Bustleholm GSP Network

Network Development Report – West MIdlands

May 2024

Electricity Distribution

nationalgrid

Contents

Bustleholm GSP Network

1. Network Overview

Bustleholm Grid Supply Point (GSP) is located in the West Midlands to the South-East of the city of Wolverhampton. It is interconnected with Bushbury, Rugeley, and Willenhall GSPs.

Bustleholm GSP is fed via four Super Grid Transformers (SGTs) and feeds eight Bulk Supply points (BSPs) under normal running configuration: Kingstanding BSP, Rushall BSP, Bentley BSP, Smethwick BSP, Perry Barr BSP, Winson Green BSP, Ladywood BSP and Walsall BSP. Over 182,000 customers are supplied from Bustleholm GSP.

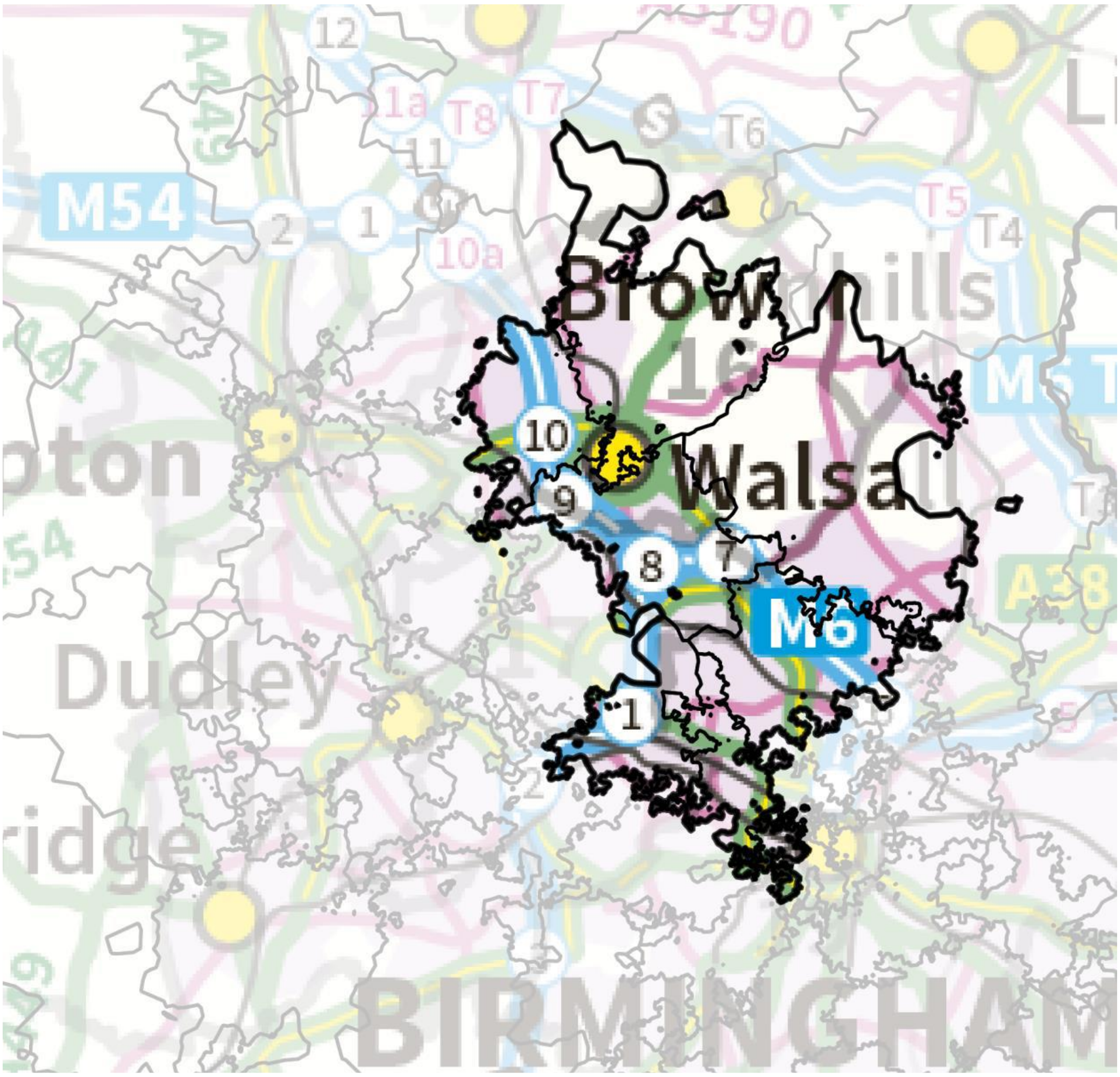

Figure 1.1 Bustleholm GSP geographic network coverage

This report discusses existing and future network constraints over a 0-10 year horizon associated with Bustleholm and its downstream network. It uses the methodology outlined in the Network Development Plan Methodology Report with Network Operability Modelling applied as outlined further below.

For the purposes of this analysis the NGED Best View Distribution Future Energy Scenario (DFES) has been used to study each year up to and including 2034. Representative days for each of the four seasons (Winter, Intermediate Cool, Intermediate Warm, and Summer) have been studied to cover the edge case scenarios for the network.

1.1 Network Topology

Bustleholm GSP is fed by four 275/132 kV SGTs currently running in parallel supplying three sections of 132 kV double busbar.

The Bustleholm GSP network is arranged as follows:

- Bustleholm GSP consists of four 240 MVA 275/132 kV SGTs feeding three sections of 132 kV double busbar running solid, the 132 kV circuit breaker for SGT3 is normally run open.
- The 132 kV busbars have feeders to three 132/11 kV transformers which supply three sections of 11 kV double busbar, run split between the transformers.
- Kingstanding BSP consists of two three-winding 132/11/11 kV transformers fed from Bustleholm GSP via two 132 kV circuits that are banked with two of Bustleholm's Grid Transformers (GTs), GT2 and GT3.
- Rushall BSP consists of 4x 132 kV busbar sections connecting four 132/11 kV transformers; the site is fed via a 132 kV infeed from Bustleholm, and has another circuit interconnector to Walsall 132 kV.
- Bentley BSP consists of two three-winding 132/11/11 kV transformers, one fed from Bustleholm GSP (via Rushall and Walsall), and the other from Willenhall GSP.
- Smethwick BSP has four 132 kV infeeds from Bustleholm GSP, connected onto four split sections of 132 kV busbars. The site consists of 3x 132/11 kV and 1x 132/25 kV transformers; one per 132 kV section. All 132/11 kV transformers run split at 11 kV.
- Perry Barr BSP has two 132 kV infeeds from Bustleholm GSP which feed three sections of 132 kV busbars run solid. There are three 132/11 kV transformers feeding three sections of 11 kV double busbars, normally run split between the transformers.
- Winson Green BSP consists of a 4-section 132 kV busbar (normally run solid) connecting 3x 132/11 kV transformers (run split at 11 kV) and 1x 132/25 kV transformer, all supplied via two circuits from Bustleholm GSP. There is a 132 kV interconnector to Hockley BSP (normally run open with Nechells East network) and a pair of 132 kV circuits feeding Ladywood BSP.
- Ladywood BSP has two three-winding 132/11/11 kV transformers connected to four sections of 11 kV double busbar that run split between the transformers.

1.2 Network Operability Modelling

The analysis modelling covers automation and manual switching schemes that represent how the network is generally operated. Some of the main ones are listed below.

Bustleholm 132 kV

- SGT3 is normally run on hot-standby, and is switched in for the loss of any of the other SGTs on-site (SGT1, SGT4 or SGT2), with some 132 kV reconfiguration where necessary.
- Arranged or fault outages leading to loss of a GT at Kingstanding, Bentley, Ladywood, Bustleholm, Perry Barr, Smethwick, and Winson Green results in the 11 kV at these sites being closed in to backfeed. Additional 11 kV reconfiguration may be also necessary to split the demand more evenly between the transformers.

Rushall BSP

- Arranged or fault outages leading to loss of GT1 results in the 11 kV being closed in to backfeed from GT2 and vice versa. The same occurs for outages affecting GT3/GT4.

Walsall BSP

- Arranged outages affecting the infeed from Rushall towards Bentley GT2 results in the 33 kV connected scheme at Walsall being disconnected, with Bentley GT2 being picked up from Willenhall BSP via the closing of CB420 at Walsall.
- Arranged outages affecting the 132 kV infeed to Bentley GT1 results in the closing of CB120 at Walsall effectively backfeeding it from Rugeley GSP.

2. Summary of Network Constraints

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

- Bustleholm transformer GT1 and GT2 overload
- Bustleholm to Kingstanding 132 kV circuit overload
- Perry Barr transformer GT2 and GT3 overload
- Winson Green transformer overload
- Rushall BSP constraints
    - Rushall GT overload
    - Rushall N-2 constraint
    - Bustleholm to Rushall 132 kV circuit overload
    - Walsall to Rushall 132 kV circuit overload

3. Network Constraints and Solution Options

3.1 Bustleholm transformer GT1 and GT2 overload

Constraint Overview

Generation Demand

Bustleholm BSP consists of three 132/11 kV transformers (commissioned in 1987) that supply the primary network. The site has three sections of double busbars that are normally run split. GT1 and GT2 backfeed each other during an outage; while GT3 is picked up by the other two when on outage.

The site is Class C under Engineering Recommendation P2.

The table below outlines the constraints identified for Best View, the conditions they occur under, and the triggering year and season.

Table 3.1.1 overview of constraint

Constraint	Condition	Trigger year per season			
		Winter	Inter Cool	Inter Warm	Summer
Bustleholm GT1 or GT2 overload	N-1: Outage of either GT1 or GT2	2032	2033	-	-

Uncertainty under other Distribution Future Energy Scenarios: The constraints above are identified under Best View and worsened under some of the other Distribution Future Energy Scenarios. The demand in the region is generally on an upward trend indicating constraints are potentially getting worse if not addressed, but the trigger year may vary depending on how quickly demand and/or generation materialises.

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 identified constraint(s)

Option	Description	Solves constraint	Potentially economic	Wider benefit	Viable or Discounted
1	No Intervention	×	✓	×	Discounted
Reinforcement (build) options					
2	Adding a fourth transformer	✓	✓	×	Viable
3	Uprating the existing transformers	✓	✓	×	Viable
Operational Mitigation					
4	Load transfers	✓	✓	×	Viable
Load Management Schemes					
5	Post-fault inter-trips	×	✓	×	Discounted
Flexibility services					
6	Flexibility service procurement	✓	✓	×	Viable

Solution Development

These options have been assessed on their technical viability and cost-effectiveness pending a more detailed cost benefit analysis (CBA) by the DNO. The section below covers more detail on these options.

Option 1 – No Intervention

Estimated capacity released: 0 MVA **Discounted**

Detailed description: The constraint is anticipated to trigger by 2032 with the demand projected to continue increasing thereafter. Doing nothing could therefore lead to thermal overloads, as described above, and to the inability to meet security of supply compliance with Engineering Recommendation P2.

New limiting factor: Rating of the transformers

Option 2 – Adding a fourth transformer

Estimated capacity released: 38 MVA **Viable**

Detailed description: Adding a fourth 132/11 kV transformer at Bustleholm BSP, the works include:

- Establishing a new 132 kV bays at Bustleholm GSP, and installing a short 132 kV feeder to the BSP side
- Installing a fourth 132/11 kV 15/30 MVA transformer
- Installing an additional two section 11 kV board suitably interconnected with the existing
- Carrying out site checks allowing the existing transformers to utilise their cyclic ratings

New limiting factor: Rating of the transformers

Option 3 – Uprating the existing transformers

Estimated capacity released: 38 MVA **Viable**

Detailed description: Uprating two of the existing three transformers, the works include:

- Replacing two of the existing 132/11 kV 15/30 MVA transformers with three-winding 132/11/11 kV transformers rated 30/60 MVA each.
- Extending the existing 11 kV board by adding additional circuit breakers and connecting each transformer low voltage (LV) winding to an 11 kV section.
- Running the transformers split at 11 kV, with sequence schemes for restoration of supplies.
- Assessing the fault levels at 11 kV and where possible, running the two LV windings (for the new three-winding transformers) in parallel with each other; where there may be fault level restrictions, then the following are to be considered, in the order listed below:
    - Uprating the impacted assets (11 kV circuits and/or downstream 11 kV switchgear);
    - Running split the two LV windings per transformer
- Carrying out site checks allowing the existing 132/11 kV transformer to utilise its cyclic ratings.

New limiting factor: Rating of the transformers

Option 4 – Operational mitigation: Load Transfer

Estimated capacity released: 15 MVA

Viable

Detailed description: The site currently runs split at 11 kV with GT1 and GT2 backfeeding each other under outage conditions. The solution is to better utilise rating of the existing transformers, and is two-fold:

- Redistributing the demand at 11 kV, during a transformer outage, more evenly between the remaining two in-service transformers.
- Carrying out site checks allowing the existing transformers to utilise their cyclic ratings.

New limiting factor: Rating of the transformers

Option 5 – Load Management Schemes: Post-fault inter-trips

Estimated capacity released: 0 MVA

Discounted

Detailed description: The site is Class C under Engineering Recommendation P2 which would require restoration of the group demand within 15 minutes for a circuit outage; therefore demand disconnection schemes (or similar) would make the site non-compliant.

New limiting factor: Engineering Recommendation P2 non-compliance

Option 6 – Flexibility service procurement

Estimated Flexibility Required (MW): 2 MW +

Viable

Detailed description: Flexibility services through generation turn up and/or demand turn down could be procured to help alleviate the constraint and defer reinforcement. This option would be subject to a cost benefit analysis closer to the time, including all necessary sufficiency checks.

New limiting factor: Existing transformer ratings

Solution Recommendation

It is recommended to pursue option 3 above (operational mitigation) as it is likely to be the most cost effective solution and could allow for better utilisation of the assets by potentially enabling the cyclic ratings of the transformers.

Any reinforcement solution however would be subject to a CBA by the DNO, and in this case, it may be tested against the flexibility market as part of the Distribution Network Options Assessment (DNOA) process. This flexibility option however, although may be technically viable, is not likely to be as cost-effective when considering the initial set up costs.

3.2 Bustleholm to Kingstanding 132 kV circuit overload

Constraint Overview

Generation | **Demand**

Kingstanding BSP consists of two three-winding 132/11/11 kV transformers fed out of Bustleholm GSP via two 132 kV circuits, banked with Bustleholm BSP's GT2 and GT3. One of the circuits loops in through two committed battery generation sites.

The 132 kV busbars normally runs solid at Kingstanding, but the transformers run split at 11 kV.

The site is with Class C under Engineering Recommendation P2.

The table below outlines the constraints identified for Best View, the conditions they occur under, and the triggering year and season.

Table 3.2.1 overview of constraint

Constraint	Condition	Trigger year per season			
		Winter	Inter Cool	Inter Warm	Summer
Bustleholm to Kingstanding 132 kV circuit overload	N-1: Fault outage affecting either infeed to the 132 kV circuits between Bustleholm and Kingstanding	2028	2029	2030	2030

Uncertainty under other Distribution Future Energy Scenarios: The constraints above are identified under Best View and worsened under some of the other Distribution Future Energy Scenarios. The demand in the region is generally on an upward trend indicating constraints are potentially getting worse if not addressed, but the trigger year may vary depending on how quickly demand and/or generation materialises.

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 identified constraint(s)

Option	Description	Solves constraint	Potentially economic	Wider benefit	Viable or Discounted
1	No Intervention	×	✓	×	Discounted
Reinforcement (build) options					
2	Uprating the existing circuits	✓	×	×	Viable
3	Adding a third circuit to Kingstanding	✓	×	×	Viable
Operational Mitigation					
4	Load transfers	✓	✓	×	Viable
Load Management Schemes					
5	Post-fault inter-trips	✓	✓	×	Viable
Flexibility services					
6	Flexibility service procurement	✓	✓	×	Viable

Solution Development

These options have been assessed on their technical viability and cost-effectiveness pending a more detailed CBA by the DNO. The section below covers more detail on these options.

Option 1 – No Intervention

Discounted

Estimated capacity released: 0 MVA

Detailed description: The constraint is anticipated to trigger by 2028, when the battery generation schemes are expected to connect, with the demand projected to continue increasing thereafter. Doing nothing could therefore lead to thermal overloads, as described above, and to the inability to meet security of supply compliance with Engineering Recommendation P2.

New limiting factor: Rating of the existing circuit

Option 2 – Uprating the existing circuits

Viable

Estimated capacity released: 75 MVA +

Detailed description: Replacing the existing two 132 kV cable circuits between Bustleholm and Kingstanding (each consisting of approximately 7.8 km of 0.6 in copper oil filled cable) with a conductor rated over 200 MVA winter cyclic, anticipated to be a minimum of 1000 mm copper.

New limiting factor: New cable circuits

Option 3 – Adding a third circuit to Kingstanding

Viable

Estimated capacity released: 125 MVA +

Detailed description: Adding a third circuit to Kingstanding, the works include:

- Establishing a new 132 kV bay at Bustleholm GSP; where space is restricted, consideration to be given to banking with an existing circuit in a similar configuration to the circuits to Kingstanding and Bustleholm BSP.
- Extending the 132 kV busbars at Kingstanding to include an additional bus-section circuit breaker and a new bay for an additional circuit.
- Installing approximately 8 km of 132 kV cable between Bustleholm GSP and Kingstanding BSP, with a minimum rating of 200 MVA winter cyclic anticipated to be 1000 mm copper cable.

New limiting factor: Rating of the existing 132 kV circuits

Option 4 – Operational mitigation: Changing normal running arrangement

Viable

Estimated capacity released: 99 MW

Detailed description: Allowing the battery generation to trip during a fault outage of either 132 kV circuit, this involves the following:

- Operating Kingstanding 132 kV busbars with a normal open point at CB120
- Ensuring the looped in 132 kV generators have the feeder circuit breaker on the Kingstanding side only, therefore tripping the battery generation during a circuit fault from the Bustleholm side

New limiting factor: Rating of the existing circuits

Option 5 – Load Management Schemes: Post-fault inter-trips

Estimated capacity released: 99 MVA

Viable

Detailed description: Implementing a load management scheme such as Active Network Management (ANM) to trip off the 132 kV connected battery generation schemes for outages affecting either of the infeeds to the group.

New limiting factor: Rating of the 132 kV circuits

Option 6 – Flexibility service procurement

Estimated Flexibility Required (MW): 35 MW +

Viable

Detailed description: Flexibility services through generation turn up and/or demand turn down could be procured to help alleviate the constraint and defer reinforcement. This option would be subject to a cost benefit analysis closer to the time, including all necessary sufficiency checks.

New limiting factor: Rating of the 132 kV circuits

Solution Recommendation

It is recommended to pursue option 4 above (operational mitigation) or option 5 (load management scheme) as they are likely to be the most cost-effective solutions and would allow for better utilisation of the assets.

Any reinforcement solution however would be subject to a CBA by the DNO, and in this case, it may be tested against the flexibility market as part of the DNOA process. The flexibility option however, although it may be technically viable, is not likely to be as cost-effective as the two options above.

3.3 Perry Barr transformer GT2 and GT3 overload

Constraint Overview

Generation | **Demand**

Perry Barr BSP consists of three 15/30 MVA 132/11 kV transformers, commissioned in 2021 (GT1), 1990 (GT2), and 2020 (GT3). The BSP has three sections of double busbar 11 kV that normally run split between the transformers. GT2 and GT3 backfeed each other during an outage of one another.

The site is Class C under Engineering Recommendation P2.

The table below outlines the constraints identified for Best View, the conditions they occur under, and the triggering year and season.

Table 3.3.1 overview of constraint

Constraint	Condition	Trigger year per season			
		Winter	Inter Cool	Inter Warm	Summer
Perry Barr GT2 or GT3 overloads	N-1: arranged outage of transformer GT2 or GT3	Baseline	Baseline	Baseline	-

Uncertainty under other Distribution Future Energy Scenarios: The constraints above are identified under Best View and worsened under some of the other Distribution Future Energy Scenarios. The demand in the region is generally on an upward trend indicating constraints are potentially getting worse if not addressed, but the trigger year may vary depending on how quickly demand and/or generation materialises.

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 identified constraint(s)

Option	Description	Solves constraint	Potentially economic	Wider benefit	Viable or Discounted
1	No Intervention	×	✓	×	Discounted
Reinforcement (build) options					
2	Adding a fourth transformer	✓	✓	×	Viable
3	Uprating existing transformers	✓	✓	×	Viable
Operational Mitigation					
4	Load transfers	✓	✓	×	Viable
Load Management Schemes					
5	Post-fault inter-trips	×	✓	×	Discounted
Flexibility services					
6	Flexibility service procurement	✓	✓	×	Viable

Solution Development

These options have been assessed on their technical viability and cost-effectiveness pending a more detailed CBA by the DNO. The section below covers more detail on these options.

Option 1 – No Intervention

Estimated capacity released: 0 MVA **Discounted**

Detailed description: The constraint is imminent and the demand is projected to continue increasing. Doing nothing could therefore lead to thermal overloads, as described above, and to the inability to meet security of supply compliance with Engineering Recommendation P2.

New limiting factor: Existing transformer constraint as detailed in Table 3.1.1.

Option 2 – Adding a fourth transformer

Estimated capacity released: 38 MVA **Viable**

Detailed description: Adding a fourth 132/11 kV transformer at Perry Barr BSP, the work include:

- Extending the 132 kV busbars at Perry Barr to include a bus-section circuit breaker and a transformer bay
- Installing a fourth 15/30 MVA 132/11 kV transformer
- Installing an additional two section 11 kV board suitably interconnected with the existing
- Purchasing additional land (due to space restrictions) to accommodate the new assets above, this will significantly increase the deliverability risk of the scheme
- Carrying out site checks allowing the existing transformers to utilise their cyclic ratings

New limiting factor: Rating of the transformers

Option 3 – Uprating existing transformers

Estimated capacity released: 38 MVA Viable

Detailed description: Uprating two of the existing three transformers, the works include:

- Replacing two of the existing 132/11 kV 15/30 MVA transformers (to include GT2) with three-winding 132/11/11 kV transformers rated 30/60 MVA each.
- Extending the existing 11 kV board by adding additional circuit breakers and connecting each transformer low voltage (LV) winding to an 11 kV section.
- Running the transformers split at 11 kV, with sequence schemes for restoration of supplies.
- Assessing the fault levels at 11 kV and where possible, running the two LV windings (for the new three-winding transformers) in parallel with each other; where there may be fault level restrictions, then the following are to be considered, in the order listed below:
    - Uprating the impacted assets (11 kV circuits and/or downstream 11 kV switchgear);
    - Running split the two LV windings per transformer
- Carrying out site checks allowing the existing 132/11 kV transformer to utilise its cyclic ratings

New limiting factor: Rating of the transformers

Option 4 – Operational mitigation: Load Transfer

Estimated capacity released: 15 MVA Viable

Detailed description: The site currently runs split at 11 kV with GT2 and GT3 backfeeding each other under outage conditions. The solution is to better utilise all transformers and is in two-fold:

- Splitting the demand (for an outage of any of the three transformers) more evenly between the remaining two transformers in-service
- Carrying out site checks allowing the existing transformers to utilise their cyclic ratings

New limiting factor: Rating of the transformers

Option 5 – Load Management Schemes: Post-fault inter-trips

Estimated capacity released: 0 MVA Discounted

Detailed description: The site is Class C under Engineering Recommendation P2 which would require restoration of the group demand within 15 minutes for a circuit outage; therefore demand disconnection schemes (or similar) would make the site non-compliant.

New limiting factor: Engineering Recommendation P2 non-compliance

Option 6 – Flexibility service procurement

Estimated Flexibility Required (MW): 15 MW + Viable

Detailed description: Flexibility services through generation turn up and/or demand turn down could be procured to help alleviate the constraint and defer reinforcement. This option would be subject to a cost benefit analysis closer to the time, including all necessary sufficiency checks.

New limiting factor: Existing transformer ratings

Solution Recommendation

It is recommended to pursue option 4 above (operational mitigation) as it is likely to be the most cost effective solution and could allow for better utilisation of the assets by potentially enabling the cyclic ratings of the transformers.

Any reinforcement solution however would be subject to a CBA by the DNO, and in this case, it may be tested against the flexibility market as part of the DNOA process. The flexibility option however, although may be technically viable, is not likely to be as cost-effective as the option above.

3.4 Winson Green transformer overloads

Constraint Overview

Generation | Demand

Winson Green BSP consists of three 132/11 kV transformers fed via two 132 kV circuits from Bustleholm GSP. GT1 and GT2 were commissioned in 1964, and GT3 in 1993.

The site has a 4-section 132 kV single busbar that normally runs solid, but the transformers run split at 11 kV. The site is Class C under Engineering Recommendation P2.

The table below outlines the constraints identified for Best View, the conditions they occur under, and the triggering year and season.

Table 3.4.1 overview of constraint

Constraint	Condition	Trigger year per season			
		Winter	Inter Cool	Inter Warm	Summer
Winson Green transformer overload	N-1: arranged or fault outage of a transformer would cause an overload of the other two in-service	2026	2026	2027	2028

Uncertainty under other Distribution Future Energy Scenarios: The constraints above are identified under Best View and worsened under some of the other Distribution Future Energy Scenarios. The demand in the region is generally on an upward trend indicating constraints are potentially getting worse if not addressed, but the trigger year may vary depending on how quickly demand and/or generation materialises.

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 identified constraint(s)

Option	Description	Solves constraint	Potentially economic	Wider benefit	Viable or Discounted
1	No Intervention	×	✓	×	Discounted
Reinforcement (build) options					
2	Adding a fourth transformer	✓	×	×	Viable
3	Uprating the existing transformers	✓	×	×	Viable
4	Upgrading 11 kV backfeed to Ladywood	✓	✓	✓	Viable
Operational Mitigation					
5	Load transfers	×	✓	×	Discounted
Load Management Schemes					
6	Post-fault inter-trips	×	✓	×	Discounted
Flexibility services					
7	Flexibility service procurement	✓	✓	×	Viable

Solution Development

These options have been assessed on their technical viability and cost-effectiveness pending a more detailed CBA by the DNO. The section below covers more detail on these options.

Option 1 – No Intervention

Estimated capacity released: 0 MVA

Discounted

Detailed description: The constraint is anticipated to trigger by 2026 with the demand projected to continue increasing thereafter. Doing nothing could therefore lead to thermal overloads, as described above, and to the inability to meet security of supply compliance with Engineering Recommendation P2.

New limiting factor: Rating of the transformers

Option 2 – Adding a fourth transformer

Estimated capacity released: 38 MVA

Viable

Detailed description: Adding a fourth 132/11 kV transformer at Winson Green BSP, the works include:

- Extending the 132 kV busbars at Winson Green to include a transformer bay and an additional bus-section circuit breaker between main 3 and main 4
- Installing a fourth 15/30 MVA transformer banked with the 132/25 kV GT4 at main 4
- Installing an additional two section 11 kV board suitably interconnected with the existing
- Purchasing additional land to accommodate the new assets above (this adds cost and deliverability risks to the scheme)
- Carrying out site checks allowing the existing transformers to utilise their cyclic ratings

New limiting factor: Rating of the transformers

Option 3 – Uprating the existing transformers

Estimated capacity released: 38 MVA

Viable

Detailed description: Uprating two of the existing three transformers on site, the works include:

- Replacing GT1 and GT2 (currently 132/11 kV 15/30 MVA transformers) with three-winding 132/11/11 kV transformers rated 30/60 MVA each.
- Extending the existing 11 kV board by adding additional circuit breakers and connecting each transformer low voltage (LV) winding to an 11 kV section.
- Running the transformers split at 11 kV, with sequence schemes for restoration of supplies.
- Assessing the fault levels at 11 kV and where possible, running the two LV windings (for the new three-winding transformers) in parallel with each other; where there may be fault level restrictions, then the following are to be considered, in the order listed below:
    - Uprating the impacted assets (11 kV circuits and/or downstream 11 kV switchgear);
    - Running split the two LV windings per transformer
- Carrying out site checks allowing the existing 132/11 kV transformer to utilise its cyclic ratings.

[Space within the compound is very limited, therefore the works above will be subject to sites surveys to determine viability.]

New limiting factor: Rating of the transformers

Option 4 – Upgrading the 11 kV backfeed to Ladywood

Estimated capacity released: 20 MVA+ Viable

Detailed description: Upgrading the 11 kV network between Winson Green and Ladywood BSPs (which are only a few km apart) to allow for sufficient transfers during outages, and for new demand to be connected to Ladywood instead of Winson Green.

In addition to the above, the option also calls for the carrying out site checks (at Winson Green and at Ladywood) allowing the existing transformers at these sites to utilise their cyclic ratings. This alone would be sufficient to manage the constraint until 2031.

New limiting factor: Rating of the transformers

Option 5 – Operational mitigation: Load Transfer

Estimated capacity released: 10-15 MVA Discounted

Detailed description: Winson Green BSP has 11 kV interconnection to Ladywood BSP which could help alleviate some of the constraints but not sufficient enough to secure the site in the long run without uprating the transformers and upgrading parts of the 11 kV network.

New limiting factor: Rating of the transformers

Option 6 – Load Management Schemes: Post-fault inter-trips

Estimated capacity released: 0 MVA Discounted

Detailed description: The site is Class C under Engineering Recommendation P2 which would require restoration of the group demand within 15 minutes for a circuit outage; therefore demand disconnection schemes (or similar) would make the site non-compliant.

New limiting factor: Engineering Recommendation P2 non-compliance

Option 7 – Flexibility service procurement

Estimated Flexibility Required (MW): 20 MW + Viable

Detailed description: Flexibility services through generation turn up and/or demand turn down could be procured to help alleviate the constraint and defer reinforcement. This option would be subject to a cost benefit analysis closer to the time, including all necessary sufficiency checks.

New limiting factor: Existing transformer ratings

Solution Recommendation

With regards to reinforcement build options, it would be recommended to pursue option 4 above (upgrading the 11 kV interconnection) as it is likely to be the most cost effective solution and could allow for better utilisation of the assets by enabling the cyclic rating of the transformers. This also has the wider benefit of increasing the capacity at Ladywood BSP.

Any reinforcement solution however would be subject to a CBA by the DNO, and in this case, it may be tested against the flexibility market as part of the DNOA process.

3.5 Rushall BSP constraints

Constraint Overview

Generation Demand

Rushall BSP consists of 4x 132/11 kV transformers normally fed out of Bustleholm GSP via a 132 kV cable circuit. It has another 132 kV circuit to Walsall switching station, picking up a battery generation site and Bentley GT2. The site has a 4-section 132 kV single busbar configuration normally run solid, but the 11 kV is split between the four transformers.

Rushall is currently Class C under Engineering Recommendation P2, but is expected to become Class D within a couple of years and then exceed 100 MW by 2032 prompting N-2 compliance in line with P2.

The table below outlines the constraints identified for Best View, the conditions they occur under, and the triggering year and season.

Table 3.5.1 overview of constraint

Constraint	Condition	Trigger year per season			
		Winter	Inter Cool	Inter Warm	Summer
Rushall transformer overload	N-1: Outage of any transformer at Rushall BSP will result in an overload on another	2029	2028	2025	2033
Rushall N-2 constraint	N-2: Arranged outage on one infeed followed by a fault on another could result in more than 100 MW demand off supply	2032	-	-	-
Bustleholm to Rushall 132 kV circuit overload	Intact; N-1: outage of the infeed to Bentley GT1 putting all of the BSP onto GT2 and therefore this circuit	2031	2029	2029	2031
Walsall to Rushall 132 kV circuit overload	Intact; N-1: outage of the infeed to Bentley GT1 putting all of the BSP onto GT2 and therefore this circuit	2031	2030	2030	2030

Uncertainty under other Distribution Future Energy Scenarios: The constraints above are identified under Best View and worsened under some of the other Distribution Future Energy Scenarios. The demand in the region is generally on an upward trend indicating constraints are potentially getting worse if not addressed, but the trigger year may vary depending on how quickly demand and/or generation materialises.

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 identified constraint(s)

Option	Description	Solves constraint	Potentially economic	Wider benefit	Viable or Discounted
1	No Intervention	×	✓	×	Discounted
Reinforcement (build) options					
2	Additional 132 kV circuits to Rushall and Walsall	✓	✓	✓	Viable
3	Establishing a 132/11 kV BSP at Walsall, and uprating the 132 kV circuits	✓	✓	×	Viable
Operational mitigation					
4	Load transfers	×	✓	×	Discounted
Load Management Schemes					
5	Post-fault inter-trips	×	✓	×	Discounted
Flexibility services					
6	Flexibility service procurement	✓	✓	×	Viable

Solution Development

These options have been assessed on their technical viability and cost-effectiveness pending a more detailed CBA by the DNO. The section below covers more detail on these options.

Option 1 – No Intervention

Estimated capacity released: 0 MVA **Discounted**

Detailed description: The constraint is anticipated to trigger by 2025 with the demand projected to continue increasing thereafter. Doing nothing could therefore lead to thermal overloads, as described above, and to the inability to meet security of supply compliance with Engineering Recommendation P2.

New limiting factor: Rating of existing transformer and P2 compliance

Option 2 – Additional 132 kV circuits to Rushall and Walsall

Estimated capacity released: 180 MVA **Viable**

Detailed description: Adding an additional infeeds to Rushall and Walsall, the works include:

- Establishing a new 132 kV bay at Bustleholm GSP (at Main 2 / Reserve 2, or at Main 3 / Reserve 3).
- At Rushall BSP, relocating the Walsall circuit from disconnector 403 to a new disconnector (303) connected to busbar section Main 3.
- Installing a new 5.5 km 132 kV cable circuit from the new bay at Bustleholm to the vacated disconnector 403 at Rushall BSP. The circuit is to have a minimum summer sustained rating of 250 MVA, anticipated to be no less than 1000 mm copper conductor laid flat.
- Installing a 2.5 km 132 kV cable circuit from Rushall Main 2 (via a new disconnector 203) to Walsall disconnector 403. The new circuit is to have a minimum summer sustained rating of 200 MVA, anticipated to be no less than 1000 mm copper conductor laid in trefoil.

  [For the connection at Walsall BSP, any committed schemes on that section may need to be relocated and banked with another generation scheme out of Walsall to free up disconnector 403.]
- Carrying out site checks at Rushall BSP allowing all the existing transformers to utilise their cyclic ratings.
- Operating the 132 kV busbars at Rushall split by running CB220 normally open.
- Operating Walsall 132 kV busbars split between Main 3 and Main 4, by running CB320 normally open; effectively splitting between the two incomers from Bustleholm and Rushall.

  [The 132 kV split configurations above are to maintain fault level stress limits, and to allow for the battery schemes to trip following a fault, thus preventing thermal overloads.]

New limiting factor: Rating of the transformers

Option 3 – Establishing a 132/11 kV BSP at Walsall, and uprating the 132 kV circuits

Estimated capacity released: 60 MVA **Viable**

Detailed description: Establishing a 132/11 kV BSP at Walsall and uprating the circuits. The works include:

- Uprating/relaying approximately 5.5 km of the 132 kV cable circuit between Bustleholm and Rushall with a suitably rated conductor
- Uprating/relaying approximately 2.5 km of the 132 kV cable circuit between Rushall and Walsall with a suitably rated conductor
- Extending the 132 kV configuration at Walsall to facilitate an additional two 132/11 kV transformers
- Installing a two 15/30 MVA transformers at Walsall BSP
- Installing four sections of 11 kV board at Walsall, suitably interconnected
- Upgrading the 11 kV network to Rushall to allow for demand transfer to the new transformers at Walsall
- Re-assessing the transfer capacity between Bustleholm, Willenhall, and Rugeley to ensure all three remain compliant
- Carrying out site checks at Rushall BSP allowing all the existing transformers to utilise their cyclic ratings

New limiting factor: Rating of the existing transformers

Option 4 – Operational mitigation: Load Transfer

Estimated capacity released: 10 MVA+ **Discounted**

Detailed description: Some 11 kV interconnection exists between Rushall and Bustleholm which can be utilised to manage the constraint in the short term; however, as demand at Rushall increases significantly these would fast become insufficient to avoid thermal overloads or to maintain network compliance.

New limiting factor: Rating of the existing transformers

Option 5 – Load Management Schemes: Post-fault inter-trips

Estimated capacity released: 0 MVA **Discounted**

Detailed description: The group is currently Class C under Engineering Recommendation P2, anticipated to become Class D in a couple of years requiring the group demand minus 20 MW to be restored immediately under a first circuit outage, with full restoration within 3 hours, therefore demand disconnection schemes (or similar) would make the network non-compliant.

Furthermore the site, which currently has only two main supplies, is expected to exceed 100 MW by 2032 requiring the demand minus 100 MW to be restored under an N-2 condition.

New limiting factor: Engineering Recommendation P2 non-compliance

Option 6 – Flexibility service procurement

Estimated Flexibility Required (MW): 23.5 MW + **Viable**

Detailed description: Flexibility services through generation turn up and/or demand turn down could be procured to help alleviate the constraint and defer reinforcement up to 2032 only, as it would not be feasible for flexibility to mitigate the N-2 loss of supply constraint.

This option would be subject to a cost benefit analysis closer to the time, including all necessary sufficiency checks.

New limiting factor: Rating of existing transformers

Solution Recommendation

With regards to reinforcement build options, it would be recommended to pursue option 2 above (installing additional circuits to Rushall and Walsall) as it is likely to be the most deliverable, enduring, and cost-effective solution longer term. It also has the wider benefit of improving the interconnections between Bustleholm, Willenhall and Rugeley GSPs.

Any reinforcement solution however would be subject to a CBA by the DNO, and in this case, it would then be tested against the flexibility market as part of the DNOA process.

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