Willoughby BSP

Network Development Report – East Midlands

May 2024

Electricity Distribution

nationalgrid

Contents

Willoughby 33 kV

1. Network Overview

Willoughby Bulk Supply Point (BSP) is fed from Ratcliffe Grid Supply Point (GSP) in National Grid Electricity Distribution's (NGED's) East Midlands licence area. Willoughby BSP is fed directly from Ratcliffe via a dual 132 kV circuit.

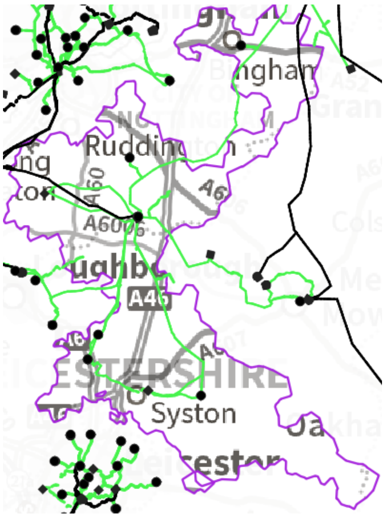

Figure 1.1 Willoughby geographic network coverage

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

Willoughby BSP has two 33 kV busbars fed by two 132/33 kV Grid Transformers (GTs), one of which is rated to 60/90/117 MVA (GT1) and the other of which is rated to 45/90/117 MVA (GT2). Willoughby BSP feeds nine primary substations: Bingham T1, East Leake, Keyworth, Mountsorrel, Old Dalby T2, South Croxton, Syston, Willoughby and a dedicated customer site. Willoughby primary is located at the same site as Willoughby BSP. All of the primaries fed from Willoughby have two 33/11 kV transformers, with the exception of South Croxton, which is a single transformer primary. There are two 33 kV tower dual circuits out of Willoughby, one of which feeds South Croxton and T1/T3 at Syston, with the other feeding Keyworth and Bingham T1.

Willoughby is interconnected with Loughborough, Hawton and Melton Mowbray BSPs. The interconnection with Loughborough is via a single 33 kV circuit which is teed off the circuit to Mountsorrel T2 (this interconnection is normally run open). The interconnection with Hawton and Melton Mowbray BSPs is via Bingham and Old Dalby primaries respectively (both of which are normally run open at both 33 kV and 11 kV).

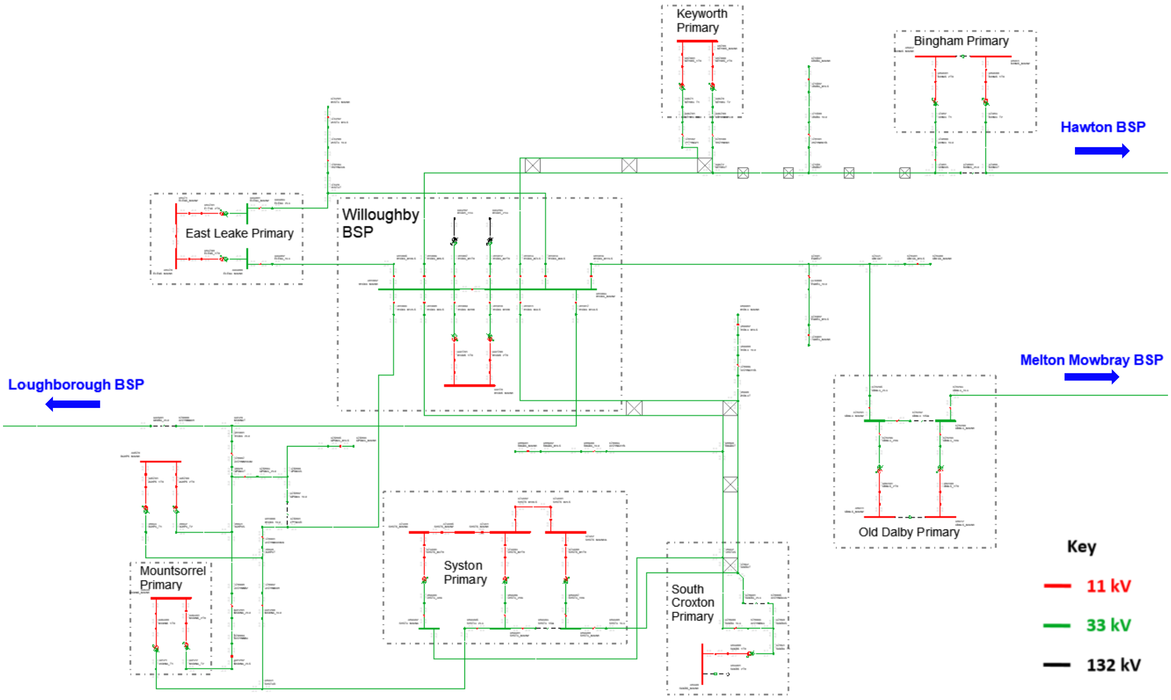

Figure 1.1.1 Willoughby 33 kV network single line diagram

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 Willoughby BSP under arranged outages, the lower voltage side circuit breaker is opened to prevent back-energisation.
- The 33 kV network downstream of Willoughby BSP is split for arranged outages on its 33 kV bus section breaker to prevent loose couples. This involves splitting Willoughby, East Leake, Keyworth, Syston and Mountsorrel primaries (and the dedicated customer site) at 11 kV.
- For an outage on any of the infeeds to (or the 33/11 kV transformers at) Syston primary, the 11 kV bus section between the two remaining transformers can be opened.
- For an outage on the 33 kV circuit to South Croxton (or main 1 at Willoughby BSP), the primary is kept on supply at 33 kV by closing disconnector 2L3 at the site (transferring it to the other 33 kV circuit fed from main 1 at Willoughby BSP).
- For an outage on the 33/11 kV transformer at South Croxton primary, the load is backfed on the 11 kV network from Syston primary.
- For an outage on the infeed from Willoughby or Hawton BSP, Bingham primary is paralleled at 11 kV and fed fully from the other BSP (i.e. for an outage on the circuit from Willoughby BSP the site is fed fully from Hawton BSP and vice versa).
- For an outage on the infeed from Willoughby or Melton Mowbray BSP, Old Dalby primary is paralleled at 11 kV and fed fully from the other BSP (i.e. for an outage on the circuit from Willoughby BSP the site is fed fully from Melton Mowbray BSP and vice versa).

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 seen by 2028 on the transformers at Mountsorrel primary and the 33 kV circuits from Loughborough during outages on either infeed, based on current demand projections.
- The three transformers at Syston, and the three 33 kV infeeds, are all expected to be thermally constrained by 2028 for outages on the 33 kV busbars at Willoughby (and by 2034 for N-1 circuit outages).
- Low volts are forecast to occur by 2028 on the 33 kV network which supplies Mountsorrel, Syston and South Croxton primaries for various outage conditions (the most onerous of which are 33 kV busbar outages at Willoughby BSP).

2.2 Mountsorrel primary transformer and circuit overloads

Constraint Overview

Generation | **Demand**

The table below outlines the nature of the thermal network constraints identified in the network analysis. These thermal constraints are exacerbated by the voltage constraints outlined in Section 2.4 of this report.

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
Mountsorrel primary transformer overloads	Arranged or fault outage on the other transformer or infeed	None	2028	2028	2028	2028
33 kV circuit from the Syston tee to Mountsorrel T1 overload	Arranged or fault outage on the 33 kV circuit to Mountsorrel T2	None	2034	2028	2034	2034
33 kV circuit from the tee point to Mountsorrel T2 overload	Arranged or fault outage on the 33 kV circuit to Mountsorrel T1	None	2034	2034	2034	2034
33 kV circuit from Willoughby BSP to the tee point	Arranged or fault outage on the main 2 33 kV busbar at Willoughby	None	2028	2028	2028	2028
33 kV circuit from Willoughby BSP to the Syston tee	Arranged or fault outage on the main 1 33 kV busbar at Willoughby	None	2028	2028	2028	2028

Uncertainty under other Distribution Future Energy Scenarios: Overloads are not projected to occur on the transformers by 2028 for System Transformation or Falling Short, but are by 2034. Higher growth is forecast under Leading the Way and Consumer Transformation, which triggers circuit overloads for other seasons in 2028.

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 Mountsorrel primary.
2	Install a third transformer and circuit to Mountsorrel primary.
3	Build a new primary substation.
Flexibility Services	
4	Procure flexibility under Mountsorrel 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 both transformers and circuits to Mountsorrel primary

Viable

Capacity released for constraint(s) considered: 15 MVA

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

Detailed description: Uprating both transformers at Mountsorrel to 20/40 MVA units would prevent the projected transformer overloads and free up capacity at the site. To free up significant capacity, 33 kV circuit works will also be required. This could involve either uprating the existing circuits, or building two new 33 kV circuits directly to Mountsorrel primary (which would also simplify the network and deload the existing circuits which currently supply a number of primaries in the area).

The overall development of the 33 kV network in the area, and the options available to free up capacity at Mountsorrel, need to be considered in conjunction with the thermal constraints at Syston (and the 33 kV circuits to Syston) described in Section 2.3, and the severe voltage constraint on this section of network outlined in Section 2.4 of this report. The existing 33 kV circuits from Willoughby to Mountsorrel are around 13 km in length, so any reinforcement strategy to uprate the existing circuits or build new circuits from Willoughby would be very expensive. Piecemeal reinforcement of the existing 33 kV circuits would not provide the capacity required to support long term growth in the area.

If a new BSP were built to the south of Mountsorrel the circuit works required to alleviate this constraint could be reduced. There are a number of other drivers for building a new BSP in the area (including constraints at Willoughby BSP itself as covered in the Ratcliffe 132 kV report). This option and its implications for the 33 kV network in the area are expounded upon in Section 2.4 of this report, as well as in the Ratcliffe 132 kV and Enderby 132 kV reports. Regardless of how the 33 kV network in the area is developed the transformers at Mountsorrel primary will need uprating.

Option 2 – Install a third transformer and circuit to Mountsorrel primary

Discounted

Capacity released for constraint(s) considered: Minimal

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

Detailed description: Installing a third transformer and 33 kV circuit to Mountsorrel primary would not free up significant capacity at the site. This is due to the fact that there are only two 33 kV busbars at Willoughby BSP, so two of the primary transformers would need to be supplied from a single busbar, and would consequently both be lost for a fault on that busbar. Installing a third 33 kV busbar at Willoughby is not likely to be carried out in the near future (the reinforcement proposals considered for the BSP are outlined in the Ratcliffe 132 kV report).

If a new BSP is built in the area, a third transformer could be supplied from it, but this has also been discounted as it would create a loose couple at 11 kV with Willoughby (or if run split would create a less than optimal running arrangement and reduce network operability).

Option 3 – Build a new primary substation

Discounted

Capacity released for constraint(s) considered: Up to 38 MVA

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

Detailed description: If a new primary substation were built in the locality of Mountsorrel, it could be used to deload the existing site and alleviate this constraint. If this primary were built between Mountsorrel and Quorn primaries (which are around 4 km apart), it could be used to deload both sites. This option is discussed in the Loughborough 33 kV report and has been discounted at this time due to the fact that it is likely more economical to uprate both sites individually first.

On the Quorn side, the capacity could be increased at a relatively low cost, without extensive 33 kV circuit works being required. On the Mountsorrel side, although significant 33 kV circuit works are required, these are triggered by the voltage constraint outlined in Section 2.4 of this report regardless (transferring some demand away from Mountsorrel would provide some benefit but would not be sufficient alone to mitigate this voltage constraint due to the high demand growth forecast for the area, most notably at Syston).

Option 4 – Procure flexibility under Mountsorrel 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 Mountsorrel primary. Flexibility is likely not suitable to help manage the low voltage constraint described in Section 2.4 of this report, so even if the thermal issues are mitigated, reinforcement may be triggered regardless. Flexibility could potentially be used to defer uprating the 33/11 kV transformers at Mountsorrel while carrying out the 33 kV circuit works required to alleviate the voltage constraint (which will also help resolve the thermal circuit constraints). The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

Uprating both transformers at Mountsorrel to 20/40 MVA units would resolve the forecast transformer constraints at the site. To free up capacity at Mountsorrel, and to also alleviate the 33 kV circuit constraints, significant works are required. Given the length of the existing circuits back to Willoughby (and a number of other drivers), a new BSP may need to be established, with new 33 kV circuits built to pick up Mountsorrel primary. Considering the time that would be required to build a new BSP (and all of the associated 132 kV works), other mitigation options, such as utilising flexibility services, may be required to prevent overloads in the interim.

2.3 Syston primary transformer and circuit overloads

Constraint Overview

Generation | **Demand**

The table below outlines the nature of the thermal network constraints identified in the network analysis. These thermal constraints are exacerbated by the voltage constraints outlined in Section 2.4 of this report. Constraints on the 33 kV circuits which supply both Syston and Mountsorrel have already been covered in Section 2.2.

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
Syston primary transformer overloads	Arranged outage on any infeed or transformer	Fault on a remaining transformer or circuit	2028	2028	2028	2028
Syston T1 overloads	Fault on the main 1 33 kV busbar at Willoughby BSP	None	2028	2028	2028	2028
Syston T1, T2 or T3 overloads	Arranged or fault outage on any circuit or transformer	None	2034	2034	2034	2034
Willoughby to South Croxton 33 kV circuit overloads	Arranged or fault outage on one of the two other infeeds	None	2034	2034	2034	2034
Willoughby to South Croxton 33 kV circuit overloads	Arranged outage on the 33 kV circuit to Syston T2	Fault on either Willoughby – South Croxton – Syston 33 kV circuit	2028	2028	2028	2028
South Croxton to Syston 33 kV circuit overloads	Arranged or fault outage on one of the two other infeeds	None	2034	2034	2034	2034
South Croxton to Syston 33 kV circuit overloads	Arranged outage on the 33 kV circuit to Syston T2	Fault on either Willoughby – South Croxton – Syston 33 kV circuit	2028	2028	2028	2028
Willoughby – South Croxton – Syston T1 33 kV circuit overloads	Fault on the main 1 33 kV busbar at Willoughby BSP	None	2028	2028	2028	2028
Syston tee to Syston T2 33 kV circuit overloads	Arranged or fault outage on one of the two other infeeds	None	2034	2034	2034	2034
Syston tee to Syston T2 33 kV circuit overloads	Arranged outage on either Willoughby – South Croxton – Syston 33 kV circuit	Fault on the remaining 33 kV infeed via South Croxton	2028	2028	2028	2028

Uncertainty under other Distribution Future Energy Scenarios: Very high demand growth is forecast for every scenario at Syston primary. Up to 2034 slightly lower growth is forecast under Falling Short, but it is still high enough to trigger significant overloads (and rapid growth is forecast beyond 2034 as well).

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 all three transformers at Syston primary.
2	Create two 20/40 MVA primaries at Syston.
3	Install a second transformer at South Croxton primary.
Operational Mitigation	
4	Alternative running arrangements.
Flexibility Services	
5	Procure flexibility under Syston 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 all three transformers at Syston primary

Discounted

Capacity released for constraint(s) considered: Up to 15 MVA

New limiting factor for constraint(s) considered: Transformer ratings for busbar outages and/or voltage constraints

Detailed description: Uprating all three transformers at Syston primary to 20/40 MVA would add capacity, and would also confer an asset condition benefit (as two of the existing transformers are close to 60 years old). This option has been discounted as two transformers could still be lost for a busbar fault at Willoughby, limiting the capacity added. Due to the high demand growth projected for Syston, further intervention at the site would soon be required if this option were implemented. Another disadvantage is that it leaves the network complex and challenging to operate.

However Syston itself is arranged, new 33 kV circuit capacity will also be required. Syston primary is around 14 km south of Willoughby BSP, with the existing 33 kV circuits feeding the primary each being around 20 km in length. Building new 33 kV circuits to Syston or uprating the existing circuits would both require extensive and costly works. If new 33 kV circuits were built to Mountsorrel, which is noted as an option in Section 2.2 of this report, then significant capacity would be freed up for Syston, but this would be an expensive reinforcement option. Implementing these costly reinforcement projects is likely not a strategic choice in the long term, as Willoughby BSP itself is also projected to be heavily constrained (as discussed in the Ratcliffe 132 kV report).

Option 2 – Create two 20/40 MVA primaries at Syston

Viable

Capacity released for constraint(s) considered: 53 MVA

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

Detailed description: Due to the challenges outlined above with leaving Syston as a three transformer primary, another option could be to rationalise the site into a two 20/40 MVA transformer site (with the option to then add two more 20/40 MVA transformers to cater for the high demand growth forecast in the area).

With two primaries at Syston, each with a firm capacity of 38 MVA, the site would have sufficient headroom to accommodate the projected growth up to 2050. This replacement would also confer the asset condition benefits of replacing the existing T1 and T2 as in option 1.

To release the full capacity quoted above, 33 kV circuit capacity will need to be created as well. Some of the possibilities for adding circuit capacity from Willoughby BSP are discussed in option 1 above. Another possibility is that Syston could instead be transferred into a new BSP, established to the north of Leicester, which has numerous benefits discussed in this report, as well as in the Ratcliffe 132 kV and Enderby 132 kV reports. Four 33 kV circuits could then be built to Syston, which would allow Syston to be transferred, as well as South Croxton via the two 33 kV circuits between the two primaries. It would also create potential future options for transferring other primaries via these circuits (such as Mountsorrel) if they were suitably rated.

Option 3 – Install a second transformer at South Croxton primary

Viable

Capacity released for constraint(s) considered: 17 MVA

New limiting factor for constraint(s) considered: Total capacity of Syston and South Croxton

Detailed description: Installing a second transformer at South Croxton primary would increase its capacity and remove its reliance on 11 kV backfeeds to Syston during outages. While the demand growth at South Croxton itself is not forecast to be high enough to warrant investment on its own, reinforcing the site could facilitate the transfer of demand away from Syston primary (which is around 4 km to the west of South Croxton) and help to alleviate the constraints there.

This reinforcement could be carried out after two 20/40 MVA transformers are installed at Syston as proposed in option 2, or after all four 20/40 MVA transformers are installed. The phasing of these reinforcement projects would be determined by where the demand growth around Syston is geographically located, as well as its magnitude (e.g. growth to the east of Syston could more easily be picked up by South Croxton). If growth at Syston is lower than expected, two transformers at Syston and two at South Croxton could potentially be sufficient to support the area. 11 kV studies will be required to determine how easily demand could be transferred to South Croxton. 33 kV circuit works beyond what is already proposed for Syston and Mountsorrel are likely not required to free up capacity at South Croxton. This is due to the fact that there are already two 33 kV circuits from Willoughby BSP to South Croxton, and two between Syston and South Croxton (so regardless of where South Croxton is fed from it has the requisite 33 kV circuits to feed two transformers).

It is recommended that the new transformer installed at South Croxton be a 12/24 MVA unit, as this would allow more capacity to be created than installing a second 6/12 MVA unit. This capacity would only be freed up once the 6/12 MVA transformer is also uprated. This could either be carried out immediately as part of the same project, or at a later date as required. Replacing the 6/12 MVA transformer at South Croxton may be triggered by its condition in the near future regardless (as the existing unit is around 50 years old), which would provide an economic opportunity to install a 12/24 MVA unit. Installing 20/40 MVA transformers has been discounted as an option, as the forecasts do not support the need for this capacity (and the site would be limited by the 33 kV infeeds to not much more than 12/24 MVA transformers would provide regardless).

Option 4 – Alternative running arrangements

Discounted

Capacity released for constraint(s) considered: Minimal

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

Detailed description: Some of the most onerous constraints on the transformers at, and 33 kV circuits to Syston primary are during N-2 outages. These could potentially be mitigated by splitting Syston during arranged outages on any infeed. This would not free up significant capacity, as a busbar fault at Willoughby would still take out two transformers. The only way to prevent this would be to parallel Syston at 33 kV between main 1 and main 2. This is also not viable as a fault on either circuit, transformer or busbar on that side of Syston would then take out both T1 and T2 (overloading T3). In summary, there is no arrangement at Syston which could bypass the fact that there are only two 33 kV busbars at Willoughby BSP.

Option 5 – Procure flexibility under Syston 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 Syston primary. Given the fact that the optimal reinforcement solution is likely to resolve constraints on the circuits to both Mountsorrel and Syston, flexibility would need to be procured at both sites to have any chance of deferring expenditure. Flexibility is likely not suitable to help manage the low voltage constraint described in Section 2.4 of this report, so even if the thermal issues are mitigated reinforcement may be triggered regardless. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

In the first instance, rationalising Syston primary into a two transformer site with two new 20/40 MVA transformers is likely the optimal reinforcement strategy. This could then be followed by an additional two transformers at Syston and/or two 12/24 MVA transformers at South Croxton primary. Syston and South Croxton would ideally then be transferred into a new BSP established to the south (which is likely necessary to support both Willoughby and BSPs within Leicester).

2.4 Syston / Mountsorrel / South Croxton low voltage

Constraint Overview

Generation | **Demand**

The table below outlines the nature of the network constraints identified in the network analysis. Low voltages are expected to be observed for a wide range of other outages (including on any of the four 33 kV circuits to Mountsorrel, Syston and South Croxton primaries). Busbar outages at Willoughby have been highlighted as the most onerous conditions due to the fact that they lead to the loss of two of the four 33 kV circuits into the group of primaries). By 2034, the voltage levels are forecast to collapse for various outages, highlighting the severity of this voltage constraint.

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
Low volts on the Mountsorrel, Syston and South Croxton network	Fault or arranged outage on either 33 kV busbar at Willoughby BSP	None	2028	2028	2028	2028

Uncertainty under other Distribution Future Energy Scenarios: As noted in Section 2.2 and Section 2.3 of this report, demand growth in the area is projected to be high under all scenarios. The lowest is seen under Falling Short, but it is still enough to trigger a severe voltage constraint for various outage conditions.

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	Build new 33 kV circuits to Mountsorrel primary.
2	Build new 33 kV circuits to Syston primary.
3	Uprate the existing 33 kV circuits to Mountsorrel and Syston primaries.
4	Build a new BSP to the south of Syston.
Flexibility Services	
5	Procure flexibility under Mountsorrel, Syston and South Croxton 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.

Option 1 – Build new 33 kV circuits to Mountsorrel primary

Discounted

Capacity released for constraint(s) considered: Up to 15 MVA at Mountsorrel if carried out alongside uprating the primary transformers

New limiting factor for constraint(s) considered: Thermal and voltage constraints at Syston

Detailed description: Building two new 33 kV circuits from Willoughby BSP to Mountsorrel primary would improve voltage regulation on this section of network and free up capacity on the existing circuits to Syston. This option was discussed in Section 2.2 of this report and subsequently discounted due to the costs, and the fact that it is not strategically prudent given the constraints forecast for Willoughby itself.

Option 2 – Build new 33 kV circuits to Syston primary

Discounted

Capacity released for constraint(s) considered: Dependent on demand growth at other primaries supplied from Willoughby

New limiting factor for constraint(s) considered: GT capacity at Willoughby BSP

Detailed description: If Syston primary were rationalised as proposed in Section 2.3 of this report, four new 33 kV circuits would be required to feed the primary. Aside from the voltage constraint, none of the existing circuits are rated high enough to support 20/40 MVA transformers. This option would free up circuit capacity for Syston, Mountsorrel and South Croxton, but has been discounted for a number of reasons:

- Well over 15 km of circuit would be required to create a new circuit from Willoughby to Syston, for a total circuit length considerably in excess of 60 km (subject to detailed route investigation and land rights). This makes this option prohibitively expensive.
- Willoughby BSP is forecast to be constrained as discussed in the Ratcliffe 132 kV report, with reinforcement options being limited. This makes building lengthy new circuits from Willoughby a poor strategic choice.

Capacity at Syston could be freed up with less circuit works, for example with only two 33 kV circuits from Willoughby, but this would still be very expensive, may not be enduring, and would not resolve the constraints at Willoughby itself.

Option 3 – Uprate the existing 33 kV circuits to Mountsorrel and Syston primaries

Discounted

Capacity released for constraint(s) considered: Dependent on demand growth at other primaries supplied from Willoughby

New limiting factor for constraint(s) considered: GT capacity at Willoughby BSP

Detailed description: Uprating the existing 33 kV circuits to Syston, Mountsorrel and South Croxton primaries could increase capacity for the primaries. However, given the severity of the projected voltage constraint virtually the entire length of all four circuits would need to be uprated to improve voltage regulation to a sufficient degree. This would require similar or greater lengths of circuit works as option 2, and carries the same disadvantages (i.e. constraints at Willoughby BSP).

Option 4 – Build a new BSP to the south of Syston

Viable

Capacity released for constraint(s) considered: Resolves voltage constraint

New limiting factor for constraint(s) considered: Transformer capacity at Mountsorrel, Syston and South Croxton primaries

Detailed description: If a new BSP were built to the north of Leicester, 33 kV circuits could be built to pick up primaries from Willoughby. Which primaries are transferred over and the length of the circuits required would be dependent on the exact location of the new BSP.

Syston is the prime candidate for transfer for a number of reasons:

- The highest demand growth is forecast at Syston out of all of the primaries supplied via Willoughby (so transferring Syston out would have the most pronounced impact on the BSP).
- Due to the high demand growth and the length of the 33 kV circuits to the primary, the most severe voltage constraints are projected at Syston among the primaries studied.
- Syston is the closest primary fed from Willoughby to the northern primaries within Leicester, which could potentially be picked up by a new BSP (to allow Leicester East and/or Leicester North BSPs to be deloaded as discussed in the Enderby 132 kV report).
- The two 33 kV circuits between Syston and South Croxton could be used to also transfer South Croxton primary (as discussed in Section 2.3 of this report).

This option would require significant investment, but is the most strategic option overall as it resolves a number of constraints and provides an enduring solution to accommodate the high demand growth in the area. The biggest challenge will likely be in building new 132 kV circuits to feed the new BSP, due to the large distance to any existing 132 kV network. The options for building new 132 kV circuits to the new BSP are discussed in the Ratcliffe 132 kV and Enderby 132 kV reports.

Option 5 – Procure flexibility under Mountsorrel, Syston and South Croxton primaries

Discounted

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

Detailed description: Flexibility services are not suitable to manage this constraint as it is voltage driven. Flexibility may be of value in helping manage the thermal constraints outlined in Section 2.2 and Section 2.3 of this report, but long term deferral of the overall reinforcement works is likely not possible.

Solution Recommendation

Due to the distance of the demand growth centre from Willoughby BSP, with the highest growth forecast at Mountsorrel and Syston primaries, building a new BSP has been identified as the optimal reinforcement solution to resolve this voltage constraint (as well as the thermal constraints discussed in Section 2.2 and Section 2.3 of this report). By also supporting the Leicester group as noted above, this option will provide the capacity required for long term growth in the whole area.

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