Tamworth Grid and Tamworth Town BSPs

Network Development Report – East Midlands

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Electricity Distribution

nationalgrid

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Tamworth 33 kV

1. Network Overview

Tamworth Grid and Tamworth Town Bulk Supply Points (BSPs) are fed from Lea Marston Grid Supply Point (GSP) in National Grid Electricity Distribution's (NGED's) East Midlands licence area. Both BSPs are fed from Lea Marston via a dual 132 kV circuit.

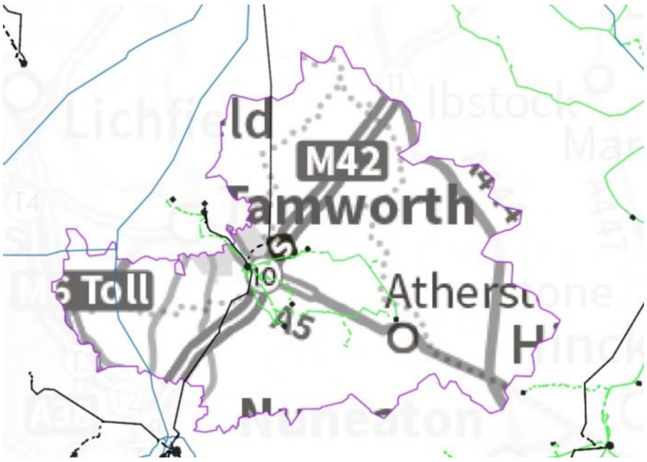

Figure 1.1 Tamworth Grid and Tamworth Town geographic network coverage

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

Tamworth Grid BSP has three 33 kV busbars fed by two 132/33 kV Grid Transformers (GTs), both rated to 45/90/117 MVA. Tamworth Grid BSP feeds five primary substations: Atherstone, Birch Coppice, Polesworth, Tamworth and Wood End. Tamworth primary is located at the same site as Tamworth Grid BSP. All of the primaries fed from Tamworth Grid have two 33/11 kV transformers. Tamworth Grid is interconnected with Tamworth Town BSP via a single dedicated 33 kV circuit (which is normally run open at Tamworth Grid).

Tamworth Town BSP has two 33 kV busbars fed by two 132/33 kV GTs, both rated to 22.5/45/58.5 MVA. Tamworth Town BSP feeds two primary substations: Apollo an Independent Distribution Network Operator (IDNO) site. Tamworth Town also has two 132/11 kV GTs (as covered in the Lea Marston 132 kV report). Tamworth Town's only interconnection at 33 kV is with Tamworth Grid BSP via a single circuit, as noted above.

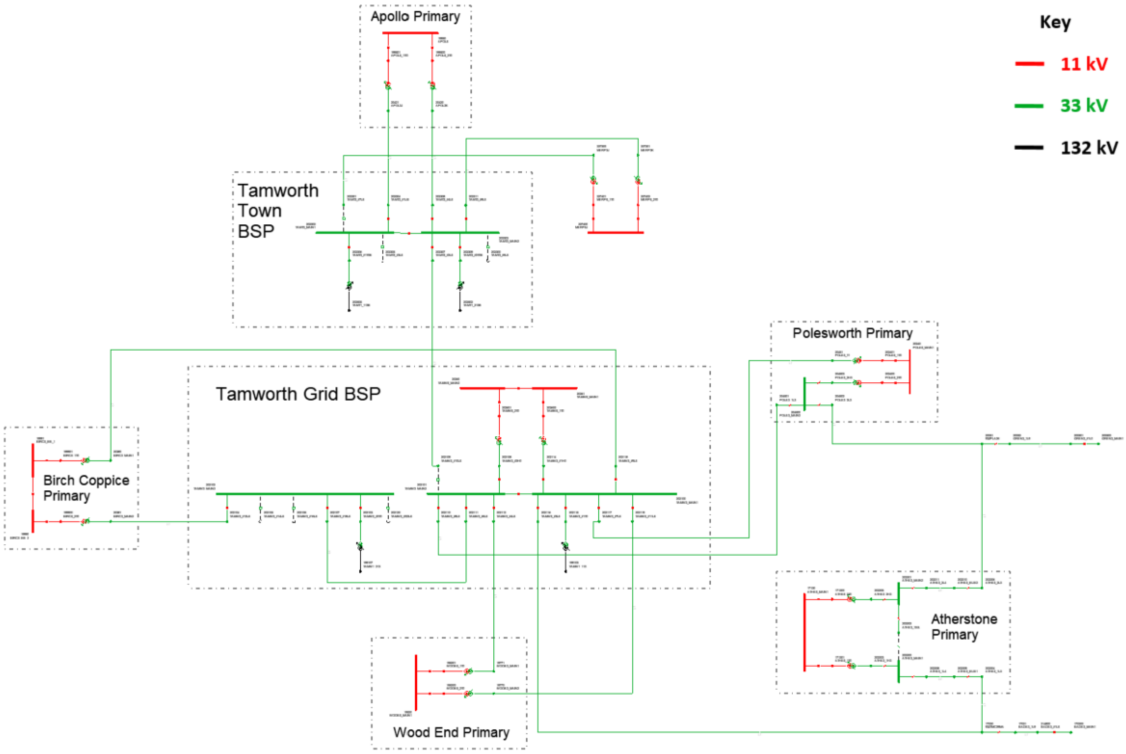

Figure 1.1.1 Tamworth Grid and Tamworth Town 33 kV network single line diagram

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 Tamworth Grid or Tamworth Town BSPs under arranged outages, the lower voltage side circuit breaker is opened to prevent back-energisation.
- The 33 kV networks downstream of Tamworth Grid and Tamworth Town BSPs are split for arranged outages on their respective 33 kV bus section breakers to prevent loose couples. This involves splitting Atherstone, Birch Coppice, Polesworth, Tamworth and Wood End primaries at 11 kV for Tamworth Grid, and splitting Apollo and the IDNO primary at 11 kV for Tamworth Town.
- For an outage on the main 2 33 kV busbar, or the 33 kV circuit between main 2 and main 3 at Tamworth Grid, Birch Coppice primary is split at 11 kV.

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 on the 33 kV circuits feeding Atherstone and Polesworth primaries. The most onerous constraint is on the circuit which supplies both primaries, for an outage on the main 1 33 kV busbar at Tamworth Grid BSP, which is present in the baseline.
- By 2028, the transformers at Atherstone primary are projected to overload for arranged or fault outages on the other transformer or circuit.
- By 2028 the transformers at Polesworth primary are projected to overload for arranged or fault outages on the other transformer or circuit.

2.2 Tamworth to Polesworth and Atherstone 33 kV 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
Tamworth to Polesworth main 2 33 kV circuit overload	Arranged or fault outage on the main 1 33 kV busbar at Tamworth Grid BSP	None	Baseline	Baseline	Baseline	2028
Tamworth to Polesworth main 2 33 kV circuit overload	Fault on the 33 kV circuit between Tamworth Grid and Atherstone T2	None	2028	Baseline	2028	2034
Polesworth to Atherstone 33 kV circuit overload	Fault on the 33 kV circuit between Tamworth Grid and Atherstone T2	None	2034	2034	2034	-

Uncertainty under other Distribution Future Energy Scenarios: This constraint is present in the baseline, and will therefore require intervention regardless of scenario.

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	Reconfigure 33 kV circuits at Tamworth Grid BSP.
2	Build a new 33 kV circuit to Polesworth primary.
3	Build two new 33 kV circuits to Tamworth primary.
Operational Mitigation	
4	Transfer demand to other primaries.
Flexibility Services	
5	Procure flexibility under Atherstone and Polesworth primaries.

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 (some additional CBA may be required as discussed below). 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 – Reconfigure 33 kV circuits at Tamworth Grid BSP

Discounted

Capacity released for constraint(s) considered: Minimal

New limiting factor for constraint(s) considered: 33 kV circuit to Polesworth main 2 rating for N-1 circuit outages

Detailed description: Two of the three 33 kV circuits from Tamworth Grid BSP that feed Atherstone and Polesworth primaries are connected to the same 33 kV busbar (Tamworth Grid main 1). By moving one of these circuits over to main 3, the most onerous constraint identified (the loss of this busbar) would be alleviated. While this option is technically viable, it would not help alleviate the N-1 circuit constraint also identified in the baseline.

Option 2 – Build a new 33 kV circuit to Polesworth primary

Viable

Capacity released for constraint(s) considered: Dependent on the demand growth at the two primaries

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

Detailed description: Building a new 33 kV circuit to Polesworth would allow Atherstone and Polesworth to be unstitched, creating two dedicated feeds to each primary. Compared to uprating the existing circuit, this option creates a simplified and more operable network, while requiring a similar length of circuit works at around 3.6 km (as the existing circuit would need to be entirely replaced to add the requisite capacity).

This option carries a number of advantages, increasing the circuit capacity to both primaries and improving network operability. However, it would not alleviate the constraints seen on the 33 kV circuits directly to Atherstone (the Atherstone to Polesworth circuit constraint is outlined above, and the direct circuit from Tamworth to Atherstone is also forecast to be out of capacity by 2034). Further intervention is therefore required, some of the options for which are discussed below.

Option 3 – Build two new 33 kV circuits to Atherstone primary

Viable

Capacity released for constraint(s) considered: Dependent on the demand growth at the two primaries

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

Detailed description: Building two new 33 kV circuits to Atherstone primary would allow the full capacity of 20/40 MVA transformers to be utilised at Atherstone (the installation of which is discussed in Section 2.3 of this report). It would also make the two circuits to Polesworth dedicated feeders, which would (along with some other works discussed in Section 2.4 of this report) increase its capacity to 23 MVA.

This option creates the most capacity for the network, which along with transformer replacements at both primaries, would be an enduring, long term solution. However, it is also the most expensive option considered, with well over 15 km of new circuit (subject to detailed route investigation and land rights) required to create two new infeeds to Atherstone. Uprating the existing Tamworth to Atherstone 33 kV circuit would likely not be economical, as the entire length would need replacing to free up significant capacity (so the existing circuit may as well be maintained, and two new circuits laid together along a potentially shorter route).

Option 4 – Transfer demand to other primaries

Viable

Capacity released for constraint(s) considered: Dependent on 11 kV transfers

New limiting factor for constraint(s) considered: 11 kV transfer capacity

Detailed description: There are a number of primaries located near Atherstone primary which are currently underutilised; Birch Coppice, Wood End and Wood Lane. It is possible that demand could be transferred to some of these primaries at 11 kV to deload the Atherstone and Polesworth 33 kV network. Even if 11 kV works are required to facilitate these transfers, this may be more economical than carrying out the works described in option 3. These transfers could potentially be used in conjunction with unstitching the two primaries as discussed in option 2 above in order to avoid the more costly reinforcement proposed in option 3.

To support the area in the long term, Wood Lane primary could also be reinforced (as the 33 kV circuits to the primary are rated high enough that they could support 12/24 MVA transformers). In depth 11 kV studies are required to assess the feasibility and potential costs associated with these transfers.

Option 5 – Procure flexibility under Atherstone and Polesworth primaries

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 33 kV circuits to Atherstone and Polesworth primaries and defer reinforcement. This deferral might need to be considered in conjunction with the transformer upgrades proposed in Section 2.3 and Section 2.4 of this report. Flexibility could potentially be used alongside 11 kV transfers (which are considered as an option above). The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

The most enduring reinforcement strategy for the area would be to install two new 33 kV circuits to Atherstone primary. This would not only allow the capacity of new transformers at both primaries to be fully utilised, it could also lay the foundation for further reinforcement (such as using the existing Tamworth to Atherstone 33 kV circuit to feed a third transformer if required). The Polesworth to Atherstone and existing Tamworth to Atherstone 33 kV circuits could also both be used to support network security in the area.

The reinforcement described above (while hugely beneficial for the network) is the most expensive option, so another option considered is unstitching the two primaries with a new Tamworth to Polesworth 33 kV circuit. This could be utilised alongside potential transfers at 11 kV and/or the procurement of flexibility. Further 11 kV studies and a CBA is required to determine if this is a feasible and economic way to support the area in the long term.

2.3 Atherstone 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
Atherstone primary transformer overload	Arranged or fault outage on either infeed to Atherstone primary	None	2034	2028	2034	2034

Uncertainty under other Distribution Future Energy Scenarios: Similar growth is forecast under Consumer Transformation and Leading the Way as under Best View (triggering overloads for all seasons by 2034). Under the two lower growth scenarios (System Transformation and Falling Short), reinforcement is not triggered 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 the transformers at Atherstone primary.
2	Install a third transformer at Atherstone primary.
Operational Mitigation	
3	Review seasonal ratings.
Flexibility Services	
4	Procure flexibility under Atherstone primary.

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full 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 DNOA process.

Option 1 – Uprate the transformers at Atherstone primary

Viable

Capacity released for constraint(s) considered: Up to 15 MVA (once 33 kV circuit works have also been carried out)

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

Detailed description: Uprating the two 33/11 kV transformers at Atherstone primary to 20/40 MVA units would alleviate this constraint, and would provide sufficient capacity to accommodate the majority of the demand growth forecast for the area up to 2050. The transformers at Atherstone are both over 50 years old, so this replacement will also confer an asset condition benefit.

Option 2 – Install a third transformer at Atherstone primary

Discounted

Capacity released for constraint(s) considered: Up to 23 MVA (once 33 kV circuit works have also been carried out)

New limiting factor for constraint(s) considered: Total transformer capacity

Detailed description: Installing a third transformer at Atherstone primary would add significant capacity to the primary. 11 kV works would be required to allow the primary to be split effectively during outages. A third 33 kV circuit would also need to be built from Tamworth Grid BSP. Significant 33 kV circuit works will be required regardless to resolve the constraint discussed in Section 2.2 of this report. This option has been discounted as overall it would be significantly more expensive than option 1 (as the existing transformers will need replacing based on their condition in the near future regardless), and would create a more complex network.

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 observed for all seasons).

Option 4 – Procure flexibility under Atherstone 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 Atherstone primary. This flexibility could overlap with any procured to manage the 33 kV circuit constraints described in Section 2.2 of this report. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

The optimal reinforcement strategy identified for resolving this constraint is to uprate the existing 33/11 kV transformers at Atherstone primary to 20/40 MVA. 33 kV circuit works will also be required to free up capacity, the options for which are outlined in Section 2.2 of this report. The new 20/40 MVA transformers would provide sufficient headroom for the majority of the growth forecast up to 2050. The growth forecast in 2050 that exceeds the capacity of 20/40 MVA transformers is not substantial enough to require significant additional investment (it could potentially be accommodated through transfers at 11 kV). Even if further investment is required, uprating the transformers at Atherstone is still the optimal initial reinforcement plan.

2.4 Polesworth primary transformer 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
Polesworth primary transformer overload	Arranged or fault outage on either infeed to Polesworth primary	None	2028	2028	2028	2034

Uncertainty under other Distribution Future Energy Scenarios: Similar growth is forecast under Consumer Transformation and Leading the Way as under Best View (triggering overloads for all seasons by 2034). Even under the two lower growth scenarios (System Transformation and Falling Short) overloads are projected to occur across multiple seasons by 2034.

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 transformers at Polesworth primary to 12/24 MVA.
2	Uprate the transformers at Polesworth primary to 20/40 MVA.
Flexibility Services	
3	Procure flexibility under Polesworth 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 the transformers at Polesworth primary to 12/24 MVA

Viable

Capacity released for constraint(s) considered: Up to 9 MVA

New limiting factor for constraint(s) considered: 33 kV circuits to Polesworth primary

Detailed description: Uprating both transformers at Polesworth primary to 12/24 MVA units would alleviate this constraint. Assuming works are carried out to unstitch Atherstone and Polesworth primaries at 33 kV (which is discussed as an option in Section 2.2 of this report), some additional capacity could also be released by uprating short sections of cable on the circuits to Polesworth. This uprating would allow the full capacity of the 12/24 MVA transformers to be utilised.

Replacing the transformers at Polesworth would also confer an asset condition benefit, as both existing units are nearly 55 years old. 12/24 MVA units will be sufficient to accommodate the majority of the demand growth up to 2050. Further uprating would not be economical or strategic as discussed in option 2 below.

Option 2 – Uprate the transformers at Polesworth primary to 20/40 MVA

Discounted

Capacity released for constraint(s) considered: 9 MVA

New limiting factor for constraint(s) considered: 33 kV circuits to Polesworth primary

Detailed description: The transformers at Polesworth could be uprated to 20/40 MVA units, which would resolve this constraint. Even if circuit works were carried out to allow Polesworth to have two dedicated 33 kV feeders, the circuits to the primary would still be the limiting factor. This reinforcement would therefore not free up any additional capacity compared to option 1, unless the entirety of both circuits to Polesworth were uprated.

Demand growth forecasts do not support the need for the additional investment required for this option, as although growth at the primary is expected to exceed 12/24 MVA by 2050, it is only by under 2 MVA. It would not be prudent to base such significant investment on this level of exceedance so far into the future, and if it does materialise it could likely be transferred out of the primary on the 11 kV network at a lower cost than fully uprating both 33 kV circuits to the primary and installing 20/40 MVA transformers. 11 kV transfers are discussed briefly in Section 2.2 of this report, the feasibility of which would need to be assessed through in depth studies at 11 kV.

Option 3 – Procure flexibility under Polesworth 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 Polesworth primary. This flexibility could potentially overlap with any volumes procured to manage the 33 kV circuit constraints described in Section 2.2 of this report. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

Uprating the transformers at Polesworth would resolve this constraint and add capacity for future load growth in the area. 12/24 MVA transformers are the most strategic choice for the new units, based on demand forecasts and other related reinforcement plans in the area (as discussed above).

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