Derby and Derby South BSPs

Network Development Report – East Midlands

May 2024

Electricity Distribution

nationalgrid

Contents

Derby and Derby South 33 kV

1. Network Overview

Derby and Derby South Bulk Supply Points (BSPs) are fed from Willington Grid Supply Point (GSP) in National Grid Electricity Distribution's (NGED's) East Midlands licence area. Both BSPs are fed directly from Willington GSP, with Derby fed via a dual 132 kV circuit and Derby South fed via two dual 132 kV circuits, one of which continues on to Spondon BSP.

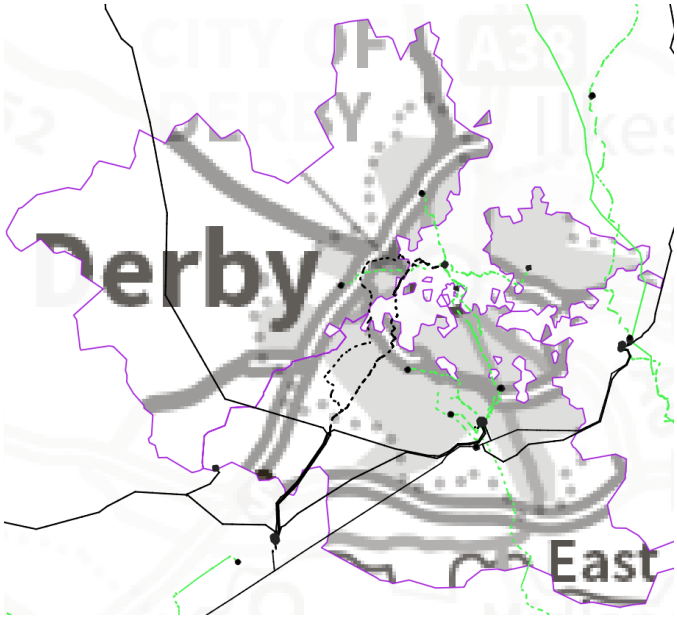

Figure 1.1 Derby and Derby South geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon identified on the 33 kV network fed from Derby and Derby South 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

Derby BSP has two 33 kV busbars fed by two 132/33 kV GTs both rated to 60/90/117 MVA. Derby BSP feeds three primary substations: Chaddesden, Darley Abbey and Mackworth (all three of which have two 33/11 kV transformers each and are supplied directly from Derby BSP. Derby BSP is interconnected with Derby South BSP at 33 kV via two dedicated customer primaries (this interconnection is normally run open).

Derby South BSP has five 33 kV busbars fed by four 132/33 kV GTs, two rated to 45/90/117 MVA (GT1/2) and two rated to 60/90/117 MVA (GT3/4). GTs 1 and 2 at Derby South feed five primary substations: Allenton, Normanton and an number of dedicated customer sites. GTs 3 and 4 at Derby South feed four primary substations including Melbourne T2, Sinfin Lane. Derby South BSP is interconnected with Spondon BSP at 33 kV via Melbourne primary (which is normally run split at 11 kV). There are also two 33 kV interconnectors between the two halves of Derby South BSP. All of the primaries are fed directly from Derby South BSP and have two primary transformers, with the exceptions of Allenton (which has three transformers) and Sinfin A (which has four).

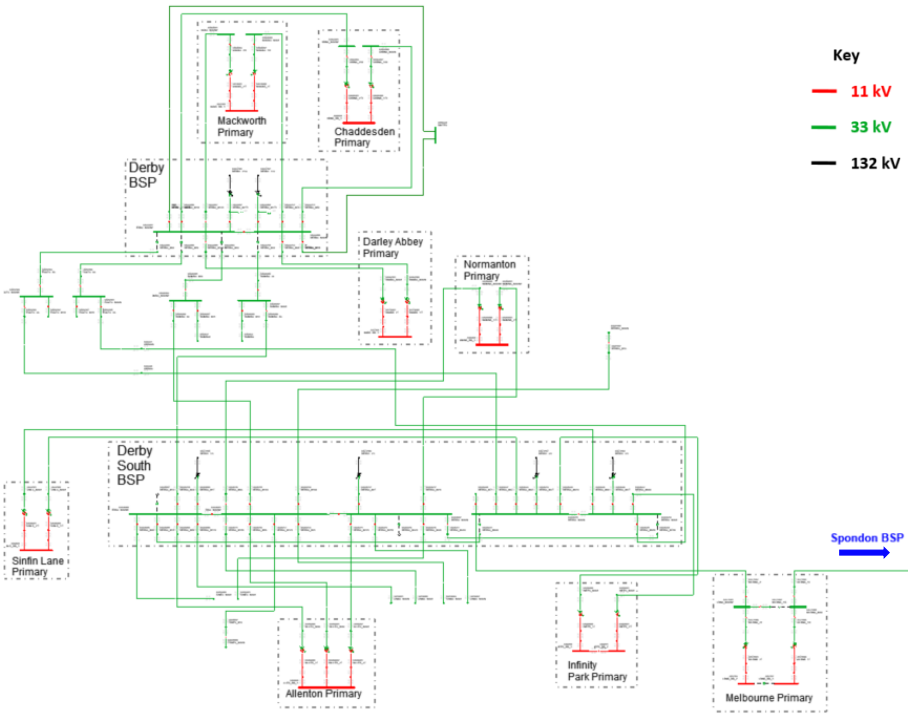

Figure 1.1.1 Derby and Derby South 33 kV network single line diagram

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, as well as proposed actions to manage some constraints identified operationally.

- For the loss of an infeed to a transformer at any of the primaries fed from Derby or Derby South BSPs under arranged outages, the lower voltage side circuit breaker is opened to prevent back-energisation.
- The 33 kV networks downstream of Derby BSP, Derby South GT1/2 and Derby South GT3/4 are split for arranged outages on their respective 33 kV bus section breakers to prevent loose couples:
    - For the Derby BSP 33 kV bus section this involves splitting Chaddesden, Mackworth and Darley Abbey primaries at 11 kV.
    - For the Derby South main 1 to main 2 33 kV bus section this involves splitting Sinfin A and Sinfin E at 6.6 kV and Allenton at 11 kV.
    - For the Derby South main 2 to main 3 33 kV bus section this involves splitting Sinfin A and Sinfin E at 6.6 kV, and Allenton and Normanton at 11 kV.
    - For the Derby South main 4 to main 5 33 kV bus section this involves splitting Infinity Park and Sinfin Lane at 11 kV.
- For an arranged outage on one of the infeeds to either of the dedicated customer primaries they are transferred into Derby South BSP.
- For an outage on any infeed to Allenton primary load is transferred to Spondon and Infinity Park primaries at 11 kV. These transfers are not carried out if demand is high enough that it could cause overloads at the other primaries. In this case Allenton is split at 11 kV between the two remaining transformers for an outage on any infeed.
- For an outage on the infeed from Derby South or Spondon BSP, Melbourne primary is paralleled at 11 kV and fed fully from the other BSP (i.e. for an outage on the circuit from Derby South BSP the site is fed fully from Spondon BSP and vice versa).

2. Network Constraints and Solution Options

2.1 Summary of Network Constraints

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

- Overloads are seen on the transformers at Sinfin Lane primary from 2034 for N-1 fault and arranged outages on the other transformer, incoming 33 kV circuit or main 4/5 busbar at Derby South BSP.

2.2 Sinfin Lane primary transformer 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
Sinfin Lane T1 or T2 overload	Arranged or fault outage on the other infeed to Sinfin Lane	None	-	2034	2034	2034

Uncertainty under other Distribution Future Energy Scenarios: Under the Leading the Way and Consumer Transformation scenarios this constraint is also present at winter peak demand in 2034. Under System Transformation the constraint is only present at intermediate cool peak demand, and under Falling Short intervention is not required 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 transformers at Sinfin Lane primary.
2	Install a third transformer at Sinfin Lane primary.
Flexibility Services	
3	Procure flexibility under Sinfin Lane 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 Distribution Network Options Assessment (DNOA) process.

Option 1 – Uprate the transformers at Sinfin Lane primary

Viable

Capacity released for constraint(s) considered: Up to 2 MVA

New limiting factor for constraint(s) considered: 33 kV circuits to Sinfin Lane

Detailed description: Uprating the two 33/11 kV transformers at Sinfin Lane primary to 20/40 MVA units would alleviate this constraint and provide additional capacity for future growth. The new limiting factor would become the 33 kV circuits to Sinfin Lane, which could then be uprated at a future date if required to further increase the firm capacity of the site.

High demand growth is projected at Sinfin Lane, which will likely eventually necessitate uprating the circuits, but analysis indicates this will not be required in 2034. This option would also benefit the condition of the transformers which are over 60 years old.

Option 2 – Install a third transformer at Sinfin Lane primary

Discounted

Capacity released for constraint(s) considered: Up to 25 MVA

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

Detailed description: Installing a third transformer at Sinfin Lane primary, with a new 33 kV circuit from Derby South would increase the capacity of the site and resolve this constraint. This option has been discounted for a number of reasons:

- Sinfin Lane is fed from the GT3/4 side of Derby South BSP which only has two 33 kV busbars. Feeding a third transformer from main 1, 2 or 3 at Derby South would create a loose couple between the two halves of the BSP. Moving the existing feeder circuits over to the GT1/2 side of Derby South is also not preferable as it would adversely affect the load balance between the two halves of the BSP. The nearest other BSP is Derby, but feeding a third transformer from there would require extensive 33 kV circuit works (as it is over four times further away from Sinfin Lane than Derby South BSP), would create a loose couple between the BSPs and would exacerbate demand constraints projected at Derby BSP (which are discussed in the Willington 132 kV report).
- Creating a three transformer primary would introduce additional operational complexity (such as having to split the site at 11 kV for outages in order to fully utilise the capacity created by the addition of a third transformer).
- This option would 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 – Procure flexibility under Sinfin Lane 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 transformers at Sinfin Lane primary. Flexibility may not be suitable to manage this constraint in the long term as it would not benefit the condition of the transformers at Sinfin Lane. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

Uprating the transformers at Sinfin Lane primary is likely to be optimal solution to manage this constraint (which will also confer an asset condition benefit as the existing transformers are over 60 years old). Further capacity could be released at a later date by uprating the 33 kV circuits to Sinfin Lane. As this constraint is observed in multiple seasons for N-1 fault conditions, no operational mitigations have been identified to defer this constraint.

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