The Nottingham Group

Network Development Report – East Midlands

May 2024

Electricity Distribution

nationalgrid

Contents

Nottingham Group 33 kV

1. Network Overview

Nottingham, Nottingham East and Nottingham North are three Bulk Supply Points (BSPs) in National Grid Electricity Distribution's (NGED's) East Midlands licence area. Nottingham BSP and the 132/11 kV Grid Transformers (GTs) at Nottingham North BSP are fed from Ratcliffe Grid Supply Point (GSP). Nottingham East BSP and the 132/33 kV GTs at Nottingham North BSP are fed from Stoke Bardolph GSP. These three BSPs collectively make up the Nottingham group, feeding a total of 20 primary substations in and around Nottingham under normal running arrangements.

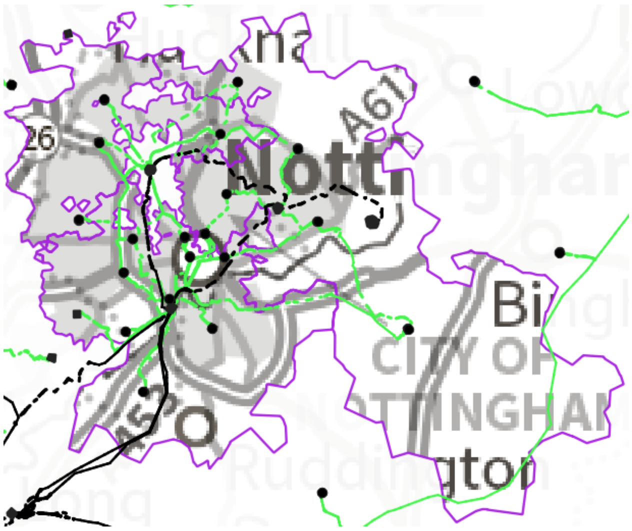

Figure 1.1 Nottingham Group geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon identified on the 33 kV network fed from Nottingham, Nottingham East and Nottingham North BSPs. 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

Nottingham BSP has four GTs, all rated to 45/90/117 MVA, which feed five 33 kV busbars. There is a normal open point between the main 1A and main 2 busbars, and the two halves of the substation are interconnected via two 33 kV cables between the main 1A and main 1B busbars. The BSP feeds twelve primary substations under normal running arrangements: Beeston, Boots, Castle Road, Clifton, Cotgrave, Lenton, North Wilford, Sneinton, Talbot Street, West Bridgford, Wollaton Road and St Anns T4. All of these primaries are fed directly from the BSP. All of these primaries have two 33/11 kV transformers, with the exception of St Anns (which has three 33/11 kV transformers fed by an 11 kV double busbar arrangement).

Nottingham East BSP has two 45/90/117 MVA GTs which feed two 33 kV busbars. The BSP feeds five primary substations under normal running arrangements: Arnold T1, Colwick, Gedling, Mapperley and St Anns T2/T3. St Anns T2 and T3 are fed via Mapperley primary. Arnold T1 is fed via Marlborough Road primary. Gedling primary is run open at 11 kV under normal running arrangements.

Nottingham North BSP has two 45/90/117 MVA GTs which feed two 33 kV busbars. The BSP feeds five primary substations under normal running arrangements: Arnold T2, Bilborough, Bulwell, Cinderhill and Marlborough Road. All of these primaries are fed directly from the BSP.

The three BSPs in the Nottingham group are not interconnected at 33 kV with any BSP outside of the group, but there is significant interconnection between the three BSPs themselves. Nottingham BSP is interconnected with Nottingham East via normal open points at St Anns, Cotgrave and Colwick primaries, and with Nottingham North via two direct 33 kV circuits (one of which tees off to Bilborough T1). Nottingham East and Nottingham North BSPs are interconnected via a normal open point at Marlborough Road, and the 11 kV at Arnold (which is paralleled under normal running arrangements, forming a loose couple between the two BSPs).

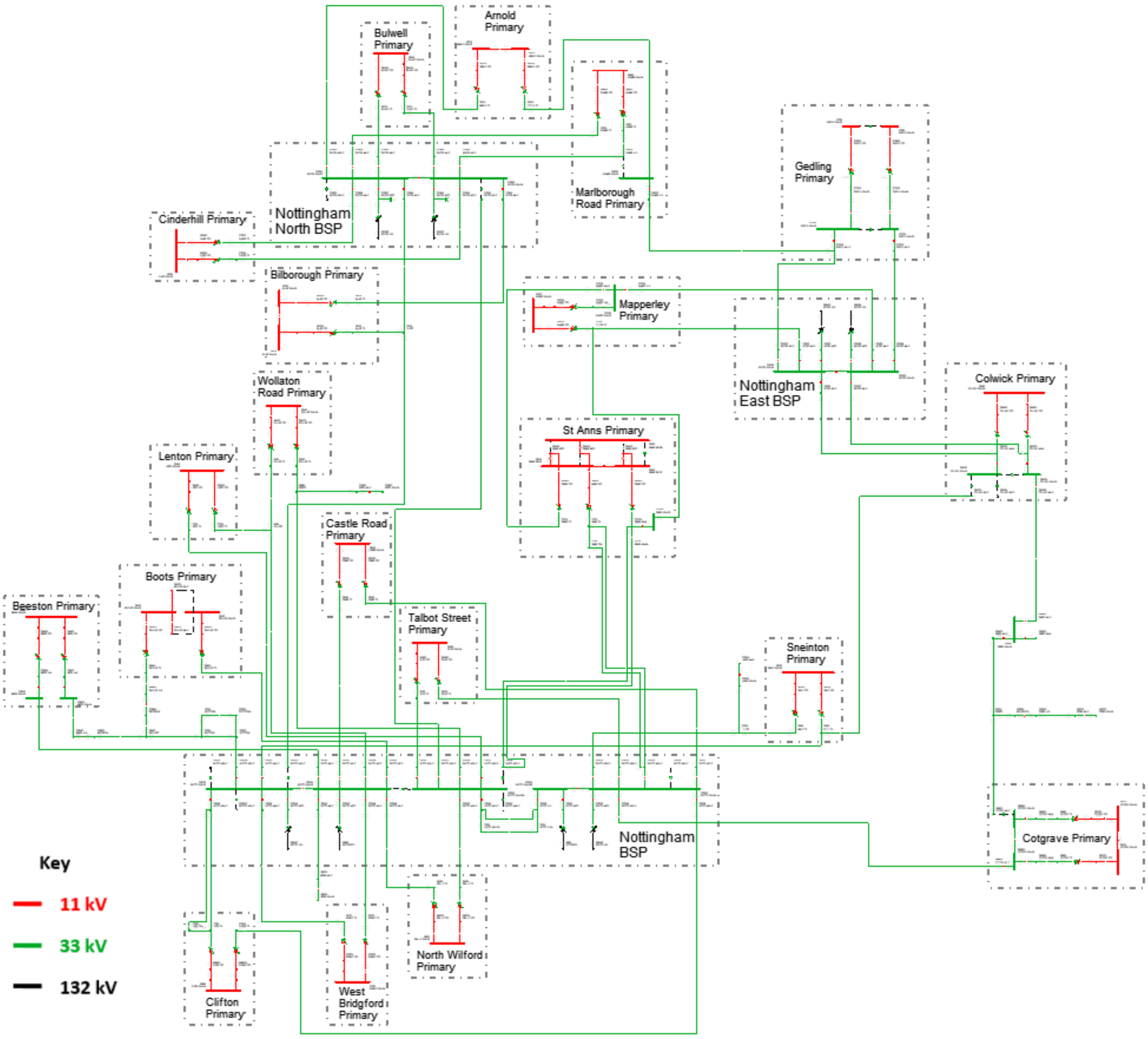

Figure 1.1.1 Nottingham Group 33 kV network single line diagram

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.

- The 33 kV networks downstream of Nottingham East and Nottingham North BSPs are split for an arranged outage on the 33 kV bus section breaker:
    - For Nottingham East this involves splitting Mapperley, Colwick, St Anns and Colwick primaries at 11 kV and transferring St Anns T3 into Nottingham.
    - For Nottingham North this involves splitting Bilborough, Cinderhill, Arnold, Bulwell and Marlborough Road primaries at 11 kV.
- The 33 kV network downstream of Nottingham is split for arranged outages on some of its 33 kV bus section breakers:
    - For the breaker between the main 2 and main 3 33 kV busbars this involves splitting Clifton, West Bridgford, Sneinton and Beeston primaries at 11 kV.
    - For the breaker between the main 1B and main 4 33 kV busbars this involves splitting Clifton, Talbot Street, Sneinton and Castle Road primaries at 11 kV.
- For an outage on any of the 132 kV infeeds to, or GTs at Nottingham BSP, the bus section breaker between the main 1A and main 2 33 kV busbars is opened to prevent loose couples.
- For arranged outages on the main 1A or main 2 33 kV busbars, 11 kV loose couples are split at Castle Road, Clifton, Sneinton and Talbot Street primaries.
- For various arranged outages on the 33 kV circuits Wollaton Road, Lenton, North Wilford and Talbot Street primaries, 11 kV loose couples are split at Castle Road, North Wilford, Clifton, Lenton, Wollaton Road, Sneinton and Talbot Street primaries.
- For outages on the main 4 33 kV busbar at Nottingham BSP, or on the 33 kV circuit to Cotgrave, the primary is transferred into Nottingham East BSP via Colwick primary.
- For arranged outages on the 33 kV circuit from Nottingham East to St Anns T3 via Mapperley primary, T3 is transferred into Nottingham BSP.
- For outages on the infeed to T4 at St Anns primary from Nottingham, the site is paralleled at 11 kV.
- For an outage on either infeed to Gedling, the primary is paralleled at 11 kV (and at 33 kV where possible).
- For the loss of an infeed to a transformer at any of the primaries within the Nottingham group under arranged outages, the lower voltage side circuit breaker is opened to prevent back-energisation.
- In future year studies, St Anns primary is split at 11 kV for arranged outages on any of its infeeds or transformers to prevent overloads for subsequent faults.

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:

- Overloads are projected to occur on the both primary transformers at West Bridgford and on both 33 kV circuits from Nottingham (by 2028 and 2034 for the transformers and circuits respectively) for N-1 outages on the other infeed.
- During arranged or fault outages on either transformer at Castle Road primary, the remaining transformer is projected to overload (this is triggered for intermediate cool, intermediate warm and summer in the baseline, 2028 and 2034 respectively).
- Both 33 kV circuits to Wollaton Road primary are forecast to be constrained (both by 2034):
    - The 33 kV circuit to the Wollaton Road tee for outages on the main 1A 33 kV busbar at Nottingham BSP.
    - A short section of cable on the circuit to Wollaton Road T1 for arranged or fault outages on the circuit to T2.
- The 33 kV circuits from Nottingham East BSP to Mapperley primary are expected to overload by 2034 based on current demand forecasts, during N-1 outages on the other circuit.

2.2 West Bridgford 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
West Bridgford primary transformer overloads	Arranged or fault outage on the other transformer or infeed	None	2034	2028	2034	2034
Nottingham to West Bridgford 33 kV circuit overloads	Arranged or fault outage on the other transformer or infeed	None	-	2034	2034	-

Uncertainty under other Distribution Future Energy Scenarios: There are no scenarios under which intervention is not triggered by 2034 (although under Falling Short and System Transformation circuit constraints may not be seen). Significantly higher growth is forecast under Leading the Way and Consumer Transformation, which would only serve to further justify the proposals discussed below.

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 both transformers and circuits to West Bridgford primary.
2	Build a new primary substation.
Operational Mitigation	
3	Review seasonal ratings.
Flexibility Services	
4	Procure flexibility under West Bridgford 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 has been carried out for this constraint as part of the RIIO-ED2 Business Plan. The use of flexibility will also be periodically tested against market provided flexibility by the DSO as part of the Distribution Network Options Assessment (DNOA) process.

Option 1 – Uprate both transformers and circuits to West Bridgford primary

Viable

Capacity released for constraint(s) considered: 3 MVA

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

Detailed description: Uprating both transformers at, and 33 kV circuits to West Bridgford primary would add capacity and help alleviate this constraint. The transformers would be uprated to 20/40 MVA units (the highest rating used by NGED as standard on the network). This replacement would also benefit the condition of the transformers, which are both over 60 years old.

The 33 kV circuits from Nottingham BSP to West Bridgford primary are each around 2.7 km in length. Almost the entire length of both circuits would require uprating to match the ratings of the new 20/40 MVA transformers. If the opportunity were taken to either install two new 33 kV circuits to West Bridgford, or replace the existing circuits with oversized cables, the possibility of feeding a new primary site could be created. As 20/40 MVA transformers will not provide sufficient capacity to supply the demand growth forecast by 2034, this new primary site may be required as discussed in option 2 below. Even with a new primary substation, uprating the transformers at West Bridgford is economical, based both on the high growth forecast for the area, and the aforementioned age of the existing transformers (i.e. both solutions are required).

Installing two new 33 kV circuits is a preferable solution compared to replacing the existing circuits, as West Bridgford and the new primary would both be supplied by dedicated feeders. Installing cables rated high enough to supply two 20/40 MVA primaries without limiting either site may also not be practical. This does however mean that two additional 33 kV breakers will be required at Nottingham BSP.

Option 2 – Build a new primary substation

Viable

Capacity released for constraint(s) considered: 38 MVA

New limiting factor for constraint(s) considered: Total capacity between the two primaries

Detailed description: If a suitable site could be identified, a new primary substation could be built near West Bridgford primary to deload the site and help alleviate this constraint. Demand growth forecasts for the area indicate this will be required even after the reinforcement described in option 1 is carried out.

Transferring a large amount of demand to any other primary is not practical, as to the south, Clifton primary is also constrained, and to the north, West Bridgford is separated from the rest of Nottingham by the river Trent (with 11 kV network crossing the river in a limited number of places).

The new primary site could potentially be located to the south of West Bridgford. This could provide the added benefit of being able to deload Clifton primary as well. While Clifton primary is not currently constrained thermally on its transformers or infeeds, physical restrictions at the site prevent new 11 kV feeders from being added, which limits growth.

Potential locations for a new BSP to deload Nottingham BSP are discussed in the Ratcliffe 132 kV report. If the new BSP were located to the south of Nottingham, the new primary could be supplied from it (potentially even being located at the same site). If this happened, it could obviate the requirement to reinforce the 33 kV circuits to West Bridgeford as discussed in option 1. However, if the new BSP were built after these circuit works are complete, they could instead be used to transfer another primary or primaries at Nottingham into the new BSP (via West Bridgford).

Option 3 – 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 2028 for intermediate cool. 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 ratings (which may be overly pessimistic). This solution is dependent on an internal review and would not be a long term solution (as by 2034 overloads are seen in all seasons and on the 33 kV circuits to West Bridgford).

Option 4 – Procure flexibility under West Bridgford primary

Viable

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

Detailed description: Flexibility services could be procured to alleviate the projected overloads on the transformers at and the 33 kV circuits to West Bridgford primary. Flexibility could be used in conjunction with the operational mitigation discussed in option 3, but would not benefit the condition of the existing transformers at the primary. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

Replacing both transformers at West Bridgford primary with 20/40 MVA units is the optimal initial reinforcement strategy, triggered both by load growth in the area and the age of the existing transformers. In the longer term, a new primary substation may be required to deload West Bridgford. Options for reinforcing the circuits to West Bridgford have been discussed, as this could provide an opportunity to create infeeds to a new primary.

2.3 Castle Road primary transformer 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 in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Castle Road primary transformer overloads	Arranged or fault outage on the other transformer or infeed	None	-	Baseline	2028	2034

Uncertainty under other Distribution Future Energy Scenarios: This constraint is present for all scenarios in the baseline in intermediate cool. Under the higher growth scenarios (Leading the Way and Consumer Transformation), overloads are triggered earlier in other seasons (including winter 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 both transformers at Castle Road primary.
Operational Mitigation	
2	Review seasonal ratings.
Flexibility Services	
3	Procure flexibility under Castle Road 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, which will then be tested against market provided flexibility by the DSO as part of the DNOA process.

Option 1 – Uprate both transformers at Castle Road primary

Viable

Capacity released for constraint(s) considered: Up to 3 MVA

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

Detailed description: Uprating both transformers at Castle Road primary would add capacity and help alleviate this constraint. The transformers would be uprated to 20/40 MVA units (the highest rating used by NGED as standard on the network). Minimal 33 kV circuit works will be required to free up this capacity, as the existing circuits to Castle Road are already rated higher than the 20/40 MVA transformers.

For seasons other than winter, which are more onerous for this constraint, significantly more capacity will be released by this reinforcement than the 3 MVA quoted above. Although 20/40 MVA transformers are insufficient to accommodate the full demand growth forecast up to 2050, the shortfall at that time is not large enough to warrant additional investment in the first instance (and as the highest rated units used are being installed already further reinforcement of Castle Road is likely not practical regardless).

This shortfall in 2050 could potentially be accommodated on the 11 kV network through transfers to other nearby primaries. An in depth 11 kV study would be required to determine how much demand could feasibly be transferred. At least some transfers are likely to be possible, given the density of 11 kV network in the area. Conversely, adding capacity at Castle Road could create opportunities to deload other primaries (reinforcement at Castle Road could even be brought forward if required in aid of this). All of the primaries in or near the centre of Nottingham (Castle Road, Sneinton, Talbot Street and St Anns) should be considered in conjunction for any reinforcement proposals in the area. Building a new primary so close to the centre of Nottingham is likely not feasible, or would be prohibitively expensive, so the existing primaries should be utilised as much as possible (which this reinforcement strategy supports).

Option 2 – 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 in 2028 for intermediate cool and intermediate warm. It is therefore possible that this constraint could be delayed 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 2034 overloads are also seen in winter).

Option 3 – Procure flexibility under Castle Road primary

Viable

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

Detailed description: Flexibility services could be procured to alleviate the projected overloads on the transformers at Castle Road primary. Flexibility could be used in conjunction with the operational mitigation discussed in option 2 above. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

The optimal reinforcement solution identified to resolve this constraint is to replace both transformers at Castle Road primary with 20/40 MVA units. In the short to medium term a review of NGED's seasonal transformer ratings could potentially defer this constraint.

2.4 Nottingham to Wollaton Road T1 circuit overloads

Constraint Overview

Generation | **Demand**

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

Table 2.4.1 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 to Wollaton Road T1 33 kV circuit overloads	Arranged or fault outage on the 33 kV circuit to T2	None	2034	2034	2034	-

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way and Consumer Transformation overloads are also observed in summer in 2034. No overloads are observed in any season by 2034 under System Transformation or Falling Short.

Solution Options

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

Table 2.4.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Uprate the limiting section of 33 kV circuit.
Flexibility Services	
2	Procure flexibility under Wollaton Road 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 limiting section of 33 kV circuit

Viable

Capacity released for constraint(s) considered: 7 MVA

New limiting factor for constraint(s) considered: Wollaton Road transformer ratings

Detailed description: The rating of the 33 kV circuit to Wollaton Road T1 is limited by 4 m of cable. Uprating this cable would increase the capacity of the circuit such that the full rating of T1 at Wollaton Road can be utilised. This reinforcement is low cost and could likely be implemented quickly.

Option 2 – Procure flexibility under Wollaton Road primary

Discounted

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

Detailed description: Flexibility services could be procured to alleviate the projected overloads on this section of 33 kV circuit, but this is likely not economical due to the low cost of the reinforcement solution outlined in option 1.

Solution Recommendation

Reinforcing the limiting section of 33 kV cable on the circuit to Wollaton Road is a low cost and low regret solution for this constraint. Reinforcement may also be required on the other infeed to Wollaton Road as discussed in Section 2.5 of this report.

2.5 Nottingham to Wollaton Road Tee circuit overloads

Constraint Overview

Generation | **Demand**

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

Table 2.5.1 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 to the Wollaton Road tee 33 kV circuit overloads	Arranged or fault outage on the main 1A 33 kV busbar at Nottingham BSP	None	-	2034	2034	-

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way and Consumer Transformation, overloads are observed for other seasons by 2034, and for other outage conditions. No overloads are observed in any season by 2034 under System Transformation or Falling Short. At Lenton, very low growth is forecast up to 2050 for all scenarios.

Solution Options

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

Table 2.5.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Uprate the 33 kV circuit to Wollaton Road T2.
2	Reconfigure Nottingham BSP.
3	Install a new 33 kV circuit to Lenton primary.
Flexibility Services	
4	Procure flexibility under Wollaton Road and Lenton primaries.

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, which will then be tested against market provided flexibility by the DSO as part of the DNOA process.

Option 1 – Uprate the 33 kV circuit to Wollaton Road T2

Discounted

Capacity released for constraint(s) considered: Dependent on demand growth at Lenton primary

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

Detailed description: Uprating the 33 kV circuit to the Wollaton Road tee (which is right next to Wollaton Road primary) would require replacing virtually the entire length (around 3.8 km). Building a new 33 kV circuit would require a similar or greater length of circuit works. This option would resolve this constraint, but has been discounted in favour of some of the more cost effective options discussed below.

Option 2 – Reconfigure Nottingham BSP

Viable

Capacity released for constraint(s) considered: Dependent on demand growth at Lenton primary

New limiting factor for constraint(s) considered: N-2 constraints

Detailed description: Moving the 33 kV circuits at Nottingham BSP such that no two of the three feeders to Wollaton Road and Lenton primaries are fed from the same 33 kV busbar would help alleviate this constraint. Rationalising Nottingham BSP is discussed as an option in the Ratcliffe 132 kV report, which could provide an opportunity to carry this out. This may not be a long term solution, as overloads would still be seen for N-2 outages (the loss of the circuits to Lenton T1 and Wollaton Road T1). This N-2 constraint could potentially be managed operationally by splitting either primary at 11 kV during arranged outages, but N-1 constraints would eventually also be observed based on the high demand growth forecast for Wollaton Road.

Option 3 – Install a new 33 kV circuit to Lenton primary

Viable

Capacity released for constraint(s) considered: Up to 17 MVA

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

Detailed description: If a new 33 kV circuit were built to Lenton primary to feed T2, Wollaton Road and Lenton primaries could be unstitched. This would create two dedicated 33 kV feeders to each site and free up significant circuit capacity at both primaries. It would also reduce network complexity and improve operability. As Lenton primary is closer to Nottingham, this would require significantly less circuit works than a new circuit to Wollaton Road as proposed in option 1 (with the existing 33 kV circuit to Lenton being around 2.6 km in length).

If two 33 kV circuits were built to Lenton primary instead of just one, the site could be prepared for installing 20/40 MVA transformers in the future. The demand growth at Lenton alone does not support this option, with the site currently being underutilised and minimal growth forecast in the future. However, demand growth at Wollaton Road is high enough that it is expected to eventually be constrained even if the circuit works discussed here and in Section 2.4 were implemented. Reinforcing Lenton could be used as a way of deloading Wollaton Road by transferring demand on the 11 kV network (the two sites are around 1.2 km apart). This supports the overall strategy of fully utilising the existing primary substations in and around Nottingham (as building new sites may not be practical or economical).

Option 4 – Procure flexibility under Wollaton Road and Lenton primaries

Viable

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

Detailed description: Flexibility services could be procured at Wollaton Road and/or Lenton primary to alleviate the projected overloads on the 33 kV circuit from Nottingham to the Wollaton Road tee. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

Building a new 33 kV circuit from Nottingham BSP to Lenton primary to allow it to be unstitched from Wollaton Road has been identified as the optimal reinforcement strategy to alleviate this constraint. Installing two 33 kV circuits has been considered as a possible option to futureproof the network. Moving 33 kV feeders at Nottingham would benefit this constraint and could be carried out if done alongside the overall reconfiguration of the BSP (which has multiple drivers).

2.6 Nottingham East to Mapperley circuit overloads

Constraint Overview

The table below outlines the nature of the N-1 network constraints identified in the network analysis. Various N-2 constraints are also observed (including any outages at Nottingham which transfer more of St Anns onto the circuits to Mapperley or the loss of any two infeeds to St Anns). These have been omitted as they can be managed operationally, but are considered in the reinforcement proposals outlined below.

Table 2.6.1 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 to Mapperley 33 kV circuit overloads	Arranged or fault outage on the other 33 kV circuit	None	2034	2034	2034	-

Uncertainty under other Distribution Future Energy Scenarios: Up to 2034, similar demands are forecast for both St Anns and Mapperley primaries for three of the other scenarios as under Best View (slightly lower under System Transformation and slightly higher under Consumer Transformation and Leading the Way). While lower growth is forecast under Falling Short up to 2034, beyond this high growth is forecast (so although trigger years may differ the justification for investment is strong across all scenarios).

Solution Options

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

Table 2.6.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Uprate both Nottingham East to Mapperley 33 kV circuits.
2	Rationalise St Anns primary.
Flexibility Services	
3	Procure flexibility under Mapperley and St Anns primaries.

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, which will then be tested against market provided flexibility by the DSO as part of the DNOA process.

Option 1 – Uprate both Nottingham East to Mapperley 33 kV circuits

Discounted

Capacity released for constraint(s) considered: Dependent on demand growth at St Anns primary

New limiting factor for constraint(s) considered: Mapperley primary transformer ratings

Detailed description: Uprating both of the 33 kV circuits to Mapperley primary (or installing two new 33 kV circuits to unstitch it from St Anns) would resolve this constraint. Both would require around 5.2 km of total circuit works (subject to detailed route investigation and land rights). This option has been discounted, as although it is technically feasible, it does not confer the overall network benefits that option 2 outlined below does.

Option 2 – Rationalise St Anns primary

Viable

Capacity released for constraint(s) considered: Dependent on demand growth at St Anns primary

New limiting factor for constraint(s) considered: Mapperley primary transformer ratings

Detailed description: Rationalising St Anns primary and feeding it fully from Nottingham BSP would alleviate this constraint, obviating the need for reinforcing the Nottingham East to Mapperley 33 kV circuits outlined in option 1 above. This reinforcement solution has a number of benefits:

- Without the demand from St Anns constraining the infeeds to Mapperley primary, the full capacity of its 20/40 MVA transformers could be utilised.
- It would reduce demand at Nottingham East BSP, which is constrained as outlined in the Ratcliffe 132 kV report. This would however increase demand at Nottingham BSP (which is also highly loaded) but if a new BSP were built to the south of Nottingham as discussed as an option in the Ratcliffe 132 kV report, then this could free up capacity for this transfer. With a new BSP to the south being one of a limited number of options for adding capacity into the Nottingham group, it would be strategically beneficial to transfer demand in this direction to allow the new BSP to better support the group as a whole.
- Rationalising St Anns would improve network operability, as the site is currently run in a non-standard arrangement with one transformer supplied from Nottingham and two supplied from Nottingham East.

There are two ways that St Anns could be rationalised. The first would be to replace the two 12/24 MVA transformers with a single 20/40 MVA transformer, creating a two transformer site fed from Nottingham with a firm capacity of 38 MVA. The two 33 kV circuits to Mapperley would be retained as interconnection between the two BSPs.

The other option for rationalising St Anns would be to replace the existing 20/40 MVA transformer with two 12/24 MVA transformers, essentially creating two primaries, each with two 12/24 MVA transformers for a total firm capacity of 46 MVA. This would not require significant 33 kV circuit works, as there are already four circuits from Nottingham to St Anns which are rated high enough to support this proposal (but would require new 33 kV switchgear at both ends). This proposal is preferable to creating a two transformer site for a number of reasons. Firstly, it creates more capacity to support demand growth in the area (which is especially vital given the overall growth forecast in the centre of Nottingham and the aforementioned difficulties with establishing a new primary site). Secondly, the existing 20/40 MVA transformer is over 50 years old, so its replacement would confer an asset condition benefit. Finally, it significantly increases option value for the network (creating opportunities such as being able to feed the two St Anns primaries from the two halves of Nottingham once it is rationalised). This option is however entirely contingent on sufficient space being available at St Anns primary.

Another option could be to use the four 33 kV circuits from Nottingham BSP to supply two primary transformers at St Anns and two additional 12/24 MVA transformers at Mapperley primary. As with the rationalisation options for St Anns itself, this would help transfer demand away from Nottingham East, but may not be possible due to space constraints. Transferring all of Mapperley into Nottingham is not an option, as that would seriously derate the site by moving it onto lower rated 33 kV circuits.

Option 3 – Procure flexibility under Mapperley and St Anns primaries

Viable

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

Detailed description: Flexibility services could be procured to alleviate the projected overloads on the 33 kV circuits between Nottingham East BSP and Mapperley primary. Flexibility would not however confer any of the additional network benefits discussed in option 2 above. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

Having to reinforce the Nottingham East to Mapperley 33 kV circuits to resolve this constraint could be avoided if St Anns primary were rationalised and fed fully from Nottingham. The options for carrying this out are discussed above, and are largely dependent on space being available at St Anns. This proposal would also shift demand away from Nottingham East BSP.

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