



Rugeley GSP Network

Network Development Report – West Midlands

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**Electricity
Distribution**

nationalgrid

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Rugeley GSP Network

1. Network Overview

Rugeley Grid Supply Point (GSP) is located in the West Midlands to the north-east of the city of Wolverhampton, and has interconnections with Bushbury, Bustleholm, and Willenhall GSPs.

Rugeley GSP is fed by two Super Grid Transformers (SGTs) and feeds six Bulk Supply Points (BSPs) under normal running conditions; these are Stafford BSP, Stafford South BSP, Rugeley Town BSP, Lichfield BSP, Burntwood BSP, and Cannock BSP. Over 116,700 customers are supplied from Rugeley GSP.

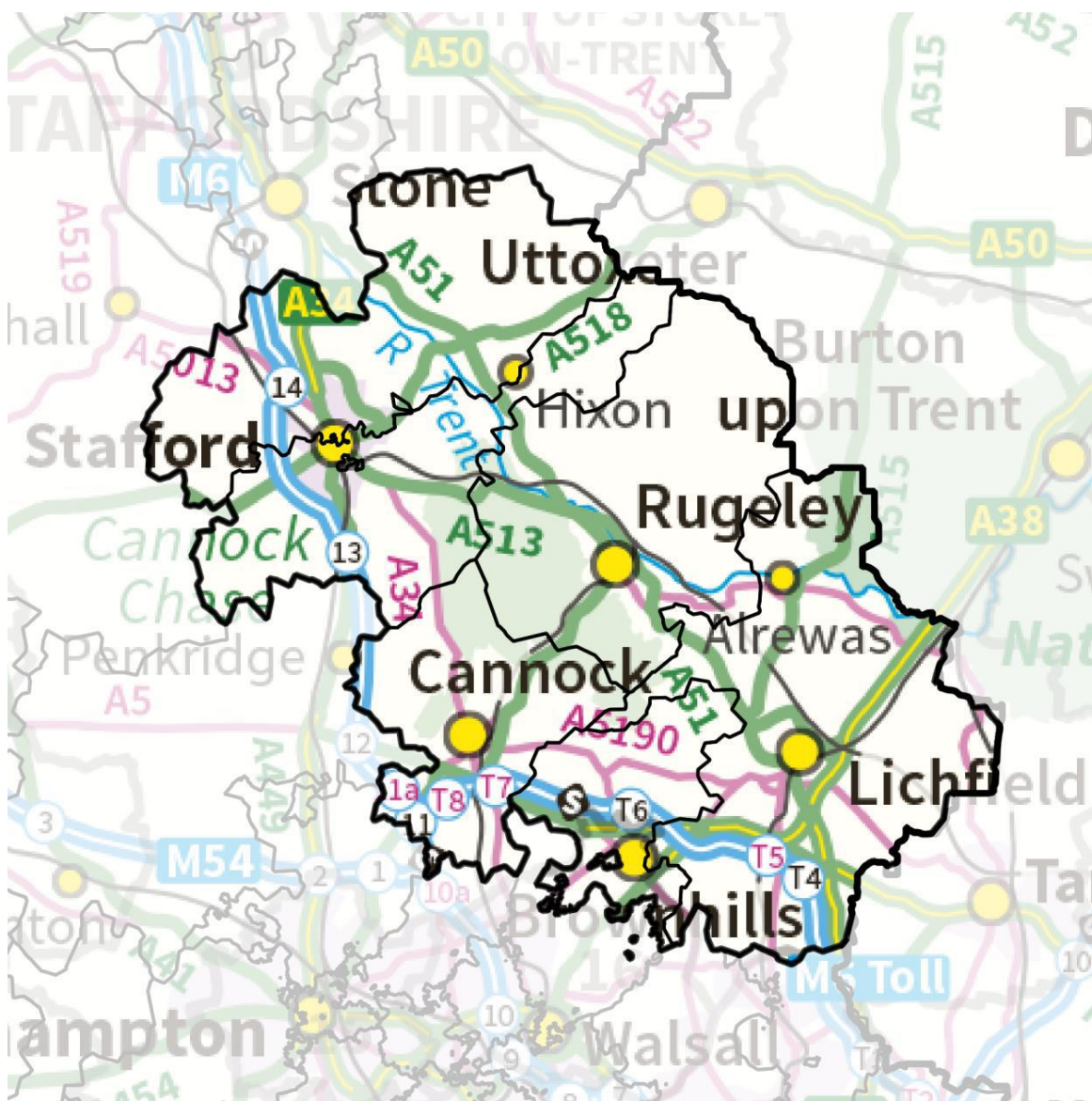


Figure 1.1 Rugeley GSP geographic network coverage

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

Rugeley GSP is a 400/132 kV site fed via two 240 MVA SGTs. SGT1 and SGT2 currently run in parallel through a 3-section 132 kV double busbar arrangement.

The Rugeley GSP network is arranged as follows:

- Rugeley Town BSP and Lichfield BSP are fed via two 132 kV circuits (banked together) from Rugeley GSP. Rugeley Town is comprised of two 132/11 kV transformers running split; and Lichfield BSP is comprised of two three-winding 132/11/11 kV transformer also running split.

[There are ongoing works to replant Rugeley 132 kV busbars and circuit breakers, due to asset condition, which will include unbanking the Rugeley Town and Lichfield 132 kV circuits.]

- Burntwood BSP is comprised of three three-winding 132/11/11 kV transformers, all normally running split at 11 kV. GT1 and GT2 are fed from Rugeley GSP while GT3 is supplied from Willenhall GSP.
- Cannock BSP also consists of three three-winding 132/11/11 kV transformers all fed from Rugeley GSP, and is normally run split at 11 kV.
- Stafford BSP is comprised of two three-winding 132/11/11 kV transformers, with GT2B fed by Rugeley GSP and GT1B from Bushbury GSP, normally run split at 11 kV.
- Stafford South BSP is also comprised of two three-winding 132/11/11 kV transformers, with GT1 fed from Rugeley GSP and GT3 from Bushbury GSP, normally run split at 11 kV.

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.

Rugeley 132 kV:

- Arranged outages affecting 132 kV circuits between Rugeley GSP and Burntwood, or between Willenhall and Burntwood, results in the 132 kV bus-section circuit breaker at Burntwood being closed in to restore supplies.
- Arranged outages affecting either 132 kV infeed to Stafford BSP result in the 132 kV bus-section circuit breaker being closed in to backfeed.
- Arranged outages affecting either 132 kV infeed to Stafford South BSP result in the 132 kV bus-section circuit breaker being closed in to backfeed.
- Arranged or fault outages leading to loss of a GT at Lichfield, Burntwood, Cannock, Rugeley Town, Stafford South, or Stafford BSPs result in the 11 kV for the affected site being reconfigured and closed in to backfeed.

2. Summary of Network Constraints

The following constraints were identified for the Best View Scenario, for which mitigation options are covered further down in the report:

- Lichfield BSP transformer overload

Transmission-Distribution interface

Rugeley GSP is a 400/132 kV site and one of the boundaries between the transmission and distribution network for that area. Condition of assets at the GSP is triggering a rebuild of the site, and in addition to that, New Connection activity at the distribution network, both demand and generation, have also triggered constraints at the transmission network with regards to SGT capacity. Initial proposals include uprating of the existing assets at Rugeley or potentially establishing another GSP at a location suitable for the region.

3. Network Constraints and Solution Options

3.1 Lichfield BSP transformer overload

Constraint Overview

 Generation
  Demand
 

Lichfield BSP is a three-winding 132/11/11 kV site consisting of two transformers fed from Rugeley GSP via two 132 kV circuits banked with the feeders to Rugeley Town BSP. The site runs split at 11 kV, and the maximum demand makes it Class C under Engineering Recommendation P2.

Table 3.1.1 outlines the constraint identified for Best View, the conditions it occurs 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 |
| Lichfield BSP transformer overload | N-1: outages of either three-winding 132/11/11 kV transformer at Lichfield | 2029 | 2030 | 2031 | - |

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 third transformer | ✓ | ✓ | × | Viable |
| 3 | Upgrading the 11 kV interconnection with Burntwood 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 third transformer

Estimated capacity released: 30 MVA

 **Viable**

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

- Extending the 132 kV busbars at Lichfield to establish a 3-section single busbar configuration (additional land may need to be sought).
- Installing a third transformer, 132/11 kV rated 15/30 MVA, such that each transformer is connected to one section of 132 kV busbar, separated by a bus-section circuit breaker.
- Installing an additional 2-section 11 kV board rated 2000 amp and suitably interconnected with the existing.
- Installing a third section of 132 kV busbar at Lichfield BSP, including the addition of a bus-section circuit breaker and a new transformer bay. Additional land may need to be sought.
- Assessing the fault level at Lichfield, possibly running the 11 kV split.
- Carrying out site checks allowing the existing transformers (GT1 and GT2) to utilise their cyclic ratings.

New limiting factor: Rating of the transformers

Option 3 – Upgrading the 11 kV interconnection with Burntwood BSP

Estimated capacity released: 10 MVA

 **Viable**

Detailed description: There is sufficient capacity at Burntwood BSP to support Lichfield but the 11 kV network would need upgrading. The works therefore include:

- Upgrading the network between Lichfield and Burntwood BSPs to allow a minimum of 10 MVA transfer capacity. The networks are approximately 5-6 km apart (9 km BSP to BSP).
- Carrying out site checks (at both Lichfield and Burntwood) to allow the existing grid transformers (GTs) at both BSPs to utilise their cyclic ratings.

New limiting factor: Rating of the transformers

Option 4 – Operational mitigation: Load Transfer

Estimated capacity released: A few MVAs

↓ **Discounted**

Detailed description: There are limited options for operational mitigation to solve this constraint due to limited 11 kV interconnection.

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): 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: Rating of the transformers

Solution Recommendation

With regards to reinforcement build options, it would be recommended to pursue option 3 above (upgrading the 11 kV network with Burntwood BSP) as it is likely to be the most economical and deliverable solution, providing a wider benefit of raising the capacity at Burntwood BSP as well as increasing the N-2 capacity at Lichfield (for the loss of both incoming 132 kV circuits).

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 Distribution Network Options Assessment (DNOA) process.



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