Bridgwater BSP and Associated 132kV Network

Network Development Report – South West

May 2024

Electricity Distribution

nationalgrid

Contents

Bridgwater BSP and Associated 132kV Network 2

1. Network Overview 2
1.1 Network Topology 3
1.2 Network Operability Modelling 3

2. Summary of Network Constraints 4

3. Network Constraint Details and Solution Options 5
3.1 Taunton GSP to Bridgwater GSP 132kV circuit overload (U + E route) 5
3.2 Bridgwater Grid Transformer and associated 132kV circuit overloads 8
3.3 Bridgwater BSP to Bath Road Primary 33kV circuit overloads and Transformer overloads 11
3.4 Bridgwater BSP to Watchfield Primary 33kV circuit overload 14

Bridgwater BSP and Associated 132kV Network

1. Network Overview

Bridgwater Bulk Supply Point (BSP) supplies a mostly urban area of 33 kV network, with the bulk of the demand centred in Bridgwater town, as well as Watchfield village and Burnham to the North of Bridgwater. It is supplied from four 132/33 kV GTs at Bridgwater BSP, fed via 132kV circuits from Bridgwater GSP. Bridgwater BSP together with Street BSP supplies approximately 93,000 customers.

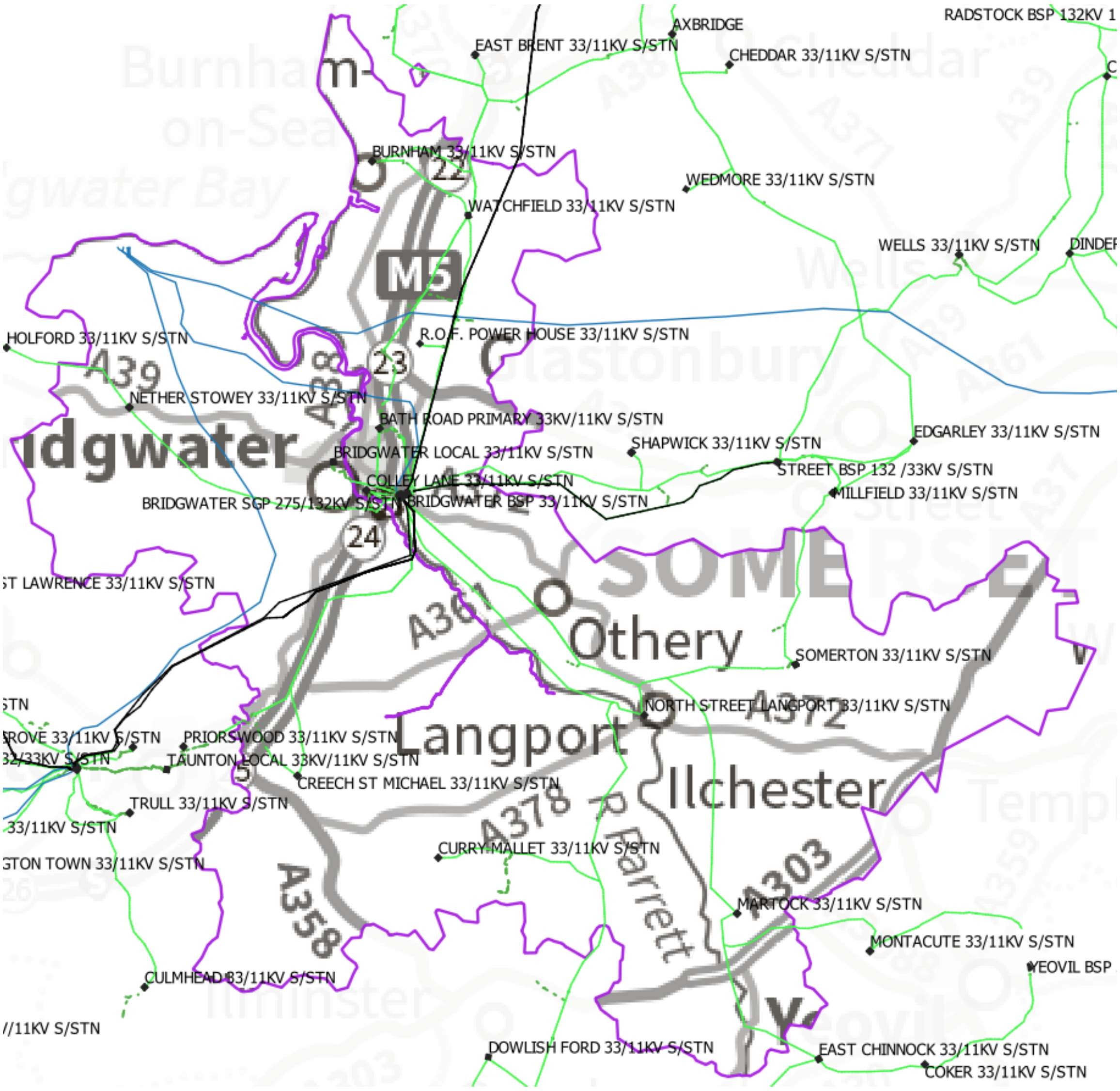

Figure 1.1 Bridgwater BSP geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon associated with the 33/11kV transformers, 33kV circuits, 132/33kV transformers and 132kV circuits which supply and are supplied by Bridgwater 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. 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 Bridgwater BSP network is arranged as follows:

- Four 132kV circuits from Bridgwater GSP supply four grid transformers (GTs) at Bridgwater BSP.
- There are two 132kV overhead line circuits between Bridgwater GSP and Taunton GSP, which are normally closed to parallel the two GSPs.
- Bridgwater GT1, GT2 and GT4 currently run in parallel supplying Bridgwater BSP, whilst GT3 is run split from the rest of the GTs at Bridgwater, in parallel with GT1 at Street BSP to supply Street.
- Curry Mallet is a single transformer primary teed off one of the Bridgwater to North Street Langport 33kV circuits
- There is a normal open point at North Street Langport primary separating two 33kV circuits between Bridgwater and North Street Langport, with one of the circuits also supplying Street BSP.
- There is a normal open point at Priorswood primary which is normally fed via a 33kV circuit from Taunton BSP but backfed from Bridgwater BSP in the event of a fault.
- There is a normal open point at Nether Stowey primary which is normally fed via a 33kV circuit from Bridgwater but backfed from Bowhays Cross in the event of a fault.
- There is a normal open point at Burnham Primary which is supplied normally by Bridgwater BSP, via Watchfield primary, but in the event of a fault is supplied from Churchill BSP with preliminary proposals to change this backfeed supply to Weston BSP via existing circuits.
- Creech St Michael, Colley Lane, Bridgwater local and Bath Road primaries are also supplied by Bridgwater BSP.

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.

- Burnham Primary substation transferred to Churchill BSP for a fault on any part of the circuit between Bridgwater and Burnham
- North Street Langport 11kV section breaker closed for a fault/outage affecting either of the 33kV circuits feeding North Street Langport from Bridgwater
- Colley Lane 11kV section breaker closed for a fault/outage affecting any of the three 33kV circuits or primary transformers feeding the site
- Colley Lane primary transformer overloads and 33kV circuit overloads under SCO solved by splitting the 11kV bar following FCO
- Bath Road 11kV section breaker closed for a fault/outage affecting T2 or the supplying 33kV circuit from Bridgwater BSP
- Bath Road primary transformer overloads and 33kV circuit overloads under SCO solved by splitting the 11kV bar following FCO
- DOC protection for Creech St Michael Primary T1 and T2.
- Priorswood Primary 2T0 breaker closed to supply Priorswood via Bridgwater BSP 8L5 circuit for a fault/outage affecting T1 or the supplying 33kV circuit from Taunton BSP
- Various winter arranged outages not permitted due to SCO overloads.
- Various SCO overloads solved by network reconfiguration for arranged outages.
- For the loss of an infeed to a transformer at any of the primaries fed from Bridgwater 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:

- Taunton GSP to Bridgwater GSP 132kV circuit overload (U+E route)
- Bridgwater Grid Transformer and associated 132kV circuit overloads
- Bridgwater 7L5 to Bath Road 2L3 33kV circuit overload
- Bridgwater 18L5 to Bath Road 1L3 33kV circuit overload
- Bath Road primary transformer overloads
- Bridgwater 20L5/ZDC route to Watchfield 1L3 33kV circuit overload
- Watchfield T2 transformer overload

3. Network Constraint Details and Solution Options

3.1 Taunton GSP to Bridgwater GSP 132kV circuit overload (U + E route)

Constraint Overview

Generation | **Demand**

The table below outlines the nature of the network constraints identified in the network analysis, with overloads anticipated to occur during an arranged outage followed by a fault (N-2 condition).

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
U route overload	Bridgwater SGT1	Bridgwater SGT2	2032	2032	2032	2032
E route overload	Bridgwater SGT1	Bridgwater SGT2	2032	2032	2032	2032

Uncertainty under other Distribution Future Energy Scenarios: Under leading the way scenario this constraint is predicted to occur as early as 2029. Under falling short it is predicted to occur in 2035.

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	Reinforce existing 132kV circuits	✓	✓	✓	Viable
2	Install additional 132kV circuits	✓	✓	✓	Viable
3	Install new SGTs and split Taunton and Bridgwater GSPs	✓	✓	×	Discounted
Operational Mitigation					
4	Limit outage window	×	×	×	Discounted
Load Management Schemes					
5	Post-fault transfers	×	×	×	Discounted
Flexibility services					
6	Procure flexibility at Bridgwater GSP	×	×	×	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 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. This would lead to an inability to meet the Security of Supply requirements of Engineering Recommendation P2 for Bridgwater GSP group demand as insufficient demand could be picked up on the 33kV circuits outside of Bridgwater for the loss of supply to the whole GSP.

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

Option 1 – Reinforce existing 132kV circuits

Capacity Released for constraint(s) considered: 27 MVA Viable

Detailed description: In the first instance re-profiling of E and U route 132kV circuits may be considered. This will require survey work to determine clearances and if any major work is required to re-profile the circuits to operate at 75°C. This will release a small amount of capacity for future growth but is unlikely to be a long term solution.

Further reinforcements may include re-conductoring the circuits with a larger conductor such as 300mm^2 All Aluminium Alloy Conductors (AAAC). This may require an upgrade to the existing tower structures to support a larger conductor.

New limiting factor for constraint(s) considered: existing 132kV circuits with higher rating.

Option 2 – Install additional 132kV circuits

Capacity Released for constraint(s) considered: 125 MVA Viable

Detailed description: U route towers are capable of having two 132kV conductors on each arm of the steel towers. However, only one conductor is currently fully strung from Bridgwater to Taunton GSP. The second conductor is partially strung from Bridgwater but an additional ~11.25km of 132kV circuit would need to be installed to complete this circuit as well as 132kV terminations into both Bridgwater and Taunton GSPs. Given the partial completion of this work this may offer a cost-effective way of releasing capacity subject to a full cost benefit analysis.

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

Option 3 –Install new SGTs and split Taunton and Bridgwater GSPs

Capacity Released for constraint(s) considered: 240MVA+ Discounted

Detailed description: This options involves splitting Taunton and Bridgwater GSPs by opening the 132kV circuits between them. This would result in the need for additional super grid transformers (SGTs) due to predicted N-1 SGT constraints with only 2 SGTs at Bridgwater (compared to the parallel group with 4 SGTs). Therefore, Bridgwater GSP would need an additional SGT imminently, whilst Taunton may later be considered for a further SGT as required.

However, to install an additional SGT at Bridgwater requires significant 400kV circuit works and switchgear, as well as a compound extension. Following joint discussions with NGET and NGESO it was determined there was no feasible way to install an additional SGT at Bridgwater GSP without prohibitive costs. Therefore, this is not a viable solution.

New limiting factor for constraint(s) considered: existing 132kV circuits in the event that a parallel is required between Taunton and Bridgwater GSP.

Option 4 – Limit Outage Window

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

Detailed description: Generation overloads are shown to occur in summer for the same conditions meaning there is no outage window for maintenance work with reinforcement work.

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

Option 5 – Post-fault transfers

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

Detailed description: There are insufficient 33kV transfers away from the Taunton/Bridgwater group to prevent 132kV circuit overloads for the conditions described.

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

Option 6 – Procure flexibility at Bridgwater GSP

Estimated Flexibility Required (MVA): Unknown Discounted

Detailed description: Due to the complex and unpredictable flows on an interconnected GSP network, and the very large group demand supported, flexibility is deemed an infeasible solution.

Solution Recommendation

It is recommended to firstly survey and assess the possibility of re-profiling the existing E and U route circuits to prevent overloads in the near future. Following this and to facilitate long term demand and generation growth, installation of an additional 132kV circuit on U route is recommended as it offers the most capacity for the cost.

3.2 Bridgwater Grid Transformer and associated 132kV circuit overloads

Constraint Overview

Generation | Demand

The table below outlines the nature of the network constraints identified in the network analysis, with overloads anticipated to occur during an arranged outage followed by a fault (N-2 condition).

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
Bridgwater GT1 overload	Bridgwater GT2 arranged outage	Bridgwater GT4 fault	Baseline	Baseline	Baseline	Baseline
Bridgwater 110 to GT1 132kV circuit overload	Bridgwater GT2 arranged outage	Bridgwater GT4 fault	Baseline	Baseline	Baseline	Baseline
Bridgwater GT2 overload	Bridgwater GT4 arranged outage	Bridgwater GT1 fault	Baseline	Baseline	Baseline	Baseline
Bridgwater 210 to GT2 132kV circuit overload	Bridgwater GT4 arranged outage	Bridgwater GT1 fault	Baseline	Baseline	Baseline	Baseline
Bridgwater GT3 overload	Bridgwater Main 1 busbar arranged outage	Bridgwater 105 – Street GT1 132kV circuit fault	2028	2028	2028	2028
Bridgwater GT4 overload	Bridgwater GT2 arranged outage	Bridgwater GT1 fault	2032	2032	2032	2032

Uncertainty under other Distribution Future Energy Scenarios: As the first constraint occurs under baseline, there is no uncertainty about future forecasts. There is a risk that demand reduces, however this is not forecast under any scenario so mitigation against this constraint is definitely required. Later constraints may have some uncertainty, however, given these relate to the same site and type of constraint, a solution should cater for all constraints.

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 existing transformers and 132kV circuits	×	×	×	Discounted
2	Install additional transformer and 132kV circuit	×	×	×	Discounted
3	Install new BSP near to Bridgwater BSP	✓	✓	✓	Viable
Operational Mitigation					
4	Change running arrangement to parallel all four transformers at Bridgwater BSP	✓	✓	✓	Viable
Load Management Schemes					
-	*None Identified*	-	-	-	-
Flexibility services					
5	Procure flexibility at Bridgwater BSP	×	×	×	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 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. As group demand at Bridgwater is approximately 225MW, there is a requirement under Engineering Recommendation P2 to restore a minimum of 75MW within 3 hours following an N-2 event (second circuit outage). This could only be met by disconnecting a significant amount of demand to prevent the remaining transformers overloading. There is no feasible way of doing this automatically and this is not to the benefit of customers who would experience potentially long interruptions. In addition, once group demand exceeds 300MW, the requirement of P2 to restore 2/3 Group Demand immediately could not be met.

Therefore, not intervening would cause problems with system integrity (overloads) and would not be an economic long term solution.

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

Option 1 – Replace existing transformers and 132kV circuits

Capacity Released for constraint(s) considered: 78 MVA **Discounted**

Detailed description: Replacing the three 60MVA transformers at Bridgwater with 90MVA units as well as upgrading the overloaded 132kV circuits. This would not be cost-effective as it would require the changing of three transformers and 132kV circuits for a limited gain in capacity compared to installing further transformers.

New limiting factor for constraint(s) considered: 90MVA transformer ratings

Option 2 – Install additional transformer and 132kV circuit

Capacity Released for constraint(s) considered: 78 MVA **Discounted**

Detailed description: Installing a fifth grid transformer at Bridgwater BSP would alleviate the constraints by ensuring three transformer remain online for any N-2 (second circuit outage) event. However, the site is limited in space and having five grid transformers connected to one 33kV switchboard would create fault level exceedances on the 33kV switchgear. Therefore, this is not a technically viable option.

New limiting factor for constraint(s) considered: Existing 60MVA transformers cyclic rating.

Option 3 – Install new BSP near to Bridgwater BSP

Capacity Released for constraint(s) considered: 180 MVA **Viable**

Detailed description: Installing a new BSP nearby to the existing Bridgwater BSP would involve running two 132kV cables from Bridgwater GSP, installing two new 90MVA grid transformers, a 33kV switchboard and all of the civil work to establish a new BSP compound. In order to reduce demand on Bridgwater BSP, existing 33kV circuits and their primary substations would need to be transferred over. Candidates include Bridgwater local primary, some or all of Bath Road Primary and some or all of Watchfield and Burnham primaries. This would transfer significant demand off Bridgwater BSP and prevent the N-2 overloads observed above.

This also releases significant capacity for further growth around the Bridgwater area via two new 90MVA grid transformers at the new BSP.

This has already been instigated with plans to install Dunwear BSP as part of works for a very large demand connection in the area.

New limiting factor for constraint(s) considered: Existing 60MVA transformers cyclic rating.

Option 4 – Change running arrangement to parallel all four transformers at Bridgwater BSP

Capacity Released for constraint(s) considered: 0MVA

Viable

Detailed description: By running all four transformers in parallel at Bridgwater BSP, this ensures two transformers remain in service for an N-2 event losing two grid transformers. This prevents overloads in the baseline scenario, however, under the Best View scenario, two grid transformers could not support all of Bridgwater BSPs demand by 2028. Therefore, if implemented this would only be a short term solution and does not release any capacity for the long term. It also causes fault level exceedances issues, meaning one grid transformer may be run on hot standby.

New limiting factor for constraint(s) considered: existing 60MVA transformers cyclic rating.

Option 6 – Procure flexibility at Bridgwater BSP

Estimated Flexibility Required (MVA): 50MVA

Discounted

Detailed description: Very large amounts of flexibility would need to be procured to mitigate against this event. Therefore, this would not be economical.

Solution Recommendation

It is recommended to firstly assess paralleling all four gird transformers at Bridgwater via the 33kV switchboard, putting a grid transformer on hot standby if necessary for fault level issues. This would only be a short term solution and does not release any capacity for the long term. It also causes fault level exceedances issues, meaning one grid transformer may be run on hot standby.

Beyond that establishing a new BSP as is already planned with Dunwear BSP offers the most cost-effective way of releasing capacity in the Bridgwater area for longer term growth.

3.3 Bridgwater BSP to Bath Road Primary 33kV circuit overloads and 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 3.3.1 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
Bridgwater 7L5 to Bath Road 2L3 33kV circuit overload	Bridgwater 18L5 circuit fault	None	Baseline	Baseline	Baseline	Baseline
Bridgwater 18L5 to Bath Road 1L3 33kV circuit overload	Bridgwater 7L5 circuit fault	None	Baseline	Baseline	Baseline	Baseline
Bath Road T1, T2 or T3 overload	Fault of T1, T2 or T3	None	2033	>2034	>2034	>2034

Uncertainty under other Distribution Future Energy Scenarios: As the 33kV circuit overload constraint occurs under baseline, there is no uncertainty about future forecasts. There is a risk that demand reduces, however this is not forecast under any scenario so mitigation against this constraint is definitely required. The transformer overloads are predicted to occur as early as 2031 under leading the way scenario or as late as 2038 under falling short scenario.

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	Reinforce existing 33kV circuits and transformers	✓	×	✓	Viable
2	Install additional 33kV circuit(s) and an reinforce transformers	✓	✓	✓	Viable
3	Reinforce 11kV circuits to transfer demand to other Primaries	✓	×	×	Discounted
Operational Mitigation					
4	Transfer demand to other Primaries	✓	×	✓	Viable
Load Management Schemes					
5	Post-fault transfers	×	×	×	Discounted
Flexibility services					
6	Procure flexibility at Bath Road Primary	✓	✓	✓	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. This would lead to an inability to meet the Security of Supply requirements of Engineering Recommendation P2 for Bath Road Primary.

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

Option 1 – Reinforce existing 33kV circuits and transformers

Capacity Released for constraint(s) considered: 12 MVA

Viable

Detailed description: Upgrading the existing 33kV circuits and installing a fourth primary transformer or upgrade the existing transformers to prevent overloads.

Several sections of the existing 7L5 and 18L5 33kV circuits would have to be upgraded to facilitate load growth. This would involve replacing several sections of overhead line and cable and making the necessary joints, as well as any CT and protection upgrades required. The sections to be replaced include:

For 7L5:

- 245m EPR Ducted Cable
- 77m XLPE Ducted Cable
- 88m Overhead line HDC
- 175m XLPE Cable
- 2453m Overhead line HDC

For 18L5:

- 2405m Overhead line HDC
- 245m EPR ducted cable
- 76m XLPE ducted cable
- 88m Overhead line HDC
- 148m XLPE cable
- 48m Overhead line HDC

New limiting factor for constraint(s) considered: Existing EPR cable which does not require up-rating.

Option 2 – Install additional 33kV circuit(s) and reinforce transformers

Capacity released for constraint(s) considered: up to 70MVA

Viable

Detailed description: Installing one or two additional 33kV circuits and upgrading or adding a transformer at Bath Road primary substation would alleviate overloads and align with the transformer overload constraint predicted to occur in 2033. This would involve installing new 33kV circuit(s) and upgrading the existing transformers or adding an additional primary transformer. Due to fault level issues switchgear upgrades are also necessary.

New limiting factor for constraint(s) considered: Capacity of existing circuits.

Option 3 – Reinforce 11kV circuits to transfer demand to other Primaries

Capacity Released for constraint(s) considered: Up to 6 MVA **Discounted**

Detailed description: To release additional capacity available at Bridgwater Local primary substation additional 11kV circuits may be installed to provide capacity in the vicinity of Bath Road. This may offer a cheaper solution than 33kV upgrades to Bath Road primary. However, it will limit potential future growth as further 11kV circuits may be required to release further capacity or 33kV upgrades at Bath Road may still be required at a later date. In addition these circuits would need to be installed in an urban area meaning costly cable installation would be required which would not be cost-effective for the amount of capacity released.

New limiting factor for constraint(s) considered: Bridgwater Local Primary substation capacity.

Option 4 – Transfer demand to other Primaries

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

Up to 4 MVA (dependent on 11kV circuit capacity)

Detailed description: Transferring approximately 4 MVA demand to Bridgwater Local from Bath Road will alleviate constraints in the short term. However, further reinforcement will be required for longer term growth at both Bridgwater Local and Bath Road. This solution may be implemented for a limited time to defer reinforcement if proven cost-effective.

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

Option 5 – Post-fault transfers

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

Detailed description: Post fault transfers cannot be utilised as the overload is beyond post-fault ratings meaning there is no window to reduce the load on the 33kV circuits through load management.

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

Option 6 – Procure flexibility at Bath Road Primary

Estimated Flexibility Required (MVA): 4 MVA+ **Viable**

Detailed description: Flexibility services could be procured to alleviate projected overloads. This could defer reinforcement but due to the large quantity of flexibility required this may not be a viable solution.

Solution Recommendation

It is recommended to assess the feasibility of transferring demand from Bath Road primary to Bridgwater local primary via the existing 11kV circuits. If the 11kV circuits do not offer sufficient capacity then flexibility could be procured at Bath Road Primary to defer the reinforcement requirements, subject to a cost benefit analysis confirmation through the DNOA process.

To facilitate longer term growth, installing additional circuits and reinforcing the transformers at Bath Road Primary will be required (option 2). This should be considered in conjunction with Watchfield primary substation reinforcement requirements due to the physical interaction between the circuits and substations and ability to provide cost-savings by carrying out some elements of the work jointly where possible. The circuit upgrades are needed imminently whilst transformer upgrades are predicted to be needed after 2030 for demand growth.

Bath Road T1 and T2 are programmed to be replaced under asset replacement around 2027 due to age and condition meaning the size of these transformers can be upgraded to release transformer capacity following the 33kV circuit upgrades.

3.4 Bridgwater BSP to Watchfield Primary 33kV circuit 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 3.4.1 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
Bridgwater 20L5/ZDC route to Watchfield 1L3 33kV circuit overload	Bridgwater Main 2A busbar fault	None	2028	2028	2028	2028
Watchfield T2 transformer overload	Bridgwater Main 3 busbar fault where DOC does not operate	None	Baseline	Baseline	Baseline	Baseline

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2027 and under falling short it is predicted to arise in 2029.

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 33kV circuits	✓	×	✓	Viable
2	Install additional 33kV circuits	✓	✓	✓	Viable
3	Reinforce 11kV circuits to transfer demand to other Primaries	×	×	×	Discounted
Operational Mitigation					
4	Transfer demand to other Primaries	×	×	×	Discounted
Load Management Schemes					
5	Post-fault transfers	×	×	×	Discounted
Flexibility services					
6	Procure flexibility at Bath Road Primary	✓	✓	✓	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. This would lead to an inability to meet the Security of Supply requirements of Engineering Recommendation P2 for Watchfield and Burnham primary substations.

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

Option 1 – Reinforce existing 33kV circuits

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

Detailed description: Several sections of the existing 20L5 circuit would have to be upgraded between Bridgwater and tower ZDC33 to facilitate load growth. This would involve replacing several sections of overhead line and cable and making the necessary joints, as well as any CT and protection upgrades required. The sections to be replaced include:

- CT limitations
- 240m OH AAAC
- 220m Cu cable
- 292m Overhead Line AAAC
- 450m Cu cable
- 93m Cu cable

New limiting factor for constraint(s) considered: Existing circuit sections on 20L5 which do not require upgrading

Option 2 – Install additional 33kV circuits

Capacity released for constraint(s) considered: 12 MVA **Viable**

Detailed description: Installing additional 33kV circuits into Watchfield would prevent overloads seen. It would also secure Burnham primary onto Bridgwater for FCO and it would no longer need to be transferred to Churchill BSP. This would involve installing some new sections of circuit and separating the bunched circuits on ZDC route to operate independently to provide two new circuits into Watchfield primary. An intertrip between the circuit breakers at Bridgwater and Watchfield could also be installed to prevent Watchfield T2 transformer overloads when Burnham is supplied through the 11kV at Watchfield and directional overcurrent protection does not operate due to the current being below the operating threshold.

This is also related requirements for Bath Road primary substation upgrades, meaning there is likely to be wider area benefits of combing these reinforcement schemes.

New limiting factor for constraint(s) considered: Existing 20L5 circuit rating and circuits between Watchfield and Burnham.

Option 3 – Reinforce 11kV circuits to transfer demand to other Primaries

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

Detailed description: As there are no primary substations nearby to Watchfield supplied by different 33kV circuits there are no options to reduce load on the Bridgwater 20L5 circuit via 11kV circuits.

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

Option 4 – Transfer demand to other Primaries

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

Detailed description: As there are no primary substations nearby to Watchfield supplied by different 33kV circuits there are no options to reduce load on the Bridgwater 20L5 circuit via 11kV circuits.

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

Option 5 – Post-fault transfers

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

Detailed description: Post fault transfers cannot be utilised as the overload is beyond post-fault ratings meaning there is no window to reduce the load on the 33kV circuits through load management.

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

Option 6 – Procure flexibility at Watchfield and/or Burnham Primary Substations

Estimated Flexibility Required (MVA): 3 MVA+ Viable

Detailed description: Flexibility services could be procured at Watchfield or Burnham to alleviate projected overloads.

Solution Recommendation

It may be possible to procure flexibility at Watchfield or Burnham Primary substation to defer the reinforcement requirements, subject to a cost benefit analysis confirmation through the DNOA process.

However, longer term an additional 33kV circuit (option 2) would provide the most capacity to the area whilst further securing supplies at Burnham primary, meaning subject to a cost benefit analysis this is likely to be the most cost-effective option.

DSO | nationalgrid electricity distribution

Registered Office: Avonbank, Feeder Road, Bristol BS2 0TB
nationalgrid.co.uk