Radstock BSP

Network Development Report – South West

May 2024

Electricity Distribution

nationalgrid

Contents

Radstock BSP

1. Network Overview

Radstock Bulk Supply Point (BSP) supplies a mixture of rural and urban sections of 33 kV network in North Somerset. It is supplied from the Y-route 132 kV circuit which is fed from Seabank Grid Supply Point (GSP), with two 60/90 MVA 132/33 kV grid transformers (GTs) supplying the group. Radstock BSP supplies approximately 44,000 customers.

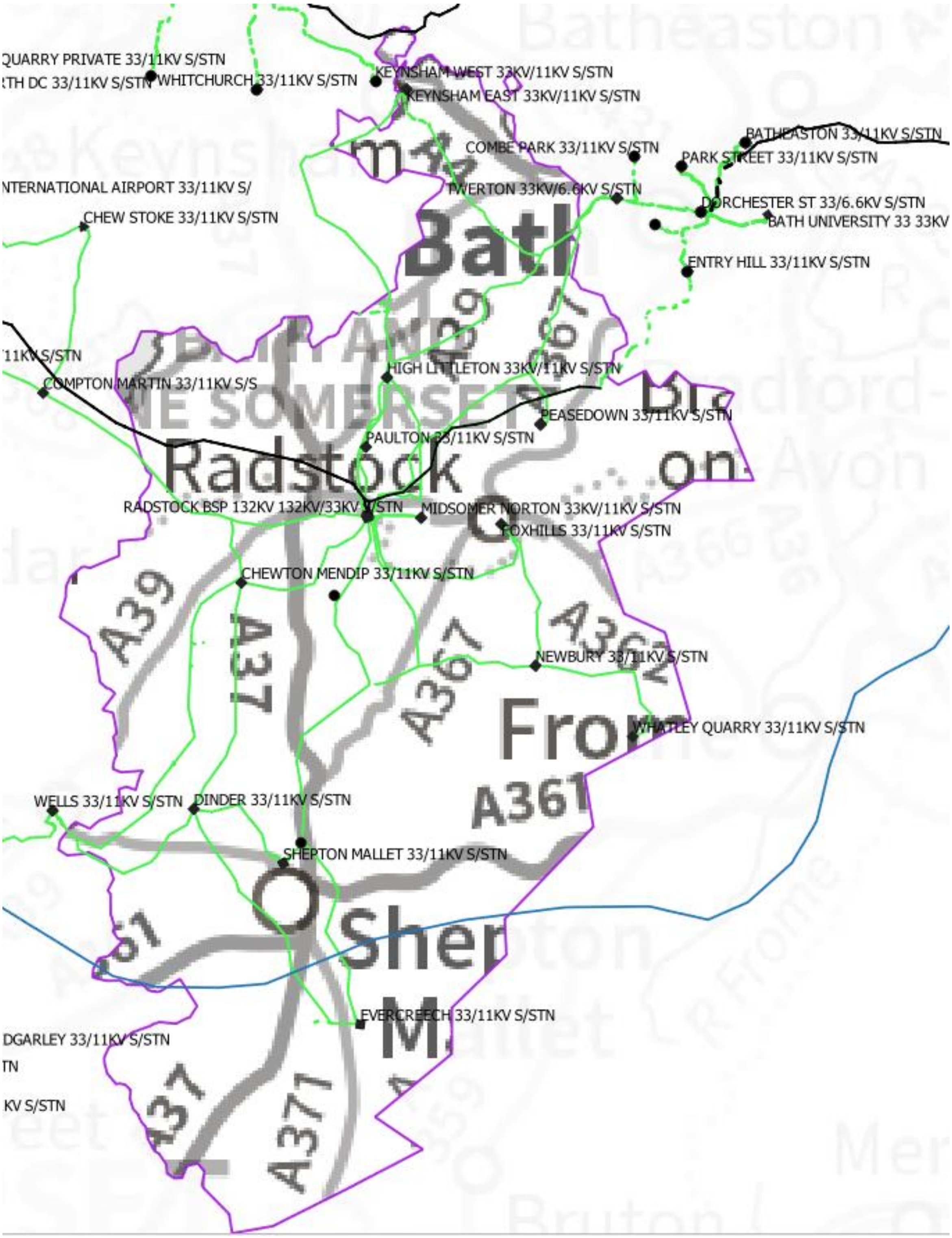

Figure 1.1 Radstock BSP geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon associated with the 33/11 kV transformers, 33 kV circuits and 132/33 kV transformers which supply or are supplied by Radstock 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. Five representative days have been studied across the four seasons: Winter Peak Demand, Intermediate Warm Peak Demand, Intermediate Cool Peak Demand, Summer Peak Demand and Summer Peak Generation.

1.1 Network Topology

The Radstock BSP network is arranged as follows:

- GT1 and GT2 currently run in parallel supplying Radstock BSP.
- Midsomer Norton Primary substation is supplied via two separate transformer feeders.
- Peasedown Primary supplied by a single circuit, with normally open 33 kV interconnection with Bath BSP via Twerton.
- A 33kV ring supplying Paulton, High Littleton and Keynsham East Primaries, along with connections to two 33 kV connected generators and normally open 33 kV interconnection with Bath BSP via Twerton.
- A 33 kV ring supplying Foxhills, Whatley Quarry & Newbury Primaries.
- A 33 kV ring supplying Evercreech, Dinder, Shepton Mallet and Chewton Mendip Primary substations, along with connections to seven 33 kV connected generators, with normally open 33 kV interconnection with Bridgwater/Street group via Wells.

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.

- For arranged outages of the 1S0 circuit breakers at Foxhills and Newbury primary substations, one of the primary transformers is run with the 11 kV circuit breaker open (i.e. on 'hot standby'). This is to reduce the risk of through-flow for credible next faults on the network, where the 11 kV network at the primary becomes a link to the wider 33 kV network and could overload transformers.
- For the loss of an infeed to a transformer at any of the primaries fed from Radstock BSP under arranged outages, the lower voltage side circuit breaker is opened to prevent back-energisation.

2. Summary of Network Constraints

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

- Radstock Grid Transformer overloads
- Keynsham East Transformer overloads
- Chewton Mendip Transformer overload
- Foxhills Transformer overloads
- Radstock/Foxhills/Newbury 33 kV circuit ring overload
- Midsomer Norton Transformer overloads
- Radstock to Midsomer Norton 33 kV circuit overloads
- Paulton/High Littleton/Keynsham East ring 33 kV circuit overloads and low volts
- Radstock/Chewton Mendip/Evercreech/Shepton Mallet ring 33 kV circuit overload and low volts
- Midsomer Norton Transformers Generation Overload due Reverse Power flow limitations

3. Network Constraint Details and Solution Options

3.1 Radstock Grid Transformer Overloads

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 3.1.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Radstock BSP GT1	Fault/outage of Radstock GT2 or associated busbar	None	2028	2028	2028	2034
Radstock BSP GT2	Fault/outage of Radstock GT1 or associated busbar	None	2028	2028	2028	2034

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2026 and under Falling Short it is 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 3.1.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Replace existing transformers	✓	×	×	Discounted
2	Install additional transformer	✓	✓	✓	Viable
3	Install new BSP	✓	✓	✓	Viable
Operational Mitigation					
4	Transfer demand to other BSPs	×	×	×	Discounted
Load Management Schemes					
5	Uprate the existing transformers via use of cyclic ratings	✓	✓	✓	Viable
Flexibility services					
6	Procure flexibility	✓	✓	✓	Viable

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 DNO to determine the optimal reinforcement solution, which will then be tested against market provided flexibility by the 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. Therefore, not intervening would cause problems with system integrity (overloads) and would not be a technically viable solution.

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

Option 1 – Replace existing transformers

Capacity Released for constraint(s) considered: Unknown — Discounted

Detailed description: As the grid transformers are already 90 MVA units which are the highest rating NGED currently procures, this would involve replacing the transformers with larger custom purchased transformers. This would be at significant cost whilst not releasing a lot of capacity. Therefore, this option has been discounted.

New limiting factor for constraint(s) considered: New transformer capacity

Option 2 – Install additional transformer

Capacity Released for constraint(s) considered: Up to 68 MVA — Viable

Detailed description: Installing a third transformer alongside switchgear and civil works would allow two transformers to remain in service for a fault of either of the existing circuits, preventing an overload. However, there are only two 132 kV circuits supplying Radstock BSP at present meaning three transformers and a significant amount of demand would be fed from only two 132 kV circuits. In addition, parts of these circuits may be used to supply Sandford GSP from Seabank GSP during a time when two SGTs are out of service at Sandford. This further limits the 132kV circuit capacity available for a third transformer. Therefore, this solution would likely require 132kV circuit reinforcement as well as an additional transformer, further adding to the cost. Therefore, comparison against a new BSP should be made to determine which the most cost-effective option is.

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

Option 3 – Install new BSP

Capacity Released for constraint(s) considered: 90 MVA — Viable

Detailed description: Installing a new BSP would require two new 132 kV circuits and two new 132kV/33 kV transformers as well as all ancillaries. This would also involving identifying a credible site to locate the new BSP. One option considered was utilising the 132 kV Y route from Melksham GSP and locating a new BSP between Bath and Radstock in order to tackle grid transformer constraints at both BSPs. This would involve surveying the line, potential extensions and coordination with NGET to determine if there is capacity at Melksham GSP.

New limiting factor for constraint(s) considered: Ability to transfer load off Radstock BSP to the new BSP via 33 kV circuits.

Option 4 – Transfer demand to other BSPs

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

Detailed description: The nearest BSP which is still 14 km away is Bath BSP. Bath BSP is also predicted to have grid transformer constraints meaning there is no capacity available for demand transfers.

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

Option 5 – Uprate the existing transformers via use of cyclic ratings

Capacity Released for constraint(s) considered: Up to 27 MVA

Viable

Detailed description: Uprate the existing transformers via use of cyclic ratings in accordance with British Standard 171/IEC60076 and NGED Standard Technique SD8C. This requires a capability assessment of all ancillaries, such as busbars, isolators, Current Transformers (CTs), cables (including cabling within the substation), switchgear, tap changer, transformer bushings, conservator and earthing transformer. In addition, an assessment of the cyclic profile of the load is required to determine if transformer temperature and ageing is within acceptable limits. This would defer reinforcement requirements to 2030 for Radstock.

New limiting factor for constraint(s) considered: Winter cyclic rating of GTs.

Option 6 – Procure flexibility

Estimated Flexibility Required (MVA): 5 MVA+

Viable

Detailed description: Flexibility services could be procured to alleviate projected overloads. The amount required will continue to grow as demand grows meaning this would likely only defer the reinforcement.

Solution Recommendation

It is recommended to determine if cyclic ratings are applicable to Radstock GTs in accordance with British Standard 171/IEC60076 and NGED Standard Technique SD8C. This could allow the transformers to be rated up to 117 MVA which would allow further mitigation to be deferred until 2030.

Following this, flexibility could be used to further defer reinforcement, subject to a cost benefit analysis confirmation through the DNOA process.

Finally, a cost benefit analysis of installing a third grid transformer and 132 kV circuit compared to installing a new BSP between Bath and Radstock to de-load both BSPs should be carried out to determine the best long term solution.

3.2 Keynsham East T1 and T2 Overloads

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 3.2.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Keynsham East T1 Overload	Fault/outage of Keynsham T2 or associated busbar	None	2026	2026	2026	2026
Keynsham East T1 Overload	None (intact)	None	2031	2031	2031	2031
Keynsham East T2 Overload	Fault/outage of Keynsham T1 or associated busbar	None	2029	2029	2029	2029

Uncertainty under other Distribution Future Energy Scenarios: T1 overload is estimated to occur in 2026 under leading the way and 2031 under falling short. T2 overload is estimated to occur in 2029 under leading the way and 2034 under falling short.

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 Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Replace one or both existing transformers	✓	✓	✓	Viable
2	Install additional transformer	✓	×	×	Discounted
Operational Mitigation					
3	Transfer demand to other Primaries	✓	✓	✓	Viable
Load Management Schemes					
4	Uprate T1 via use of cyclic ratings	✓	×	×	Discounted
Flexibility services					
5	Procure flexibility	✓	✓	✓	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. Therefore, not intervening would cause problems with system integrity (overloads) and would not be a technically viable solution.

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

Option 1 – Replace one or both existing transformers

Capacity Released for constraint(s) considered: **Viable**

4 MVA one transformer, 9MVA both transformers

Detailed description: T2 was recently replaced with a 7.5/15 MVA unit whilst T1 is a 10 MVA unit from 1964. 12/24 MVA units would be more suitable and if installed mitigate both T1 and T2 constraints predicted. However, as T2 was replaced recently it would not be cost-effective to upgrade it to 12/24 MVA in the near term. If T1 was changed for a 7.5/15 MVA unit or a 12/24 MVA unit to future-proof the site this would release capacity up until 2029 and prevent intact overloads of T1 predicted in 2031. However, beyond 2029 this solution is insufficient due to T2 rating, meaning demand transfers to Keynsham West need to be considered in conjunction (option 3) and if not possible both units will need to be upgraded to 12/24 MVA.

New limiting factor for constraint(s) considered: Existing T2 transformer

Option 2 – Install additional transformer

Capacity Released for constraint(s) considered: 10 MVA **Discounted**

Detailed description: Installing a third transformer alongside switchgear and civil works would allow two transformers to remain in service for a fault of either of the existing circuits, preventing an overload. However, there are only two 33 kV circuits with insufficient capacity for a third transformer. Therefore, this option would require a long 33 kV circuit to be installed so would not be cost-effective.

New limiting factor for constraint(s) considered: Existing transformers.

Option 3 – Transfer demand to other Primaries

Capacity Released for constraint(s) considered: **Viable**

Up to 10 MVA depending on 11 kV circuit capacity

Detailed description: Keynsham West is the nearest primary substation. It has 12/24 MVA units and up to 10.5 MVA spare capacity predicted in 2040. Therefore, transferring demand would prevent overloads on Keynsham East

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

Option 4 – Uprate T1 via use of cyclic ratings

Capacity Released for constraint(s) considered: 3 MVA **Discounted**

Detailed description: Uprate the existing transformers via use of cyclic ratings in accordance with British Standard 171/IEC60076 and NGED Standard Technique SD8C. This requires a capability assessment of all ancillaries, such as busbars, isolators, CTs, cables (including cabling within the substation), switchgear, tap changer, transformer bushings, conservator and earthing transformer. In addition, an assessment of the cyclic profile of the load is required to determine if transformer temperature and ageing is within acceptable limits.

Due to the age of T1 installed in 1964 it is recommended to replace this over use of cyclic ratings to secure capacity for long term growth.

New limiting factor for constraint(s) considered: Winter cyclic rating of T1

Option 5 – Procure flexibility

Estimated Flexibility Required (MVA): 1MVA+ **Viable**

Detailed description: Flexibility services could be procured to alleviate projected overloads. The amount required will continue to grow as demand grows meaning this would likely only defer the reinforcement.

Solution Recommendation

Flexibility could be considered to defer reinforcement in the short term. However, it is recommended to replace Keynsham East T1 due to its age (installed in 1964). Whilst a 12/24 MVA unit would be most appropriate, it would not increase capacity significantly as T2 is a 7.5/15 MVA unit. As T2 was replaced recently it would not be cost-effective to also upgrade it to 12/24 MVA in the near term. T1 could be replaced with a 7.5/15 MVA unit or a 12/24 MVA unit to future-proof the site. However, due to the rating of T2, beyond 2029 this solution is insufficient.

Keynsham West has two 12/24 MVA transformers at present and there is significant spare transformer capacity. Therefore, transferring demand with 11 kV reinforcement if required is likely to be required in the long term to prevent overloads on Keynsham East 7.5/15 MVA unit. This is dependent on sufficient 33 kV circuit capacity and GT capacity at Feeder Road BSP and a cost benefit analysis should be conducted to compare 11 kV options to replacing both Keynsham East transformers with 12/24 MVA units.

3.3 Chewton Mendip Transformer Overload

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 studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Chewton Mendip T1 demand overload	None (intact)	None	2030	2030	2030	2030
Chewton Mendip T1 generation overload	None (intact)	None	N/A	N/A	N/A	2028

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, the demand constraint is predicted to arise in 2027 and under Falling Short it is predicted to arise in 2033.

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 Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Replace existing transformer	✓	✓	✓	Viable
2	Install additional transformer and 33 kV circuit	×	×	×	Discounted
Operational Mitigation					
3	Transfer demand to other Primaries	×	×	×	Discounted
Load Management Schemes					
4	Uprate the existing transformers via use of cyclic ratings	×	×	×	Discounted
Flexibility services					
5	Procure flexibility	✓	✓	✓	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. Therefore, not intervening would cause problems with system integrity (overloads) and would not be a technically viable solution.

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

Option 1 – Replace existing transformers

Capacity Released for constraint(s) considered: 9 MVA

Viable

Detailed description: This would involve replacing the existing transformer with a 7.5/15 MVA unit. Given the age of the transformer (installed 1964) this would have a dual benefit in terms of releasing capacity and replacing aging assets.

New limiting factor for constraint(s) considered: New transformer rating.

Option 2 – Install additional transformer and 33 kV circuit

Capacity Released for constraint(s) considered: 0 MVA

Discounted

Detailed description: Installing an additional transformer would mitigate the intact overloads but this would then become an N-1 (first circuit outage) constraint which would still need to be mitigated. Therefore, this option is not technically viable but may be considered in the long term to improve security of supply at Chewton Mendip.

New limiting factor for constraint(s) considered: Existing transformers.

Option 3 – Transfer demand to other Primaries

Capacity Released for constraint(s) considered: 0 MVA

Discounted

Detailed description: Chewton Mendip is very remote with the nearest primary substation of Paulton being upwards of 6 km away. Therefore, demand transfer options are very limited and there is unlikely to be any significant transfer capacity available. Therefore, this is not a viable solution.

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

Option 4 – Uprate the existing transformers via use of cyclic ratings

Capacity Released for constraint(s) considered: 0 MVA

Discounted

As Chewton Mendip is a single transformer primary the transformer does not run in parallel with a second transformer. Therefore, it is already subject to an increased aging rate as it experiences the full load during normal running (compared to 50% for parallel operation) and cannot be uprated.

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

Option 5 – Procure flexibility

Estimated Flexibility Required (MVA): 0.5 MVA+

Viable

Detailed description: Flexibility services could be procured to alleviate projected demand and generation overloads. The amount required will continue to grow as demand grows meaning this would likely only defer the reinforcement.

Solution Recommendation

It is recommended to firstly consider flexibility as an option for both demand and generation constraints to defer reinforcement, subject to a cost benefit analysis confirmation through the DNOA process. Following this, it is recommended to replace the existing transformer with a 7.5/15 MVA unit to allow for long term growth in the area and replace an aging asset. It may also be considered in the works to allow for a second transformer in the future as Chewton Mendip is a single transformer primary reliant on 11 kV backfeeds during fault/outage.

3.4 Foxhills and Midsomer Norton Transformer Overloads and 33 kV circuit overloads

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 3.4.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Foxhills T1 Overload	Fault/outage of Foxhills T2 or associated busbar	None	2034	2034	2034	2034
Foxhills T2 Overload	Fault/outage of Foxhills T1 or associated busbar	None	2034	2034	2034	2034
Radstock/Foxhills /Newbury 33 kV circuit ring overload	Fault/outage of either end of the ring	None	2036	2036	2036	2036
Midsomer Norton T1 Overload	Fault/outage of Midsomer Norton T2 or associated busbar	None	2033	2033	2034	2034
Midsomer Norton T2 Overload	Fault/outage of Midsomer Norton T1 or associated busbar	None	2033	2033	2034	2034
Radstock 8L5 to Midsomer Norton 33 kV circuit overload	Fault/outage of Midsomer Norton 13L5	None	2033	2033	2034	2034
Radstock 13L5 to Midsomer Norton 33 kV circuit overload	Fault/outage of Midsomer Norton 8L5	None	2033	2033	2034	2034

Uncertainty under other Distribution Future Energy Scenarios:

- Foxhills transformer overload is estimated to occur in 2032 under leading the way and 2040 under falling short.
- Radstock/Foxhills/Newbury 33 kV circuit ring overload is estimated to occur in 2033 under leading the way and 2041 under falling short.
- Midsomer Norton transformer and circuit overload is estimated to occur in 2031 under leading the way and 2040 under falling short.

Solution Options

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

Table 3.4.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Reinforce existing transformers and 33 kV circuits	×	×	×	Discounted
2	Install additional transformer and 33 kV circuit	✓	✓	✓	Viable
3	Install new primary substation	✓	✓	✓	Viable
Operational Mitigation					
4	Transfer demand to other Primaries	×	✓	×	Discounted
Load Management Schemes					
-	*None Identified*	-	-	-	-
Flexibility services					
5	Procure flexibility	✓	✓	✓	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. Therefore, not intervening would cause problems with system integrity (overloads) and would not be a technically viable solution.

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

Option 1 – Reinforce existing transformers and 33 kV circuits

Capacity Released for constraint(s) considered: 13 MVA

Discounted

Detailed description: This would involve replacing the transformers at Midsomer Norton with 20/40 MVA units and reinforcing the 33 kV circuits. These transformers were installed in 1988 so are not due to be replaced, in addition, the 33 kV circuits could not be rated high enough without installing a third circuit. Similarly further 33 kV circuits and 12/24 MVA transformers would be required for Foxhills. Therefore, this is not a viable solution and would be very high cost.

New limiting factor for constraint(s) considered: 40 MVA transformer ratings

Option 2 – Install additional transformer and 33 kV circuit

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

Detailed description: Installing a third transformer alongside switchgear and civil works and a new 33 kV circuit into Midsomer Norton is an option that could be considered. It would allow two transformers to remain in service for a fault of any circuit/transformer, preventing an N-1 overload. Furthermore, demand could be transferred from Foxhills to prevent an overload assuming the 11 kV circuits are capable. However, a three transformer primary would have N-2 overloads and would not be as secure as installing a new primary substation with two dedicated 33 kV circuits and two new transformers. Furthermore, it is required to take demand off Radstock for grid transformer constraints which could not be easily achieved by installing an additional circuit and transformer at the existing site as compared to a new primary which can have 33 kV cables from a new BSP in the proximity. Therefore, a cost benefit analysis should be carried out against a new primary substation.

New limiting factor for constraint(s) considered: 11 kV transfer availability from Foxhills

Option 3 – Install new primary substation

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

Detailed description: Installing a new primary in the proximity of Foxhills and Midsomer Norton and transferring demand via new and existing 11 kV circuits would mitigate the primary transformer overloads and circuit overloads at both sites. Due to Radstock and Bath grid transformer constraints, if a new BSP is also established in this proximity it may be possible to feed this new primary from here. This may offer a more cost-effective and strategic long term solution than extending Midsomer Norton primary subject to a cost benefit analysis of these two options.

New limiting factor for constraint(s) considered: 11 kV circuit capacity

Option 4 – Transfer demand to other Primaries

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

Detailed description: There are no primary substations with capacity in the area meaning demand transfer is not an option.

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

Option 5 – Procure flexibility

Estimated Flexibility Required (MVA): 2 MVA+ Viable

Detailed description: Flexibility services could be procured at both Midsomer Norton and Foxhills to alleviate projected overloads. The amount required will continue to grow as demand grows meaning this would likely only defer the reinforcement.

Solution Recommendation

Flexibility could be considered at both sites in the first instance in order to defer reinforcement.

Following this, it is recommended to carry out a cost benefit analysis of installing a third transformer and 33 kV circuit into Midsomer Norton as well as transferring demand off Foxhills compared to a new primary substation in the area.

A new primary substation would require a suitable site to be identified in the proximity of Midsomer Norton and Foxhills. Due to Radstock and Bath grid transformer constraints, if a new BSP is also established in this proximity it may be possible to feed this new primary from here. This would allow both Primary substations and both sets of 33 kV circuits to be de-loaded to prevent overloads and reduce load on Radstock to de-load the grid transformers.

Nonetheless, as there is some uncertainty and the constraints could occur as late as 2040 the timing and requirement for reinforcement should be monitored as demand grows.

3.5 Radstock/Chewton Mendip/Evercreech/Shepton Mallet ring 33 kV circuit overload and low volts

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 and summer peak generation.

Table 3.5.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Radstock 6L5 to EVER3T 33 kV circuit overload	Dinder 1S4 Isolator arranged outage OR Radstock Main 3 bubsar fault/outage	None	2028	2028	2028	>2034
Radstock 11L5 to RADS3T 33 kV circuit overload	Radstock 6L5 33 kV circuit fault/outage OR Shepton Mallet Main 2 outage	None	2028	2028	2028	>2034
Shepton Mallet 2L3 to 16PL3_ZO115 33 kV circuit overload	Radstock Main 3 busbar fault/outage OR Radstock 11L5 circuit arranged outage	None	2028	2028	>2034	>2034
Various demand overloads	Various arranged outages	Various faults	Baseline	Baseline	Baseline	Baseline
Low volts at customer sites	Radstock 33 kV bubsar faults/outages and various other circuit/busbar fault/outages	None	Baseline	Baseline	Baseline	Baseline
Radstock 6L5 33 kV circuit **generation overload**	Radstock Main 3 bubsar fault/outage OR Radstock 11L5 circuit arranged outage	None	N/A	N/A	N/A	2028
Various generation overloads	Various arranged outages	Various faults	N/A	N/A	N/A	2028

Uncertainty under other Distribution Future Energy Scenarios: These constraints are forecast to occur around the same time. Under Leading the Way Scenario, this constraint is predicted to arise in 2026 and under Falling Short it is predicted to arise in 2031.

Solution Options

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

Table 3.5.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Reinforce existing 33 kV circuits	✓	✓	✓	Viable
2	Install additional 33 kV circuit	✓	✓	✓	Viable
3	Change running arrangement with reinforcement	✓	✓	✓	Viable
Operational Mitigation					
4	Transfer demand to other Primaries	×	×	×	Discounted
Load Management Schemes					
-	*None Identified*	-	-	-	-
Flexibility services					
5	Procure flexibility	✓	✓	✓	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. Therefore, not intervening would cause problems with system integrity (overloads) and would not be a technically viable solution.

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

Option 1 – Reinforce existing 33 kV circuits

Capacity Released for constraint(s) considered: Viable

12.8 MVA (assuming 0.1 in^2 HDC 33 kV overhead conductor is re-conductored with 150 mm^2 Cu and there are no other limitations)

Detailed description: This options involves reinforcing the existing overhead line, cable sections and ancillaries which limit the rating of the existing circuits. Due to the significant length of the existing circuits this is likely to prove more cost-effective than installing additional new circuits. However, it is dependent on the existing overhead line structures being able to support larger conductors and achieving a high enough rating to prevent overloads, therefore this may not be possible and new circuits may be required.

New limiting factor for constraint(s) considered: New circuit rating.

Option 2 – Install additional 33 kV circuits

Capacity released for constraint(s) considered: 22.7 MVA Viable

Detailed description: Installing an additional 33 kV circuit from Radstock BSP to Chewton Mendip/Dinder/Evercreech would mitigate this constraint by leaving an additional circuit in service for the fault of any existing circuit. Given the significant length of this circuit and termination works required, reinforcement of the existing circuits should be considered in the first instance.

New limiting factor for constraint(s) considered: Existing 33 kV circuits.

Option 3 – Change running arrangement with reinforcement

Capacity released for constraint(s) considered: Unknown Viable

Detailed description: This would involve considering the options to install additional circuit breakers and/or shorter 33 kV circuits in order to prevent the overloads observed.

One option considered was to install a circuit breaker to run normally closed in place of Chewton Mendip 1L4 isolator which was shown to remove some of the overloads. However, this is not P18 compliant as there would be too many circuit breakers to isolate that circuit. Therefore, further exploration of this option and others such as splitting up the interconnected rings into simpler two circuit rings could be considered in order to facilitate long term growth at the most economical cost.

New limiting factor for constraint(s) considered: Existing 33 kV circuits.

Option 4 – Transfer demand to other Primaries

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

Detailed description: There are no primary substations in proximity that are not part of the ring meaning this is not a technically viable option.

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

Option 5 – Procure flexibility

Estimated Flexibility Required (MVA): 2 MVA+ Viable

Detailed description: Flexibility services could be procured at Evercreech and Shepton Mallet in order to prevent the demand driven overloads predicted. The amount required will continue to grow as demand grows meaning this would likely only defer the reinforcement.

Solution Recommendation

It may be possible to procure flexibility at Evercreech and Shepton Mallet in order to prevent the demand driven overloads predicted, subject to a cost benefit analysis confirmation through the DNOA process. Flexibility from generators would benefit the generation constraints if this could be procured also.

However, longer term a review of running arrangement should be carried out to determine if further infeeds can be brought into the group. For example, replacing Chewton Mendip 1L4 isolator with a circuit breaker and making the necessary modifications to achieve P18 compliance which may involve additional circuits and switchgear, or breaking the interconnected loops into simpler two circuit loops through reinforcement. This would be subject to technical review and cost benefit analysis of the options.

If this is not possible or does not also solve all demand, voltage and generation constraints re-conductoring of the existing 33 kV circuits is recommended assuming the existing poles are capable. If this is not possible, it may be necessary to install additional 33 kV circuits the whole distance of the existing circuits to prevent the predicted overloads.

3.6 Paulton/High Littleton/Keynsham East ring 33 kV circuit overloads

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 3.6.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
High Littleton 3L5 to Keynsham East 1L3 33 kV circuit overload	Fault/arranged outage of Radstock 5L5	None	2034	2034	2034	2034
Radstock 5L5 to Keynsham East 2L3 33 kV circuit overload	Fault/outage of High Littleton 3L5 to Keynsham East 1L3	None	2034	2034	2034	2034
Radstock 12L5 to Paulton 2L3 33 kV circuit overload AND Paulton 1L3 to High Littleton 2L4 overload	Fault/arranged outage of Radstock 7L5	None	2034	2034	2034	2034
Radstock 7L5 to High Littleton 4L5 33 kV circuit overload	Fault/arranged outage of Radstock Main 3 33 kV busbar	None	2034	2034	2034	2034
Various demand overloads	Various arranged outages	Various faults	Baseline	Baseline	Baseline	Baseline

Uncertainty under other Distribution Future Energy Scenarios: These constraints are related and forecasted to occur around the same time. Under Leading the Way Scenario, these constraints are predicted to arise in 2031 and under Falling Short it is predicted to arise after 2040.

Solution Options

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

Table 3.6.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Reinforce existing 33 kV circuits	✓	×	✓	Viable
2	Install additional 33 kV circuit	✓	×	✓	Viable
Operational Mitigation					
3	Transfer demand to Keynsham West	✓	✓	✓	Viable
Load Management Schemes					
-	*None Identified*	-	-	-	-
Flexibility services					
4	Procure flexibility	✓	✓	✓	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: Detailed description: Doing nothing to mitigate the constraint would result in overloads for the conditions described above. Therefore, not intervening would cause problems with system integrity (overloads) and would not be a technically viable solution.

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

Option 1 – Reinforce existing 33 kV circuits

Capacity Released for constraint(s) considered: **Viable**

12.8 MVA (assuming 0.1 in^2 HDC 33 kV overhead conductor is re-conductored with 150 mm^2 Cu and there are no other limitations)

Detailed description: This options involves reinforcing the existing overhead line, cable sections and ancillaries which limit the rating of the existing circuits. Due to the significant length of the existing circuits this is likely to prove more cost-effective than installing additional new circuits. However, it is dependent on the existing overhead line structures being able to support larger conductors and achieving a high enough rating to prevent overloads, therefore this may not be possible and new circuits may be required.

New limiting factor for constraint(s) considered: Existing 33 kV cable sections

Option 2 – Install additional 33 kV circuits

Capacity released for constraint(s) considered: 22.7 MVA **Viable**

Detailed description: Installing an additional 33 kV circuit from Radstock BSP to Paulton/High Littleton/Keynsham East would mitigate this constraint by leaving an additional circuit in service for the fault of any existing circuit. Given the significant length of this circuit and termination works required, reinforcement of the existing circuits should be considered in the first instance.

New limiting factor for constraint(s) considered: Existing 33 kV circuits

Option 3 – Transfer demand to Keynsham West

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

Detailed description: Keynsham West has two 12/24 MVA transformers and up to 10.5 MVA spare capacity predicted in 2040 depending on 33 kV and 11 kV circuit capacity. Transferring approximately 10.5 MVA demand would prevent overloads on Keynsham East in Best View in 2034.

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

Option 4 – Procure flexibility

Estimated Flexibility Required (MVA): 10.5 MVA+ **Viable**

Detailed description: Flexibility services could be procured at Keynsham East to alleviate projected overloads. The amount required will continue to grow as demand grows meaning this would likely only defer the reinforcement. In addition, a significant amount of flex is required to remove all constraints in 2034 Best View.

Solution Recommendation

It may be possible to procure flexibility at Keynsham East primary to defer the reinforcement requirements, however, it is unlikely sufficient flexibility will be procured to prevent the constraints seen.

In conjunction with this, it is recommended to transfer as much demand as possible off Keynsham East onto Keynsham West. This has dual benefits towards the 33 kV circuit overloads noted above and the Keynsham East transformer overloads as noted in that section of this report. Transferring around 10.5 MW in 2034 Best View is shown to prevent all overloads for the conditions above but this will depend on transfer capacity based on 11 kV and 33 kV circuits.

Following this, reinforcement of the existing circuits for the overloads shown above should be considered due to the significant length of circuit out to Keynsham East from Radstock, meaning this is likely to prove more cost-effective than installing further circuits provided the existing infrastructure can be upgraded through re-conductoring and replacement of other limiting factors.

To mitigate the second circuit outage overloads (N-2), the possible faults following a specific arranged outage should be considered and the network reconfigured as appropriate to prevent overloads. The proposals to solve N-1 issues discussed will help with N-2 overloads but is unlikely to mitigate against them completely meaning outages should be planned appropriately before they are taken.

3.7 Midsomer Norton Transformers Generation Overload due Reverse Power flow limitations

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 and summer peak generation.

Table 3.7.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Midsomer Norton Transformers Generation Overload	Midsomer Norton Transformer fault/outage	None	N/A	N/A	N/A	2028

Solution Recommendation

Due to the anticipated low cost, it is recommended to make the necessary ancillary reinforcement to remove the reverse power flow limitations on Midsomer Norton Transformers, such as installing load blinding relays if necessary.

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