Uttoxeter BSP

Network Development Report – East Midlands

May 2024

Electricity Distribution

nationalgrid

Contents

Uttoxeter 33 kV

1. Network Overview

Uttoxeter Bulk Supply Point (BSP) is fed from Willington Grid Supply Point (GSP) in National Grid Electricity Distribution's (NGED's) East Midlands licence area. Uttoxeter BSP is fed from Willington via a dual 132 kV circuit (which also supplies Burnaston BSP) teed off the dual circuit to Winster BSP.

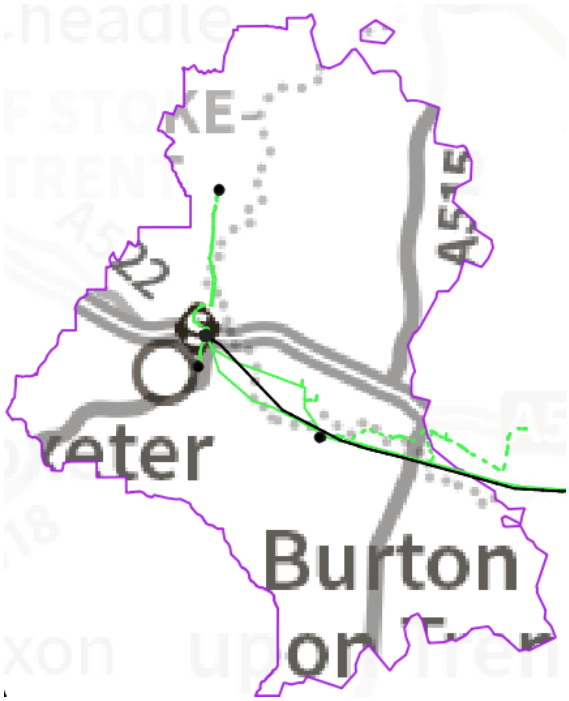

Figure 1.1 Uttoxeter geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon identified on the 33 kV network fed from Uttoxeter BSP. This uses the methodology outlined in the Network Development Plan Methodology Report with Network Operability Modelling applied as outlined below.

For the purposes of this analysis the NGED Best View Distribution Future Energy Scenario (DFES) has been used to study the years 2022 (baseline), 2028 and 2034, with consideration given to how proposals could change under the other scenarios. Five representative days have been studied across the four seasons: Winter Peak Demand, Intermediate Warm Peak Demand, Intermediate Cool Peak Demand, Summer Peak Demand and Summer Peak Generation.

1.1 Network Topology

Uttoxeter BSP has two 33 kV busbars fed by two 132/33 kV Grid Transformers (GTs) both rated to 22.5/45/58.5 MVA. Uttoxeter BSP feeds four primary substations: Church Street, Dove Valley, Marchington and Rocester.

All four primaries have two 33/11 kV transformers each, and are supplied directly from Uttoxeter (with the exception of Dove Valley which is supplied via Marchington primary). Uttoxeter BSP is interconnected at 33 kV with Burton BSP via a single 33 kV circuit from Marchington primary (which is run open under normal running arrangements).

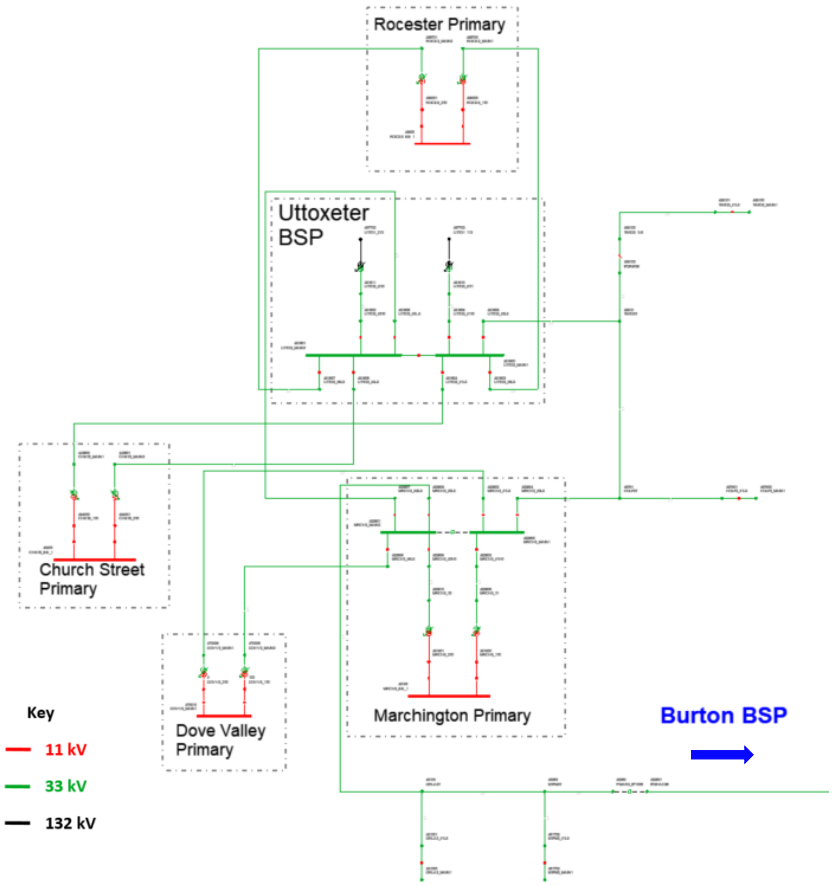

Figure 1.1.1 Uttoxeter 33 kV network single line diagram

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.

- For the loss of an infeed to a transformer at any of the primaries fed from Uttoxeter BSP under arranged outages, the lower voltage side circuit breaker is opened to prevent back-energisation.
- The 33 kV network downstream of Uttoxeter BSP is split for arranged outages on its 33 kV bus section breaker to prevent loose couples. This involves splitting all four primaries fed from Uttoxeter at 11 kV (Church Street, Dove Valley, Marchington and Rocester).

2. Network Constraints and Solution Options

2.1 Summary of Network Constraints

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

- Both of the transformers at and both of the 33 kV infeeds to Church Street primary are projected to overload for arranged or fault outages on the other transformer/circuit by 2034 (at times of peak demand in any season).
- Sections of the 33 kV circuits from Uttoxeter BSP to Marchington primary are projected to be constrained based on generation growth forecasts in 2034 (for outages on either circuit to the primary).

2.2 Church Street primary transformer and circuit overloads

Constraint Overview

Generation Demand

The table below outlines the nature of the network constraints identified in the network analysis.

Table 2.2.1 constraint(s) and conditions under which constraint(s) occur

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
Church Street transformer overload	Arranged or fault outage on either transformer or circuit	None	2034	2034	2034	2034
Uttoxeter to Church Street 33 kV circuit overload	Arranged or fault outage on either transformer or circuit	None	2034	2034	2034	2034

Uncertainty under other Distribution Future Energy Scenarios: This constraint is not present under any scenario for any season in 2028 (despite significantly higher growth being seen in the Consumer Transformation and Leading the Way scenarios). The lowest growth is forecast under Falling Short, for which overloads are still projected by 2034 in some seasons.

Solution Options

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

Table 2.2.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Uprate the transformers and circuits to Church Street primary.
2	Install a third transformer at Church Street primary.
3	Install primary transformers at Uttoxeter BSP.
Flexibility Services	
4	Procure flexibility under Church Street primary.

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 1 – Uprate the transformers and circuits to Church Street primary

Viable

Capacity released for constraint(s) considered: 15 MVA

New limiting factor for constraint(s) considered: Transformer ratings

Detailed description: Overloads are observed on both the transformers and 33 kV feeder circuits to Church Street primary by 2034, necessitating intervention for both sets of assets. This could involve uprating both the transformers and 33 kV circuits to Church Street, which would fully resolve this constraint in 2034 and provide significant additional capacity for future growth.

The new transformers would be rated to 20/40 MVA (the highest rated units used by NGED as standard on the distribution network). This would also confer an asset condition benefit, as the existing units are over 55 years old.

Uprating the 33 kV infeeds to Church Street primary would only require around 1 km of total circuit works (around 0.5 km per circuit), as approximately half the length of each of the existing circuits from Uttoxeter BSP is already rated high enough to allow the full capacity of 20/40 MVA transformers to be utilised.

Option 2 – Install a third transformer at Church Street primary

Discounted

Capacity released for constraint(s) considered: Minimal

New limiting factor for constraint(s) considered: Ratings of the existing transformers

Detailed description: Installing a third transformer at Church Street primary rated to 12/24 MVA to match the existing units, with a new 33 kV circuit from Uttoxeter BSP would not significantly increase the capacity of the substation. This is because there are only two 33 kV busbars at Uttoxeter, with no current plans to add a third, so for the loss of a busbar two transformers would be lost at Church Street primary (as two of the circuits to Church Street would have to be from the same busbar).

This option has been discounted, as in addition to the issues discussed above (and the disadvantages for network operability of creating a three transformer primary) it would also not benefit the condition of the existing transformers as option 1 described above would (so the existing transformers would likely need replacing based on their condition soon regardless).

Option 3 – Install primary transformers at Uttoxeter BSP

Discounted

Capacity released for constraint(s) considered: 38 MVA or 23 MVA

New limiting factor for constraint(s) considered: Total primary capacity of Church and the new Uttoxeter primary

Detailed description: This constraint could be resolved by building a new primary substation at Uttoxeter BSP and transferring demand out of Church Street (Uttoxeter BSP is under 1 km from Church Street primary, with both located in Uttoxeter).

This option has been discounted based on a number of factors:

- Creating a new primary (even at an existing site) would be significantly more expensive than upgrading Church Street itself as put forward in option 1.
- Due to their age, the primary transformers at Church Street are likely to need replacing based on their condition in the near future regardless (which will provide an economic opportunity to uprate them to 20/40 MVA units).
- New 11 kV network would need to be built to allow the new primary to pick up demand (although this would likely not need to be extensive due to the proximity of the two sites).

While this option has been discounted at this time, it could potentially be utilised to provide additional capacity for the area further into the future. This could be required if demand growth in and around Uttoxeter is higher than projected (forecasts for Church Street indicate it will exceed the new firm capacity created by option 1 by 2050, but not by a significant enough margin to warrant a new primary site).

Option 4 – Procure flexibility under Church Street primary

Viable

Flexibility service type: Generation turn up/demand turn down.

Detailed description: Flexibility services could be procured to alleviate the projected overloads seen on the 33 kV circuits to and the primary transformers at Church Street. Flexibility would also provide no benefit for the condition of the transformers at Church Street, so flexibility could not be used to defer the reinforcement of the transformers once their replacement is triggered based on their condition. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

Uprating both of the primary transformers at Church Street to 20/40 MVA units (and sections of the 33 kV circuits from Uttoxeter BSP to match) has been identified as the optimal reinforcement solution.

2.3 Uttoxeter to Marchington 33 kV circuit overloads

Constraint Overview

Generation Demand

The table below outlines the nature of the network constraints identified in the network analysis.

Table 2.3.1 constraint(s) and conditions under which constraint(s) occur

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed under Best View
			Summer (generation)
Uttoxeter to Marchington main 1 33 kV circuit overload	Marchington T2, Uttoxeter main 2 33 kV busbar or circuit outage	None	2034
Uttoxeter to Marchington main 2 33 kV circuit overload	Marchington T1, Uttoxeter main 1 33 kV busbar or circuit outage	None	2034

Uncertainty under other Distribution Future Energy Scenarios: Similar generation growth is forecast under Consumer Transformation as under Best View for Marchington primary. Lower generation growth is forecast under the other three scenarios. The lowest growth is forecast under Falling Short (for which overloads are not triggered by 2034).

Solution Options

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

Table 2.3.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Uprate the 33 kV circuits to Marchington primary.
Operational Mitigation	
2	Transfer 33 kV generators into Burton BSP.
3	Active Network Management.
Flexibility Services	
4	Procure flexibility under Marchington primary.

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full CBA. This CBA will be subsequently carried out by the DNO to determine the optimal reinforcement solution.

Option 1 – Uprate the 33 kV circuits to Marchington primary

Viable

Capacity released for constraint(s) considered: 6 MVA

New limiting factor for constraint(s) considered: Transformer ratings for reverse power flow at Marchington primary

Detailed description: There are a number of options for increasing the capacity of the 33 kV network between Uttoxeter BSP and Marchington primary. For the 33 kV circuit to main 2, 3 MVA of capacity could be released by uprating a short section of cable. However, releasing any further capacity would require uprating over 5 km of circuit (virtually the entire length).

On the main 1 side, the infeed is currently limited by the section of circuit between Uttoxeter BSP and the first tee point. Similarly to the circuit to main 2, nearly this entire section of circuit (which is over 3.5 km in length) would need uprating to release any more than 1 MVA of capacity.

Building new 33 kV circuits from Uttoxeter BSP to Marchington primary, while expensive, is likely the most strategic enduring solution should the high generation growth forecast for the area materialise. This would also free up significant demand headroom at both Marchington and Dove Valley primaries. Despite demand forecasts for the area being low, this would still create option value for the network.

Option 2 – Transfer 33 kV generators into Burton BSP

Discounted

Capacity released for constraint(s) considered: Generation output of the 33 kV generators

New limiting factor for constraint(s) considered: As before

Detailed description: A number of generators connected at 33 kV export via Marchington primary. The 33 kV circuit which these generators are connected to continues on to Hatton primary (supplied from Burton BSP). Moving the normal open point on this 33 kV circuit to Marchington would reduce loading on the Uttoxeter to Marchington circuits, helping alleviate this constraint.

This option has been discounted, as it would increase complexity and leave the network non-compliant with Engineering Recommendation P18. It would also only benefit the circuit to main 2, and would have implications at 132 kV (as it would transfer generation from Willington GSP to Drakelow GSP).

Option 3 – Active Network Management

Viable

Capacity released for constraint(s) considered: Dependent on curtailment

New limiting factor for constraint(s) considered: As before

Detailed description: Any additional connections fed via these 33 kV circuits could be included in an Active Network Management (ANM) scheme. ANM schemes are used to manage constraints on over-committed networks.

Option 4 – Procure flexibility under Marchington primary

Discounted

Flexibility service type: Generation turn down/demand turn up.

Detailed description: Flexibility is not suitable to manage this constraint as it is generation driven. Managing generation constraints using flexibility procurement is technically feasible, but NGED's internal tools and processes for calculating flexibility requirements for generation constraints are still in development.

Solution Recommendation

Active Network Management (ANM) could potentially be used to manage this constraint, meaning reinforcement would be deferred. Once reinforcement is triggered, the most enduring solution identified is to build new 33 kV circuits between Uttoxeter BSP and Marchington primary, which would free up significant headroom for both demand and generation growth in the area.

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