Willenhall GSP Network

Network Development Report – West MIdlands

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Electricity Distribution

nationalgrid

Contents

Willenhall GSP Network

1. Network Overview

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

The GSP is fed via two 240 MVA 275/132 kV Super Grid Transformers (SGTs), which subsequently feeds three Bulk Supply Points (BSPs) under normal running configurations (Wolverhampton BSP, Bentley BSP, and Burntwood BSP) supplying over 56,000 customers.

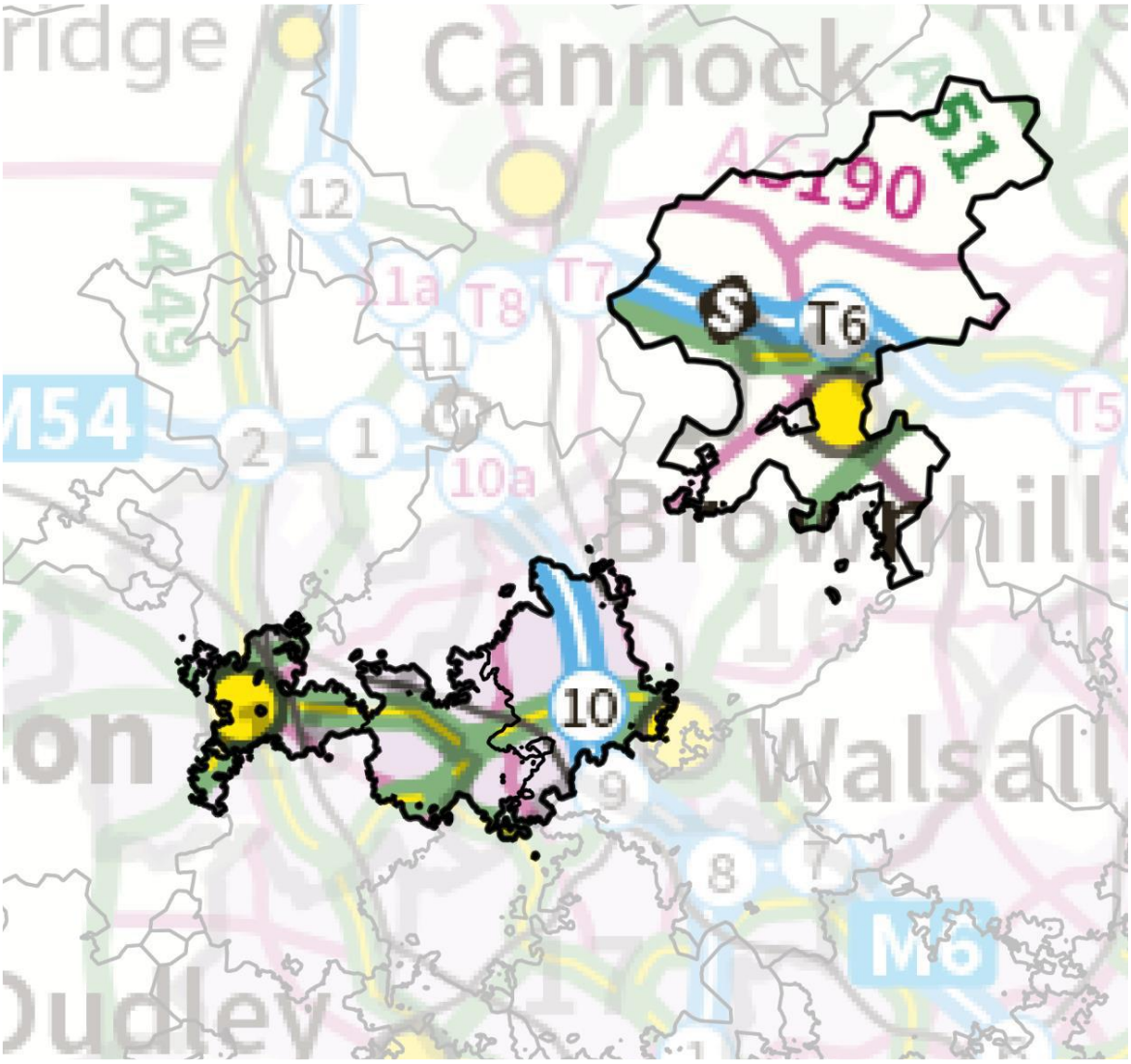

Figure 1.1 Willenhall GSP geographic network coverage

This report discusses existing and future network constraints over a 0-10 year horizon associated with Willenhall 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

Willenhall GSP is fed via a pair of 240 MVA 275/132 kV SGTs running in parallel at 132 kV through three sections of double busbars.

The Willenhall GSP network is arranged as follows:

- Willenhall BSP consisting of three 132/11 kV transforms (normally run split) that are fed via three 132 kV circuits from the GSP's double busbars.
- Wolverhampton BSP that is fed via two dedicated 132 kV circuits, consisting of two three-winding 132/11/11 kV transformers (normally run split) and a 132/33 kV transformer that predominantly supplies 33 kV connected customers.
- Bentley BSP consisting of two three-winding 132/11/11 kV transformers (normally run split) that are fed via a pair of 132 kV circuits from Walsall BSP, configured such that one transformer is supplied from Willenhall GSP and the other from Bustleholm GSP.
- Burntwood BSP consisting of three three-winding 132/11/11 kV transformer that normally run split at 11 kV, and configured such that two of the transformers are fed via the Rugeley network, and the third is fed from Willenhall GPS via Walsall.

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.

Willenhall 132 kV

- Arranged outages affecting the SGT parallel at Willenhall GSP result in reconfiguration of the 132 kV busbars to reinstate the parallel, where possible.
- Arranged or fault outages leading to the loss of a Grid Transformer (GT) at Willenhall BSP, Wolverhampton BSP, Burntwood BSP and Bentley BSP result in the 11 kV, at the affected sites, being closed in (and reconfigured in some cases) to backfeed the demand.

Walsall BSP

- Arranged outages affecting the infeed from Rushall towards Bentley GT2 result in the 33 kV battery schemes being curtailed, and Bentley GT2 being backfed from Willenhall BSP via CB420 at Walsall.
- Arranged outages affecting Bentley GT1's 132 kV infeed from Willenhall results in Walsall CB120 being closed in to backfeed it from Rugeley GSP network.

2. Summary of Network Constraints

The following constraint has been identified for the Best View Scenario, for which mitigation options will be discussed:

- Bentley BSP transformer overload

3. Network Constraints and Solution Options

3.1 Bentley BSP transformer overload

Constraint Overview

Generation **Demand**

Bentley BSP is comprised of two three-winding 132/11/11 kV grid transformers: GT1 supplied from Willenhall GSP via Walsall BSP and GT2 supplied from Bustleholm GSP via Rushall and Walsall. The group demand at Bentley BSP 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
Bentley transformer overloads	N-1: arranged outage of either transformer at Bentley overloads the other	2029	2029	2029	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 at Willenhall BSP with 11 kV upgrades to Bentley BSP	✓	✓	✓	Viable
3	Adding a third transformer at Bentley BSP	✓	✓	×	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 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 2029 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 transformers

Option 2 – Adding a fourth transformer at Willenhall BSP with 11 kV upgrades to Bentley BSP

Estimated capacity released: 38 MVA

Viable

Detailed description: Adding a fourth transformer at Willenhall BSP, the works include:

- Establishing a new 132 kV bay at Willenhall GSP
- Installing a relatively short 132 kV circuit from the new bay to Willenhall BSP site
- Installing a fourth 132/11 kV transformer at Willenhall BSP
- Installing an additional two section 11 kV board suitably interconnected with the existing
- Upgrading the 11 kV network between Willenhall and Bentley BSPs (approximately 3 km apart) to allow future demand growth in the area to be picked up by Willenhall instead of Bentley
- Carrying out site checks at Bentley and at Willenhall BSPs allowing the existing transformers to utilise their cyclic ratings

New limiting factor: Rating of existing transformers

Option 3 – Adding a third transformer at Bentley BSP

Estimated capacity released: 38 MVA

Viable

Detailed description: Adding a third transformer at Bentley BSP, the works include:

- Extending the 132 kV busbars at Bentley BSP
- Installing a third 132/11 kV transformer
- Installing a 2-section 11 kV board suitably interconnected with the existing sections
- Carrying out site checks allowing the existing transformers to utilise their cyclic ratings

New limiting factor: Rating of transformers

Option 4 – Operational mitigation: Load Transfer

Estimated capacity released: A few MVAs

Discounted

Detailed description: There are some 11 kV transfers to neighbouring sites but these interconnections are insufficient to fully mitigate the constraints.

New limiting factor: Rating of existing 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): 23 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 existing transformers

Solution Recommendation

With regards to reinforcement build options, it would be recommended to pursue option 2 above (installing a fourth GT at Willenhall and upgrading the 11 kV network to pick up future load growth) as this option is likely to be more cost-effective in the long run, avoids complicating the network, and provides a wider benefit of improving the N-2 security of supply at Bentley and Willenhall BSPs.

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.

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