Feeder Road BSP Network

Network Development Report – South West

May 2024

Electricity Distribution

nationalgrid

Contents

Feeder Road BSP

1. Network Overview

Feeder Road Bulk Supply Point (BSP) supplies a mostly urban area of 33 kV network, with the bulk of the demand centred in the City of Bristol. It is supplied from four 132/33 kV Grid Transformers (GTs) at Feeder Road BSP. Feeder Road BSP supplies approximately 130,000 customers.

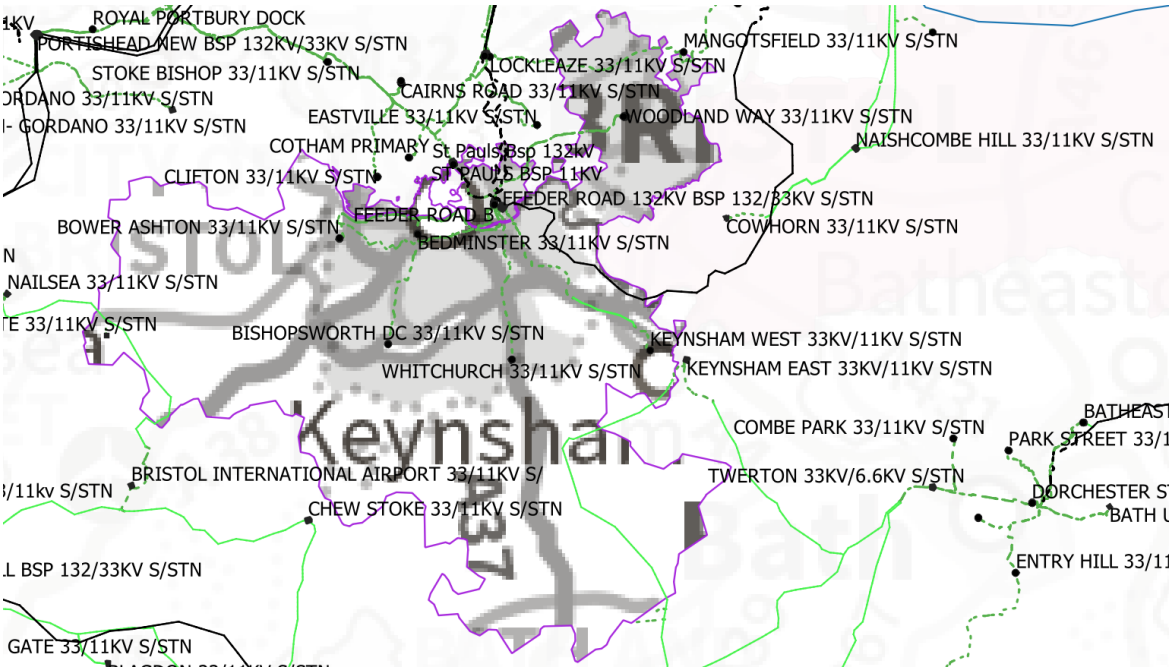

Figure 1.1 Feeder Road BSP geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon associated with the 33/11 kV transformers and 33 kV circuits which supply and are supplied by Feeder Road BSP. This uses the methodology outlined in the Network Development Plan Methodology Report with Network Operability Modelling applied as outlined below.

For the purposes of this analysis the NGED Best View Distribution Future Energy Scenario (DFES) has been used to study the years 2022 (baseline), 2028 and 2034, with consideration given to how proposals could change under the other scenarios. For some cases further scenarios were studied as volume of connection applications for a certain area was larger than expected, this also matches with funding that certain local authorities got particularly Bristol City Council for their District Heat Network. The two most onerous half-hours have been studied for each of the five representative days considered: Winter Peak Demand, Intermediate Warm Peak Demand, Intermediate Cool Peak Demand, Summer Peak Demand and Summer Peak Generation.

1.1 Network Topology

The Feeder Road BSP network is arranged as follows:

- Is fed by four GTs and the site is run split on the section breakers, with GT2 and GT4 as a pair and GT3 and GT1 as another pair.
- Whithcurch Primary with two 132 kV construction oil filled cable operating at 33 kV.
- Broadweir Primary with two 33 kV circuits from Feeder Road and a 33 kV normally open interconnection to Avonmouth BSP through Stoke Bishop.
- Feeder Road A with four 33 kV circuits and Feeder Road B with two other circuits situated close to the BSP.
- Woodland Way Primary is supplied with four 33 kV circuits.
- Bedminster Primary is supplied with two 33 kV clean circuits and a tee-off between Bower Ashton and Bedminster, besides that Bower Ashton is supplied from another tee-off

between itself and Keynsham West, Keynsham West is supplied by another tee-off between itself and Bishopsworth.

- Bishopsworth Primary has one clean circuit from Feeder Road BSP besides the one described above.

1.2 Network Operability Modelling

The following network automation and manual switching schemes have been modelled in the analysis of this area, aligning to how the network is currently operated, as well as proposed actions, to manage some constraints identified operationally.

- Modelled the 33 kV auto close at Feeder Road up to the 132 kV busbar at Iron Acton. However, it currently does not cover the busbar. This will be very important if there is any thought given to go back to a three way split. If this happens some intertrips will need to exist to trip St Pauls transformers to avoid backfeeds.

2. Summary of Network Constraints

The following constraints were identified for the Best View Scenario, for which mitigation options will be discussed:

- Bedminster – Bower Ashton circuit overload and Bedminster Transformers
- Feeder Road A and B primary capacities
- Woodland Way running arrangement proposed change

3. Network Constraint Details and Solution Options

3.1 Bedminster – Bower Ashton circuit overload and Bedminster Transformers

Constraint Overview

Generation **Demand**

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads seen at winter peak demand but in reality n-2.

Table 3.1.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
33 kV Circuit Capacity Feeder Road to Bedminster/Bower Ashton	Arranged outage of either Bedminster T1 or T2 or bar fault	Loss of either T1 or T2 including circuits	Baseline	Baseline	Baseline	Baseline

Uncertainty under other Distribution Future Energy Scenarios: As this constraint occurs under baseline, there is no uncertainty about future forecasts. Under the credible envelope demand is not projected to decrease which makes the risk of the solution becoming obsolete very small.

Solution Options

A list of each of the options considered for this constraint is given in the table below.

Table 3.1.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	**Discounted**
Reinforcement					
1	New 33 kV circuit from Feeder Road to Bedminster to unbank it	✓	✓	×	**Viable**
2	Create n-2 intertrips to avoid a situation where one Transformer is left on load	✓	×	×	**Viable**
Operational Mitigation					
3	Pre-emptively sectionalise network	✓	×	✓	**Viable**
Load Management Schemes					
4	Post-fault transfers	×	×	✓	**Discounted**
Flexibility services					
5	Procure flexibility	✓	×	✓	**Discounted**

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full cost benefit analysis (CBA). This CBA will be subsequently carried out by the Distribution Network Operator (DNO) to determine the optimal reinforcement solution, which will then be tested against market provided flexibility by the Distribution System Operator (DSO) as part of the Distribution Network Options Assessment (DNOA) process.

Option 0 – No Intervention

Capacity Released for constraint(s) considered: 0 MVA — **Discounted**

Detailed description: Doing nothing to mitigate the constraint would result in overloads for the conditions described above. This would lead to an inability to maintain network integrity and subsequently security of supply.

New limiting factor for constraint(s) considered: N/A

Option 1 – New 33 kV circuit from Feeder Road to Bedminster to unbank it

Capacity Released for constraint(s) considered: 23 MVA — **Viable**

Detailed description: This would create the most capacity as it would allow for largest circuit capacity. It is recommended to make provision for an additional circuit at Feeder Road as there is currently asset replacement works ongoing to replace the 33 kV board. Because of the large costs of this would be dig and lay, it could be a better option than going for the intertrip, due to intertrips also needing dig and lay. The length of the circuit would be about 2.5 km and recommended size at least 185 mm^2 Copper Cu.

New limiting factor for constraint(s) considered: Bedminster Transformer capacity.

Option 2 – Create n-2 intertrips to avoid a situation where one Transformer is left on load

Capacity released for constraint(s) considered: 0 MVA — **Viable**

Detailed description: This option suggests the creation of n-2 intertrips which would avoid any transformer being on its own. However, there may be cheaper options by sectionalising the network during the outage. This would mean less overloads in the Bedminster-Bower Ashton circuit.

New limiting factor for constraint(s) considered: Bedminster Transformer capacity.

Option 3 - Pre-emptively sectionalise network

Capacity Released for constraint(s) considered: 0 MVA — **Viable**

Detailed description: This option would arrange the network by having all three Transformers on one side of the busbar to avoid the situation of having one isolated Transformer. For an arranged outage of any of the transformers/circuits/bars open Bower Ashton T1 Circuit Breaker (CB) to allow for demand to drop and not overload the circuit. This would also work by allowing Transformers to run split on the 11 kV by opening CB 9 or 15 depending which circuit/transformer is on outage, 11 kV balancing may be required due it being three bars and two transformers left.

New limiting factor for constraint(s) considered: Bedminster Transformer capacity.

Option 4 – Post-fault transfers

Capacity Released for constraint(s) considered: 0 MVA — **Discounted**

Detailed description: Post fault transfers would not help in this case because the Transformers would be overloaded for the fault case.

New limiting factor for constraint(s) considered: Bedminster Transformer capacity.

Option 5 Procure flexibility

Capacity Released for constraint(s) considered: 0 MVA — **Viable**

Detailed description: Flexibility could help delay the reinforcement if enough can be procured.

New limiting factor for constraint(s) considered: Bedminster Transformer capacity.

Solution Recommendation

Bedminster Transformers will need to be assessed to start using cyclic ratings, once the limitation is solved the transformers will be limited by the 1250 A CB. It is recommended that outages should be limited to summer only until the circuit is reinforced. Network should be sectionalised for any arranged outage on the Bedminster clean circuits. According to Best View the Bedminster/Bower Ashton 33 kV circuit will need reinforcing in 2032 after the change in operational behaviour that

could be done in the baseline (move all circuits to the same busbar and split 11kV for any arranged outage).

3.2 Feeder Road A primary capacity

Constraint Overview

Generation Demand

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads happening during outage season.

Table 3.2.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Transformer Capacity	Loss of one Transformer	Loss of another Transformer	2026	2027	2029	2028

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2024 and under Falling Short is it predicted to arise in 2030.

Solution Options

A list of each of the options considered for this constraint is given in the table below.

Table 3.2.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	New 132/11/11 kV Feeder Road primary	✓	✓	×	Viable
2	New 33/11 kV larger transformers	✓	×	×	Viable
Operational Mitigation					
3	Transfer demand to neighbouring primaries	✓	×	✓	Discounted
4	11 kV site rebuild with 8 busbar sections	✓	✓	×	Viable
Load Management Schemes					
5	Post-fault transfers	×	×	×	Discounted
Flexibility services					
6	Procure flexibility around Feeder Road A primary	✓	×	✓	Viable

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full CBA. This CBA will be subsequently carried out by the DNO to determine the optimal reinforcement solution, which will then be tested against market provided flexibility by the DSO as part of the DNOA process.

Option 0 – No Intervention

Capacity Released for constraint(s) considered: 0 MVA — **Discounted**

Detailed description: Doing nothing to mitigate the constraint would result in overloads for the conditions described above.

New limiting factor for constraint(s) considered: N/A

Option 1 – New 132/11/11 kV primary at Feeder Road

Capacity Released for constraint(s) considered: Viable

55 MVA (includes the retirement of Feeder Road B for asset replacement soon)

Detailed description: This option would be a traditional 2 GT site with circuits double banked from the remaining two GTs at Feeder Road BSP. Consideration will need to be given how the 11 kV busbar design is made as potentially 8 section busbar will allow for full capacity of the windings to be used. It would also alleviate Feeder Road BSP capacity and St Pauls. The Feeder Road reactors are a limiting factor of the transformers at this moment. To increase its rating cyclic ratings will need to be used and checks need to be carried out to enable these. Replacing of the reactors could be done which would improve the rating by only 9MVA, but may not be necessary anymore and a more in depth fault level analysis for this area may be needed.

New limiting factor for constraint(s) considered: New primary capacity and 132 kV circuits.

Option 2 – New 33/11 kV larger transformers

Capacity released for constraint(s) considered: 14 MVA Viable

Detailed description: As Feeder Road B Transformers are getting close to needing replacing they could be replaced with larger units. These could be 20/40 MVA units which would mean upgrading the cables, circuits and protection. This may not be enough for the scale of growth seen past 2040 so Option 1 could be a better strategic option.

New limiting factor for constraint(s) considered: Capacity of new Primary Transformers.

Option 3 – Transfer demand to neighbouring primaries

Capacity Released for constraint(s) considered: 0 MVA Discounted

Detailed description: It would be recommended not to pursue this option as neighbouring primaries are also experiencing a large amount of projected growth.

New limiting factor for constraint(s) considered: N/A

Option 4 – 11kV site rebuild with 8 busbar sections

Capacity Released for constraint(s) considered: 23 MVA Viable

Detailed description: This is a mix of reinforcement and change in running arrangement. It can be quite expensive to do, combined with the reduced security of supply for n-2. A need for it will need to be assessed against the ease of balancing load across the feeders on the 11kV at the new or older Feeder Road site.

New limiting factor for constraint(s) considered: New configuration capacity.

Option 5 – Post-fault transfers

Capacity Released for constraint(s) considered: 0 MVA Discounted

Detailed description: Post fault transfers cannot be utilised as this is a network integrity issue for a loss of one transformer.

New limiting factor for constraint(s) considered: N/A

Option 6 – Procure flexibility at Feeder Road A Primary

Estimated Flexibility Required (MVA): Viable

5 MVA for worst case scenario by 2028

Detailed description: This a simple case so if there is enough interest in the area it could alleviate this constraint.

Solution Recommendation

It is recommended that cyclic ratings are enabled at Feeder Road A. Due to the 11 kV not allowing for full utilisation of the capacity of three transformers the reinforcement at primary level will be needed. It is recommended to go for a 132/11/11 kV primary due to the high levels of demand required in a small area. The earliest need for it would be 2026 which if full electrification was the chosen path for Bristol could very much be a real possibility.

3.3 Woodland Way capacity

Constraint Overview

Generation | Demand

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads seen at winter peak demand.

Table 3.3.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Primary Transformer Overload for a loss of two transformers	Feeder Road Main 1 or Reserve 1 busbar fault	None	2027	2027	2027	2031

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2024 and under falling short is it predicted to arise in 2029. The Firm capacity of the site being around 69 MVA is only projected to be exceeded around the late 2030s for Best View 2032 for Leading the Way and early 2040s in Falling Short.

Solution Options

A list of each of the options considered for this constraint is given in the table below.

Table 3.3.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	New primary 33/11 kV	✓	✓	×	Viable
2	Transfer demand to other primaries	✓	✓	×	Discounted
3	Uprate two of the four transformers to 20/40 MVA units and respective circuits	✓	✓	×	Viable
Operational Mitigation					
4	Running arrangement change – all circuits on the same busbar	✓	×	✓	Viable
5	Running arrangement change – run it as two independent primaries and switch out the autoclose	✓	×	✓	Viable
Load Management Schemes					
6	Post-fault transfers	✓	×	✓	Discounted
Flexibility services					
7	Procure flexibility at Woodland Way primary	✓	✓	✓	Viable

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full CBA. This CBA will be subsequently carried out by the DNO to determine the optimal reinforcement solution, which will then be tested against market provided flexibility by the DSO as part of the DNOA process.

Option 0 – No Intervention

Capacity Released for constraint(s) considered: 0 MVA — **Discounted**

Detailed description: Doing nothing to mitigate the constraint would result in overloads for the conditions described above. This would lead to an inability to maintain network integrity.

New limiting factor for constraint(s) considered: N/A

Option 1 – New primary 33/11 kV

Capacity Released for constraint(s) considered: 23 MVA — **Viable**

Detailed description: This option should only be considered after Option 3 has been fully considered and assessed.

Due to the proximity with another constraint a joint approach between Cowhorn constraint in the Chipping Sodbury BSP report and this report should be taken. Due to this area being a lot closer to Feeder Road over Chipping Sodbury it could make sense building a new primary from Feeder Road that would take both South West and West Midlands customers.

New limiting factor for constraint(s) considered: New primary Transformers.

Option 2 – Transfer demand to other primaries

Capacity released for constraint(s) considered: 0 MVA — **Discounted**

Detailed description: Woodland Way is close to an area with minimal network. This is due to it being in a licence area border and the neighbouring primary from the West Midlands, Cowhorn, being 3.8 km away. Cowhorn is in another licence area which would would make it difficult to transfer demand to so that would not be an option, the only primaries around would be Mangotsfield which has limited capacity and its own problems from 2032. In summary, there isn't an option to transfer out demand.

New limiting factor for constraint(s) considered: Current primary capacities

Option 3 – Uprate two of the four transformers to 20/40 MVA units and respective circuits

Capacity released for constraint(s) considered: 15 MVA — **Viable**

Detailed description: This option would release 15 MVA of capacity which would take us to 2032 under Leading the Way if the 11 kV assessment was to limit the capacity of Woodland Way to 46 MVA.

New limiting factor for constraint(s) considered: New primary Transformers.

Option 4 – Running arrangement change – all circuits on the same busbar

Capacity Released for constraint(s) considered: 0 MVA — **Viable**

Detailed description: The easier way of fixing this issue would be to move half of the Woodland Way circuits into one busbar and the other half onto the other making T1/ T2 onto one busbar and T3/T4 onto another. If there was to be a busbar fault it would not leave Woodland Way on two transformers and affect network integrity. The autoclose would still function if a Transformer Circuit breaker was to be opened, the network would need to be sectionalised post autoclose operation. This option would solve the network integrity issue but it would need to be assessed against the increase in CIs and CMLs in the local area, which would happen anyway if nothing is done. The 11 kV only has 4 busbar sections which will not permit the full use of the capacity of three transformers.

New limiting factor for constraint(s) considered: N/A

Option 5 – Running arrangement change – run it as two independent primaries and switch out the autoclose

Capacity Released for constraint(s) considered: 0 MVA — **Discounted**

Detailed description: Due to the high loading at Woodland Way this would not work as aggregated demand is already above 46 MVA.

New limiting factor for constraint(s) considered: N/A

Option 6 – Post-fault transfers

Capacity Released for constraint(s) considered: 0 MVA

Discounted

Detailed description: Not applicable as this is an n-1 issue.

New limiting factor for constraint(s) considered: N/A

Option 7 – Procure flexibility at Woodland Way Primary Substation

Estimated Flexibility Required (MVA):

Viable

3 MVA by 2027 (to lengthen current running arrangement)

Detailed description: Flexibility services could be procured at Woodland Way primary to alleviate projected overloads if current running arrangement is kept.

Solution Recommendation

It is recommended that Woodland Way changes its running arrangement and its security of supply is reduced to save network integrity, but due to the 11kV arrangement this may only last until 2027.

However, for the longer term the preferred option is to build a new primary from Feeder Road BSP that will feed South West and West Midlands' customers. This would solve this constraint and Cowhorn's primary substation in the West Midlands. Until 2031 a reduced outage window will solve the issue temporarily.

If the decision is to take independent approaches between licence areas 20/40MVA transformers will be needed for half of Woodland Way and respective circuits will need to be uprated.

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