DNOs to publish information on their actions to manage Distribution Losses.

3.2 Secondary Investment Driver

A secondary investment driver is that SHEPD and SEPD have a licence obligation (SLC 49 - Electricity Distribution Losses Management Obligation and Distribution Losses Strategy) which requires the licensee to ensure that Distribution Losses from its Distribution System are as low as reasonably practicable, and to maintain and act in accordance with its Distribution Losses Strategy.

3.3 Expected Outputs and Year of Delivery

The implementation of TASS will be sensibly phased over the RIIO-ED2 period to provide steady continuity in the evaluation of site suitability and implementation of TASS technology.

4 Background Information

This section of the report provides additional background information which has been used to inform the planned investment in TASS. This includes the options considered, licence conditions, EAP minimum requirements and the approach used to identify the best solution to reduce technical losses for RIIO-ED2 and our SBT. TASS implementation also reduces our Business Carbon Footprint (BCF) with the reduction of CO_2 emissions from losses, and reduces the cost of losses which is currently calculated by Ofgem at £58.17 per MWh.

Industry figures indicate that losses account for ~6% of the energy entering the distribution system from transmission networks and distributed generation. Electrical losses are inherent in the physics of how key electricity system components operate, however DNOs have a licence obligation to ensure that distribution losses are as low as reasonably practicable. Strategies to reduce technical losses create a more efficient network which reduces costs to customers and equates to lower carbon emissions.
These economic and environmental benefits highlight the importance of working to reduce losses and for RIIO-ED2, reduction of losses forms part of the EAP as one of ten minimum requirements in the EAP. The Ofgem requirement for losses is that DNOs:

> *"Implement a strategy to efficiently manage losses, both technical and non-technical, on the network over the long term. Contribute to the evidence base on the proportion of losses that network companies can influence/control."*

Losses are categorised in two main elements, technical and non-technical losses and make up 91% of SSEN Distribution's BCF (Scope 1 & 2).

Scope 1 covers direct emissions from owned or controlled sources. Scope 2 covers indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed (or lost) by the reporting company.

For Distribution networks:

- Technical Losses are further categorised into Fixed and Variable losses:
  - Fixed losses - energy required regardless of the level of demand, e.g. to energise transformers
  - Variable losses - energy which increases with demand, e.g. heat due to energy flowing through cables or overhead lines - I^2R

- Non-Technical Losses are categorised as inaccurate metering and billing, and energy theft

4.1 Project LEAN (Low Energy Automated Networks)

In 2019 SSEN concluded the Low Energy Automated Networks (LEAN) project, which focused on reducing losses at 33/11kV primary substations.

This Low Carbon Networks Fund (LCNF) innovation project successfully developed, implemented and demonstrated TASS technology to reduce losses at 33/11kV primary substations.

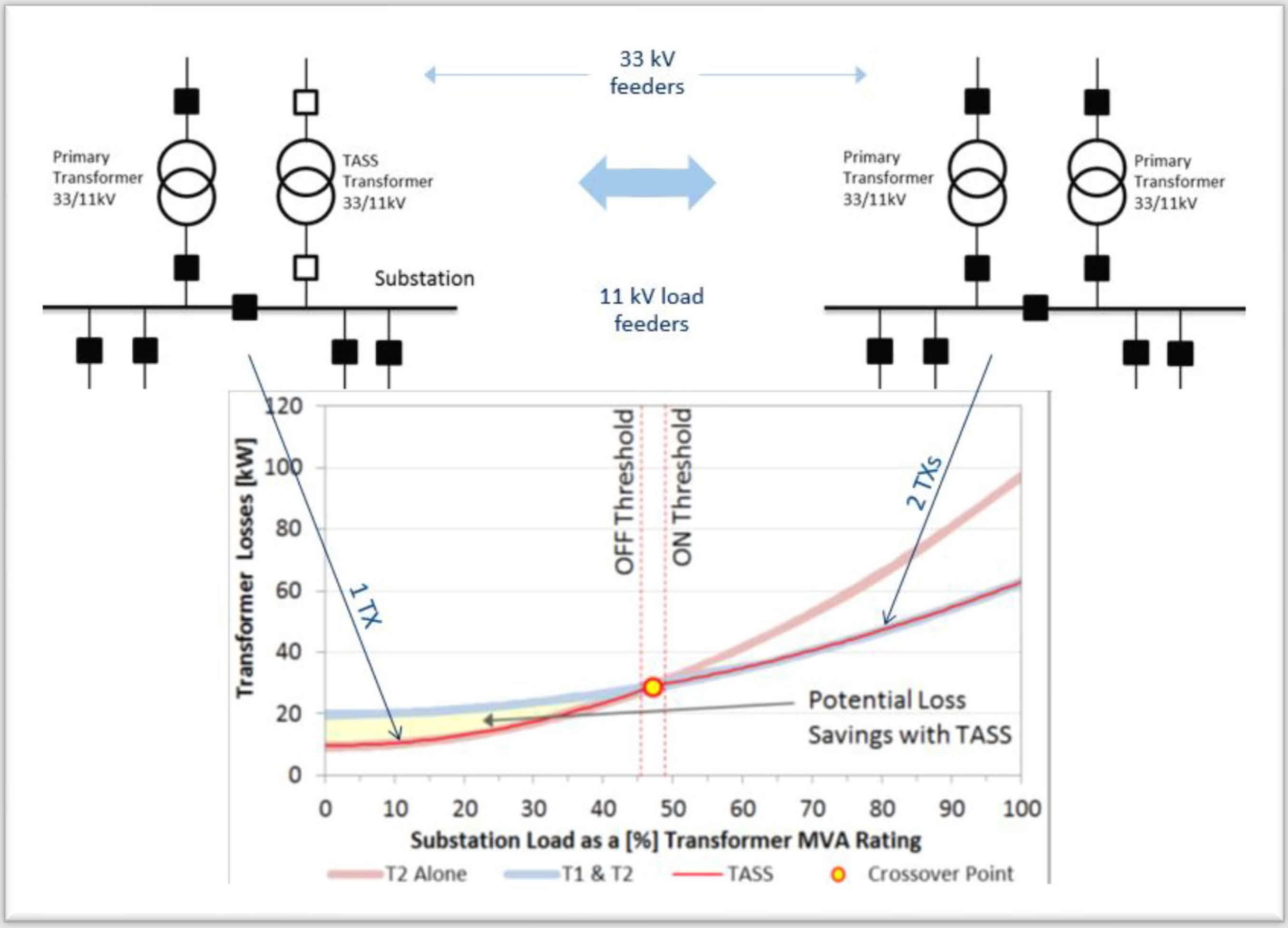
The key principle of TASS is to switch off one of a number of transformers in a primary substation at times of low demand to avoid the fixed iron losses associated with that transformer.

The TASS system provides local, automated control within the substation to monitor the loading, control the switching and to respond to SCADA alarms and status information from other network assets. In addition, commands incorporated into the Distribution Management System provide the central network Control Room with remote supervision and management capability. The technology has been operating on the SEPD network since June 2018, and over the course of the project (to December 2019) achieved losses savings of over 100 MWh from two primary substations, providing carbon savings of over 38 tCO_2e. Full operation of TASS reduces transformer losses by ~25-30% at each site. No impacts on asset health due to TASS operation were identified through the suite of testing and monitoring techniques applied.

The system continues to operate as designed, demonstrating the ability to both reduce losses and respond appropriately to different network situations, and the scheme design developed through the project provides a streamlined system for integration with existing assets to deliver the TASS functionality.

The TASS transformer switching principle is represented in Figure 1 below. The pink and blue lines represent the substation losses associated with running one and two transformers, and the red line indicates the principle of alternating between one or two transformers. The yellow dot is the crossover point, which is set specifically for each substation based on information about the transformers at the site and an assessment of their inherent losses, and the yellow area on the left reflects the saving in energy losses that can be made by switching to one transformer at times of low demand.

Figure 1 - TASS transformer switching principle - source S&C Electric Europe Ltd for SSEN's LEAN innovation project



Relating this to the operation of a transformer, essentially the 'iron losses' from the magnetisation of the transformer core are fixed regardless of transformer loading, and 'copper losses' associated with the current flow increase with loading. It is therefore possible to save fixed losses by switching off a transformer at times of low demand, and these savings can be greater than the increase in on-load losses in the remaining transformer.

Increasing levels of embedded generation and low carbon technologies such as electric vehicles, or behavioural changes influenced by the increasing deployment of smart meters or time of use tariffs, will influence the load patterns seen at some primary substations in time. Such changes to energy use patterns may result in some transformers spending a larger proportion of the year lightly loaded, or greater variations in the peak and low load demand levels, in which case the energy savings achievable through the deployment of TASS may significantly increase.

The success of the LEAN project has led to SSEN retaining the TASS solution at the trial sites beyond the end of the project, with the intention to implement the scheme more widely throughout RIIO-ED2.

4.2 Licence Obligations and Environmental Action Plan Minimum Requirements

SHEPD and SEPD have a licence obligation (SLC 49 - Electricity Distribution Losses Management Obligation and Distribution Losses Strategy) which requires the licensee to ensure that Distribution Losses from its Distribution System are as low as reasonably practicable, and to maintain and act in accordance with its Distribution Losses Strategy.

In addition to our licence obligation Ofgem have introduced a requirement for DNOs to submit an EAP which has minimum requirements which need to be met to ensure DNOs contribute to decarbonising the energy system and reduce the impact of network activity on the environment.

Our Losses Strategy supports the implementation of TASS to reduce our technical losses, reduce the BCF associated with losses, and reduce the cost of losses to customers.

4.3 Identifying Sites for TASS Implementation

To support the identification of substations that would be suitable for TASS deployment, a TASS Evaluation Tool to provide Cost Benefit Analysis (CBA), together with a TASS Substation Assessment Technical Guide, were developed through the LEAN project.

The TASS Evaluation Tool appraises the financial viability of applying TASS at individual substations by simulating TASS operation with site specific load profiles and assigning monetary values to the derived losses saving and associated reduction in CO_2 emissions.

The process set out in the TASS Substation Assessment Technical Guide then provides a framework around the use of the cost benefit analysis tool to evaluate the technical feasibility of TASS application at specific substations.

The assessment process comprises five key steps:

- Step One - TASS Evaluation Tool cost benefit analysis - generic cost assumptions
- Step Two - is there a dedicated 33 kV circuit breaker?
- Step Three - review of asset condition
- Step Four - detailed protection and control study
- Step Five - TASS Evaluation Tool cost benefit analysis - with site specific costs

A site survey for TASS deployment must also be undertaken to gather relevant information on:

- asset health, through visual inspection of the substation equipment
- site specific substation asset or system configurations that must be considered when undertaking the protection and control study to tailor integration of the TASS system at the site
- suitable locations for installation of the TASS equipment

It is also recommended that oil samples are taken from the transformers to provide reference/benchmark data for any future tests following the application of TASS. Partial Discharge (PD) surveys and/or transformer condition assessment tests may also be considered of value to further validate that there are no pre-existing issues with the assets.

This process is described in the TASS Technology Substation Assessment Guide[1] created through the project to support decisions on the application of TASS at individual primaries.

For RIIO-ED2, Steps One and Two have been undertaken which has resulted in 58 sites identified for SHEPD and 76 sites for SEPD, which merit further steps to be undertaken to identify suitable sites for the potential deployment of TASS. Sites which have been identified for further analysis are shown in Appendix A.

4.4 Stakeholder Engagement Feedback

The following SSEN Stakeholder Engagement events have been held which have helped shape our approach to TASS implementation:

Table 2: Stakeholder Engagement Events

Stakeholder Event	Date	Relevant Topics
Distribution Annual Workshop North	24th September 2020, 1st October 2020	○ Sustainability - helping the UK meet its net zero emissions targets ○ Maintaining a reliable and resilient network for the future
Distribution Annual Workshop South	23rd September 2020, 30th September 2020	○ Sustainability - helping the UK meet its net zero emissions targets ○ Maintaining a reliable and resilient network for the future
SSEN Distribution Stakeholder Workshops	September 2019	○ Shaping our future and the next price control - RIIO-ED2 ○ Operating in a sustainable world

The sections below show the relevant stakeholder questions and feedback received which relate directly to SSEN's network losses, which the TASS innovative solution aims to minimise.

4.4.1 SSEN Distribution Stakeholder Workshop (SEPD) September 2020

Stakeholders provided strong views on losses and expressed that there should be a general rule to reduce losses where possible and SSEN should be taking a lead on this. They stated SSEN needed to be realistic about losses reduction and to strike a balance to ensure that customers do not end up paying too much.

Question - 'On a scale of 1-5, how ambitious do you think SSEN should be in the following environmental area?' (5 being the most important).

Losses came out as the 7th most important environmental area (11 total) with a score of 4.3.

4.4.2 SSEN Distribution Stakeholder Workshop (SHEPD) September 2020

Question - 'On a scale of 1-5, how ambitious do you think SSEN should be in the following environmental area?' (5 being the most important).

[1] https://www.ssen.co.uk/LEAN/Learning/ - SDRC 9.7 Network Losses Evaluation Tool

Losses came out as the 4th most important environmental area (11 total) with a score of 4.22.

5 Optioneering – Investment Under Consideration

This section describes the options considered for the implementation of TASS. The options considered address the needs described in Section 3 and can actively reduce technical losses on the SSEN network.

Table 3 below summarises the evaluation options considered for TASS implementation. Options 1, 2 and 3 reflect different TASS deployment scenarios relating to asset health assessment and controlled Point on Wave (PoW) switching, option 4 appraises the benefits to the end of transformer life, rather than constraining appraisal to 12 years.

Table 3 - TASS Evaluation Options Summary Table

Option	Description	Status
0	Do Nothing	Not viable
1	TASS Evaluation 1 – sites that would benefit from TASS application comprising: - TASS wall box (inc. TASS control device & associated components) - site survey & protection study based on a financial assessment over 12 years.	Progressed
2	TASS Evaluation 2 - sites that would benefit from TASS application comprising: - TASS wall box (inc. TASS control device & associated components) - site survey & protection study - suite of transformer condition assessment tests & PD surveys plus all sites in TASS Evaluation 1, based on a financial assessment over 12 years.	Progressed
3	TASS Evaluation 3 – sites that would benefit from TASS application comprising: - TASS wall box (inc. TASS control device & associated components) - site survey & protection study - synchronysing relays to provide controlled PoW switching plus all sites in TASS Evaluations 1 & 2, based on a financial assessment over 12 years.	Progressed
4	TASS Evaluation- as per TASS Evaluation 3 for application options, however based on financial assessment to end of transformer life.	Preferred

The following sections present the analysis undertaken for this EJP based on CBA results from the TASS Evaluation Tool and assessment in line with Steps One & Two of the TASS Substation Assessment Process.

5.1 Do nothing

The current transformers continue to operate as is with no TASS technology applied to them. Losses associated with the transformers will continue, with no interventions applied to efficiently manage losses on our Network over the long term.

5.2 Option 1 - TASS Evaluation 1 - benefits over 12 years

Implement TASS at sites which have been identified as only suitable for TASS where this can be deployed with the minimum level of investment, which comprises the TASS wall box (inc. control device & associated components) together with a site survey & protection study, with the financial benefit of losses reductions assessed over a 12-year period. The carbon savings for this option are estimated to be **136.85 tCO_2e** to 12 years from the start of RIIO-ED2.

Table 4 - Option 1

RIIO-ED2 SHEPD	2023/24	2024/25	2025/26	2026/27	2027/28	Total
# TASS wall box	3	3	3	3	2	**14**
RIIO-ED2 SEPD	**2023/24**	**2024/25**	**2025/26**	**2026/27**	**2027/28**	**Total**
# TASS wall box	3	3	3	3	2	**14**

Option 1 progressed – not recommended as low reduction in tCo2 emitted.

5.3 Option 2 - TASS Evaluation 2 - benefits over 12 years

Implement TASS at sites identified in Evaluation 1 and at sites where TASS would be financially viable when deployment comprises the TASS wall box and site survey & protection study, plus transformer condition assessment tests and PD surveys, with the financial benefit of losses reductions assessed over a 12-year period. The carbon savings for this option are estimated to be **429.68 tCO_2e** to 12 years from the start of RIIO-ED2.

Table 5 - Option 2

RIIO-ED2 SHEPD	2023/24	2024/25	2025/26	2026/27	2027/28	Total
# TASS wall box	3	3	3	3	2	**14**
# TASS wall box, TX tests & PD surveys	3	3	3	3	2	**14**
RIIO-ED2 SEPD	**2023/24**	**2024/25**	**2025/26**	**2026/27**	**2027/28**	**Total**
# TASS wall box	3	3	3	3	2	**14**
# TASS wall box, TX tests & PD surveys	3	3	3	3	3	**15**

Option 2 progressed – not recommended as low reduction in tCo2 emitted.

5.4 Option 3 - TASS Evaluation 3 - benefits over 12 years

Implement TASS at sites identified in Evaluations 1 & 2 and at sites where TASS would be financially viable when deployment comprises the TASS wall box and site survey & protection study, plus synchronising relays to provide controlled PoW switching, with the financial benefit of losses reductions assessed over a 12-year period. The carbon savings for this option are estimated to be **528.85 tCO_2e** to 12 years from the start of RIIO-ED2.

Table 6 - Option 3

RIIO-ED2 SHEPD	2023/24	2024/25	2025/26	2026/27	2027/28	Total
# TASS wall box	3	3	3	3	2	**14**
# TASS wall box, TX tests & PD surveys	3	3	3	3	2	**14**
# TASS wall box, synch. relays	1					**1**
RIIO-ED2 SEPD	**2023/24**	**2024/25**	**2025/26**	**2026/27**	**2027/28**	**Total**
# TASS wall box	3	3	3	3	2	**14**
# TASS wall box, TX tests & PD surveys	3	3	3	3	3	**15**
# TASS wall box, synch. relays	1	1	1			**3**

Option 3 progressed – not recommended as low reduction in tCo2 emitted.

5.5 Option 4 - TASS Evaluation 4- benefits over 30 years

Implement TASS at sites evaluated in line with Options 1, 2 & 3, however based on financial assessment to end of transformer life at each substation. The carbon savings for this option are estimated to be **595.41 tCO_2e** to 30 years from the start of RIIO-ED2.

Table 7 - Option 4

RIIO-ED2 SHEPD	2023/24	2024/25	2025/26	2026/27	2027/28	Total
# TASS wall box	5	5	5	5	5	**25**
# TASS wall box, TX tests & PD surveys	5	5	5	6	6	**27**
# TASS wall box, synch. relays	1	1	1	1	2	**6**
RIIO-ED2 SEPD	**2023/24**	**2024/25**	**2025/26**	**2026/27**	**2027/28**	**Total**
# TASS wall box	**8**	**8**	**8**	**9**	**10**	**43**
# TASS wall box, TX tests & PD surveys	**4**	**5**	**5**	**5**	**5**	**24**
# TASS wall box, synch. relays	**1**	**2**	**2**	**2**	**2**	**9**

Option 4 progressed – recommended as this offers the greatest reduction in tCo2 emitted and reflects the fact that TASS technology would remain operating in a substation beyond 12 years.

6 Analysis and Cost

6.1 TASS Deployment Costs

The LEAN project established current costs for a range of TASS deployment scenarios, including with or without the application of synchronising relays to provide controlled PoW switching. PoW switching can be applied where required to limit the voltage step change when energising a transformer by minimising the associated inrush currents.

Table 2 shows cost estimates per primary substation as at January 2020, representing the different TASS deployment scenarios which have been used in our CBA.

Table 8 - Indicative current costs for estimates for TASS deployment at primary substation

TASS Deployment Scenario	Lower Band	Mid-Range	Higher Band
EVAL 1 - TASS wall box (inc. TASS control device & associated components) together with site survey & protection study	£[redacted]	£[redacted]	£[redacted]
EVAL 2 - TASS wall box, with transformer condition assessment tests & PD surveys	£[redacted]	£[redacted]	£[redacted]
EVAL 3 - TASS wall box & synch. relays	£[redacted]	£[redacted]	£[redacted]
Operational costs	£[redacted]	£[redacted]	£[redacted]

Table 3 below shows the breakdown of the costs for each potential element of TASS deployment. These costs have been included in the option unit costs shown in Table 2. For Option 4, additional costs of £[redacted] have been added per site for programme management costs associated with delivery of TASS roll out.

Table 9 - Assumptions for TASS Implementation by activity/component

TASS Deployment Scenario	Indicative CAPEX Costs – mid range	No	Assumptions
TASS System Implementation			
Site Survey	£[redacted] per site	1 per site	**mid-range:** 2-3 hours per site for a suitably authorised & competent person **higher & lower bands:** +/-10% to reflect greater travel distances, economies of scale where booking higher numbers of sites, etc.
Detailed Protection Study	£[redacted] per site	1 per site	**mid-range:** half a day for a Protection Engineer **higher & lower bands:** +/-10% to reflect varying complexities of site
TASS Wall Box - kit - inst. & comm.	£[redacted] per unit £[redacted] per site	1 unit per site	**mid-range:** indicative cost per unit at present 4.75 PDE per site for installation & commissioning by a suitably authorised & competent person **higher & lower bands:** range of 3.5 to 6 PDE for installation & commissioning to reflect varying complexities of site, greater travel distances.
System Integration	minimal cost per site		To integrate the TASS control device with SCADA the RTU configuration at each site is updated to include the minor modifications defined in the RTS 'TASS template', at present this

			requires the support of the RTS team, however this has minimal time and resource implications, and for wider roll out this task could potentially be carried out by the TASS installation team. To incorporate TASS information and commands into the DMS, the PowerOn Fusion template developed during the project must be applied on a site by site basis in line with deployment at specific sites, however minimal time is required for a Cartographer to add this TASS functionality.
Synchronising Relays - kit - site support	£[redacted] per unit £[redacted] per site	1 unit per TX, 2 TXs per site	**mid-range:** indicative cost per unit at present 2.25 PDE per site for site support from a suitably authorised & competent person **higher & lower bands:** -10% on kit for economies of scale where purchasing more units range of 1.5 to 3 PDE for site support to reflect varying complexities of site, greater travel distances.

The total forecast cost for TASS implementation across 58 SHEPD sites is £[redacted].

Table 10 - SHEPD Total Forecast cost for TASS Implementation

SHEPD	# Assets	Cost (£)
# TASS wall box	25	£[redacted]
# TASS wall box, TX tests & PD surveys	27	£[redacted]
# TASS wall box, synch. relays	6	£[redacted]
Operating Costs per year	58	£[redacted]
Total Costs		**£**[redacted]

The total forecast cost for TASS implementation across 76 SEPD sites is £1.2m.

Table 11 - SEPD Total Forecast for TASS Implementation

SEPD	# Assets	Cost (£)
# TASS wall box	43	£[redacted]
# TASS wall box, TX tests & PD surveys	24	£[redacted]
# TASS wall box, synch. relays	9	£[redacted]
Operating Costs per year	76	£[redacted]
Total Costs		**£**[redacted]

6.2 CBA Results

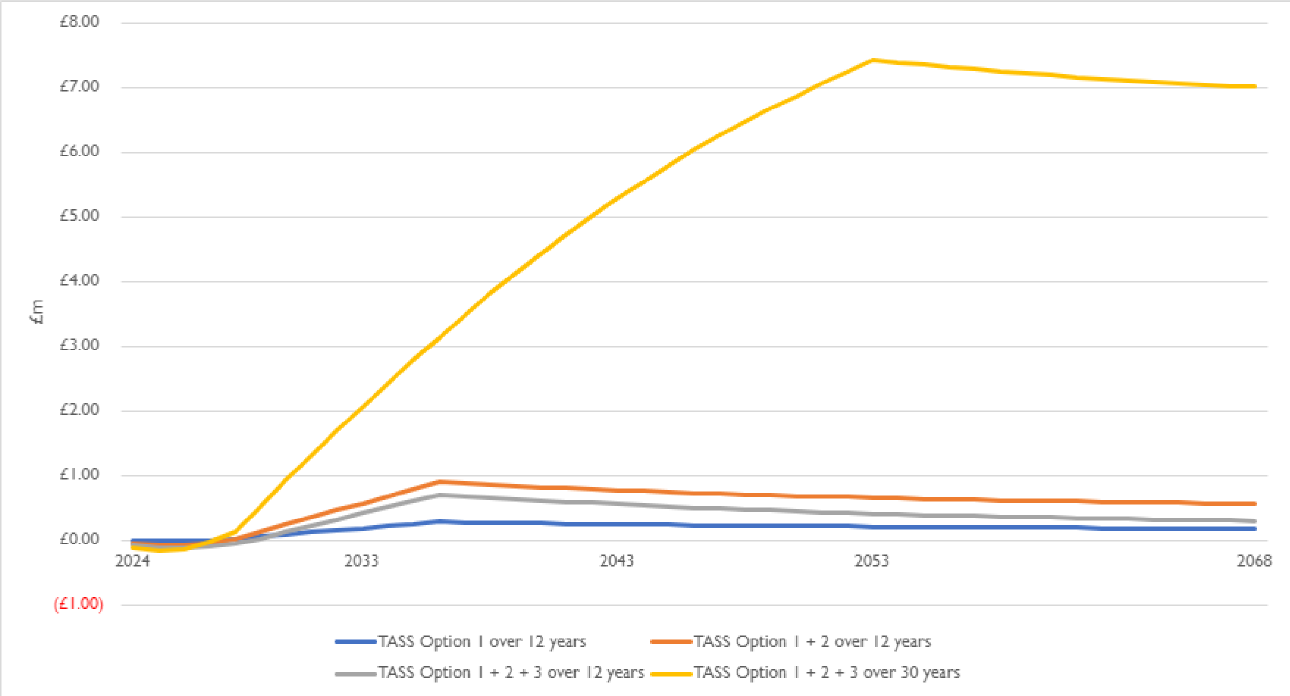
Table 12 - CBA Results

Option	Description	# Units	Capex	Opex (for length of option)	Co2 saving kg (for length of option)	NPV (length of option)	NPV (45 years)	Avoided consumer costs	Wider Societal Benefits
	Do Nothing	-	Not viable	Not viable	Not viable	Not viable	Not viable	Not viable	Not viable
1	TASS Evaluation 1 for 12 years	28	£[redacted]	£[redacted]	136.85 tCO_2e	£[redacted]	£[redacted]	£[redacted]	£[redacted]
2	TASS Evaluation 2 for 12 years	57	£[redacted]	£[redacted]	429.68 tCO_2e	£[redacted]	£[redacted]	£[redacted]	£[redacted]
3	TASS Evaluation 3 for 12 years	61	£[redacted]	£[redacted]	528.85 tCO_2e	£[redacted]	£[redacted]	£[redacted]	£[redacted]
4	TASS Evaluation 4 for 30 years	134	£[redacted]	£[redacted]				£[redacted]	£[redacted]

The graph below shows how the cumulative NPV progresses over time, reflecting the planned roll out programme. The lines show the different options for each evaluation which are:

- Evaluation 1 – TASS Option 1 over 12 years
- Evaluation 2 - TASS Option 1 + 2 over 12 years
- Evaluation 3 - TASS Option 1 + 2 +3 over 12 years
- Evaluation for 30 years - TASS Option 1 + 2 + 3 over 30 years

Table 13 - NPV Progress over Time



6.3 Preferred Options

The preferences outlined above involved the investigation of the implementation of TASS technology in substations which meet the TASS evaluation criteria. Options 1, 2, 3 and 4 were considered but the preferred option is option 4, which involves installing TASS technology in substations which meet the criteria for installation and over a longer time period of 30 years.

Installing TASS technology as per option 4 over 30 years, has the highest NPV of £6,920.8k, which is the highest positive CBA compared to the other options.

The implementation of TASS technology for the preferred evaluation would reduce network losses saving ~595.41 tCO_2e over a 30-year time span.

6.4 Summary Table

Table 14 - Total Volumes and Costs

	# Assets	Cost (£m)
SHEPD	58	£[redacted]
SEPD	76	£[redacted]
Total Costs	**134**	£[redacted]

7 Deliverability and Risk

Our ***Ensuring Deliverability and a Resilient Workforce (Chapter 16)*** of our business plan it describes our approach to evidencing the deliverability of our overall plan as a package, and its individual components. Testing of our EJPs has prioritised assessment of efficiency and capacity, and this has ensured that we can demonstrate a credible plan to move from SSEN's ED1 performance to our target RIIO-ED2 efficiency. We have also demonstrated that SSEN's in-house and contractor options can, or will through investment or managed change, provide the capacity and skills at the right time, in the right locations.

Our deliverability testing has identified a major strategic opportunity which is relevant to all EJPs:

- In RIIO-ED2 SSEN will change the way Capital Expenditure is delivered, maximising synergies within the network to minimise disruptions for our customers. This is particularly relevant for a Price Control period where volumes of work are increasing across all work types.
- The principle is to develop and deliver Programmes of work, manage risk and complexity at Programme level and to develop strategic relationships with our Suppliers and Partners to enable efficiency realisation.
- The Commercial strategy will explore the creation of Work Banks (WB) and identify key constraints. The Load work will be the primary driver for a WB, supplemented by Non-Load work at a given Primary Substation. This approach will capitalise on synergies between the Load and Non-Load work, whereby the associated downstream work from a Primary Substation will maximise outage utilisation, enabling the programme to touch the network in a controlled manner with the objective of touching the network once. Where there is no Primary Load scheme to support the Non-Load work, these will be considered and packaged separately, either insourced or outsourced dependant on volume, size and complexity.
- Transparency with the Supplier in terms of constraints, challenges, outage planning and engineering standards will capitalise on efficiencies, supported by a robust contracting strategy.

The specific considerations for deliverability based on the scope of this EJP are detailed below:

- Training
- Location including access issues and civils
- Supply chain
- Work phasing and project interdependencies
- System interfaces for controls, Network operation and SCADA

7.1 ED1 Costs

There are no identified costs for the implementation of TASS in ED1.

7.2 RIIO-ED2 BPDT Figures

Within RIIO-ED2 innovation roll out forms part of the Business Plan Incentive proposals, which also indicate that additional totex allowances may be available where it can be demonstrated that additional funding is needed. As TASS delivers societal (Non-DNO) benefits through energy efficiency which reduces costs to customers and equates to lower CO_2e and contributes to the aims set out by government in The Carbon Plan and actions required to meet the UK's 2050 Net Zero target, TASS aligns with the EAP minimum requirements to reduce our controllable losses on our Network.

The tables below show the current best estimates of our proposed spend over RIIO-ED2 associated with the planned programme for analysis and implementation of TASS across SHEPD and SEPD.

TASS Volumes and Type Identified

Table 15 - Volumes and Type Identified

RIIO-ED2 SEPD	2023/24	2024/25	2025/26	2026/27	2027/28	Total
# Tass wall box	8	8	8	9	10	**43**
# TASS wall box, TX tests & PD surveys	4	5	5	5	5	**24**
# TASS wall box, synch. relays	1	2	2	2	2	**9**
Total	**13**	**15**	**15**	**16**	**17**	**76**
RIIO-ED2 SHEPD	**2023/24**	**2024/25**	**2025/26**	**2026/27**	**2027/28**	**Total**
# Tass wall box	5	5	5	5	5	**25**
# TASS wall box, TX tests & PD surveys	5	5	5	6	6	**27**
# TASS wall box, synch. relays	1	1	1	1	2	**6**
Total	**11**	**11**	**11**	**12**	**13**	**58**

RIIO-ED2 SEPD Estimated Costs	2023/24	2024/25	2025/26	2026/27	2027/28	Total
£(m)	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]

RIIO-ED2 SHEPD Estimated Costs	2023/24	2024/25	2025/26	2026/27	2027/28	Total
£(m)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

7.3 Deliverability

Resource requirements for the analysis and implementation of TASS have been estimated by Project LEAN, as shown in Table 4 below, and these have been included in the unit costs of each level of TASS implementation.

Table 16 - Summary of indicative resource requirements for TASS installation & commissioning

	Time on Site	Person Day Equivalent	Notes
Assumptions for Wider Roll Out	2 to 3.5 days:	5 to 9 PDE:	
TASS installation & commissioning	1.5 to 2.5 days	3.5 to 6 PDE	Assumes a further ~25% reduction in typical time & resources required for wider roll out based on further refinement of the process and experience of staff, with ranges applied to reflect varying complexities of site, travel distance, etc.
Synch. relay installation & commissioning	1 to 1.5 days	1.5 to 3 PDE	

Table 5 below indicates where each aspect of TASS delivery may best sit within the business, making reference to the TASS Substation Assessment Process. This is representative and open to further discussion.

Scottish & Southern Electricity Networks

Whilst many activities sit within existing business teams, creation of a 'TASS delivery team' would provide a focus for efficiently coordinating activities.

Table 17 - Summary of TASS Integration into BAU

TASS Activity	Potential Team	Notes
Implementation of TASS		
Substation Assessment Process Steps One to Three, Step Five (CBA, confirmation re 33kV CB, asset condition assessment)	Portfolio Management	-
TASS site surveys	Customer Operations, suitable contractors	-
Substation Assessment Process Step Four (protection & control study)	Substation Design, in collaboration with RTS & Protection	-
Approval/sign off for TASS application at sites which are financially & technically suitable	*TBC by the business*	-
TASS installation & commissioning	*proposed 'TASS delivery team' inc. Strategic Investment, Customer Operations, RTS, NMC Cartographers, suitable contractors*	Various material created for use during the trials is available to support these activities, including: - Commissioning Plan - TASS Site Testing Specification - Substation Signage - PowerOn Fusion template
Updating the schematics for each TASS substation	CAD team	-
Training for 33kV authorised field staff in the associated Regions	SSEN Training team - the roll out of training should be aligned with TASS application in the different Regions	*The training provided during the project covered the 33kV authorised staff in the Wessex Region* Staff from other Regions and new 33kV authorised staff would require training to be coordinated & delivered by the Training team. Training material & handouts have been created through the project to support this.

		The Training team attended a couple of project training sessions to observe delivery by the project team.
Briefings for all other field staff in the associated Regions	Regional team managers via team briefings - the roll out of briefings should be aligned with TASS application in the different Regions	This approach was taken during the project for staff from the Wessex Region. Briefing material & handouts have been created through the project to support this.
Training for EHV Control Engineers		*Training provided during the project covered each of the current SEPD EHV Control Engineers* New EHV Control Engineers may be cascade trained by existing staff. Training material & handouts have been created through the project to support this.
Briefings for all relevant NMC staff	NMC team managers	*Briefings given during the project covered the NMC staff at the time* New NMC staff may similarly be briefed by NMC team managers. Briefing material & handouts have been created through the project to support this.
Ongoing ownership / supervision / interaction with / reporting of TASS		
Ownership of the TASS system, including supervising its operation, maintenance & upgrades, responding to any issues, and being the point of contact for enquiries from the Control Room, Regional teams & Asset Management	RTS	Various material created for use during the trials is available to support RTS adoption of the TASS control system, including: - TASS Risk Mitigation Strategy - system architecture documentation - information on the operation of the TASS scheme & its response to SCADA

		data from other network assets - TASS System and Algorithm Technical Specification - TASS Algorithm Flow Chart - TASS T300 algorithm software - ISaGRAF - an Excel tool created to automatically generate TASS DNP3 data point mapping from the Whitebook for a given substation - TASS Wall Box Design Drawings - PI ProcessBook templates to provide remote, realtime information on the status of the TASS system - TASS Scalability & Replicability Assessment
Ownership of the SynchroTeq relays which provide controlled PoW switching as part of the TASS scheme	Operational Technology	TG-NET-PAC-004 'Approved Protection Relays and Intelligent Electronic Devices for use in SSEN' sets out requirements associated with the OT technical approval process - at present this only references protection devices however it is in the process of being updated to include additional OT devices such as RTUs and other controllers (e.g. this synch. relay).
Supervision of the TASS substations & responding to any issues	EHV Control Engineers	*As already established for the project trials wrt SEPD* For roll out at additional sites within SHEPD training would be required.
Adhering to the TASS substation entry process and maintaining an awareness of the requirements for working at sites with TASS	Regional Field teams	*As already established for the project trials wrt the Wessex Region* For roll out at additional sites within other Regions training would be required.
Assessing the losses saved through TASS for reporting purposes	Asset Management, Regulatory Reporting	A PI Datalink spreadsheet template has been created through the project and

- Losses Strategy, Losses Discretionary Reward submission, RIGs, Environmental Report, etc.		this can be replicated to semi-automate this process.
Monitoring TASS Transformer health	Portfolio Management	The health of the TASS transformers may be monitored through standard business processes, or through additional more refined monitoring.

8 Conclusion

The purpose of this EJP has been to describe the overarching investment strategy that SSEN intends to take during RIIO-ED2 for the implementation of t TASS technology in order to reduce losses on our network.

A background into TASS has been provided showing how TASS delivers societal benefits through energy efficiency which reduces costs to customers and equates to lower CO_2 emissions. Implementation of this technology contributes towards our published Losses Strategy to reduce losses on our network, and supports achievement of our SBT, which we registered our commitment to in December 2020 through the SBTi. In addition, SHEPD and SEPD have a licence obligation (SLC 49 - Electricity Distribution Losses Management Obligation and Distribution Losses Strategy) which requires the licensee to ensure that Distribution Losses from its Distribution System are as low as reasonably practicable, and to maintain and act in accordance with its Distribution Losses Strategy.

Option 4 has been determined as the best option to take forward for RIIO-ED2 and all volumes and costs are shown above for the investment. In total 134 sites have been identified for TASS implementation - 58 in SHEPD and 76 in SEPD. The costs for this option chosen are £[redacted] for SHEPD and £[redacted] for SEPD.

In summary, the total RIIO-ED2 funding request for TASS is £[redacted].

Appendix A Sites identified for further evaluation for TASS Implementation

Table 18: Sites Identified for further evaluation SHEPD

SHEPD - CBA End of TX Life	Substation
# TASS wall box, synch. relays	HARBOUR PRIMARY
	BRIDGE OF EARN PRIMARY
	LOCHGILPHEAD PRIMARY
	SALEN PRIMARY
	CULTER PRIMARY
	SCONE PRIMARY
# TASS wall box, TX tests & PD surveys	CAPUTH PRIMARY
	DUNOON PRIMARY
	SANDBANK PRIMARY
	STROMNESS PRIMARY
	GLENSANDA PRIMARY
	FYVIE PRIMARY
	HUNTLY PRIMARY
	MAUD PRIMARY
	MINTLAW PRIMARY
	ST CYRUS PRIMARY
	TORRYBURN PRIMARY
	MILTON OF CRAIGIE PRIMARY
	ASHLUDIE PRIMARY
	BURGHMUIR PRIMARY
	BLAIRGOWRIE PRIMARY
	MACDUFF PRIMARY
	BUCKIE PRIMARY
	ELGIN PRIMARY
	GRANTOWN PRIMARY
	PINEGROVE PRIMARY
	ABOYNE PRIMARY
	BALLATER PRIMARY
	INVERBERVIE PRIMARY
	KINCORTH PRIMARY
	NEW PITSLIGO PRIMARY
	OLDMELDRUM PRIMARY
	TURRIFF PRIMARY
# Tass wall box	LYNDHURST PRIMARY

	MILL RD PRIMARY MONTROSE
	LUNANHEAD PRIMARY
	MARYTON PRIMARY
	ERROL PRIMARY
	ABERFELDY PRIMARY
	CAMPBELTOWN PRIMARY
	MARNOCH PRIMARY
	DUFFTOWN PRIMARY
	DINGWALL PRIMARY
	BRORA PRIMARY
	PEDDIESTON PRIMARY
	TARBERT PRIMARY
	AVIEMORE PRIMARY
	BALLINDALLOCH PRIMARY
	FOYERS PRIMARY
	NAIRN CENTRAL PRIMARY
	INVERNESS PRIMARY
	RAIGMORE PRIMARY
	ELLON PRIMARY
	HATTON PRIMARY
	INVERURIE PRIMARY
	LAURENCEKIRK PRIMARY
	METHLICK PRIMARY
	WHITEHOUSE PRIMARY
Total	**58**

Table 19: Sites Identified for further evaluation SEPD

SEPD CBA - End of TX Life	Substation
# TASS wall box, synch. relays	EAST BEDFONT
	LEAFIELD
	PIDDLETRENTHIDE
	PYESTOCK N.G.T.E
	SPARKFORD
	ANDOVER
	HEDGE END
	MVEE
	PINGEWOOD
# TASS wall box, TX tests & PD surveys	BLACK BOURTON
	COKES LANE

	DENHAM
	DENHAM AVENUE
	HINDHEAD
	HAREFIELD
	PORTSMOUTH
	PRESTON CANDOVER
	STANDLAKE
	REDLANDS
	ROSE GREEN
	AWRE
	BASINGSTOKE
	BRAMLEY GREEN
	CARTERTON
	CHARLBURY
	CHISLEDON
	WESTON
	FARNBORO AIRFIELD
	GILLINGHAM
	MINETY VILLAGE
	PARK HOUSE
	PEACOCK FARM
	WHITCHURCH
# Tass wall box	BEMERTON
	BEACONSFIELD
	BEENHAM
	BILSHAM
	BOURTON
	BOVINGTON
	BURFORD
	CALNE
	CHICHESTER
	CHICKERELL
	CHISBRIDGE
	EASTERTON
	COTTISFORD
	FORDINGBRIDGE
	HAWLEY
	HASLINGBOURNE
	MIDHURST
	HURSTBOURNE TARRANT

Scottish & Southern Electricity Networks

	KINTBURY
	KNOWL HILL
	LAMBOURN
	LANGLEY
	LECHLADE
	LECKHAMPSTEAD
	NORTH HINKSEY
	NORTHLEACH
	PANGBOURNE
	PEWSEY
	TADLEY
	QUEENSMEAD
	ROWNER PARK
	SHRIVENHAM
	SILKSTEAD
	SOUTHCOTE
	WINCANTON
	WOKINGHAM
	THRUXTON
	TISBURY
	WROUGHTON
	VERWOOD
	WANTAGE
	WEST STOUR
	YEOVIL
Total	**76**

Appendix B Business Plan Data Table References

Table 20: BPDT References

BPDT Reference No	BPDT Title	BPDT Revision	Date
CV21	*5/SSEPD/ENV/LOSSES*	-	30/09/2021