Melton and Oakham BSPs

Network Development Report – East Midlands

May 2024

Electricity Distribution

nationalgrid

Contents

Melton and Oakham 33 kV

1. Network Overview

Melton Mowbray Bulk Supply Point (BSP) is fed from Grendon Grid Supply Point (GSP) via Corby BSP in National Grid Electricity Distribution's (NGED's) East Midlands licence area. Oakham BSP is also fed from Grendon GSP.

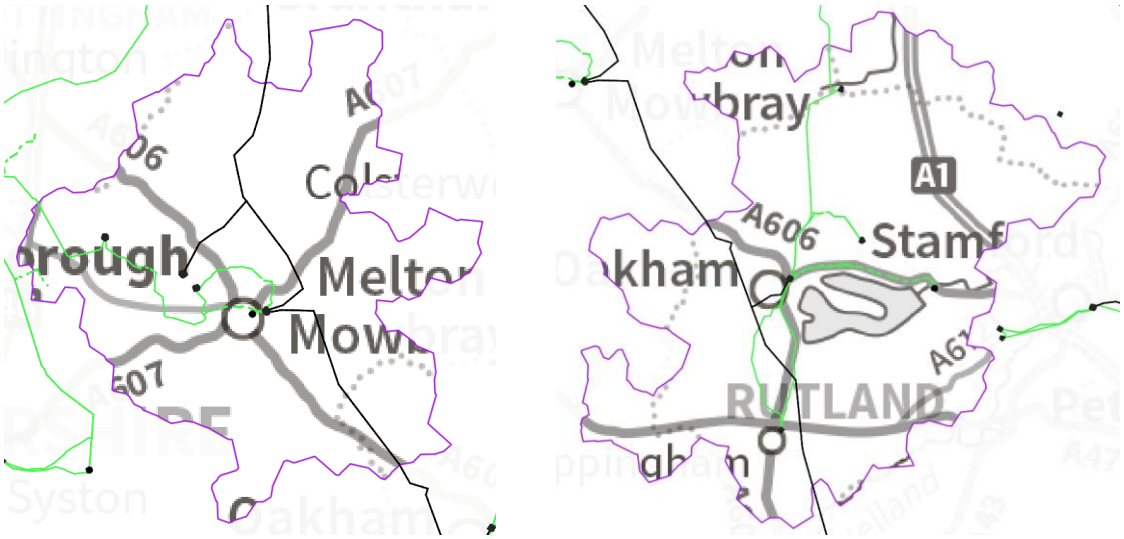

Figure 1.1 Melton and Oakham geographic network coverages

This report discusses all existing and future network constraints over a 0-10 year horizon identified on the 33 kV network fed from and the Grid Transformers (GTs) at Melton Mowbray and Oakham 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

Melton Mowbray BSP (or Melton BSP) has two 33 kV busbars fed by two 132/33 kV GTs, both rated to 22.5/45/58.5 MVA. Melton Mowbray BSP feeds four primary substations: Melton Mowbray, Old Dalby T1, Holwell and Regent Street. Melton Mowbray primary is located at the same site as Melton BSP. Each primary is fed directly from Melton BSP, with Old Dalby T1 being teed off the circuit to Holwell T2. Melton BSP is interconnected with Willoughby BSP at 33 kV via Old Dalby primary (which is normally run open at 11 kV).

Oakham BSP similarly has two 33 kV busbars fed by two GTs, with these GTs being rated to 30/60/78 MVA. Oakham BSP feeds five primary substations: Oakham, Uppingham, Empingham, Exton and Market Overton. Oakham primary is located at the same site as Oakham BSP. Each primary is fed directly from Oakham BSP, with Market Overton T1 being teed off the circuit to Exton T1. Oakham BSP is interconnected with Grantham BSP at 33 kV via Market Overton primary (which is normally run open at 11 kV).

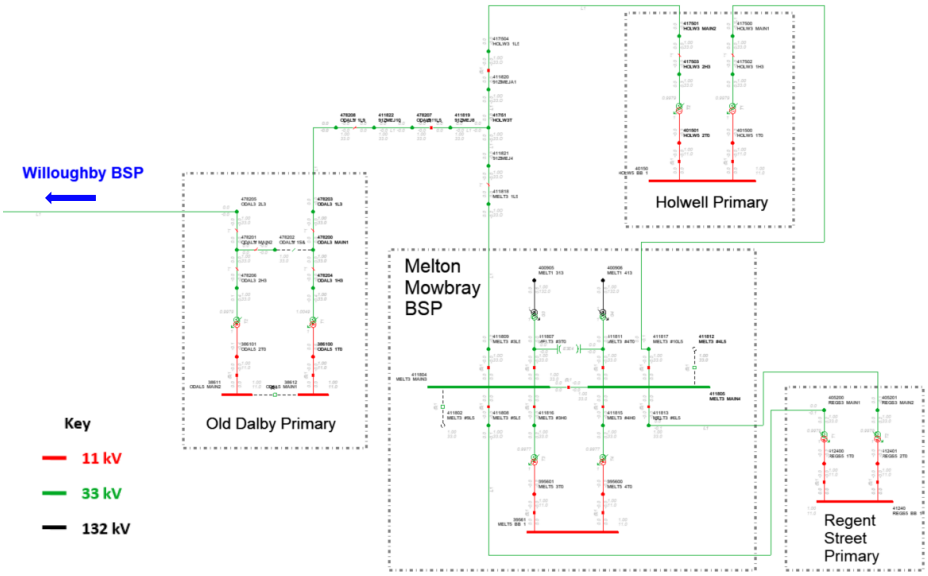

Figure 1.1.1 Melton 33 kV network single line diagram

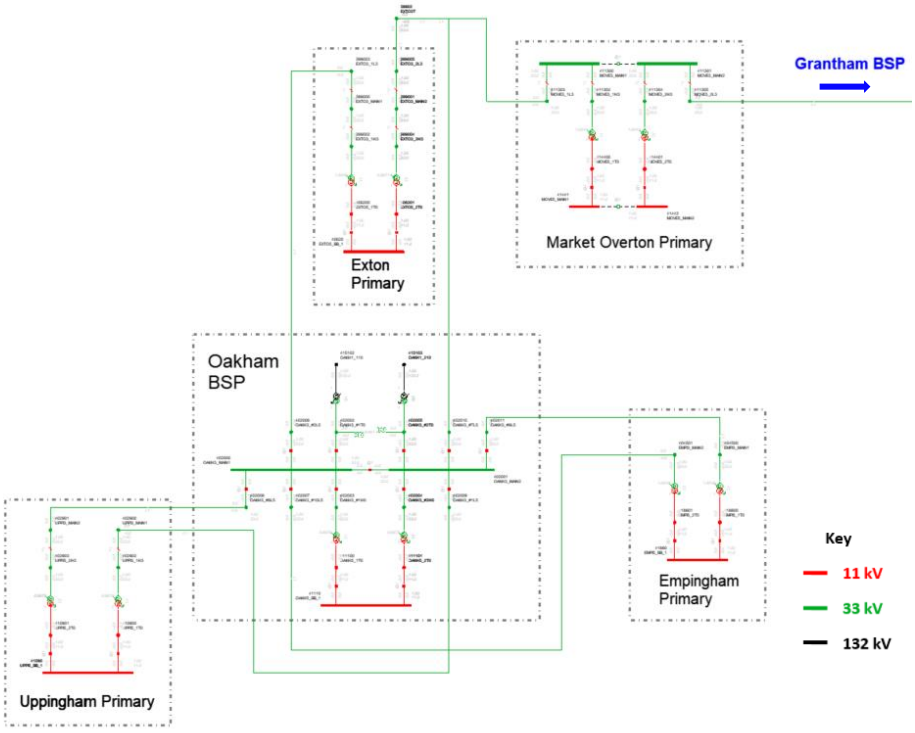

Figure 1.1.2 Oakham 33 kV network single line diagram

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 account for expected network changes.

- Melton and Oakham's 33 kV networks are split for arranged outages on their respective 33 kV bus section breakers to prevent loose couples. For Melton, this involves splitting Melton, Holwell and Regent Street primaries (all of which are fed from both bars) at 11 kV. For Oakham, this involves splitting Oakham, Uppingham, Exton and Empingham primaries (all of which are fed from both bars) at 11 kV.
- Market Overton primary is switched fully into Grantham BSP for an outage on the infeed from Oakham BSP, and vice versa for an arranged outage on the infeed from Grantham BSP.
- Old Dalby primary is switched fully into Willoughby BSP for an outage on the infeed from Melton BSP, and vice versa for an outage on the infeed from Willoughby BSP.
- In future year studies, Regent Street primary is decommissioned and its demand transferred into Melton primary. Studies have also been carried out without this demand transfer modelled.
- For the loss of an infeed to a transformer at any of the primaries fed from Oakham and Melton BSPs 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 constraints were identified for the Best View Scenario, for which mitigation options will be discussed:

- Overloads are observed on the transformers at Melton primary for a fault or arranged outage on the other transformer or 33 kV busbar at Melton BSP by 2028.
- Overloads are observed on the transformers at Oakham primary for a fault or arranged outage on the other transformer or 33 kV busbar at Oakham BSP by 2028.
- By 2028, overloads are projected for both GTs at Melton BSP during arranged or fault outages on the other GT, 132 kV infeed or 33 kV busbar.

2.2 Melton Mowbray 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
Melton primary transformer overloads	Arranged or fault outage on the other transformer or 33 kV busbar at Melton BSP	None	2028	2028	2028	2028

Uncertainty under other Distribution Future Energy Scenarios: Significantly higher demand growth is forecast under the Leading the Way and Consumer Transformation scenarios. There are no scenarios under which overloads are not observed for every season by 2028 (with the additional demand transferred from Regent Street primary included).

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 primary transformers at Melton primary.
2	Install a third transformer at Melton primary.
3	Build a new primary substation.
4	Install two 132/11 kV GTs at Melton BSP.
Flexibility Services	
5	Procure flexibility under Melton primary.

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness. Additional Cost Benefit Analysis (CBA) has been carried out as part of the DNOA process, which is discussed in option 5 (regarding the use of flexibility services) below.

Option 1 – Uprate both transformers at Melton primary

Viable

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

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

Detailed description: Uprating both of the transformers at Melton primary would resolve this constraint in the short and medium term. 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 almost 60 years old and are due for asset replacement. Minimal 33 kV circuit works will be required to free up this capacity as Melton primary is located at the same site as Melton BSP.

Option 2 – Install a third transformer at Melton 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 at Melton 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 Melton 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 or arranged outage on that busbar.

This solution would also not benefit the condition of the existing transformers, which is expected to trigger intervention before load growth at the primary does.

Option 3 – Install two 132/11 kV GTs at Melton BSP

Discounted

Capacity released for constraint(s) considered: Dependent on load growth at Oakham BSP

New limiting factor for constraint(s) considered: 132 kV circuit capacity to the Oakham tee

Detailed description: Replacing the two primary transformers at Melton with 132/11 kV GTs would resolve this constraint, as well as pulling enough demand off the existing 132/33 kV GTs to prevent the projected overloads discussed in Section 2.4 of this report. A significant portion of the existing and forecast demand at Melton BSP is on the 11 kV:

- 45% of the demand on Melton BSP at present is at Melton primary, forecast to rise to 55% by 2034 and 65% by 2050.
- With the additional demand from Regent Street primary, 70% of the demand at Melton BSP would be at Melton primary (this proportion is forecast to remain roughly the same).

Despite the high growth forecast within Melton Mowbray itself, the overall demand forecast does not warrant four GTs. This option has therefore been discounted due to the significant additional expenditure which would be required compared with options 1 and 4.

Option 4 – Build a new primary substation

Discounted

Capacity released for constraint(s) considered: Up to 23 MVA

New limiting factor for constraint(s) considered: Melton GT capacity

Detailed description: Building a new primary substation in Melton Mowbray (likely to the south of the BSP) would allow load to be transferred away from Melton primary, resolving this constraint. In the short term this option has been discounted as it would require significantly higher expenditure than the replacement of the existing primary transformers at Melton primary with 20/40 MVA units (which is triggered based on their condition regardless).

This solution remains an option in the longer term as demand forecasts indicate additional capacity will be required beyond 2034. Retaining Regent Street primary could be considered for this purpose, but this option has been discounted due to both the condition of the site and the high fault levels at the primary. In the short term there is also minimal value in retaining Regent Street as this would not defer expenditure at Melton primary (which as noted above is triggered anyway due to the condition of the transformers, and overloads are observed at Melton by 2028 even without the additional demand from Regent Street).

Option 5 – Procure flexibility under Melton primary

Discounted

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 Melton primary. Flexibility will not however benefit the condition of the transformers at the primary. The viability of utilising flexibility for this constraint has been discussed in depth in Appendix A of the 2024 DNOA publication, which demonstrated that deferral of reinforcement is not viable.

Solution Recommendation

Uprating the 33/11 kV transformers at Melton primary to 20/40 MVA units has been identified as the optimal reinforcement strategy, triggered by both demand increases and the condition of the assets. Other reinforcement options, as well as the use of flexibility have been discounted (but a new primary substation could be viable and required beyond 2034).

2.3 Oakham 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
Oakham primary transformer overloads	Arranged or fault outage on the other transformer or 33 kV busbar at Oakham BSP	None	2034	2028	2028	2034

Uncertainty under other Distribution Future Energy Scenarios: Significantly higher demand growth is forecast under the Leading the Way and Consumer Transformation scenarios, triggering overloads in other seasons in 2028. By 2034 overloads are observed across multiple seasons even under the lower growth scenarios (System Transformation and Falling Short).

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 primary transformers at Oakham primary.
2	Install a third transformer at Oakham primary.
3	Install two 132/11 kV GTs at Oakham BSP.
Operational Mitigation	
4	Review seasonal ratings.
Flexibility Services	
5	Procure flexibility under Oakham 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 both transformers at Oakham primary

Viable

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

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

Detailed description: Uprating both of the transformers at Oakham primary to 20/40 MVA units would resolve this constraint. Forecasts indicate the capacity added by this reinforcement will be sufficient to cater for most of the demand growth up to 2050. By 2050, demand is forecast to exceed the new firm capacity by only 5 MVA. Given how far in the future this forecast demand is, and the relatively small magnitude of the exceedance, additional expenditure (such as installing 132/11 kV GTs as considered in option 3) is not justifiable. If this demand does materialise, it could likely be accommodated using 11 kV transfers to other primaries in the area at a much lower cost than installing two GTs.

Option 2 – Install a third transformer at Oakham 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 at Oakham 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 Oakham 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 or arranged outage on that busbar.

Option 3 – Install two 132/11 kV GTs at Oakham BSP

Discounted

Capacity released for constraint(s) considered: Dependent on load growth at Melton BSP and on the other primaries supplied from Oakham BSP

New limiting factor for constraint(s) considered: 132 kV circuits to Oakham BSP

Detailed description: Replacing the 33/11 kV transformers at Oakham with 132/11 kV GTs would resolve this constraint, adding significant capacity to the site. It would also deload the existing 132/33 kV GTs. This option has been discounted as it is significantly more expensive than uprating the primary transformers, with the load forecast at Oakham not warranting this level of investment (as discussed in option 1).

The benefit this option would convey for the existing 132/33 kV GTs at Oakham does not justify this level of investment either, as no constraints on these GTs have been identified as part of these studies. While forecasts indicate that the GTs at Oakham may eventually become constrained, it is not expected for demand at Oakham to increase to a level which requires four GTs (so the constraint could be resolved by simply upgrading the existing 132/33 kV GTs).

Option 4 – 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 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 (by 2034 overloads are seen in all seasons).

Option 5 – Procure flexibility under Oakham 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 Oakham primary. This could be carried out alongside the operational mitigation discussed in option 4 above. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

The optimal reinforcement strategy identified is to uprate the primary transformers at Oakham to 20/40 MVA units. These works could potentially be deferred by an internal review of seasonal transformer ratings.

2.4 Melton Mowbray BSP GT 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
Melton BSP GT overloads	Arranged or fault outage on the other GT, 132 kV infeed or 33 kV busbar at Melton BSP	None	2034	2028	2034	-

Uncertainty under other Distribution Future Energy Scenarios: Similar overloads are seen to Best View under the System Transformation scenario. While lower growth is forecast under the Falling Short scenario, intervention is still triggered by 2034. Significantly higher demand growth is forecast under the Leading the Way and Consumer Transformation scenarios, triggering overloads in other seasons in 2028.

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 both GTs at Melton BSP.
2	Install two 132/11 kV GTs at Melton BSP.
Operational Mitigation	
3	Review seasonal ratings.
Flexibility Services	
4	Procure flexibility under Melton BSP.

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 GTs at Melton BSP

Viable

Capacity released for constraint(s) considered: Dependent on load growth at Oakham BSP

New limiting factor for constraint(s) considered: 132 kV circuit capacity to the Oakham tee

Detailed description: Uprating the two GTs at Melton BSP would resolve this constraint and add significant capacity to the site. It would also benefit the condition of the existing assets, which are almost 60 years old. The GTs could be uprated to either 30/60/78 MVA or 60/90/117 MVA units.

Forecasts indicate that 30/60/78 MVA units would provide enough demand capacity at the site for growth up to 2050. However, demand at that point will be close to the new GT ratings. It should therefore be considered if the additional expenditure associated with installing larger (60/90/117 MVA) units is worth the option value created. Options for transferring additional load into the group to deload nearby BSPs such as Willoughby and Oakham may be limited, but larger units would account for the inherent uncertainty in long term load forecasts.

To free up this extra capacity, 132 kV works would be required as otherwise the 132 kV circuits to the Oakham tee become the next limiting factor. The extent to which this is the case will depend on the load growth at Oakham BSP. This may make installing 60/90/117 MVA units not worth the additional investment.

Option 2 – Install two 132/11 kV GTs at Melton BSP

Discounted

Capacity released for constraint(s) considered: Dependent on load growth at Oakham BSP

New limiting factor for constraint(s) considered: 132 kV circuit capacity to the Oakham tee

Detailed description: Replacing the primary transformers at Melton with 132/11 kV GTs would deload the existing 132/33 kV GTs, resolving this constraint. This option has been considered and discounted based on its high cost, as discussed in Section 2.2 of this report.

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 by 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 (by 2034 overloads are also seen at winter peak demand). This option would also not provide any benefit for the condition of the GTs.

Option 4 – Procure flexibility under Melton 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 Melton BSP. This could be carried out alongside the operational mitigation discussed in option 3 above. The use of flexibility would not provide any benefit for the condition of the existing GTs. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

The optimal reinforcement strategy identified to resolve this constraint is to uprate both GTs at Melton BSP. As demand grows and forecasts evolve, future NDP reports will reassess what rating of new GTs should be installed (current forecasts indicate 30/60/78 MVA GTs will provide just enough capacity).

DSO | nationalgrid electricity distribution

Registered Office: Avonbank, Feeder Road, Bristol BS2 0TB
nationalgrid.co.uk