Stoke Bardolph GSP

Network Development Report – East Midlands

May 2024

Electricity Distribution

nationalgrid

Contents

Stoke Bardolph 132 kV

1. Network Overview

Stoke Bardolph Grid Supply Point (GSP) supplies two Bulk Supply Points (BSPs) in National Grid Electricity Distribution's (NGED's) East Midlands licence area in and around Nottingham. These two BSPs are Nottingham East and Nottingham North 33 kV.

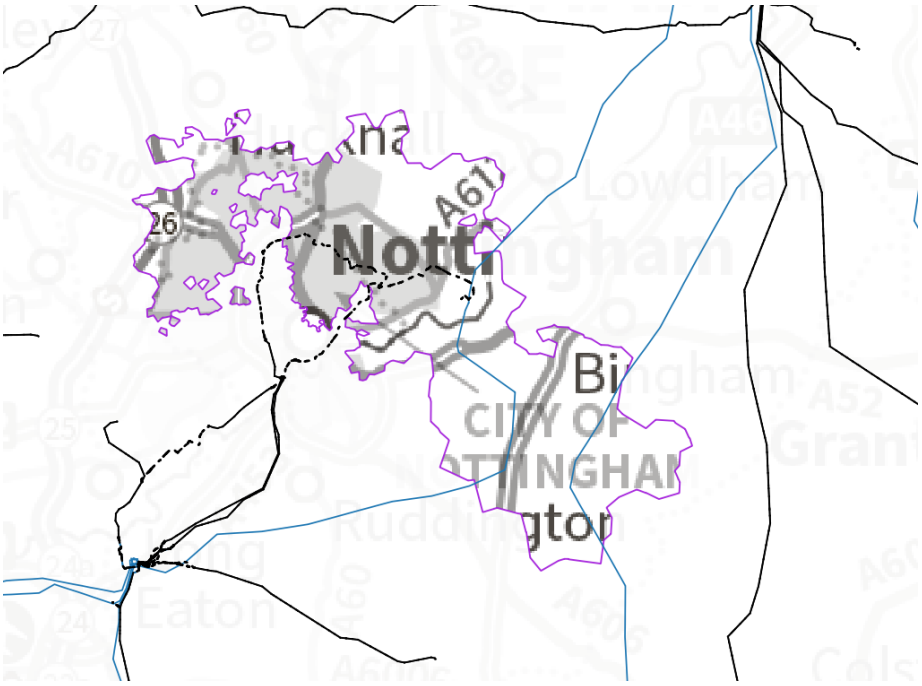

Figure 1.1 Stoke Bardolph GSP geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon identified on the 132 kV network fed from Stoke Bardolph GSP. 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

Stoke Bardolph has two 400/132 kV super grid transformers (SGTs) feeding onto two 132 kV busbars. The site is run in parallel under normal running arrangements. There is one 132 kV dual circuit out of the GSP to Nottingham East BSP (which has two 132/33 kV grid transformers (GTs)). From Nottingham East there are two 132 kV dual circuits, one to Nottingham BSP (which is fed from Ratcliffe GSP) and one feeding Nottingham North BSP. Nottingham North BSP has four GTs (two 132/33 kV and two 132/11 kV), with the two 132/33 kV GTs fed from Stoke Bardolph and the two 132/11 kV GTs fed from Ratcliffe via a 132 kV dual circuit from Nottingham BSP. The only GSP which Stoke Bardolph is interconnected with at 132 kV is Ratcliffe, via the two 132 kV dual circuits from Nottingham BSP mentioned above.

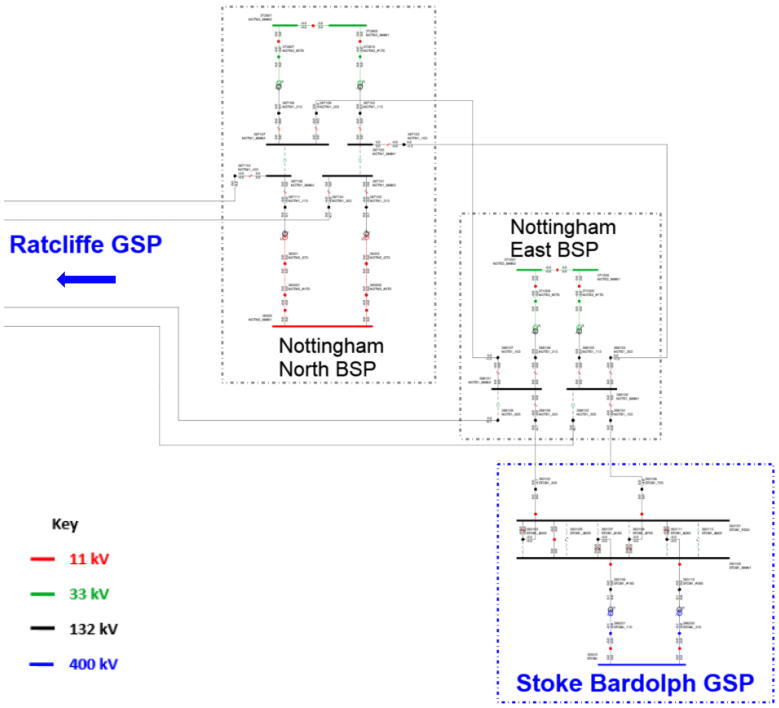

Figure 1.1.1 Stoke Bardolph 132 kV network single line diagram

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.

- Arranged outages on either 132 kV busbar at Stoke Bardolph GSP are modelled such that circuits are secured onto the other busbar.
- For any arranged outages at Stoke Bardolph (on the SGTs, the 132 kV busbars or on either 132 kV circuit to Nottingham East BSP) both BSPs are transferred into Ratcliffe GSP. Nottingham North is transferred by paralleling the 33 kV side with the 11 kV side fed from Ratcliffe, and Nottingham East is transferred by closing the 132 kV normal open points to Nottingham BSP. Nottingham North 33 kV is also transferred to Ratcliffe for outages on either 132 kV circuit between Nottingham East and Nottingham North.
- For outages on either GT or 132 kV busbar at Nottingham East or Nottingham North, the loose couple between the two BSPs is broken by splitting Arnold primary at 11 kV.
- The 33 kV and 11 kV networks downstream of Nottingham East and Nottingham North BSPs are split for arranged outages on the 33 kV bus section couplers (see the Nottingham Group 33 kV report for more details).
- For the loss of an infeed to a transformer at any of the BSPs fed from Stoke Bardolph GSP under arranged outages, the lower voltage side circuit breaker is opened to prevent back-energisation.

2. Network Constraints and Solution Options

2.1 Summary of Network Constraints

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

- Both GTs at Nottingham East BSP are projected to overload in 2028 for arranged or fault outages on the other GT or 132 kV infeed. These overloads are exacerbated by any arranged outages at Nottingham BSP or Nottingham North BSP, which trigger demand being transferred into Nottingham East.

2.2 Nottingham East Grid Transformer overloads

Constraint Overview

Generation **Demand**

The table below outlines the nature of the network constraints identified in the network analysis. Constraints were also identified on the 132 kV circuits from Nottingham BSP to Nottingham East BSP, during outages where Nottingham East is transferred into Ratcliffe GSP (these overloads could be managed operationally by restricting outages, and regardless would only be possible if the GTs at Nottingham East were already well over their capacity).

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
Nottingham East GT overloads	Fault or arranged outage on either GT	None	2028	Baseline	2028	2028
Nottingham East GT overloads	Nottingham BSP arranged outage	Fault on either GT at Nottingham East BSP	2028	Baseline	Baseline	2028

Uncertainty under other Distribution Future Energy Scenarios: Long term demand forecasts for the area are high under every scenario. Regardless of scenario some form of intervention is required as overloads are seen in the baseline. Under Falling Short and System Transformation overloads are not seen in every season in 2028 (but they are for both by 2034).

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 GTs at Nottingham East BSP.
2	Install a third GT at Nottingham East BSP.
3	Build a new BSP.
Operational Mitigation	
4	Restrict outage seasons.
5	Review seasonal ratings.
6	Transfer demand out of Nottingham East BSP.
Flexibility Services	
7	Procure flexibility under Nottingham East BSP.

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 GTs at Nottingham East BSP

Discounted

Capacity released for constraint(s) considered: N/A

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

Detailed description: Uprating the 132/33 kV GTs at Nottingham East BSP would alleviate this constraint. This option is not viable as the GTs are already the highest rating NGED uses on the network as standard. Utilising non-standard equipment creates a number of issues, such as finding replacements if serious faults occur.

Option 2 – Install a third GT at Nottingham East BSP

Viable

Capacity released for constraint(s) considered: Up to 114 MVA

New limiting factor for constraint(s) considered: GT and 132 kV circuit ratings

Detailed description: Installing a third GT (and associated 33 kV busbar) at Nottingham East BSP would add significant capacity to the site and resolve this constraint. The exact capacity freed up would be dependent on the load balance between the 33 kV busbars (as this will determine how the site can be split during arranged outages on one of the GTs). There is a large amount of capacity on the 132 kV circuits from Stoke Bardolph GSP so, depending on the growth seen at Nottingham North 33 kV, they should not significantly restrict the BSP. Adding a third GT at Nottingham East BSP would be subject to sufficient space being available, which would be assessed prior to reinforcement being triggered through detailed network design.

One disadvantage of reinforcing Nottingham East is that as demand grows it could take it over the capacity of the 132 kV circuits from Nottingham BSP. This would make transfers out of Stoke Bardolph GSP during outages more challenging and could potentially reduce security of supply. This would be of concern regardless of how capacity is added to Nottingham East BSP (i.e. the same problem would occur if a new BSP were built as suggested in option 3 below). This would need to be looked at as part of the overall strategy for Stoke Bardolph 132 kV. Options for reinforcing Stoke Bardolph (such as installing additional SGTs) are discussed in the Ratcliffe 132 kV report.

Option 3 – Build a new BSP

Viable

Capacity released for constraint(s) considered: Up to 114 MVA

New limiting factor for constraint(s) considered: 33 kV transfer capacity to the new BSP

Detailed description: As noted above there is sufficient capacity on the existing 132 kV circuits from Stoke Bardolph to supply a new BSP (which may be required if it is determined that reinforcement at the existing Nottingham East site is not feasible). Due to the number of addresses on the circuits, this would only be possible if existing sites were unstitched by building new 132 kV circuits (which would be expensive). Another concern would be that, while a new BSP nearer to the centre of Nottingham would place it closer to the load centre, it would make it very difficult to acquire land for a site.

One other option could be to build a new BSP at or near Stoke Bardolph GSP itself, which could then be used to support Nottingham East by transferring over primaries such as Colwick. It would also provide an opportunity to support Nottingham, which currently supplies the area to the south of Stoke Bardolph, where demand is expected to grow. This would be subject to being able to build new 33 kV circuits that cross the river Trent.

Option 4 – Restrict outage seasons

Viable

Capacity released for constraint(s) considered: Half the demand of St Anns primary

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

Detailed description: The most onerous constraint identified is for N-2 outages, which could be mitigated in the short term by restricting outages to summer. As an N-1 constraint is also observed in the baseline, this option alone is insufficient to fully manage the network. This is not a long term solution as, by 2028, overloads are projected for N-1 outages across all seasons. One disadvantage of this solution is that it reduces network operability.

Option 5 – Review seasonal ratings

Viable

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

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

Detailed description: Overloads are only seen in the baseline for intermediate cool and intermediate warm. It is therefore possible that this constraint could be delayed slightly by reviewing NGED's internal policy regarding transformer ratings, which does not currently distinguish between summer and intermediate cool or intermediate warm ratings (which may be overly pessimistic). This solution is dependent on an internal review and would not be a long term solution (as by 2028 overloads are projected across all four seasons).

Option 6 – Transfer demand out of Nottingham East BSP

Viable

Capacity released for constraint(s) considered: Dependent on transfers taken

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

Detailed description: Nottingham East is interconnected with two other BSPs at 33 kV: Nottingham North and Nottingham. Nottingham North is the least heavily loaded of the three BSPs at 33 kV, so there is potential for some demand to be transferred over from Nottingham East. This would however require 33 kV circuit works, but could provide an opportunity to rationalise the network (e.g. by transferring Arnold primary fully into Nottingham North).

Transfers to Nottingham BSP would be hindered initially by the limited capacity available at Nottingham. However, in the longer term, once Nottingham BSP is reinforced (as discussed in the Ratcliffe 132 kV report), demand could then be transferred across. This possibility would be further supported if a new BSP were built to the south of Nottingham (which is also discussed as an option in the Ratcliffe 132 kV report as a way to free up even more capacity at Nottingham). One potential transfer could be having St Anns primary fully supplied from Nottingham BSP (which is highlighted as an option in the Nottingham 33 kV report). Any other transfers would likely require significant 33 kV circuit works to facilitate (which may be required if this option is used to support Nottingham East in the long term).

If transfers to Nottingham North require freeing up capacity at the BSP, this could potentially be achieved by transferring demand from Nottingham North BSP over to Nottingham BSP (assuming it is reinforced to free up capacity as discussed above). This could be achieved by moving Bilborough primary, which has 33 kV circuits from both BSPs.

Option 7 – Procure flexibility under Nottingham East BSP

Viable

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

Detailed description: Flexibility services could be procured to alleviate the projected overloads on the GTs at Nottingham East BSP. This could be carried out alongside the operational mitigations discussed in options 3, 4 and 5 above. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

The reinforcement of Nottingham BSP is expected to be triggered before the reinforcement of Nottingham East BSP, based on current load projections, which is the optimal way of adding capacity to the area in the first instance. Transfers within the Nottingham group at 33 kV could then be used to support Nottingham East BSP. Other mitigation options, which could be used alongside these transfers, include a review of seasonal transformer ratings, restricting outage seasons and procuring flexibility. Once all these mitigation options have been exhausted, the two main options for reinforcing Nottingham East are adding a third GT to the site itself, and building a new BSP (the advantages and disadvantages of which are discussed above).

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