Scottish & Southern Electricity Networks

# RIIO-ED2 Engineering Justification Paper (EJP)

## Fleet-Alton/Fernhurst 132kV Network Reinforcement

Investment Reference No: 58/SEPD/LRE/ALTON

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# Definitions and Abbreviations

| Acronym | Definition |
|---|---|
| AIS | Air-insulated Switchgear |
| ASCR | Aluminium Conductor Steel Reinforced |
| BSP | Bulk Supply Point |
| CBA | Cost Benefit Analysis |
| CBRM | Condition Based Risk Management |
| CEM | Common Evaluation Methodology |
| CI | Customer Interruptions |
| CML | Customer Minutes Lost |
| CT | Consumer Transformation |
| DFES | Distribution Future Energy Scenarios |
| DNO | Distribution Network Operator |
| EJP | Engineering Justification Paper |
| ESA | Electricity Supply Area |
| EV | Electric Vehicle |
| FCO | First Circuit Outage |
| FES | Future Energy Scenarios |
| GIS | Geographic Information System |
| GM | Ground Mounted |
| GSP | Grid Supply Point |
| HI | Health Index |
| IDP | Investment Decision Pack |
| LCT | Low Carbon Technology |
| LEP | Local Enterprise Partnership |
| LI | Load Index |
| LRE | Load Related Expenditure |
| LW | Leading the Way |
| NPV | Net Present Value |
| OHL | Overhead Line |
| PM | Pole Mounted |
| PV | Photovoltaics |
| RSN | Relevant Section of Network |
| SCO | Second Circuit Outage |
| SSEN | Scottish and Southern Electricity Network |
| SP | Steady Progression |
| ST | System Transformation |
| XLPE | Cross-linked Polyethylene |

## 1 Executive Summary

Our proposed investment within the Alton/Fernhurst 132kV network will deliver P2/7 compliance for an expenditure of £13.8m during RIIO-ED2 with a total project spend of £14.37m (£0.57m spend in RIIO ED1).

The primary investment driver for this scheme is a load related P2/7 compliance issue experienced within the Alton/Fernhrust 132kV network. The P2/7 compliance issue is apparent under four Distribution Future Energy Scenario (DFES) scenarios (System Transformation, Consumer Transformation, Leading the way, and Steady Progression). Given that both Hampshire and West Sussex council have pledged to become carbon neutral and are supporting the uptake of low carbon technologies, without investment to mitigate this P2/7 non-compliance issue there is a real risk the existing Alton/Fernhurst 132kV network will not adequately support the demand growth risking the supply to customers under N-2 conditions.

The EJP considers a range of options to address the P2/7 compliance issues, setting out the options that have been considered and rejected prior to the CBA analysis, and the short list of those options included within the analysis, with a clear rationale for including or excluding each option.

The Cost Benefit Analysis results shown below in Table 1 demonstrates that the most cost-effective solution, that delivers the best value for consumers in terms of the whole life Net Present Value (£m), is option 2 which will provide additional assets onto the network.

| Options | Net Present Value (NPV) After 45 Years (£k) | Investment (£k) |
|---|---|---|
| **Option 2 – Additional of 132kV switching Station** | -10,186 | 13,801 |
| **Option 3 – Establish an additional 132kV circuit** | -11,226 | 20,150 |

*Table 1: CBA Results*

Following the optioneering and detailed analysis, as set out in this paper, the proposed scope of works for Option 2 is presented in Table 2:

| Asset | Volume | Costs |
|---|---|---|
| 132kV CB (Air insulated busbars)(OD)(GM) | 9 | [redacted] |
| 132kV UG Cable (Non Pressurised) | 10.46 km | [redacted] |
| 132kV Tower | 4 | [redacted] |
| Land Purchase | 1 | [redacted] |
| Compulsory Purchase Order ( Legal/ Land Agent Fees) | 1 | [redacted] |
| **Total** | | [redacted] |

*Table 2 Investment Summary*

This scheme delivers the following outputs and benefits:

- Ensures the Alton/Fernhurst 132kV network compliant with P2/7.
- The uplift in SCO network capacity from 45.6MVA to 176.6MVA to meet the needs of our customers.
- Facilitates the efficient, economic, and co-ordinated development of our Distribution Network for Net Zero.

The total cost to deliver the preferred solution is £14.37m, with £0.57m spend in RIIO-ED1 and £13.801 spend in RIIO-ED2. The works are planned to be completed in 2024. This EJP investment sits within our Net Zero Totex ask.

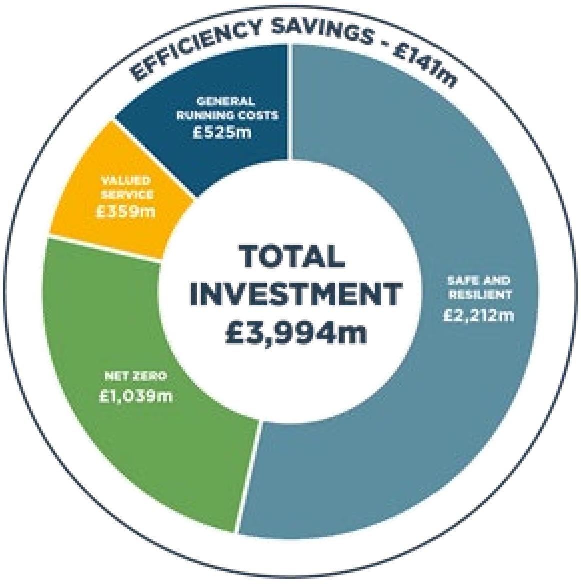



Figure 1: SSEN total investment cost within RIIO ED2

## 2 Investment Summary Table

The table below provides a high-level summary of this Engineering Justification Paper (EJP) and the Cost and Volume (CV) impacts within our Business Plan Data Templates.

| Engineering Justification Paper Investment Summary | | | | |
|---|---|---|---|---|
| **Name of Scheme/Programme** | Fleet-Alton/Fernhurst 132 kV Network Reinforcement | | | |
| **Primary Investment Driver** | Load – P2 non-compliance under SCO | | | |
| **Scheme reference/ mechanism or category** | 58/SEPD/LRE/ALTON | | | |
| **Output reference/type** | 132kV circuits<br>132kV switchgear<br>132kV towers | | | |
| **Cost** | £13.801m | | | |
| **Delivery Year** | 2023/24 | | | |
| **Reporting Table** | CV1: Primary Reinforcement | | | |
| **Outputs in RIIO ED1 Business Plan?** | Yes | | | |
| **Spend Apportionment** | (£m) | **ED1** | **ED2** | **ED3+** |
| | **SEPD** | 0.57 | 13.801 | 0 |

*Table 3: Investment Summary*

# 3 Introduction

Our ***Load Related Plan Build and Strategy (Annex 10.1)***[1] sets out our methodology for assessing load-related expenditure and describes how we use the Distribution Future Energy Scenarios (DFES) 2020 as the basis for our proposals. We have established a baseline view of demand, providing a robust projection of the drivers of load-related expenditure for the ED2 period. Our ex-ante baseline funding request is based on the minimum investment required under all credible scenarios and is strongly supported by our stakeholders. Our plan will create smart, flexible, local energy networks that facilitate the accelerated progress towards net zero – with an increased focus on collaboration and whole-systems approaches.

This investment is a component of our strategic goal of 'Accelerating progress towards a net zero world'.

**Section 4** of this Engineering Justification Paper (EJP) describes our proposed load related investment plan for the reinforcement of the Alton/Fernhurst 132kV network in RIIO-ED2. The primary driver considered within this paper is load related P2/7 compliance issue due to forecast demand growth from our Stakeholder supported Distribution Future Energy Scenario (DFES).

This EJP provides high-level background information for this proposed scheme explaining the existing network arranges, the load growth forecasts through the Distribution Future Energy Scenarios (DFES) and setting out the need for this project. The Detailed Analysis section of the EJP describes the network studies undertaken, detailing the results which further justify the need of the proposed investment.

**Section 5** provides an exhaustive list of the options considered through the optioneering process to establish the most economic and efficient solution. Each option is described in detail, with the EJP setting out the justification for those options which are deemed unviable solutions, and therefore not taken forward to the Cost Benefit Analysis.

**Section 6**, Cost Benefit Analysis (CBA) Summary, provides the comparative results of all the options considered within the CBA and sets out the rationale and justification for the preferred solution. This section also describes how we have established the cost efficiency of the plan with reference to the unit costs that have been chosen.

Finally, **Section 7** of this EJP also sets out the deliverability of the plan for RIIO-ED2 and this proposed investment.

[1] ***SECTION D: (Chapter 10), Responding to the net zero Opportunity, (Annex 10.1), Load Related Plan Build and Strategy***

# 4 Background Information and Analysis

Alton and Fernhurst BSPs are located within the Hampshire and West Sussex region of the SEPD licence area. These substations are supplied from the Fleet GSP. The 2019/20 winter and spring/autumn peak demand were 149.9MVA and 127MVA respectively.

## 4.1 Existing Network Arrangement

Figure 2 and Figure 3 show the geographical layout and the network schematic for the Alton/Fernhurst 132kV circuits. Alton BSP and Fernhurst BSP are both fed from Fleet GSP via two 132kV circuits. The two 132kV circuits comprise of 2 x 175mm² Lynx (twin) 50° overhead lines, approximately 16.6km, to the Alton/Fernhurst tee point and 2 x 175mm² Lynx 50° overhead lines, approximately 2km, to Alton 132/33kV substation.

The 132kV circuits from the Alton/Fernhurst tee point to Fernhurst 132/33kV substation comprise of 1 x 300mm² Upas 75° overhead line and one circuit featuring a combination of 175mm² Lynx 50° overhead line and 300mm² Upas 75° overhead line. Each circuit is approximately 20km long.

The Fleet-Alton/Fernhurst 132kV circuits have a maximum winter rating of 247MVA up to the Alton tee point and a minimum summer rating of 198.5MVA. The 132kV circuits from the Alton/Fernhurst tee point to Alton 132/33kV substation, have a maximum winter rating of 123.7MVA and the 132kV circuits from the Alton/Fernhurst tee point to Fernhurst 132/33kV substation have a maximum winter rating of 146MVA on the Fernhurst T1 circuit and 124MVA on the Fernhurst T2 circuit. The FCO firm capacity of the BSP group is 247MVA.

There is also a circuit to Winchester 132/33kV substation, currently disconnected, which tees into one of the Fleet/Alton/Fernhurst circuit. This circuit comprises of approximately 33km of 175mm² Lynx (twin) 50° and has a winter rating of 247MVA, however, the upstream circuit to Nursling have a winter rating of 123.7MVA. The droppers at towers PK192 and PK86 have been disconnected and this circuit has been out of service for some time.

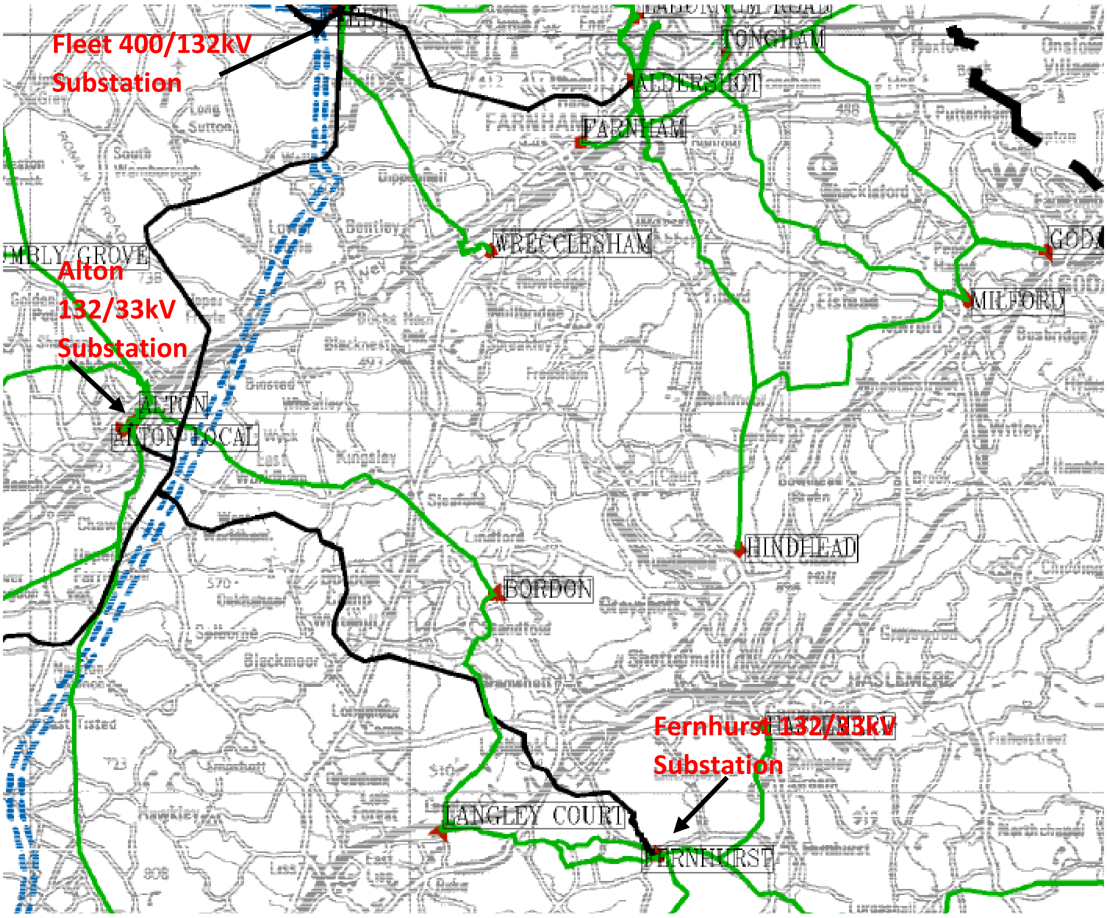



Figure 2:Geographical Schematic of Alton/Fernhurst Substations

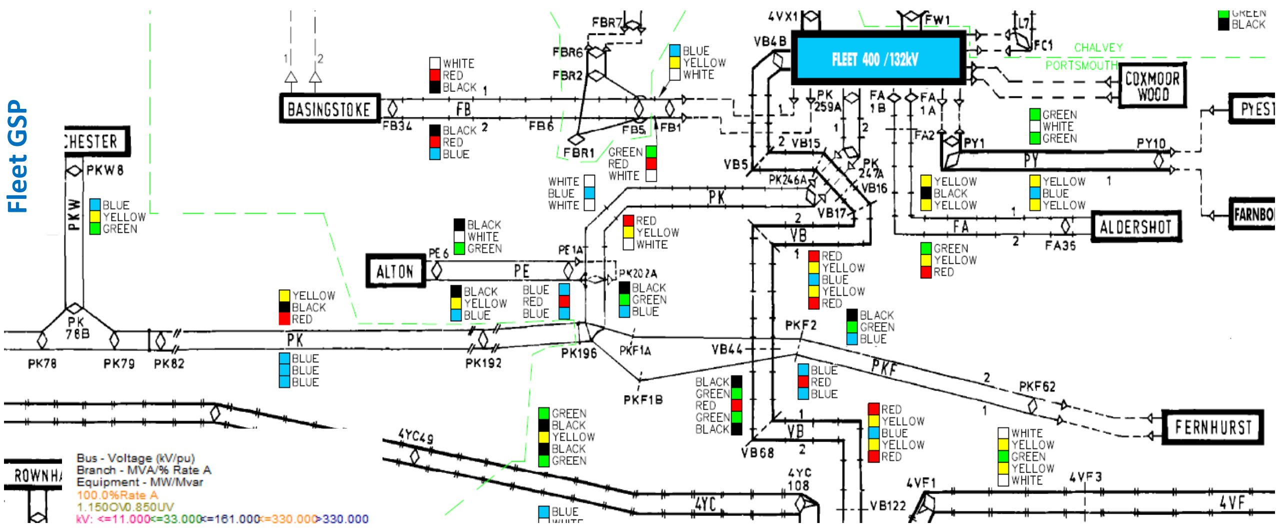



Figure 3:Fleet – Alton/Fernhurst Network Arrangement SLD (Single Line Diagram).

The Alton/Fernhurst substations have interconnection to Basingstoke BSP via two 33kV circuits; Herriard-Down Grange circuit and Humbly Grove-Down Grange. Each of these circuits have a Spring/Autumn rating of

16.8MVA (33.6MVA total). There is also a 33kV interconnection to Chichester BSP via Billinghurst primary substation. This circuit has a spring/autumn rating of 21.6MVA however once the existing load connected to this circuit is accounted for, the circuit will have approximately 12MVA of spare capacity.

### 4.2 Local Area Energy Plan

Both Hampshire and West Sussex County councils have declared a climate emergency and have developed both a climate change strategy and action plan. As a result, the councils have agreed to:

- Become carbon neutral
  - West Sussex County council has committed to this by 2030
  - Hampshire County Council has committed to this by 2050
- Support the uptake of Electric Vehicles
  - Hampshire councils are planning to deploy 1000 EV charge points over the next 12 months
  - West Sussex aims to have 70% of new cars be electric by 2030 anticipating that over 7000 charge points will be needed to support this.
- Enable and support the reduction in residential based carbon emission through fuel switching, low carbon technology integration and community energy projects.
- A Reduction in County Council dependency on fossil-based fuels
- Support for green business growth

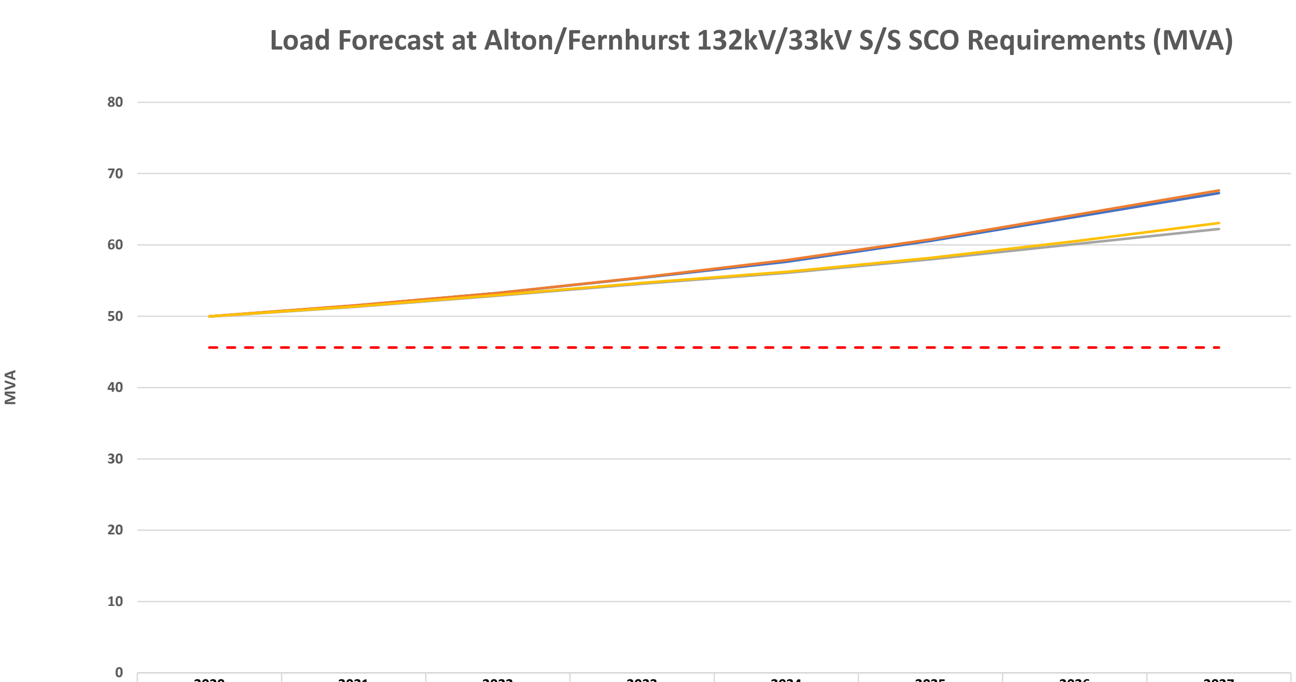
### 4.3 Demand Forecast for Alton & Fernhurst BSP

We have carried out extensive scenario studies – the Distribution Future Energy Scenarios (DFES). The basis for this work is National Grid's Future Energy Scenarios (FES) 2020. This framework comprises four potential pathways for the future of energy based on how much energy may be needed and where it might come from. The variables for the four scenarios are driven by government policy, economics and consumer attitudes related to the speed of decarbonisation and the level of decentralisation of the energy industry. We have worked closely with our partner Regen to develop the forecasts between 2020 and 2050 through enhanced engagement with the local authorities, local enterprise partnerships (LEPs), devolved governments, community energy groups and other stakeholders.

Based on the enhanced stakeholder engagement feedback, we have chosen Consumer Transformation as the baseline scenario for our investment. We are protecting customers from the impact of forecasting uncertainties through our baseline funding only including load related investment required in the first two years in the RIIO-ED2 period, unless it is also required by other net zero scenarios. Full details on our DFES methodology, stakeholder input and regulatory treatments of load related investment can be found in the ***Load Related Plan Build and Strategy (Annex 10.1)***[2].

Figure 4 below shows the demand projections in MVA for the Alton and Fernhurst substations for all DFES forecast scenarios. Figure 4 shows the demand growth and the second circuit outage (SCO) limit for the two substations for all DFES scenarios. In this case, it is shown there are issues with meeting SCO requirements which is discussed further in section 6.

[2] Link to ***Load Related Plan Build and Strategy (Annex 10.1)***




| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|---|---|---|
| SP | 49.99655779 | 51.49008655 | 53.26331524 | 55.39340593 | 57.64186901 | 60.55342076 | 63.89995265 | 67.27363439 |
| CT | 49.99489442 | 51.5000954 | 53.26697464 | 55.44009042 | 57.86509979 | 60.75781526 | 64.18118152 | 67.6295341 |
| LW | 49.96100062 | 51.30291516 | 52.88327361 | 54.56248268 | 56.09214662 | 57.98614884 | 60.09797074 | 62.23330886 |
| ST | 49.97169861 | 51.35206436 | 52.96446326 | 54.67124518 | 56.23368919 | 58.16769733 | 60.50198348 | 63.06963833 |
| SCO Limit | 45.6 | 45.6 | 45.6 | 45.6 | 45.6 | 45.6 | 45.6 | 45.6 |

Year

*Figure 4:Alton/Fernhurst SCO Requirement*

Peak demand is expected to increase at the Alton and Fernhurst BSPs by approximately 52MVA from 2019/20 to 2027/28 when following the baseline CT scenario. The projected primary demand of 202MVA (Winter Peak) by the end of ED2 is split as in Figure 5 below by demand type. The chart shows the largest impact on demand in the area is from EVs and heat pumps, each equating to 10% of the overall projected demand increase respectively, aligning with West Sussex and Hampshire County councils decarbonisation and EV uptake plans.

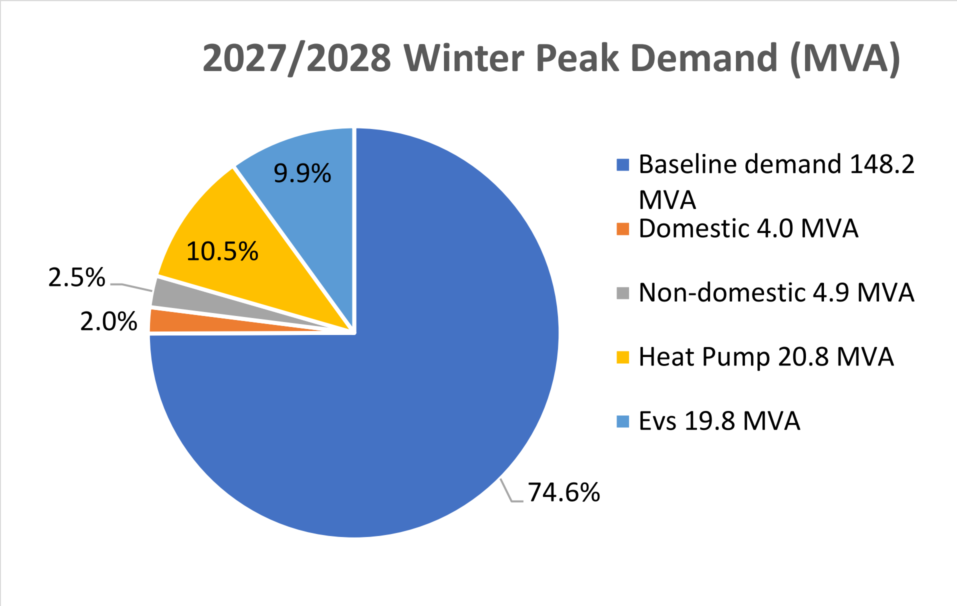



*Figure 5: Alton & Fernhurst BSPs Winter peak demand split by 2027/28 – CT scenario.*

### 4.4 Existing Asset Condition

The Health Index (HI) of the Alton 132/33kV transformers are currently HI2 and HI3 and are expected to progress to HI3 and HI4 by the end of RIIO ED2. The Fernhurst 132/33kV transformers are currently HI1 and HI5 and are expected to progress to HI2 and HI5 by the end of RIIO ED2. As this EJP focusses on the circuit capacity of the network under SCO conditions, there is no plan to replace the existing assets as part of this project. It is part of the non-load workstream to refurbish the transformer at Fernhurst BSP which is currently HI5 to mitigate against risk of asset failure.

### 4.5 Thermal Flow Analysis

For Alton and Fernhurst Substations, the demand forecast in the Consumer Transformation (CT) Distribution Future Energy Scenarios (DFES) show that under a First Circuit Outage (FCO) condition in Winter the remaining in service 132kV connection will be loaded (worse case) to 91% of the circuit rating and therefore, compliant with Engineering Recommendation P2/7 described above during the ED2 period.

Under SCO, the Alton/Fernhurst network would rely on the 33kV interconnection to nearby BSPs to pick up the minimum demand as set out in P2/7. The Alton/Fernhurst substations have interconnection to Basingstoke BSP via two 33kV circuits; Herriard-Down Grange circuit and Humbly Grove-Down Grange. Each of these circuits have a Spring/Autumn rating of 16.8MVA (33.6MVA total). There is also a 33kV interconnection to Chichester BSP via Billinghurst primary substation. This circuit has a spring/autumn rating of 21.6MVA however once the existing load connected to this circuit is accounted for, the circuit will have approximately 12MVA of spare capacity. The CT DFES scenario shows that in 2020/21 the forecasted demand is 149.9MVA increasing to 201.8MVA by the end of ED2. Considering this, compliance with P2/7 requires; 50MVA of demand to be met for 2020/21 and 67.6MVA of demand to be met for 2027/28.

The current network infrastructure will allow 45.6MVA (thermal flow analysis results in Table 4) to be supplied via these 33kV interconnection circuits without causing overloading on the existing 33kV network. Since the full SCO demand requirements for the Alton/Fernhurst BSP group cannot be met this causes a non-compliance with P2/7 under SCO conditions and as a result a solution is required to address this non-compliance issue.

| Demand Group | Season | Group Class | Contingency<br>1st outage | 2nd outage | Loaded Circuit / Transformer | SCO Demand to be Met | SCO Available Capacity |
|---|---|---|---|---|---|---|---|
| Alton/Fernhurst | Spring/ Autumn | D | **FLEE-S08 - ALTO-A2T** | **FLEE-S07 - ALTO-A1T** | Backfeed from Basingstoke via 33kV Circuit | 202.8/3 = 67.6 MVA | 45.6 MVA |

*Table 4 Second Circuit Outage (SCO) Analysis in 2027/28- CT Scenario*

Reinforcement is required due to P2/7 non-compliance under SCO conditions.

The thermal analysis results also show that the Alton 132/33kV transformers will be overloaded under FCO conditions by the end of the RIIO ED2 price control period. This issue is not addressed as part of this project as it is not included in the baseline project portfolio. This EJP will focus on resolving the SCO issue described above.

### 4.6 Voltage Level Assessment

Voltages at the 132kV and the 33kV busbars remain within statutory limits. Reinforcement is not required as voltage compliance is met.

### 4.7 Fault Level Assessment Under CT Scenario

The fault levels at the 33kV bus bars in the Alton/Fernhurst BSP group were assessed for both three phase and single phase to ground faults. It is not expected fault levels will exceed the switchgear rating and therefore reinforcement if not required based on fault level.

### 4.1 Network Analysis Summary

The analysis above has shown that intervention to reinforce the Alton/Fernhurst 132kV network will be required within RIIO-ED2 as a result of non-compliance with P2/7 under SCO conditions. The DFES forecasted increase in demand will result in unsuitable levels of back feeding capability via the current 33kV interconnectors to maintain the minimum demand requirements according to P2/7.

# 5 Summary of Options Considered

This section sets out the investment options that were considered when resolving the P2/7 non-compliance issue at Alton/Fernhurst. As described below, a holistic approach has been taken to ensure investment options represent best value for money for network customers are identified.

## 5.1 Whole System Considerations

We have additionally considered the potential for using Whole System solutions (involving collaboration with third parties) to deliver this investment programme. We set out our assessment in Appendix 2: Whole Systems consideration. This follows our standardised approach for embedding Whole System considerations into our load and non-load investment decisions (in line with Ofgem's ED2 business plan guidance), as described in our ***Whole System (Annex 12.1)***.

Our assessment enables us to take a proportionate consideration of Whole System options, based on the feasibility of such options existing and materiality of the costs involved.

In this case, our Whole Systems assessment finds that this programme is not expected to have any wider Whole System interactions and there are no feasible Whole Systems solutions.

## 5.2 Summary of Options

Table 5 below provides a high-level summary of the four investment options under consideration along with the advantages and disadvantages associated with each option. A more detailed description of each option is then provided within the proceeding sub-sections.

| Option | Description | Advantages | Disadvantages | Result |
|---|---|---|---|---|
| **1. Do Minimum** | Reconnect the existing 132kV circuit to Winchester/Nursling | Minimum cost and workload;<br>Short delivery time. | further reinforcement will still be required. | Not progressed to CBA |
| **2. Addition of 132kV Switching Station** | Establish switching station within the vicinity of the Fernhurst-Winchester Tee, reconfigure the 132kV Winchester/Nursling circuit from a twin circuit to two single circuits and connect to new switching station | Relatively low cost<br>Defers need for network reinforcement | Additional land purchase will be required for switching station location.<br>Can incur large civil costs. | Progressed to CBA |
| **3. Addition of a new 132kV Circuit** | Establish switching station within the vicinity of the Alton/Fernhurst Tee point with the addition of a new 132kV circuit to Fleet | Enables more flexible operation<br>Relieves SCO issues | Additional land purchase will be required for switching station location.<br>Can incur large civil costs. | Progressed to CBA |
| **4. Flexible Solution** | Flexible Contract to reduce peak demand and defer capital investment | Enables more flexible operation<br>Relieves SCO issues | Amount of flexibility depends on location specific resources and interests. Capex may still be required. | Not progressed to CBA |

*Table 5 Summary of Options*

## 5.3 Detailed Option Analysis

### 5.3.1 Option 1: Do-Minimum

**Estimated Cost: £202.7k**

The do minimum option for this scenario is to reconnect the 132kV circuit to Winchester/Nursling as per the current set up. The proposed solution is shown in Figure 6. In this case, the 132kV circuit to Nursling/Winchester will only be operational if both 132kV circuits from Fleet are lost (SCO conditions). The circuit which is currently built but disconnected has a winter rating of 247MVA and a spring/autumn rating of 230MVA. Network analysis has shown that this proposed solution will be able to support the Alton/Fernhurst substations under SCO conditions until the later years of ED2. Further investigation however has highlighted that the upstream circuit Nursling/Winchester tee point, which is limited to 115MVA in spring/autumn, will become overloaded under a planned maintenance outage where the remaining in-service circuit is lost (SCO conditions) from the year 2027. As a result, this solution will require reinforcement of these circuits to continue to support the Alton and Fernhurst substations towards the end of ED2.

As the P2/7 non-compliance issue will not be fully resolved without the need for further reinforcement, this option has been deemed inadequate and has been rejected. As this option did not fully resolve the overloading issue, it has not been assessed in the OFGEM CBA.

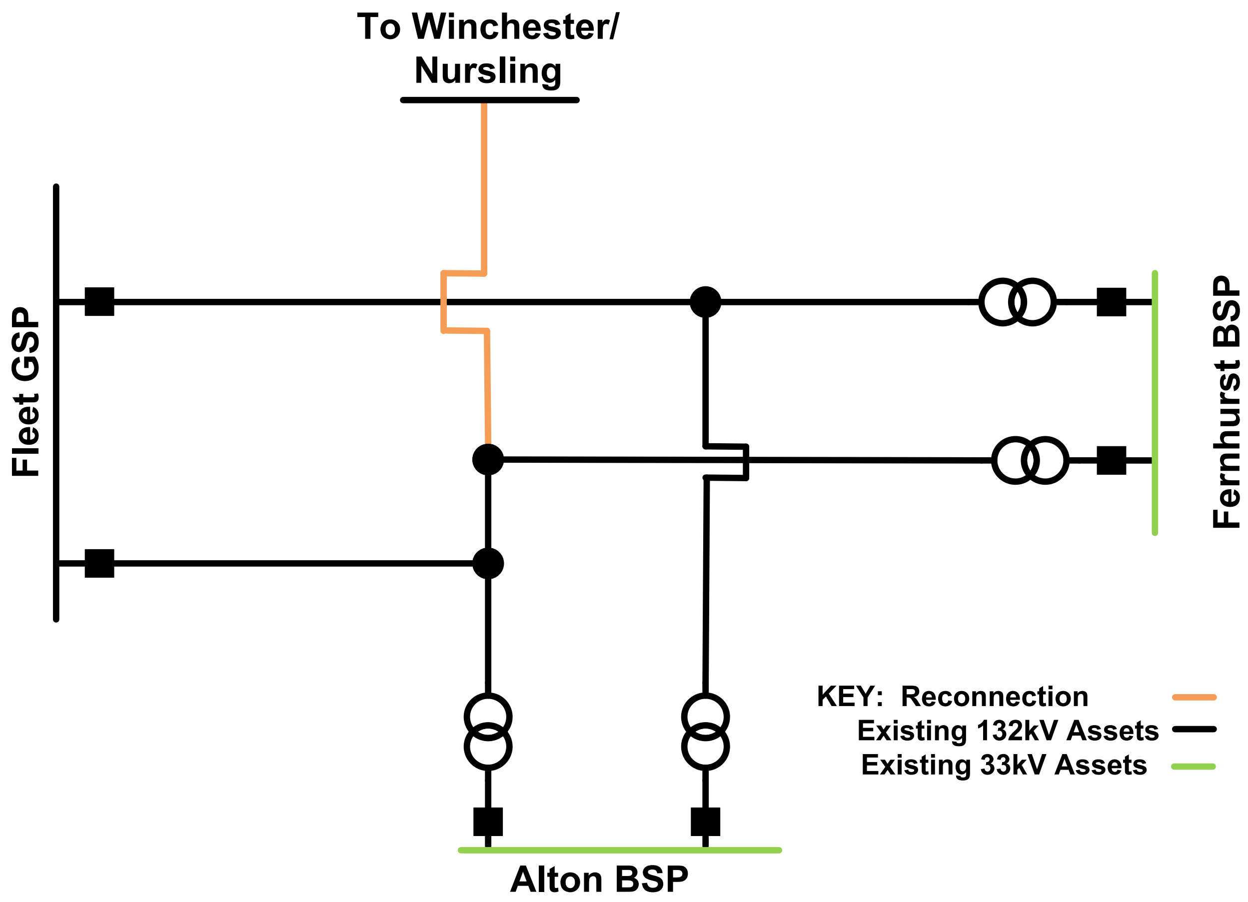



*Figure 6:132kV Reinforcement Solution Option 1*

### 5.3.2 Option 2: Addition of a 132kV Switching station at Winchester Tee Point

**Estimated Cost: 13,801k**

In this solution it is proposed to build a switching station within proximity of the Winchester Tee point. A schematic of this proposed solution is Figure 7. This solution will be achieved by:

- Establishing a switching station near the Winchester tee point comprising of 9 x 132kV circuit breakers rated at 100kA peak make and 40kA rms break.
- Reconfigure the existing disconnected 132kV circuit to Winchester Nursling from a twin circuit to two single circuits. Each single circuit will have a winter rating of 124MVA and a spring/autumn rating of 115MVA.
- Connect each of the new single circuits described above into the existing 132kV Nursling – Winchester circuits and connect to the new switching station
- Unbank the Alton and Fernhurst substations from the 132kV circuits from Fleet GSP. Connect the new feed circuits from Fleet GSP to the Switching station as well as the feeder circuits to Alton and Fernhurst BSPs. A section of cable will be required to extend these circuits to the new switching station located near the Winchester tee point. The length of this cable section will be dependent on the final location of the switching station however for the purpose of the CBA, 10.46km of cable (total) has been estimated for this solution.

With this configuration, the minimum SCO demand at Alton and Fernhurnst substation can be supported by Winchester/Nursling under SCO conditions ensuring compliance with P2/7. This new arrangement shall create 230MVA of capacity. Accounting for the existing Winchester loading, 2028 DFES spring/autumn forecast of 98.65MVA, there is approximately 131MVA of capacity available on the circuits from the new switching station to Winchester/Nursling.

Given the SCO requirement for Alton/Ferhnurst is 67MVA, this solution will create more than enough capacity to meet the minimum load to comply with P2/7 SCO requirements. The SCO will increase from 45.6MVA to 176.6MVA. It is expected that the 132kV circuits to Winchester/Nursling will only be utilised during SCO conditions and will not be in service under normal operating conditions.

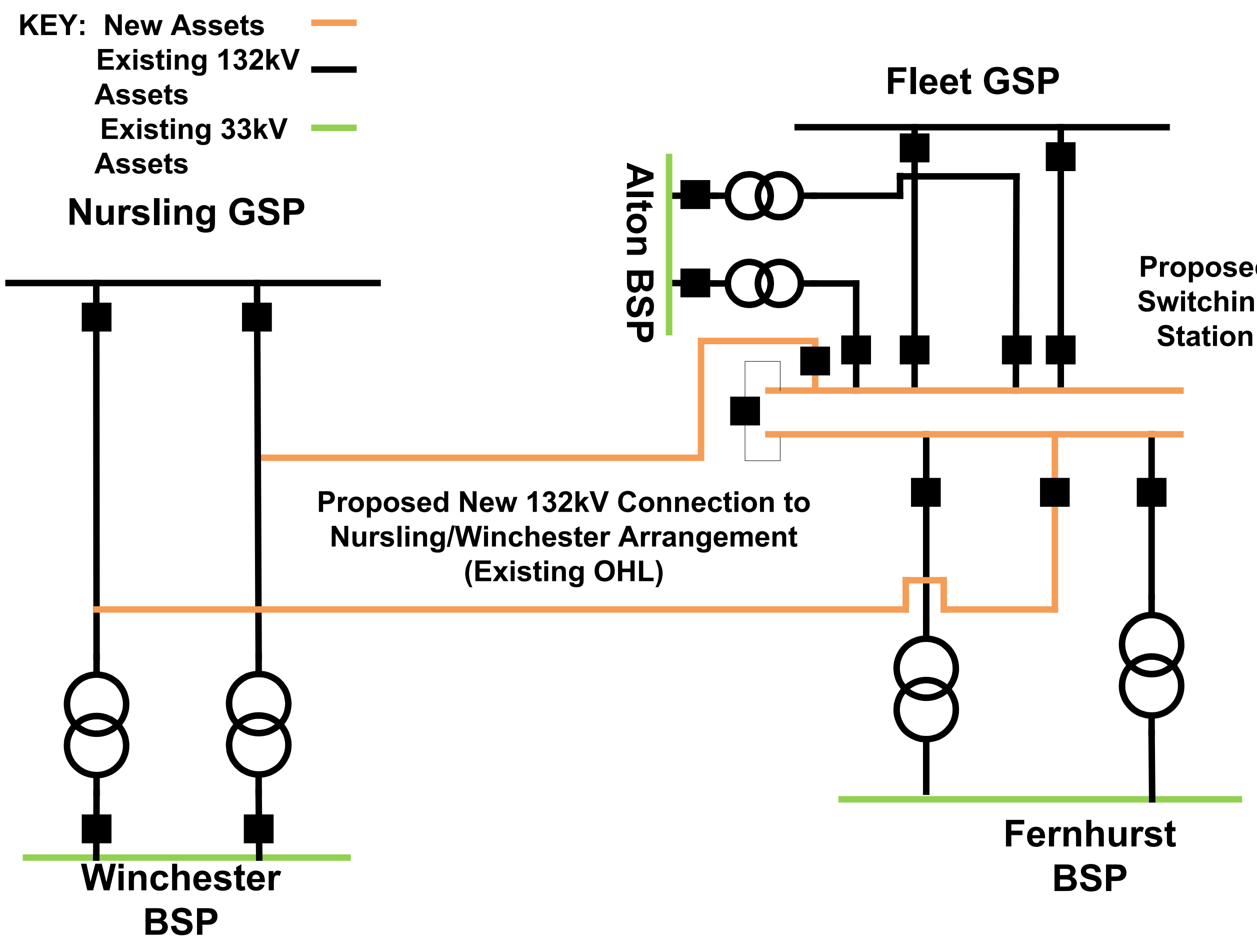



*Figure 7:132 kV reinforcement scheme in Option 2*

Further thermal studies have been re-assessed for the proposed solution which have been based on the SCO demand of 67.33MVA. This was achieved by using lumped loads of 33.67MVA at the 33kV bus bars of the Alton and Fernhurst BSP substations.

The results of the thermal analysis show that under SCO conditions for Alton and Fernhurst BSPs, the proposed solution is sufficient to meet the requirements of P2/7 for this scenario. This solution will be able to provide the minimum 67.3MVA SCO demand plus an additional 63.4MVA.

The voltages at the 132kV and 33kV bus bars have been also assessed for this proposed solution. The voltage study results show that all voltages at the 132kV and 33kV bus bars remain within statutory limits.

The fault levels at the 132kV and 33kV bus bars in the Alton/Fernhurst group have been assessed for both three phase and single phase faults for the proposed solution. The system intact fault level study shows that this proposed solution will marginally increase the fault levels at the 33kV bus bars however fault levels are not expected to increase beyond the capability of the switchgear.

### 5.3.3 Option 3: Addition of a New 132kV Circuit from Fleet GSP to Alton/Fernhurst Tee Point

**Estimated Cost: £20,150k.**

This proposed solution will see the addition of a new 132kV circuit to the Fleet-Alton/Fernhurst Tee point and a new 132kV switching station will be established at the Alton/Fernhurst Tee off. This solution will be achieved through the following:

- Establish a 132kV switching station near the Alton Fernhurst tee point comprising of 9 x 132kV circuit breakers with a peak make rating of 100kA and a RMS break rating of 40kA.
- Install a 132kV circuit, approximately 17km, from the new switching station back to Fleet GSP with a winter rating of 247MVA and a spring/autumn rating of 230MVA.
- Unbank the Alton and Fernhurst BSP from the 132kV circuits from fleet.
- Connect the new clean 132kV circuit from Fleet GSP, Alton BSP and Fernhurst BSP to the new switching station.

The proposed solution configuration can be seen in Figure 8 . The proposed solution will also increase the 33kV fault level at Fernhrust BSP beyond the equipment ratings and as such the lower rated circuit breakers will require replacing.

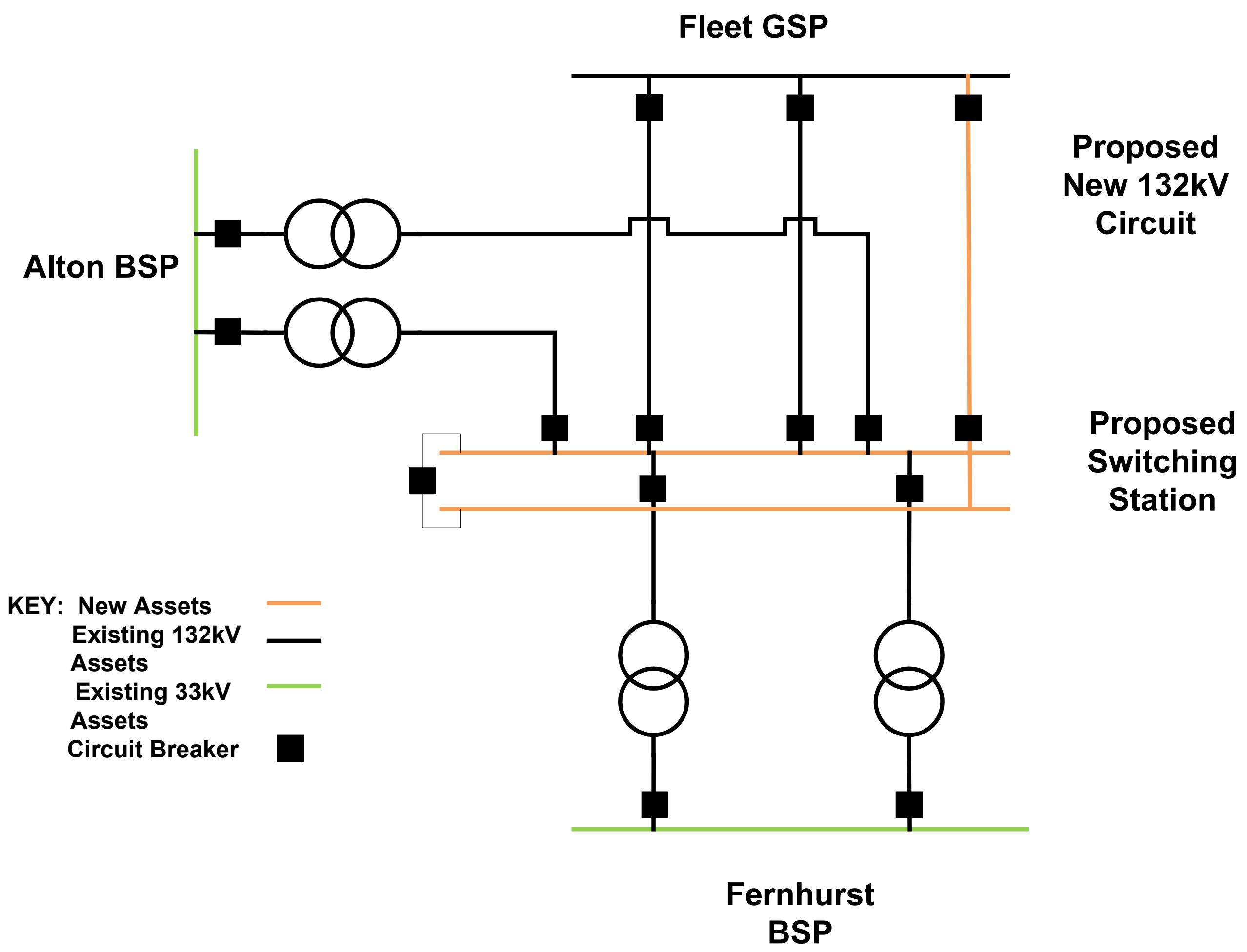



*Figure 8:132 kV reinforcement scheme in Option 3*

This new 132kV circuit will be approximately 17km long and will have a minimum winter rating of 247MVA and a Spring/Autumn rating of 230MVA. Land will be required as close to the Alton/Fernhurst tee point as possible to build this switching station which will comprise of 3 x incomer breakers, 4 x feeder breakers, a bus coupler and a bus section breaker. It will also be required to install switchgear at the new 132kV switching station with equipment rated at 79kA peak make and 31.5kA rms break.

Based on the Winter and Spring/Autumn ratings, the proposed solution will provide more than enough capacity to meet minimum demand requirements, under second circuit outage conditions, ensuring compliance with P2/7. This solution will ensure security of supply to all customers under SCO conditions based on the ED2 load forecast; will add additional capacity to the Alton/Fernhusrt group; and future proof the network beyond ED2.

Further thermal studies have been re-assessed for the proposed solution. The thermal analysis is based on the SCO demand of 67.33MVA (Spring/Autumn). This was achieved by using lumped loads of 33.67MVA at the 33kV bus bars of the Alton and Fernhurst BSP substations. The results show that the circuits within the Alton/Fernhurst group will remain within their permissible ratings as a result of this solution. This proposed solution is not only able to meet the minimum demand required under SCO conditions of P2/7 but is able to supply the full forecasted demand for all ED2 years.

The voltages at the 132kV and 33kV bus bars have been also investigated for this proposed solution. The voltage study results show that all voltages at the 132kV and 33kV bus bars remain within statutory limits.

A fault level study has been carried out under intact network conditions for both three phase and single phase faults. The fault level study highlighted that this solution would increase the 33kV fault level at the Fernhust BSP beyond the equipment rating and consequently the lower rated circuit breakers at this substation will require replacement. It should be noted that the switchgear at the new 132kV substation will require to have a peak make rating of 100kA and a rms break rating of 40kA.

### 5.3.4 Option 4: Flexible Solution

**Estimated Cost: N/A**

The CEM framework would evaluate options around timing of network investments, in particular taking into account:

- the range of different options available (e.g., reinforcing the network, using flexibility, or doing nothing);
- the time periods in which actions can be taken; and
- the existence of uncertainty, and the impact of incremental information which becomes available over time.

Figure 9 shows a typical load profile of a spring/autumn day in 2023 and in 2028. The plot shows the peak demand exceeds the SCO rating for approximately 10.5 hours and 17.5 hours respectively. Flexibility services in the form of increasing generation export or decreasing demand import could be used to reduce the peak.

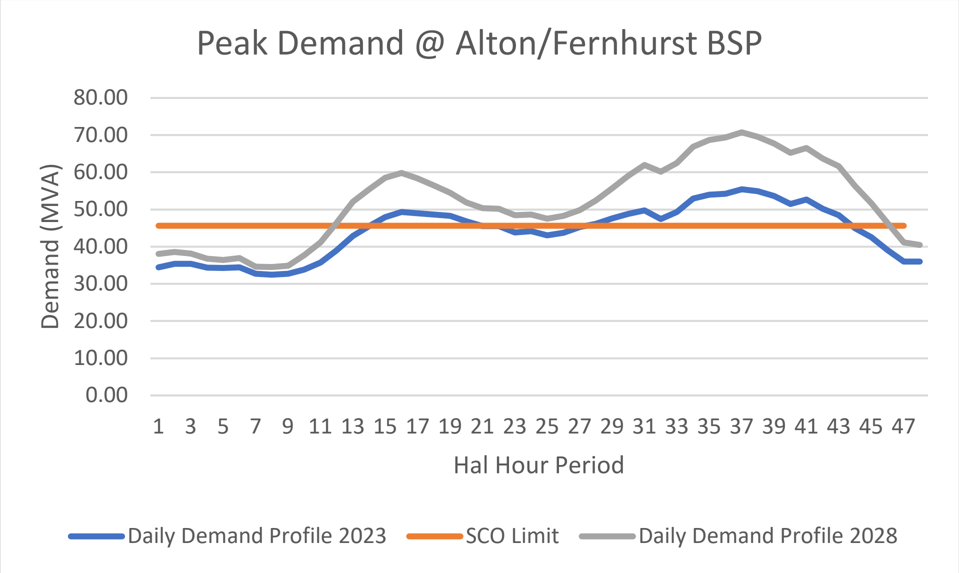



*Figure 9: Alton/Fernhurst Spring/Autumn Peak Demand 2023 and 2028 without Flexibility Services*

The MW exceedance, the daily and annual overload hours (Table 6) and the flexibility unit costs of £150 per MW per hour and £150 per MWh were used as input parameters in the CEM CBA model.

| | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|
| **Hours/day required** | 13.5 | 14.5 | 16.0 | 16.5 | 17.5 |
| **Days/year required** | 128 | 128 | 128 | 128 | 128 |
| **Utilisation Volumes (MWh)** | 1853 | 2546 | 3440 | 4365 | 5332 |
| **Dispatch duration** | 13.5 | 14.5 | 16.0 | 16.5 | 17.5 |

*Table 6 Estimated Dispatch requirements for Flexibility Solutions*

Flexibility has only been assessed over the Spring/Autumn period. The CEM flexibility CBA suggests that under the CT DFES 2020 scenario, there is no benefit of deferring conventional reinforcement using flexibility services as presented in Figure 10. As a result of this, the use of flexible services has not been carried through to the OFGEM CBA.

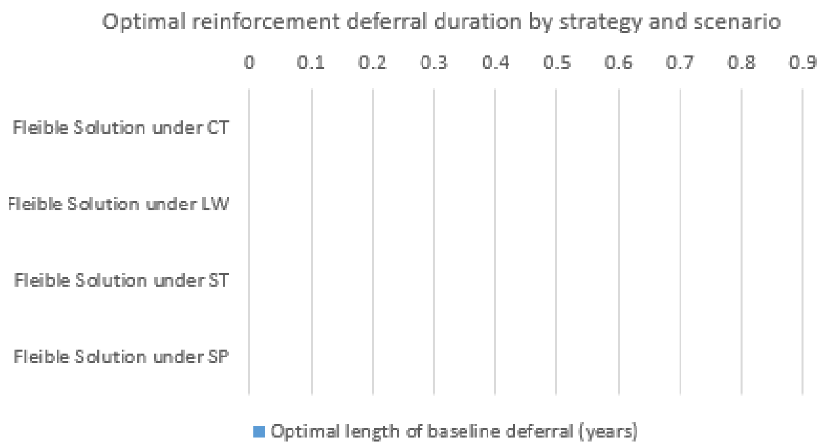



*Figure 10: CEM Flexibility CBA Optimal Deferral Results*

Despite our commitment to the Flexibility First approach, in this scenario the current assessment has concluded the required Flexibility could not be secured effectively within the allocated investment for the scheme. Flexibility will only be pursued where the economic benefit of deferring the capital investment exceeds the additional cost of the flexibility service, providing an optimised net present value to consumers or potentially delivering additional whole system benefits.

However, flexibility may provide OPEX benefits to SSEN and our customers during scheme delivery by;

a) Avoiding/reducing the risk of outages during planned works through load/generation management
b) Avoiding/reducing the need for Mobile Diesel Generation in planned or unplanned outage scenarios
c) Reducing the scale of the works through the implementation of a 'Hybrid' scheme, part reinforcement and part Flexibility.

These opportunities will be reviewed, and Flexibility secured should the CEM Framework CBA prove a positive benefit, with justification of the decisions/reviews presented as required.

Further detail of our Flexibility First approach and assessment methodology can be found in our ***DSO Strategy (Annex 11.1) Appendix F - Delivering Value through Flexibility.***

## 6 Cost Benefit Analysis comparisons

This section provides an overview of the results from the Cost Benefit Analysis (CBA). This detailed exercise has been undertaken to support the investment strategies discussed within this EJP.

### 6.1 CBA of investment options

Ofgem's RIIO-ED2 standard CBA template was used to assess costs and benefits of the conventional options for each circuit individually. Capital reinforcement costs, CI/CML penalties, network losses and other societal benefits are the key parameters used in the CBAs of the three options progressed. The customer interruptions / customer minutes lost (CI/CML) were calculated based on the potential overload and the probability of a failure.

Further information on our Cost Benefit Analysis (CBA) approach is set out within our ***Cost Benefit Analysis Process (Annex 15.8)***.

### 6.2 CBA Results

Table 7 summarises the CBA outcome for all the valid options considered to resolve the thermal constraints at the Alton/Fernhurst Substations. The results of the cost benefit analysis show that option 2 is the preferred option for resolving the thermal constraints at the Alton/Fernhurst substation. This option has the lowest CAPEX cost and subsequently the lowest NPV value of all the options assessed. It should be noted that as this is an ED1 carry over project, the costs reflected in the table below reflect only the costs associated in the ED2 price control period.

| Options | NPV After 45 Years (£k) | Total Investment Cost (£k) |
|---|---|---|
| **Option 2 – Add New Asset: 132kV switching Station** | -10,186 | 13,801 |
| **Option 3 – Add New Asset: New 132kV circuit** | -11,226 | 20,150 |

*Table 7 CBA Results Summary*

| Options | Unit | 2023/24 | 2024/25 | 2025/26 | 2026/27 | 2027/28 | Total |
|---|---|---|---|---|---|---|---|
| **Option 2 – Reinforcement by installing a switching station at the Winchester tee point** | £m | 13.801 | 0 | 0 | 0 | 0 | 13.801 |
| **Option 3 – Reinforcement though the connection of a new 132kV circuit to Fleet** | £m | 20.15 | 0 | 0 | 0 | 0 | 20.15 |

*Table 8 Summary of ED2 Investment Costs*

### 6.3 Options Summary

Option one does not provide sufficient capability to meet the projected network requirements and is not considered a cost effective, long term enduring solution. The solution is therefore rejected and not carried through to the CBA analysis.

Option 4 does not provide the required level of security of supply through the use of Flexible solutions.

The only remaining options which satisfy the P2 compliance requirements are options two and three. These options both provide the required security of supply through additional assets at Alton/Fernhurst BSPs. Option 2 benefits from significantly less 132kV cable requirements than option 3. Therefore, Option 2 is the preferred solution based on cost.

### 6.4 Costing Approach

Our RIIO ED2 Business Plan costs are derived from our outturn RIIO ED1 expenditure. We have modified costs per activity, capturing and reporting those adjustments in our cost-book. By tying our costs back to reported, outturn, real life data this approach provides multiple data points on which both the Regulator and we can benchmark cost efficiency.

It provides a high level of cost confidence in our Business Plan cost forecast for RIIO ED2. Through our benchmarking analysis, we recognised that not all Non-Load related RIIO-ED1 actual unit costs sit within the upper quartile efficiency band. Where this is the case, we have applied a catch-up efficiency to those cost categories.

Further detail on our unit cost approach, cost efficiency and cost confidence for RIIO-ED2 can be found within our ***Cost Efficiency(Annex 15.1)***[3]. Following our draft Business Plan, we have continued to develop project scopes and costs, utilising valuable stakeholder feedback. We have included developments of our Commercial Strategy within the updated project scope and delivery strategy.

Unlike asset replacement, large load projects will include more unique and site-specific costs for example civils, waterway, road or rail crossings and local planning considerations. Through detailed bottom-up project assessment, we have identified projects that are impacted by Regional and Site factors driving additional costs. The following cost and volume in Table 9 is associated with this investment which is reflective of the ED2 costs only.

[3] Link to ***Cost Efficiency (Annex 15.1)***.

| Category | Sub-category | Unit Cost (£k) | Unit | Asset Count | Predominant Costing Approach | Cost £k |
|---|---|---|---|---|---|---|
| Switchgear | 132kV CB (Air Insulated Busbars) (OD) (GM) | [redacted] | # | 9 | ED1 6yr average actual unit rates | [redacted] |
| Cable | 132kV UG Cable (Non-Pressurised) | [redacted] | km | 10.46 | ED1 6yr average actual unit rates | [redacted] |
| Overhead Line | 132kV Tower | [redacted] | # | 4 | ED1 6yr average actual unit rates | [redacted] |
| Abnormal | Land Purchase | [redacted] | # | 1 | | [redacted] |
| Abnormal | CPO Legal/ Land Agent Fees | [redacted] | # | 1 | | [redacted] |
| | | | | | **Project Total** | [redacted] |

*Table 9 Cost and Volumes Breakdown*

## 7 Deliverability and Risk

Between our draft and final Business Plans we have carried out a more detailed deliverability assessment of our overall plan as a package and its component investments. Using our draft Business Plan investment and phasing as a baseline we have followed our deliverability assessment methodology. We have assessed any potential delivery constraints to our plan based on:

- In-house workforce capacity and skills constraints based on the our planned recruitment and training profile and planned sourcing mix as well as the efficiencies we have built into our Business Plan ***(detailed in our Workforce Resilience Strategy in (Annex 16.3)*** and ***Cost Efficiency (Annex 15.1))***
- Assessment of the specific lead and delivery timelines for the asset classes in our planned schemes
- We have evaluated our sourcing mix where there were known delivery constraints to assess opportunities to alleviate any constraints through outsourcing
- We have engaged our supply chain detailed in our ***Supply Chain Strategy (Annex 16.2)*** to explore how the supply chain could support us to efficiently deliver greater volumes of work and how we could implement a range of alternative contracting strategies to deliver this
- We have also engaged with the supply chain on the delivery of work volumes that sit within Uncertainty Mechanisms to ensure we have plans in place to deliver this work if and when the need arises
- Specific to load schemes: We have carried out flexibility assessments at all voltage levels in order to understand when we can defer reinforcement through paying for flexibility services, therefore ensuring our investment profile is deliverable and at the lowest cost to consumers ***see Flexibility within Load Related Plan Build and Strategy (Annex 10.1***)
- We have assessed the synergies between our planned load, non-load and environmental investments to most efficiently plan the scheduling of work and minimise disruption to consumers
- Based on our assessment of delivery constraints and potential solutions to resolve them, we have revised our investment phasing accordingly to ensure our Business Plan is deliverable, meets our consumers' needs and is most cost efficient for our consumers

The table below sets out the revised investment phasing based on the outcome of our deliverability assessment:

| | 2023 | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|
| Revised Investment Phasing (£m) | 0 | 13.801 | 0 | 0 | 0 |

*Table 10 Revised investment phasing*

This investment scheme is part of the wider load-related investment portfolio in RIIO-ED2. We have developed a strategy to deliver a much larger volume of work in comparison with the level of investment in ED1. We have engaged with our supply chain to negotiate the most effective unit costs and we have taken measures to ensure we secure a future workforce with the right skills and competencies to deliver capital projects in ED2.

In RIIO-ED1, SEPD have delivered a number of 132kV, 33kV and 11kV projects using internal workforce. The experience and skills acquired from these projects lay the foundation for the delivery of the proposed option within this paper.

This scheme was originally included in our baseline for delivery during the RIIO-ED1 period, however, through changes in the demand or generation background the need has not materialised as expected. This means it is not economic or efficient to progress with this project within RIIO-ED1. Our decision to defer this scheme means that, where necessary, we are able to use this allowance to efficiently deliver other projects which may have arisen within RIIO-ED1. This allows us to continually meet the requirements of our network and the needs of our customers throughout the price control.

## 8 Conclusion

This Engineering Justification Paper (EJP) provides relevant information in relation to the load related investment at Alton and Fernhurst 132/33kV substations in RIIO-ED2. This project was originally included as part of the RIIO-ED1 business plan but will be carried over into RIIO-ED2.

The thermal overloading of the two 132/33 kV circuits that feed these substations is triggered by all DFES scenarios during the ED2 price control.

The following options were considered in the Ofgem's standard CBA and the CEM flexibility CBA

- Option 2: Reinforcement by the addition of a switching station and network reconfiguration.
- Option 3: Reinforcement through the addition of a new 132kV circuit.
- Option 4: Flexible Solution

Option 2 is the preferred option due to its superior NPV value compared to conventional reinforcement and the network capacity added. To date this project has spent £0.57m on associated design costs which means the total project spend will be £14.37m

## Appendix 1. Assumptions

| Year | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|---|---|---|
| CT* | 83.91 | 91.46 | 94.13 | 97.16 | 100.38 | 104.57 | 109.63 | 114.81 | 120.05 |
| Firm Capacity | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 |
| Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.05 |
| | | | | | | | | | |
| **Customer No.** 1% Growth** | 62603 | 63229 | 63861 | 64500 | 65145 | 65796 | 66454 | 67119 | 67790 |
| MW per customer | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | |
| No. Faults per Year | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| | | | | | | | | | |
| **Final Input** | | | | | | | | | |
| CI | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -2898 |
| CML | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -521681 |

*Includes Winchester Demand forecast, **Total customer number adjusted to reflect SCO demand.

*Table 11 CI/CML for Do Minimum*

| Year | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|---|---|---|
| CT | 50.00 | 51.49 | 53.26 | 55.39 | 57.64 | 60.55 | 63.90 | 67.27 | 70.73 |
| Firm Capacity | 131 | 131 | 131 | 131 | 131 | 131 | 131 | 131 | 131 |
| Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Customer No.** 1% Growth* | 28661 | 28947 | 29237 | 29529 | 29824 | 30123 | 30424 | 30728 | 31035 |
| MW per customer | 0.0004 | 0.0004 | 0.0005 | 0.0006 | 0.0006 | 0.0007 | 0.0008 | 0.0009 | 0.001 |
| No. Faults per Year | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| **Final Input** | | | | | | | | | |
| CI | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CML | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 12 CI/CML for Option 2*

| Year | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|---|---|---|
| CT | 50.00 | 51.49 | 53.26 | 55.39 | 57.64 | 60.55 | 63.90 | 67.27 | 70.73 |
| Firm Capacity | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 |
| Difference | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Customer No.** 1% Growth | 28661 | 28947 | 29237 | 29529 | 29824 | 30123 | 30424 | 30728 | 31035 |
| MW per customer | 0.0004 | 0.0004 | 0.0005 | 0.0006 | 0.0006 | 0.0007 | 0.0008 | 0.0009 | 0.001 |
| No. Faults per Year | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| **Final Input** | | | | | | | | | |
| CI | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CML | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 13 CI/CML for Option 3*

## Appendix 2: Whole Systems consideration

In augmenting our decision-making processes to consider Whole System solutions, we have introduced an assessment to identify where a Whole Systems CBA would be a useful decision-making tool for ED2 load and non-load schemes. While our work with the ENA to undertake Whole Systems CBAs is ongoing, we have introduced the 'Whole Systems CBA test' to identify where a scheme may be suitable for a Whole Systems CBA to be conducted. Where a Whole Systems CBA is determined to be a useful decision-making tool, these would be conducted in addition to the standard Ofgem CBA and/or SSEN's flexibility CBA. We have introduced this test in line with Ofgem's expectations for "proportionality when submitting a Whole System CBA. For example, smaller or simple projects following the standard CBA template, whereas larger or more complex projects requiring bespoke analytical approaches" (Ofgem BPG, section 4.28, p.34).

The 'Whole Systems CBA test' involves assessing each investment scheme of over £2m (the threshold to develop an EJP for load and non-load investments) against 5 tests. These 5 tests help determine whether a Whole Systems CBA is a useful decision-making tool based on the characteristics of the scheme, including whether it will have wider cross sector or societal impacts.

Details on each of the tests are provided in case study 6 in our ***Whole System (Annex 12.1)***. Tests 1-3 are aligned with the ENA's guidance for Whole System CBA tests. We have added Tests 4 and 5 to clarify whether a Whole Systems CBA is required based on the materiality / proportionality of the investment (Test 4) and whether a flexibility CBA only is sufficient (Test 5). Table 14 below outlines our Whole Systems CBA test for Fleet-Alton/Fernhurst SCO 132kV Reinforcement.

| Scheme | Test 1: Are there Whole Systems interactions, or is there potential for it? | Test 2: Could a Whole Systems CBA drive you to make a different decision? | Test 3: Is a Whole Systems CBA reasonable? | Test 4 - Is the project valued at over £2m? | Test 5 - Is the investment plan related to procuring flexible solutions only? |
|---|---|---|---|---|---|
| Fleet-Alton/Fernhurst SCO 132kV Reinforcement | No – We consider there to be limited potential for Whole Systems interactions with third parties to deliver this investment programme, and accordingly we do not consider there to be potential for Whole Systems solution(s). | No – As noted under Test 1 we do not consider there to be potential for Whole Systems solution(s) in this case. | No – As noted under Test 1 we do not consider there to be potential for Whole Systems solution(s) in this case. | Yes | No |

*Table 14 Whole Systems CBA test for Fleet-Alton/Fernhurst SCO 132kV Reinforcement*

As the result of tests 1, 2 and 3 above is "No", a Whole Systems CBA is not required for this investment. It is not expected to have any wider Whole System interactions or potential Whole Systems solutions.