EJP/SEPD/IVES/DENH/002

DENHAM BSP ENGINEERING JUSTIFICATION PAPER

Scottish & Southern Electricity Networks

CONTENTS

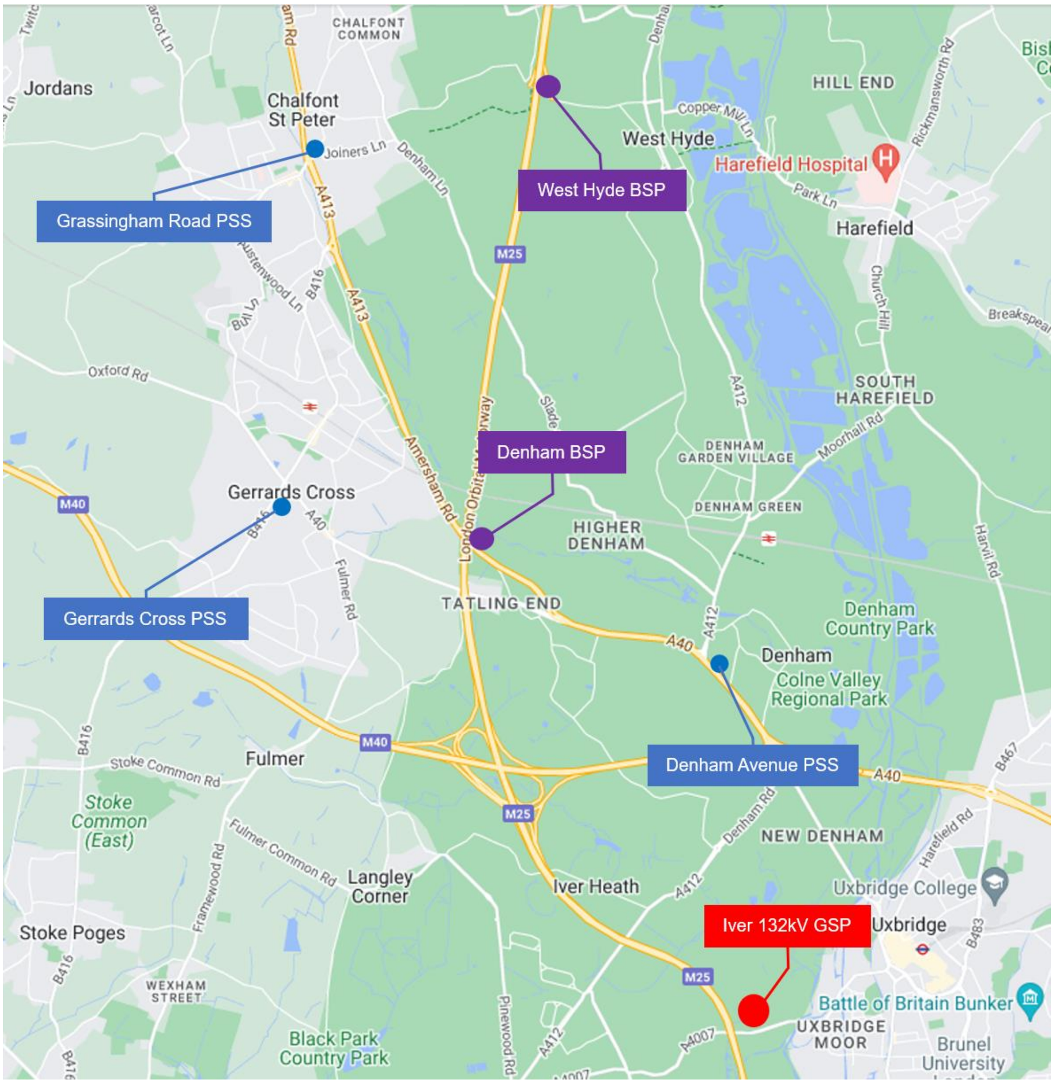
1 Executive Summary

1.1 Summary

The primary investment driver for this scheme is load related but there is also a need to rationalise the non-standard voltage levels fed from Denham Bulk Supply Point (BSP). The thermal overload issues at Denham Bulk Supply Point, and the primary substations it feeds, have already been highlighted in recent technical reports. However, these issues are even more apparent when considering the forecasted demand for 2050 under the Consumer Transformation Net Zero scenario for investment in ED2. This project resolves both current and forecasted network restrictions in the Denham, Chalfont St Peter, and Gerrards Cross areas. These works are required to enable our accelerating progress towards Net Zero.

This EJP considers a range of options to address the thermal overloading issues, setting out the options that have been considered and rejected prior to a CBA analysis. Also included within the analysis, is a list of the options considered with a clear rationale for including or excluding each option.

From the analysis carried out, it was concluded that ‘Option 4’ (see section 6.4 for full detail) is the preferred scope of works. These works are to be funded under the uncertainty mechanism.



2 Investment Summary Table

Table 1 – Summary Table

Name of Scheme/Programme	Denham 132/33kV Bulk Supply Point	
Primary Investment Driver	Load Related – Substation Thermal Overload	
Scheme reference/ mechanism or category	EJP/SEPD/IVES/DENH/002 Uncertainty Mechanism	
Output reference/type	132kV Indoor Circuit Breakers 132kV Circuits 132/33kV Transformers 33kV Indoor Circuit Breakers 33kV Circuits 33/11/6.6kV Transformers	
Cost	[redacted]	
Delivery Year	2024 - 2028	
Reporting Table(s)	CV1: Primary Reinforcement	
Outputs in RIIO ED2 Business Plan	No.	
Spend Apportionment	**ED2**	**ED3+**
	[redacted]	-
MVA released	90 MVA at Denham BSP 12.8 MVA at Gerrards Cross PSS (at 6.6kV) 12.8 MVA at Denham Avenue PSS (at 6.6kV)	-

3 Introduction

Our **Load Related Plan Build and Strategy (Annex 10.1)** sets out our methodology for assessing load-related expenditure and describes how we use the Distribution Future Energy Scenarios (DFES) 2022 as the basis for our proposals. We have established a baseline view of demand which provides a credible forward projection of load-related expenditure for the ED2 period and reflects strongly evidenced support from our stakeholders. Our ex-ante baseline funding request is based on the minimum investment required under all credible scenarios. Our plan will create smart, flexible, local energy networks that accelerate 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 Denham Bulk Supply Point as well as Gerards Cross and Denham Avenue Primary Substations in RIIO-ED2. The primary driver considered within this paper is load-related, specifically thermal overloading and fault level issues triggered by recent large connection applications as well as the demand forecasts.

Section 5 provides an overview of the considered options and identifies the most appropriate option as proposed solution to address the network congestion. This section includes a table that summarises the net present value of all the options included in the Cost Benefit Analysis, the year in which each cost is incurred and the year in which each option would need to be triggered.

Section 6 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 7 details the Cost Benefit Analysis (CBA) and provides comparative results of all the options considered within the CBA. It 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.

Section 8 describes the deliverability of the plan for RIIO-ED2, and this proposed investment. It also describes risks based on the required works, the proposed assts and other surrounding factors, such as the procurement of additional construction space.

Section 9 addresses the strategic aspect of the investment and highlights the long-term aspects of operating a congestion-free grid until at least 2050.

Section 10 concludes the EJP and provides a summary of main conclusions and recommendations contained within this document. This includes the recommended preferred option, a summary of the costs and timeline of this option, a reasoning on the use of flexibility as well as key risk and delivering options.

4 Background Information

4.1 Existing Network Arrangements

Figure 1 and Figure 2 show the 132kV and 22kV running arrangements for the network concerning Denham BSP. Table 2 then shows the breakdown of assets at each of the substations.

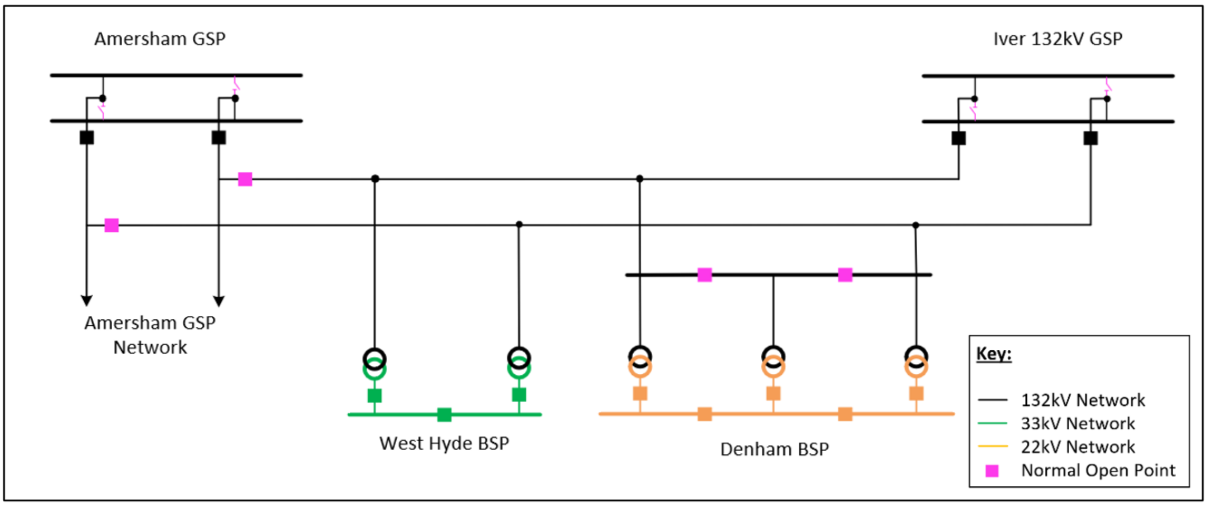


Figure 1 – 132kV Existing Configuration

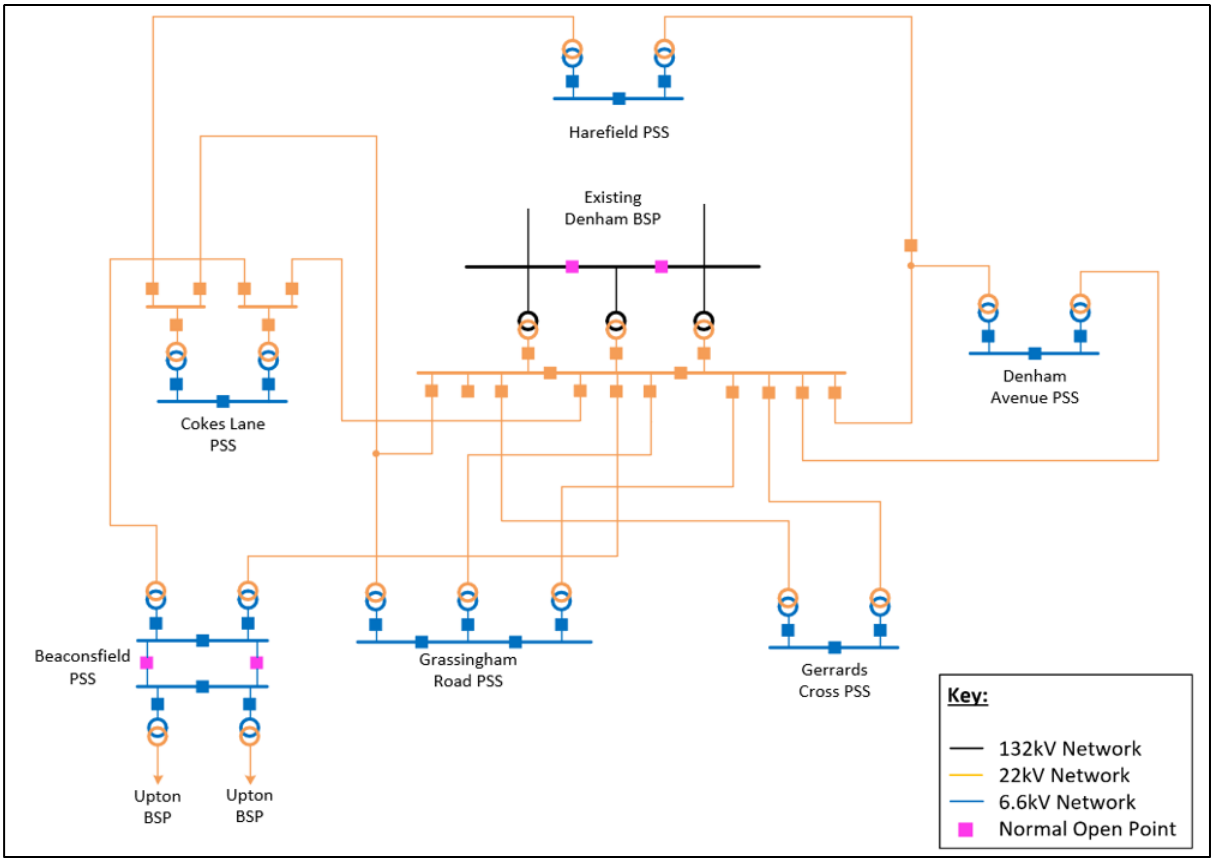


Figure 2 – 22/6.6kV Existing Configuration

Table 2 – Existing Network Arrangements

S/S	Arrangement
Denham BSP	[redacted] • 3 x 132/33kV 45MVA Transformers (fed by 2 x 132kV circuits meshed with West Hyde BSP) • 3 x 2200A Transformer AIS Circuit Breakers (25kA Break Fault Rated) • 2 x 2200A Bus Coupler AIS Circuit Breakers (25kA Break Fault Rated) • 10 x 1250A Feeder AIS Circuit Breakers (25kA Break Fault Rated) **Number of Customers Supplying: 28,273 (21,335 after Beaconsfield PSS is transferred away)**
Denham Avenue PSS	[redacted] • 2 x 22/6.6kV 10MVA Transformers Fed Via a Meshed 22kV Network. • 2 x 1200A Transformer Circuit Breakers (25kA Break Fault Rated) • 2 x 2000A Bus Section Circuit Breakers (25kA Break Fault Rated) • 8 x 2000A Feeder AIS Circuit Breakers (25kA Break Fault Rated) **Number of Customers Supplying: 4175**

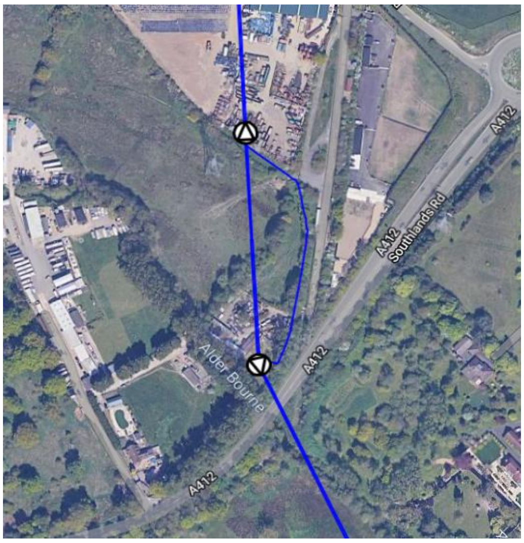
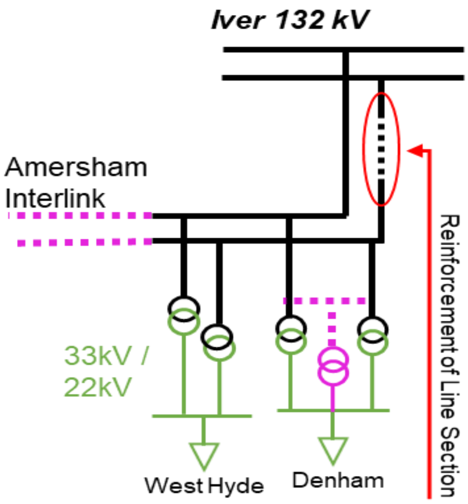
Harefield PSS	[redacted] • 2 x 22/6.6kV 10/12.5MVA Transformers Fed Via a Meshed 22kV Network. • 2 x 1250A Transformer Circuit Breakers (25kA Break Fault Rated) • 1 x 1250A Bus Section Circuit Breakers (25kA Break Fault Rated) • 5 x 630A Feeder Circuit Breakers (25kA Break Fault Rated) **Number of Customers Supplying: 2533**
Cokes Lane PSS	[redacted] • 2 x 22/22kV 10/12.5MVA Transformers Fed Via a Meshed 22kV Network. • 2 x 1600A Transformer Circuit Breakers (13.1kA Break Fault Rated) • 1 x 1600A Bus Section Circuit Breakers (13.1kA Break Fault Rated) • 3 x 400A Feeder Circuit Breakers (13.1kA Break Fault Rated) **Number of Customers Supplying: 2137**

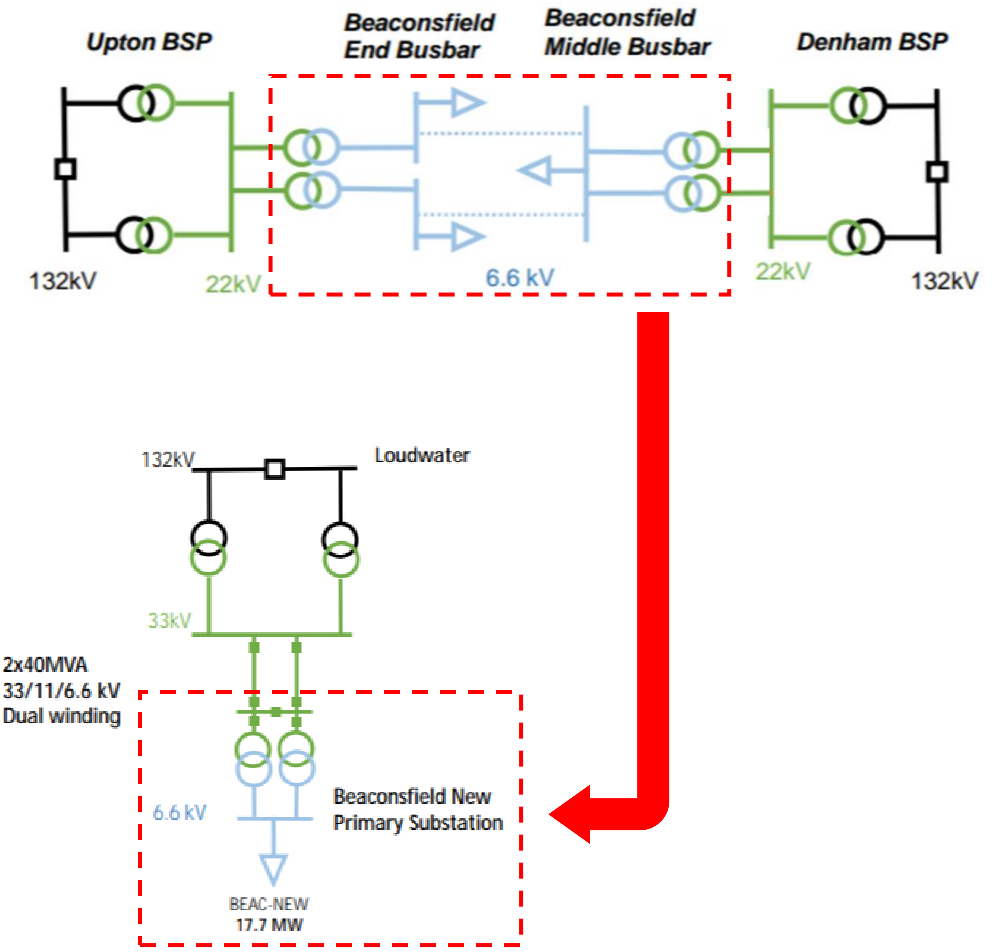
Grassingham Road PSS	[redacted] • 3 x 22/6.6kV 7.5/15 MVA Transformers Fed Via a Meshed 22kV Network. • 3 x 2000A Transformer Circuit Breakers (25kA Break Fault Rated) • 1 x 2000A Bus Section Circuit Breakers (25kA Break Fault Rated) • 11 x 630A Feeder Circuit Breakers (25kA Break Fault Rated) **Number of Customers Supplying: 5429**
Gerrards Cross PSS	[redacted] • 2 x 22/6.6kV 10/12.5 MVA Transformers Fed Via Two Direct 22kV Circuits from Denham BSP. • 2 x 2000A Transformer Circuit Breakers (25kA Break Fault Rated) • 14 x 630A Feeder Circuit Breakers (25kA Break Fault Rated) **Number of Customers Supplying: 5429**

4.2 EJP Interdependency

This paper must consider the reinforcements triggered by other EJPs to provide an accurate representation of the projected condition of the network and, therefore, what intervention should be considered. This enables the avoidance of unnecessary network reinforcement or a solution that may no longer be viable. To appreciate the projects that influence the optioneering in this EJP, please refer to Table 3.

Table 3 – Related EJPs

EJP Reference	Scope of Works to be Considered
Denham (PS007706)	 This EJP consists of reinforcing a small section of one of the 132kV circuits feeding Denham and West Hyde BSPs. These works consist of the following. • Decommissioning 0.27km of oil filled 132kV cable. • Commissioning 0.27km of non-pressurised 132kV cable. • Connection of new cable on to existing terminal towers. [redacted]

<table>
<tr>
<td>Beaconsfield (PS007701)</td>
<td>


This EJP consists of removing Beaconsfield PSS away from Denham and Upton BSPs and onto Loudwater BSP.

2 new 33/11/6.6 kV 40 MVA transformer at Beaconsfield primary
2 new 33 kV CB (Air Insulated Busbars) (OD) (GM) at Loudwater BSP
New 33 kV busbar at Beaconsfield with 5 new 33 kV circuit breakers at Beaconsfield BSP
New 12 km 33 kV circuits from Loudwater BSP to Beaconsfield primary
13 new 6.6/11 kV CB (GM) Primary

[redacted]
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4.3 Load Forecast for the Denham Group Demand

To understand the future pathways for demand and generation at Denham bulk supply point and the primary substation it feeds, SSEN has carried out extensive scenario studies (Distribution Future Energy Scenarios (DFES)). This framework comprises of 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 2022 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.

To make this EJP more concise, only substations where thermal capacity is constrained before 2035 have been included. Figures 3 to 12 include graphs and diagrams that aim to show the point at which assets at each substation become both constrained and non-compliant. It is worth noting that the results shown in the Figures do not incorporate any power losses realised when modelling the network. Therefore, the year that each asset realistically becomes constrained would be earlier than what is represented in the Figures. The following conclusions can be made from these Figures.

- [redacted]
- [redacted]
- [redacted]
- [redacted]

<u>Denham BSP:</u>

As explained in Table 2, Denham BSP has an arrangement where two transformers normally feed the 22kV switchboard. [redacted]

[redacted]

[redacted]

Denham and West Hyde BSPs:

As shown in Figure 5, Denham and West Hyde BSPs are fed via two 132kV circuits [redacted]

[redacted]

[redacted]

Denham Avenue PSS:

[redacted] Therefore, there is an urgent requirement to reinforce the transformers during ED2.

[redacted]

Gerrards Cross PSS:

[redacted]. This means that there is an urgent need to reinforce the transformers at Gerrards Cross PSS.

[redacted]

[redacted]

4.4 Existing Asset Conditions

[redacted]

Figure 11

The existing and forecasted health conditions of the assets at Denham BSP and concerned primary substations were reviewed and have been summarised in Figure 11. The following conclusions have been made as a result.

- [redacted]
- [redacted]
- [redacted]

4.5 Existing Operational Issues

132kV Network Feeding Denham and West Hyde BSPs:

There are two meshed 132kV circuits feeding Denham and West Hyde BSPs from Iver 132kV GSP. For the case where we need to take one of the 132kV circuits out for a maintenance or if there is a fault on one of the circuits then the next outage needs to be considered. Under this circumstance of both 132kV circuits being out of service, there would be 21,336 customers off supply. [redacted] Currently, there is only a 132kV switchboard at Denham BSP to facilitate a hot-standby (swinger) transformer arrangement whilst West Hyde BSP only has two 132kV transformer circuit breakers.

[redacted]

[redacted]

[redacted]

Denham 22kV Network:

Denham BSP currently feeds a 22kV ring that supplies Denham Avenue, Grassingham Road, Harefield and Cokes Lane Primary Substations (see Figure 2). This 22kV ring arrangement means that in some cases, if there is loss of a section of the ring, multiple primaries are left with a single circuit risk. An example of this, is the 22kV circuits between Denham BSP and Denham Avenue PSS. Under an outage of one of these circuits, a circuit breaker trips on the other circuit meaning that Denham is separated from the ring of primaries and left at single circuit risk. However, this means that Harefield PSS is left with a single circuit risk as well.

The 22kV network is a non-standard network voltage now. [redacted]

The final solution proposes moving Denham Avenue and Gerrards Cross primary substations from the current Denham BSP 22kV board to a new 33kV switchboard via two new 132/33kV transformers. To accommodate the new transformers, one of the existing 132/22kV transformers feeding the current 22kV switchboard will need to be decommissioned. As a result, load needs to be reduced on the existing 22kV switchboard and so reinforcing and transferring the primary substations to the new 33kV switchboard cannot be deferred using flexibility.

6.6kV Networks:

The primary substations fed by Denham BSP all operate at 6.6kV. [redacted]

4.6 Network Analysis Summary

Following the completion of the network analysis using the forecasted demands for 2050 (shown in Section 4.3) and the networks including the works triggered by related EJPs (shown in Section 4.2), the following constraints/conclusions have been identified.

First Circuit Outage Thermal Constraints:

Denham and West Hyde BSPs Group Demand:

There are two meshed 132kV circuits feeding Denham and West Hyde BSPs from Iver 132kV GSP. In the case that one of these circuits is lost there is sufficient thermal capacity out to the forecasted demand for 2050. However, this is subject to the completion of the reinforcement proposed under another Denham EJP (see Table 3 – Related EJPs).

Denham BSP Demand:

There are currently two transformers normally feeding Denham BSP with a 'swinger' transformer on hot standby in case of an outage (see Figure 3). As shown in Figure 4, there is not sufficient thermal capacity at Denham BSP from 2035 onwards. This [redacted] means there is a requirement to replace these transformers.

After the completion of the reinforcements proposed under this EJP, two of three transformers will remain, but a lot of the load will be moved on to a new 33kV board fed via two new 132/33kV transformers. [redacted] They shall be replaced with 90MVA 132/33/22kV (dual ration) transformers so that they can be used elsewhere once all of the 22kV network is rationalised.

Denham 22kV Network Demand:

Denham BSP currently feeds a 22kV ring that supplies Denham Avenue, Grassingham Road, Harefield and Cokes Lane Primary Substations (see Figure 2). [redacted].

After the completion of the reinforcements proposed under this EJP, only Harefield, Grassingham Road and Cokes Lane primary substations will remain on the 22kV ring. The other primary substations will be moved to a new 33kV board. [redacted]

Denham Avenue PSS Demand:

Denham Avenue PSS is currently supported by two transformers. [redacted]

After the completion of the reinforcements proposed under this EJP, [redacted] This is because the transformers will be replaced and will be fed via two new circuits that will be connected from a new 33kV board at Denham BSP.

Gerrards Cross PSS Demand:

Gerrards Cross PSS is currently supported by two transformers. [redacted]

[redacted] This is because the transformers will be replaced and will be fed via two new circuits that will be connected from a new 33kV board at Denham BSP.

Second Circuit Outage Thermal Constraints:

Denham and West Hyde BSPs Group Demand:

There are two meshed 132kV circuits feeding Denham and West Hyde BSPs from Iver 132kV GSP. Before the reinforcement proposed under this EJP, [redacted]

After the reinforcement proposed in this EJP, [redacted]

Reverse Power-Flow Thermal Constraints:

Existing Denham BSP 22kV Board:

There is currently potential for some reverse Power Flow through the 132/22kV transformers feeding Denham BSP. However, the recent technical reports with generation have proposed load blinders as well as ensuring the AVC scheme at Denham BSP is capable of reverse power-flow. However, with the forecasted demand increasing, this issue is likely to be lessened.

Newly Proposed Denham BSP 33kV Board:

The newly proposed 33kV board triggered by this EJP, will feed two primary substations and one large generation site. As the minimum demand is unknown, the transformers, AVC schemes and tap changers shall be designed such that reverse power-flow through the new 33/132kV transformers is enabled.

Voltage Constraints:

After reviewing all relevant voltage assessments under Denham BSP, no voltage issues were identified. This includes an assessment of voltages under different network circumstances at all primary substations fed by Denham BSP as well as Denham BSP itself.

Fault Level Constraints:

Following an assessment of the worst-case running arrangement for fault levels before and after the reinforcement proposed under this EJP, there were no new issues identified. There are concerns around the fault levels at Iver 132kV GSP. However, the replacement of circuit breakers at these substations have already been triggered. This EJP will be made dependent on the completion of these works.

4.7 Regional Stakeholder Engagement and Whole systems analysis Summary

Denham Bulk Supply Point supplies Buckinghamshire, Hillingdon, and, to a lesser extent, Three Rivers.

SSEN has strong working relationships with local authorities and other key stakeholders in the region. We engage with the Greater Southeast Net Zero Hub, of which the Buckinghamshire and Hertfordshire Local Enterprise Partnerships are members. We have also met with Buckinghamshire Council to discuss local area energy planning, tools to support efficient data exchange, and the potential to collaborate on projects in the near future.

We have engaged with the Greater London Authority – of which Hillingdon is a member – to discuss local energy planning and the West London Area Energy Planning Partnership. We also met with Transport for London in March 2023 to discuss electric vehicles and the connections timeline. This engagement has helped SSEN stay informed about planning and development that will impact local communities' use of the network.

As detailed in its Climate Change and Air Quality Strategy and on its website, Buckinghamshire Council plans to reduce council emissions 75% by 2030 and to meet the national target of net zero by 2050. The council has:

- Established a £5 million Climate Change Fund, used in part to increase renewable generation capacity;
- Organised a group purchasing scheme with Solar Together in 2022, which delivered over a thousand solar PV, electric vehicle charger, and home battery installations across the council area;
- Planned to install more than 1000 electric vehicle charge points by 2027;
- Begun to electrify its vehicle fleet, including waste collection services; and
- Installed heat pumps and solar panels on council-owned properties.

Hillingdon Council's operations will be carbon neutral by 2030, and they aim to roll out 300 electric vehicle charging points across the borough by 2030.

Three Rivers District Council aims for its own operations to be net zero by 2030, and for the wider district to be net zero by 2045, as laid out in their Climate Emergency and Sustainability Strategy. They ran a successful solar group purchasing scheme in support of this, with 203 homes participating, and plan to establish a business case for more widespread solar PV on council owned properties.

When considering the whole system, it should also be mentioned that there are ongoing plans for multiple constructions that impact this EJP. There are works to be carried out to the 132kV circuits feeding Denham and West Hyde BSPs as well as reinforcement to Beaconsfield PSS. These are considered in this EJP and more detail of the works proposed can be found in Section 4.2. Although these projects help facilitate load growth in some of the area covered by Denham BSP, there is a requirement to further reinforce the network to allow sufficient load growth across the entire geographical area fed by Denham BSP.

4.8 Flexible Market Viability

Flexibility procurement is a methodology that can allow future load growth and, therefore, the integration of new customers, without the need to reinforce network. This section explores whether it is possible to procure the required flexibility to either defer network reinforcement or avoid it all together. For the case of Denham BSP flexibility assessments were to not be worthwhile for the following reasons.

Compliance with Engineering Recommendation P2/8:

[redacted] Therefore, improving the operational capability and, consequently, the security of this 132kV network is necessary regardless of how much flexibility can be procured.

Asset Health:

[redacted].

Complexity of Programme of Works:

Voltage rationalisation of the 22kV network fed from Denham, makes the programme of works complex and so there will be different requirements from flexibility at different stages of the works. For example, as per Option 4, two new additional transformers are to be established in the Denham BSP compound to feed a new 33kV switchboard which will require the decommissioning of one of the existing 132/22kV transformers.

4.9 Confidence Table

Table 4 – Confidence Table provides an analysis of the confidence in the different elements explored as part of this Engineering Justification Paper.

Table 4 – Confidence Table

Confidence Factor	Certainty (High, Medium, Low)	Comments
Load Forecast	High	High confidence in the load forecast as a large part of the additional load comes from new customer connections that were already accepted.
Existing Asset Condition	Medium	There is sufficient information for the transformers and circuit breakers at Denham bulk supply point the primary substations it feeds.
[redacted]	[redacted]	[redacted]
Connections Activity	High	Accepted new connections at Denham BSP as well as Denham Avenue and Gerrards cross primary substations have been incorporated in this EJP.
Regional Stakeholder Engagement	High	The local authorities are committed to achieve the zero net goals and we are working in a collaborated effort to provide the needed power grid to enable their goals.
Flexible market Viability	High	High confidence that flexibility cannot be procured based on the need for increased network control on the 132kV network whilst there also be a need to rationalise the 22kV network.
Funding Position	Medium	The needed funding to address the issues have increased due to the inflation in the price of electrical distribution assets. Furthermore, there is a high likelihood that opportunities and issues will be realised during feasibility assessments for this project. This will correlate to changes in costs and, therefore, the funding required.

5 Summary of options considered.

5.1 Summary of Options

Table 5 provides a summary of the investment options along with the advantages and disadvantages associated with each. A more detailed description of each option is then provided within Section 6.

Table 5 – Summary of Options

Option	Description	Advantages	Disadvantages	CBA Consideration and Result
1. Do Nothing	[redacted]	No work required.	[redacted]	Not progressed to CBA
2. Flexible Solution	Using flexibility to either defer or avoid reinforcement of the Denham BSP 132kV and 22kV network.	There would be no requirement to deliver a complicated and expensive programme of works.	Deemed unviable to defer reinforcement to the 132kV network. In tandem with Option 4 flexibility is also unviable due to the complexity of the programme.	Not Progressed to CBA
3. Network Reinforcement	This option proposes the reinforcement of the Denham BSP 132kV and 22kV networks including the reinforcement of constrained primary substations fed from Denham BSP.	[redacted] Provides capacity on the Denham 132kV and 22kV network such that the forecasted demand for 2050 is met.	Does not rationalise the 22kV network so proposes investment on network with a non-standard voltage. Does not increase the capacity of the 6.6kV network.	Progressed to CBA
4. Network Reinforcement and Voltage Rationalisation **Preferred Option**	This option proposes the reinforcement of the Denham BSP 132kV and 22kV networks whilst also starting the change from the 22kV network to a standardised 33kV network. Option also includes	[redacted] Provides capacity on the Denham 132kV and 22kV network such that the forecasted demand for 2050 is met.	Does not increase the capacity of the 6.6kV network. Proposes a challenging programme of works to deliver.	Progressed to CBA

	reinforcement of constrained primary substations fed from Denham BSP.	Partially rationalises the 22kV network to a standardised 33kV network.		

5.2 Options comparison table

Table 6 – Option Cost Comparison

Option		CBA Total Results (Whole Life NPV £m)	C0(a) costs (£m)			
			2024/25	2025/26	2026/27	2027/28
3	Network Reinforcement	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
4	Network Reinforcement and Voltage Rationalisation	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

6 Detailed option analysis

[redacted] This section aims to explain the different options and provide an analysis on whether it is the best option for SSEN to proceed with. In the case of Denham BSP where the 22kV network is a non-standard voltage level, voltage rationalisation shall also be considered as part of the optioneering process.

6.1 Option 1: Do Nothing

The option of doing nothing is high risk given that the confidence in the load growth (show in Section 4.3) is high. Therefore, the following are the likely consequences of doing nothing based on existing network constraints and those forecasted.

- Equipment will be overloaded and, therefore, its life span will be shorter.
- Assets operating at non-standard voltages such as those on the 22kV or 6.6kV networks will become increasingly difficult to maintain or replace. This will increase the likelihood of asset failures.
- Planned outages are already high risk and so there is potential for an event where a substantial number of customers will be left off for an extended period.
- Load growth will see the network become non-compliant with Engineering Recommendation P2/8 on the 132kV, 22kV and 6.6kV voltage levels.
- New connections will see long wait times to connect to the grid and, therefore, cause a bottleneck to known local developments and ambitions to meeting 2050 Net Zero targets.

6.2 Option 2: Flexible Solution

Flexibility can be procured to efficiently integrate additional customer capacity on to the network without triggering reinforcement. It is important to understand whether flexibility can offer a more cost-effective approach to providing network capacity.

For the case of Denham BSP and its downstream networks, no flexibility assessments were carried out due to two main operational issues that rendered the use of flexibility services to defer reinforcement unviable. These are explained in more depth in Section 4.5, however, please see these issues summarised below.

- Lack of network operability on the 132kV circuits feeding Denham and West Hyde BSPs means that under a second circuit outage there are the following issues:
  - [redacted]
  - 21,336 customers could be left off for a long duration.
  - High risk under a planned outage for routine maintenances.
- Complexity of the programme of works means that it is impractical to manage when and where flexibility might be required. This is because of the following.
  - Voltage rationalisation of the 22kV network requires strategically moving primary substations from a 22kV network to a newly established 33kV network. This means that the constraints will change.
  - [redacted] and to accommodate the new 132/33kV transformers whilst maintaining a 22kV switchboard requires the de-commissioning of one of the 132/22kV transformers.

- To swap Denham Avenue primary substation across to the new 33kV switchboard, the transformers at the primary substations will need to be changed to 33/11/6.6kV dual ratio transformers.

6.3 Option 3: Network Reinforcement

Table 7 – Option 3 Cost Breakdown

Assets	Volume	Cost C0(a) (2021 Baseline)
132kV UG Cable	4 x 0.5km	[redacted]
132kV CB (Gas Insulated Busbars) (ID) (GM)	11	[redacted]
132kV Tower	1	[redacted]
22kV UG Cable	Total of 10km	[redacted]
22/6.6kV – 20/40MVA Transformers	4	[redacted]
Fibre Optics	Total of 10km	[redacted]
	Total	[redacted]

This option proposes the reinforcement of the 132kV network feeding Denham and West Hyde BSPs whilst proposing reinforcement to the 22kV networks feeding Denham Avenue and Gerrards Cross primary substations. A full cost breakdown of the works required can be seen in Table 7 – Option 3 Cost Breakdown. To best explain the scheme of works, this detailed analysis of option 3 has been split into two sections; one to consider the 132kV reinforcement and the other for the 22kV reinforcement.

132kV Reinforcements:

This option proposes a solution that allows the 132kV network feeding Denham and West Hyde BSPs to be flexibly operated such that Denham BSP is secure for a second circuit outage. [redacted] In addition, the three 132/22kV transformers feeding Denham BSP shall be replaced to provide enough capacity to meet the forecasted demand shown in Figure 4.

To achieve this, a new dual busbar (GIS) 132kV switchboard is to be cut into the existing 132kV circuits to Denham and West Hyde 132kV BSPs (see Figure 12). This new switchboard is to be installed and commissioned in the existing Denham BSP compound. The new 132/22kV transformers to feed Denham BSP will then be fed from this new 132kV switchboard.

However, the drawback of this design is that West Hyde BSP is still meshed in the 132kV circuits from the new 132kV switchboard (to be established) to the normally open circuit breakers on the Amersham GSP network. This is not a concern for now as there is only one large customer fed from West Hyde BSP and this scheme of works still improves the security of their supply. Though this does mean that if more customers were transferred to West Hyde BSP, then additional 132kV reinforcements would be required.

Additionally, to cut in a new 132kV switchboard to facilitate to the new arrangement, a new 132kV termination tower will be required. This will mean more land will be required near the existing 132kV termination tower for the circuits feeding Denham BSP (See Figure 19).

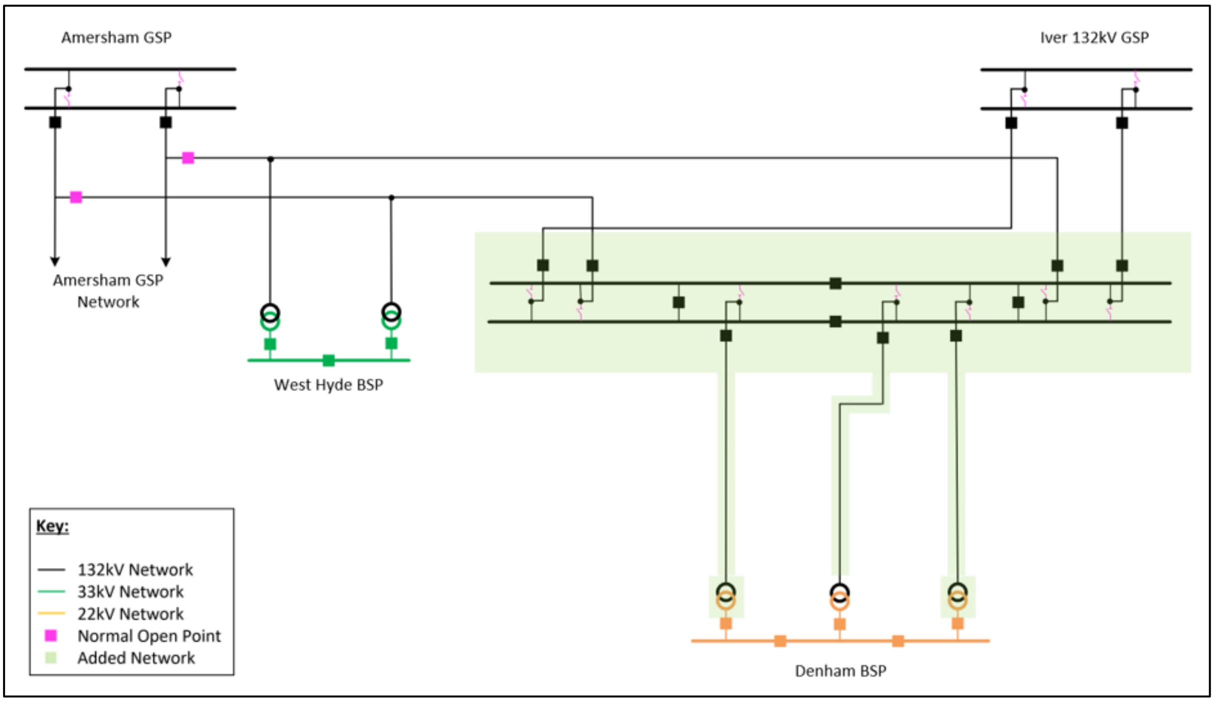


Figure 12

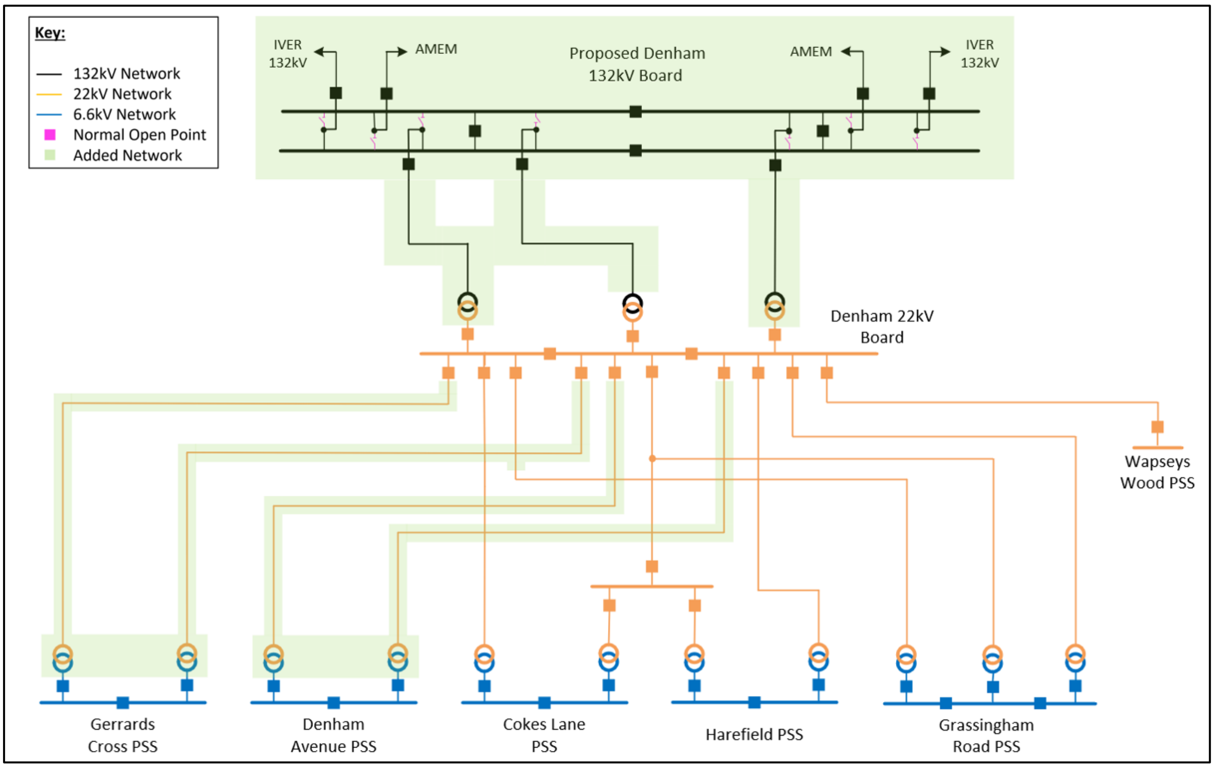
22kV Network and Primary Substation Reinforcements:

The 22kV circuits and 22/6.6kV transformers feeding Denham Avenue and Gerrards Cross primary substations are currently constrained as seen in Section 4.3. As a result, this option proposes cutting the constrained primary substations out of the existing 22kV ring whilst ensuring the 22kV networks to be installed have sufficient capacity so to meet the demands forecasted for 2050.

This shall be achieved by laying new 22kV dual underground circuits from the existing 22kV switchboard at Denham BSP to each of the constrained primary substations. The transformers at each of the primary substations will also be replaced so to meet the forecasted demands for 2050 from Figure 8 and Figure 10 (for Denham Avenue and Gerrards Cross primary substations, respectively). The new network configuration can be seen in Figure 13 and Figure 14.

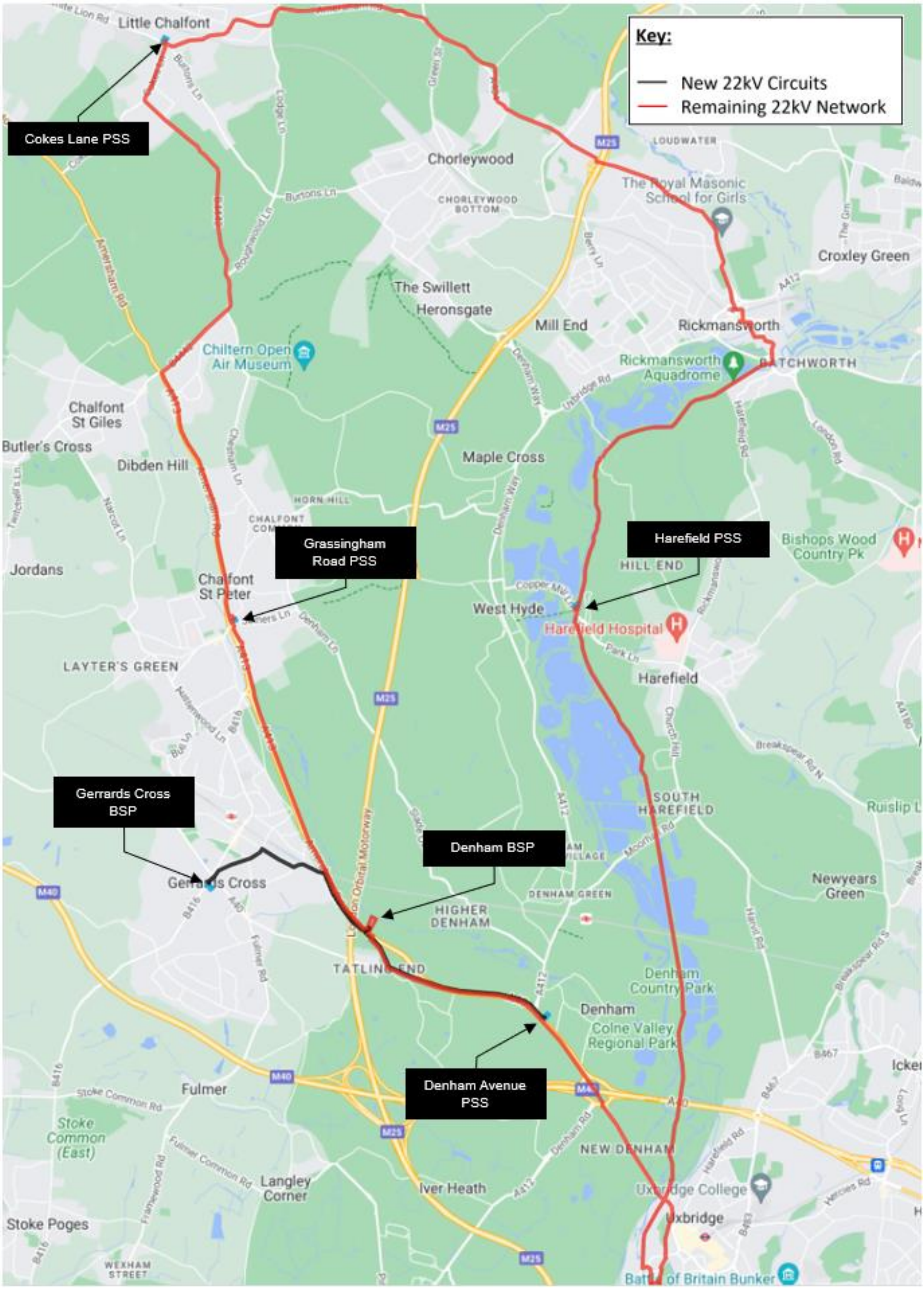
However, the main concern with this option is that there is no voltage rationalisation of the 22kV network. Instead, this option triggers more investment into a voltage that is not standard and will likely become increasingly difficult to maintain, repair and operate. This means that faults are likely to be more frequent and more likely to leave customers off for longer periods of time. Additionally, a 22kV network does not have the potential to provide as much capacity as a 33kV network and so the network become increasingly difficult to reinforce as network demands increase in the area.

Furthermore, this option does not consider reinforcement to the 6.6kV network and so even though capacity is released on the 22kV network feeding primary substations fed from Denham, there will still be a requirement to reinforce the 6.6kV networks for new connections to the local networks. As a result, for Gerrards Cross primary substation, this option only releases capacity sufficient to support demand forecasted for 2035 (as seen in Figure 10).



Key:
132kV Network
22kV Network
6.6kV Network
Normal Open Point
Added Network
IVER 132kV
AMEM
Proposed Denham 132kV Board
AMEM
IVER 132kV
Denham 22kV Board
Wapseys Wood PSS
Gerrards Cross PSS
Denham Avenue PSS
Cokes Lane PSS
Harefield PSS
Grassingham Road PSS

Figure 13



Key:
New 22kV Circuits
Remaining 22kV Network
Cokes Lane PSS
Grassingham Road PSS
Harefield PSS
Gerrards Cross BSP
Denham BSP
Denham Avenue PSS
Little Chalfont
Chorleywood
The Swillett
Heronsgate
Mill End
Rickmansworth
Croxley Green
Chalfont St Giles
Dibden Hill
Jordans
Chalfont St Peter
Maple Cross
West Hyde
Harefield Hospital
Harefield
Gerrards Cross
Denham
Fulmer
Iver Heath
Uxbridge
Stoke Poges

Figure 14

6.4 Option 4: Network Reinforcement and Voltage Rationalisation

Table 8 – Option 4 Cost Breakdown

Assets	Volume	Cost C0(a) (2021 Baseline)
Transformer 132/33kV 90 MVA	2	[redacted]
132kV UG Cable	4 x 0.5km	[redacted]
132kV CB (Gas Insulated Busbars) (ID) (GM)	12	[redacted]
132kV Tower	1	[redacted]
33kV CB (Gas Insulated Busbars) (ID) (GM)	10	[redacted]
33kV UG Cable	Total of 10km	[redacted]
33/11/6.6kV - 20/40MVA Transformers	4	[redacted]
Fibre Optics	Total of 10km	[redacted]
	Total	[redacted]

This option proposes the reinforcement of the 132kV network feeding Denham and West Hyde BSPs whilst proposing reinforcement and voltage rationalisation of the 22kV networks feeding Denham Avenue and Gerrards Cross primary substations. A full cost breakdown of the works required can be seen in Table 8 – Option 4 Cost Breakdown. To best explain the scheme of works, this detailed analysis of option 4 has been split into two sections; one to consider the 132kV reinforcement and the other for the 22kV reinforcement.

132kV Reinforcements:

This option proposes a solution that allows the 132kV network feeding Denham and West Hyde BSPs to be flexibly operated such that Denham BSP is secure for a second circuit outage. [redacted] In addition, two new 132/33kV transformers will be installed and will feed onto a new 33kV switchboard to be established in the existing Denham BSP compound.

To achieve this, a new dual busbar (GIS) 132kV switchboard is to be cut into the existing 132kV circuits to Denham and West Hyde 132kV BSPs (see Figure 15). This new switchboard is to be installed and commissioned in the existing Denham BSP compound. The new 132kV switchboard will then feed the existing 22kV Denham board as well as a new 33kV board which will be fed via two new 132/33kV transformers. To install the two new 132/33kV transformers in the Denham BSP compound, one of the existing 132/22kV transformers feeding the existing 22kV switchboard will need to be de-commissioned and removed from the site.

These reinforcements will facilitate enough capacity on the EHV network at Denham to meet the demand forecasted for 2050 (as seen in Figure 4). The reinforcement also enhances the operability of the network thus allowing the flexibility to manage the network under first and second circuit outages in a way that customer losses are kept to a minimum. Furthermore, the establishment of a new 33kV switchboard whilst keeping the old 22kV switchboard allows a staged process of changing the 22kV network to 33kV.

The drawback of this design is that West Hyde BSP is still meshed in the 132kV circuits from the new 132kV switchboard (to be established) to the normally open circuit breakers on the Amersham GSP network. This is not a concern for now as there is only one large customer fed from West Hyde BSP and this scheme of works still improves the security of their supply. Though this does mean that if more customers were transferred to West Hyde BSP, then additional 132kV reinforcements would be required.

Additionally, to cut in a new 132kV switchboard to facilitate to the new arrangement, a new 132kV termination tower will be required. This will mean more land will be required near the existing 132kV termination tower for the circuits feeding Denham BSP (See Figure 19).

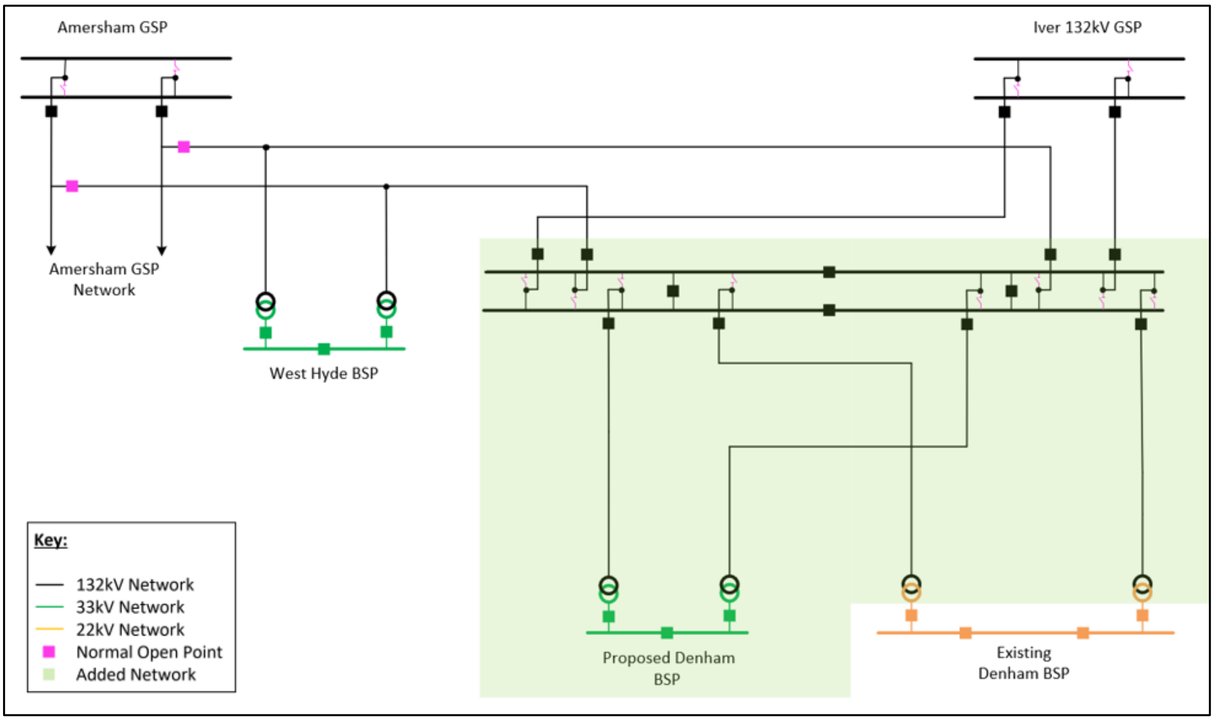


Figure 15

22kV/33kV Network and Primary Substation Reinforcements:

The 22kV circuits and 22/6.6kV transformers feeding Denham Avenue and Gerrards Cross primary substations are currently constrained as seen in Section 4.3. As a result, this option proposes cutting the constrained primary substations out of the existing 22kV ring whilst ensuring the new 33kV circuits and 33/11/6.6kV transformers to be installed have sufficient capacity so to meet the demands forecasted for 2050.

This shall be achieved by laying new 33kV dual underground circuits from a new 33kV switchboard at Denham BSP to each of the constrained primary substations. The transformers at each of the primary substations will also be replaced with 33/11/6.6kV transformers so to meet the forecasted demands for 2050 from Figure 8 and Figure 10 (for Denham Avenue and Gerrards Cross primary substations, respectively). Dual ratio transformers shall be installed to prepare for the voltage rationalisation of the 6.6kV network to an 11kV network. The new network configuration can be seen in Figure 16 and Figure 17.

The remaining 22kV network will be left to feed Cokes Lane and Harefield primary substations (as seen in Figure 16). Rationalisation of the remaining 22kV network will be proposed under ED3 as these primary substations do not become constrained before 2035.

This option provides the EHV network fed from Denham BSP with enough capacity to meet the forecasted demands in 2050 (see Section 4.3) whilst rationalising majority of the 22kV to a standardised

33kV network fed from Denham BSP. This starts the process of removing the 22kV network which is becoming increasingly difficult to operate.

However, this option does not consider reinforcement to the 6.6kV network and so even though capacity is released on the 33kV and 22kV network feeding primary substations fed from Denham, there will still be a requirement to reinforce the 6.6kV networks for new connections to the local networks. As a result, for Gerrards Cross primary substations, this option only releases capacity sufficient to support demand forecasted for 2035 (as seen in Figure 10).

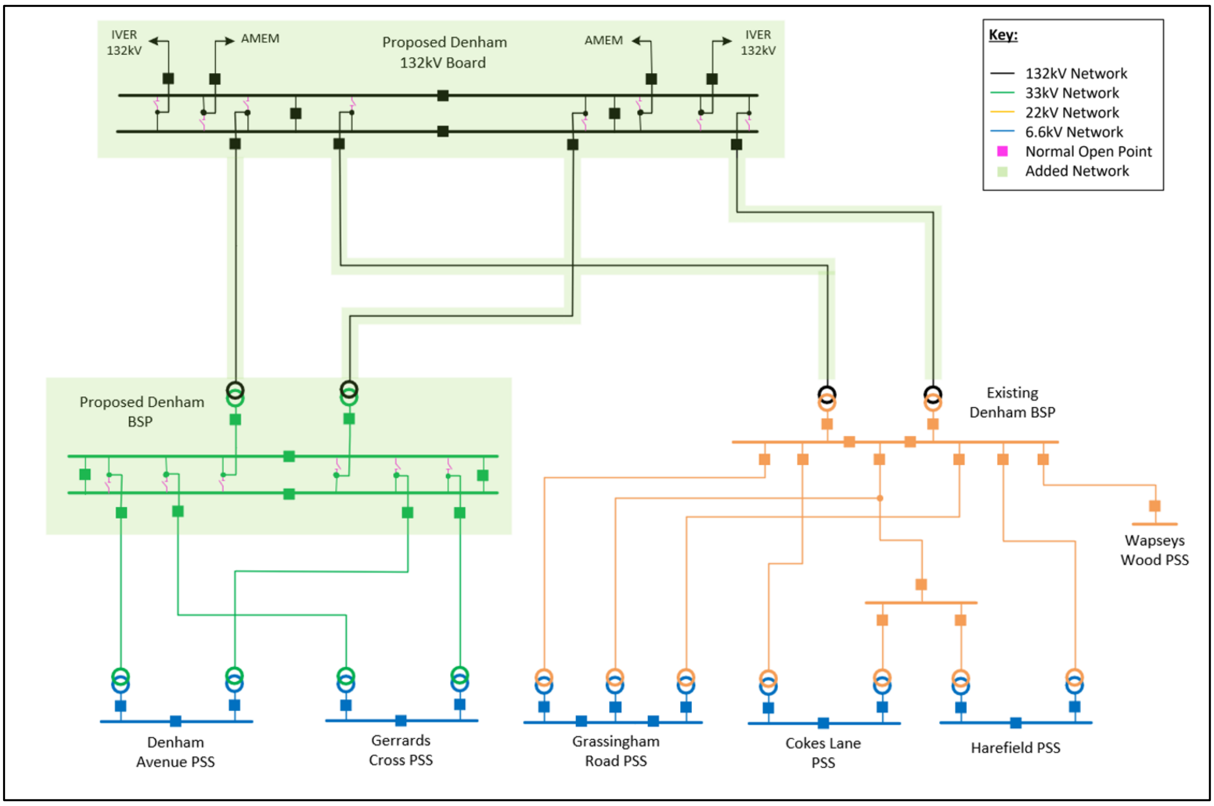
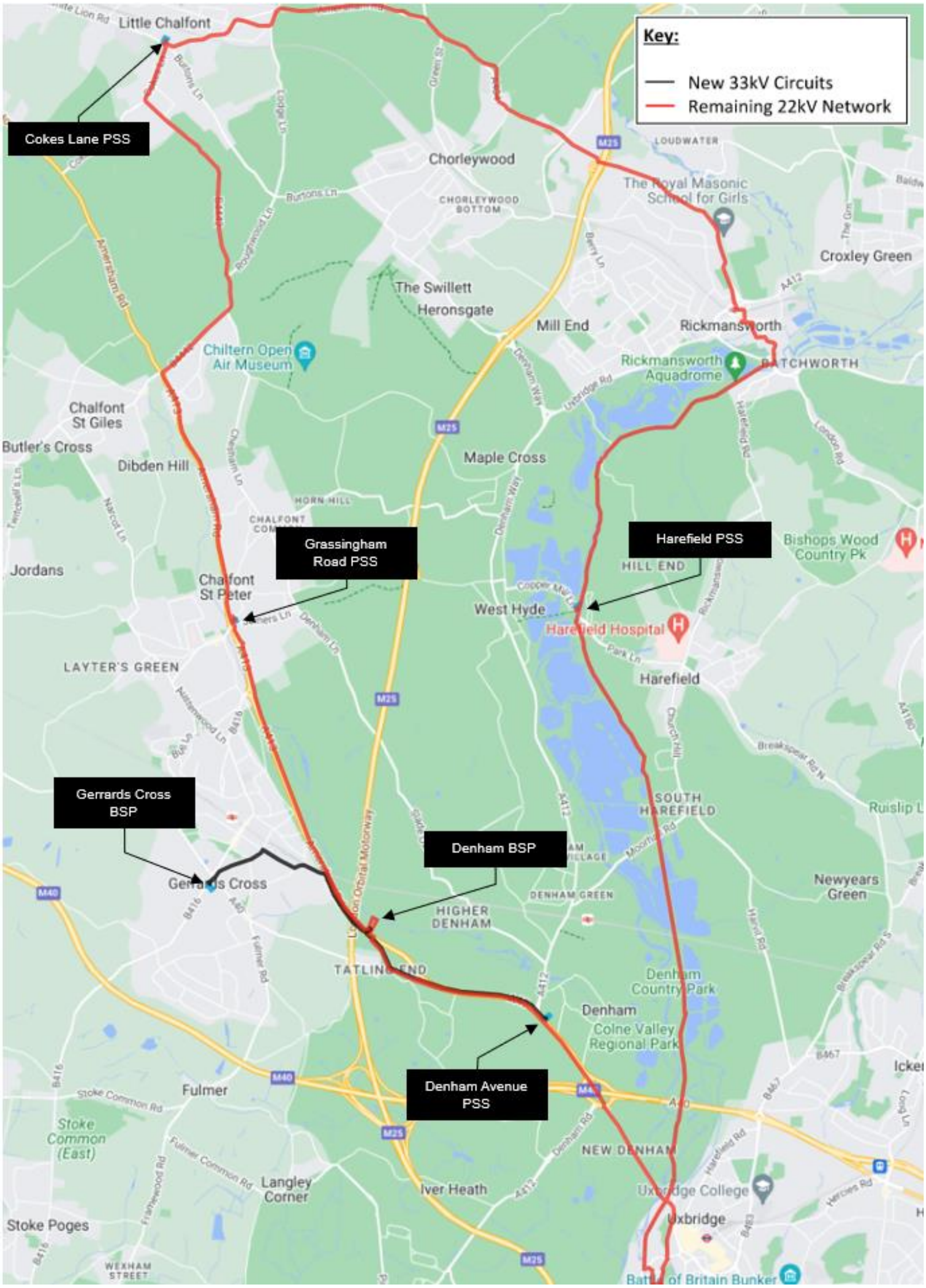


Figure 16



Key:
New 33kV Circuits
Remaining 22kV Network
Cokes Lane PSS
Grassingham Road PSS
Harefield PSS
Gerrards Cross BSP
Denham BSP
Denham Avenue PSS
Little Chalfont
Chorleywood
Chorleywood Bottom
The Royal Masonic School for Girls
Croxley Green
The Swillett
Heronsgate
Mill End
Rickmansworth
Rickmansworth Aquadrome
Batchworth
Chiltern Open Air Museum
Chalfont St Giles
Butler's Cross
Dibden Hill
Maple Cross
Horn Hill
Chalfont Common
Jordans
Chalfont St Peter
West Hyde
Hill End
Harefield Hospital
Bishops Wood Country Pk
Layter's Green
Harefield
South Harefield
Ruislip
Higher Denham
Denham Green
Newyears Green
Gerrards Cross
Tatling End
Denham
Denham Country Park
Colne Valley Regional Park
Fulmer
Stoke Common (East)
New Denham
Langley Corner
Iver Heath
Uxbridge College
Uxbridge
Stoke Poges
Wexham Street
Battle of Britain Bunker
Loudwater

Figure 17

7 Cost Benefit Analysis (CBA)

7.1 CBA of investment options

Table 9 summarises the justifications for why only two options were carried forward to the Ofgem CBA.

Table 9 – CBA Justification

Option	Meets 2035 Forecasted Demand	Meets 2050 Forecasted Demand	Carry Forward to OFGEM CBA	Justification
1	No	No	No	Doing nothing would lead to a non-compliant network. The confidence in load growth in the Denham area is high and this option would cause a bottle neck to new developments in the area.
2	No	No	No	Flexibility was deemed to be unviable and so this option is not possible for this EJP.
3	Yes	No	Yes	This option would provide sufficient capacity on the 132kV and 22kV networks out to 2050 despite not rationalising the 22kV network.
4	Yes	No	Yes	This option would provide sufficient capacity on the 132kV and 22kV networks out to 2050 whilst partially rationalising the 22kV network.

7.2 CBA Results

Only options 3 and 4 were carried forward to the Ofgem Cost Benefit Analysis as per the justifications in Table 9. To carry out a comprehensive analysis of the network development options for the Denham BSP, two CBAs were carried out. One for the works to be completed for options 3 and 4 as proposed in this EJP and the other for the further reinforcement that would be required to meet the 2050 forecasted demands under Denham BSP. It is worth noting that, it was assumed that the remaining works to reinforce Denham BSP so to meet the 2050 forecasted demands were to be completed within the ED3 price control period. The NPVs from these CBAs are shown in Table 10 and Table 11 (respectively).

Table 10 – CBA Results Short Term

Option	Whole Life Net Present Value in £m	45-year Net Present Value in in £m
Option 3 – Reinforcement by Building a New Substation	[redacted]	
Option 4 – Reinforcement by Adding Assets to Existing Subs		

Table 11 – CBA Results Long Term

Option	Whole Life Net Present Value in £m	45-year Net Present Value in in £m
Option 3 – Reinforcement by Building a New Substation	[redacted]	
Option 4 – Reinforcement by Adding Assets to Existing Subs		

Table 10 shows that the 'Whole Life' and '45-year' NPVs for Option 3 are lower than the NPVs for Option 4. However, if the total reinforcement required under the Denham BSP to meet the 2050 forecasted demands, then the NPVs for Option 4 are lower than those for Option 3 (see Table 11). This means that in the long run, Option 4 would be the most cost-effective method to reinforce the Denham BSP network. This supports SSENs ambition to standardise the voltage levels across West London.

8 Deliverability and Risk

Table 12 summarises any risks or deliverability concerns identified for the preferred option (Option 4). A detailed summary of Option 4 can be found in Section 6.

Table 12 – Deliverability and Risk

Risk No.	Risk / Deliverability	Potential Mitigations	RAG
1	**Space in the Denham BSP Compound:** From desktop studies there appears to be sufficient space to accommodate the required new assets (as per Option 4) in the Denham BSP compound. There is potential for this to not be feasible.	There are a few fields adjacent to Denham BSP compound. One of these could be purchased to accommodate the growth of the Denham BSP compound. See Figure 18 for potential land purchasing opportunity.	[redacted]
2	**Land and Work for Cables:** Whilst the cable routes will be short, there is a river between Denham BSP compound and where the current 132kV termination tower is.	The existing two 132kV oil filled circuits were drilled under the river and so by replacing them with non-pressurised cable, an environmental risk would be mitigated.	[redacted]
3	**Termination Tower Arrangement:** There is an existing term tower with two sets of terminations. However, another two terminations are required to allow for the new 132kV arrangement. (See Figure 19).	Worst case, a new termination tower will need to be installed to allow for the new 132kV arrangement feeding Denham and West Hyde BSPs.	[redacted]
4	**Transmission Constraints:** National Grid is working to upgrade the capacity at Iver 132kV GSP. However, additional applications to National Grid will be required to investigate capacity requirements on a case-by-case basis.	National Grid are already aware of the load growth in the Denham area but engagements with them would ensure there is not a drawn-out shortfall of capacity.	[redacted]
5	**Dependency on Other Reinforcement:** Reinforcement of a section of a 132kV circuit feeding Denham and West Hyde BSPs. (See Table 3). Reinforcement and transfer of Beaconsfield PSS. Includes moving a group demand from Denham BSP to Loudwater BSP. (See Table 3). Replacement of the 132kV board at Iver 132kV GSP with a new indoor (GIS) board.	Scope of works can be carried out alongside the works already in progress. This will help ensure that these projects do not hold back the delivery of the works proposed in this EJP.	[redacted]
6	**Planned Outages at Denham:** With only two circuits feeding Denham and West Hyde BSPs taking an outage is generally high risk. This is because there is little interconnectivity on the existing 22kV network with any other BSP.	Outages to be taken at least risky time of year with a plan for restoration.	[redacted]

7	**Voltage Rationalisation:** The complexity of the programme of works will be greatly influenced by rationalising the 22kV voltage level. There is a requirement to de-commission an existing 132/22kV transformer and replace it with a new 132/33kV transformer.	Careful management of the programme of works will be required to ensure that the network is not put at unnecessary risk.	[redacted]
8	**Re-Quote of a Customer Triggered Job:** If a 30MW PV farm proceeds after receiving a response from National Grid, this job will need to be re-quoted to be moved on to the new 33kV switchboard so to avoid thermally overloading the 132/22kV transformers at Denham BSP under a worst-case reverse power-flow scenario.	This project and the customer will need to be carefully consulted to ensure that this is captured.	
9	**Non-Standard Transformers:** There is a requirement for 33/11/6.6kV dual ratio transformers to be installed at Denham Avenue and Gerrards Cross primary substations. This is to allow for voltage rationalisation of the 6.6kV networks in the future.	By installing 33/11/6.6kV transformers, SSEN avoids the risk of having to change the transformers as a result of voltage rationalisation again.	

[redacted]

[redacted]

9 Outlook to 2050

Based on the forecasted demand for 2050 (as seen in Section 4.3), the recommended option provides sufficient capacity to the 132kV and 33kV network whilst providing a good platform to continue the voltage rationalisation of the networks fed from Denham BSP. As a result, the current and projected technical issues are resolved and so the risk of taking a planned outage for reinforcement or maintenance works will be greatly reduced. This is conducive to an efficiently run distribution network that will be able to facilitate an acceleration to Net Zero.

Despite this, from 2035 onwards, the remaining 22kV network (as seen in Figure 16) feeding Cokes Lane, Grassingham Road and Harefield primary substations will also need to be replaced to fully rationalise the voltages at Denham BSP. This would eventually involve installing a new 132/33kV transformer to feed the new 33kV switchboard so to take the demand of Cokes Lane and Harefield primary substations.

Moreover, this EJP does not consider the already constrained 6.6kV networks fed from each of the primary substations under Denham BSP. The 6.6kV network is a non-standard electrical distribution voltage level. In order, to maximise the capacity released from this EJP, the 6.6kV network will need to be rationalised to an 11kV network.

Ultimately, the proposed solution (Option 4) is the first step for both increasing the thermal capacity and rationalising the voltage levels at Denham BSP. With this in mind, and the fact that the programme of works is complex, it is paramount that these works are triggered now and completed in a timely manner.

10 Conclusion and Recommendation

This EJP has raised the need to invest in reinforcement on the Denham BSP 132kV and 22kV network within the ED2 price control period. This need for investment is driven by existing technical issues as well as the forecasted demand shown in Section 4.3.

Four options have been carefully considered to ensure that the most appropriate solution is proposed. This includes assessing whether reinforcement can be avoided or deferred by considering the feasibility of flexibility. Unfortunately, there is no achievable flexible solution and so the considerations for the end solution were purely based on the deliverability and impact of each reinforcement option.

Out of the options reviewed, two options are technically viable and will provide sufficient thermal capacity. From the Ofgem CBA carried out for these options it was discovered that in the short term, Option 3 has the lower NPV whilst Option 4 had the lower NPV in the long run. This, coupled with SSEN's ambition to rationalise the voltages in West London, makes Option 4 the more desirable solution.

A comprehensive approach is taken when selecting this technically viable option. Option 4 will have the capability to resolve all issues at hand and add adequate network capacity that meets the forecasted demand for 2050 whilst maintaining compliance with Engineering Recommendation P2/8. This scheme will release 25.6MVA of capacity on the 6.6kV network and 90MVA on the 132kV network for the wider Denham area by the end of 2028. The scheme will also partially rationalise the 22kV network fed from Denham BSP. Consequently, this will facilitate local projects and developments that will support the local economy whilst aligning with the local government's ambition to transition to Net Zero.

11 References

The documents detailed in Table 11.1 - Scottish and Southern Electricity Networks Documents, Table 11.2 – External Documents, and Table 11.3 – Miscellaneous Documents, should be used in conjunction with this document.

Table 11.1 - Scottish and Southern Electricity Networks Documents

Reference	Title

Table 11.2 – External Documents

Reference	Title

Table 11.3 – Miscellaneous Documents

Title

12 Revision History

No	Overview of Amendments	Previous Document	Revision	Authorisation
01				
02				

Appendix A Definitions and Abbreviations

Table 4

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

Appendix B Sensitivity Analysis

For each investment proposed in this EJP, we have reviewed the annual max demand figures under all DFES scenarios out to 2050. Based on this assessment, we will place this investment into one of the categories from Table 5.

Table 5

Category	Description	Applies to this EJP?
A	Schemes where the chosen investment size is large enough to meet peak demand/generation under all net zero compliant scenarios to 2050	✓
B	Schemes where we would require further future reinforcement of the particular asset(s) being proposed under a more aggressive scenario to 2050	
C	Schemes where the proposed investment is not required under any scenario to 2050 (if any)	
D	Schemes where investment can be deferred until a later date under some scenarios i.e. ST scenario indicates no investment needed until 2030	

Justification for Categorisation:

The Denham EJP considers a complex solution including voltage rationalisation to resolve several network constraints and, therefore, careful consideration has been taken when carrying out the sensitivity analysis that determined this EJP to be a category A project. To make the justification of the categorisation of this EJP more digestible, the constraints have been split into individual sections accompanied by graphs that aim to show the load growth from the different distribution future energy scenarios for each constraint identified in this EJP (these justifications are summarised in Table 6). This allows us to understand if a different scenario were considered whether the same network intervention would be required. The graphs also show the constraint following the works triggered in this EJP to demonstrate whether it would be suitable for all scenarios.

Table 6

Constraint	Category	Justification
Denham Avenue PSS	A	[redacted] Solution proposed meets forecasted demand out to 2050 for all scenarios.
Gerrards Cross PSS	A	[redacted]. Solution does not meet forecasted demand out to 2050 for all scenarios but does provide a suitable platform to enable intervention later.
Denham BSP	A	[redacted] solution required to facilitate the reinforcement of Denham Avenue and Gerrards Cross primary substations. Solution proposed meets forecasted demand out to 2050 for all scenarios.
Denham and West Hyde BSPs	A	[redacted] Solution proposed meets forecasted demand out to 2050 for all scenarios.

[redacted]

[redacted] the triggered works from this EJP facilitate sufficient capacity out to 2050 under all the DFES scenarios (worst case being 18MVA against 22.8MVA under CT).

[redacted]

[redacted] However, the works triggered at Gerrards Cross PSS only facilitate enough capacity to meet the forecasted demand under all the scenarios out to 2039 (scenarios CT and LW exceeding the capacity in this year). Despite this, the constraint at Gerrards Cross PSS is the 6.6kV circuit breakers and the solution proposed in this EJP helps to allow the rationalisation of this voltage level to 11kV, which will eventually mean that the constraint will be 38.1MVA rather than 22.8MVA (represented in Figure 21 with a green-dashed line). This is evidence that the solution proposed in the EJP provides a suitable platform to meet the forecasted demands under all the DFES scenarios by 2050 and so regardless of the DFES scenario considered, the same solution would be proposed in this EJP.

<u>Denham BSP Constraint:</u>

[redacted]

Figure 22

Although Figure 22 only shows that the load growth under scenarios CT and ST is significant enough to constrain the Denham BSP network by 2035 (91.1MVA and 105.1MVA against 90MVA under CT and ST, respectfully), the establishment of a new 132/33kV bulk supply point is required to facilitate the reinforcement required for Denham Avenue and Gerrards Cross primary substations. This is to avoid significant reinforcement of the 22kV network (a non-standard distribution voltage level) and instead use the opportunity to begin the process of rationalising the voltage level of the network fed from Denham BSP to 33kV. Additionally, Figure 22 shows that under all scenarios the proposed solution is forecasted to provide sufficient capacity out to 2050 (worst case being 114.9MVA against 180MVA under CT). Ultimately, the same solution would be proposed in this EJP regardless of the DFES scenario considered.

[redacted]

[redacted] Therefore, network intervention is required under any DFES scenario. The new constraint after the completion of the works proposed is a first circuit outage of the 132kV network feeding Denham and West Hyde BSPs. With 159.9MVA being the highest forecasted demand for 2050 under the CT scenario against a new constraint of 200MVA, the proposed solution in this EJP would be the same regardless of the DFES scenario considered.