Chesterfield, Goitside and Buxton BSPs

Network Development Report – East Midlands

May 2024

Electricity Distribution

nationalgrid

Contents

Chesterfield / Goitside / Buxton 33 kV

1. Network Overview

Chesterfield and Goitside Bulk Supply Points (BSPs) are fed from Chesterfield Grid Supply Point (GSP) in National Grid Electricity Distribution's (NGED's) East Midlands licence area. Both BSPs are fed directly from Chesterfield, with Goitside fed via a 132 kV dual circuit (the DH-route) and Chesterfield located at the same site as the GSP. Although Buxton BSP is fed from outside of NGED's distribution network and is not owned and/or operated by NGED, NGED own and operate 33 kV (and below) networks supplied from Buxton BSP.

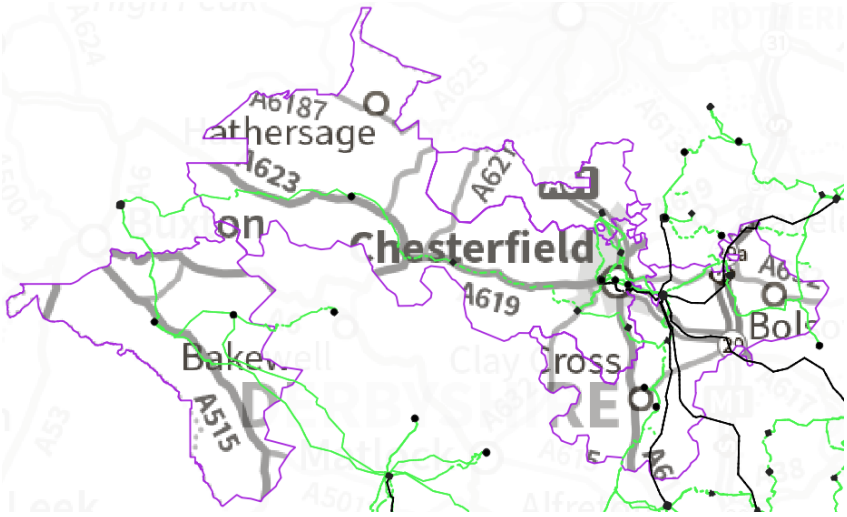

Figure 1.1 Chesterfield, Goitside and Buxton geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon identified on the Grid Transformers (GTs) at and the 33 kV network fed from Chesterfield and Goitside BSPs, as well as the 33 kV network fed from Buxton BSP within NGED's East Midlands licence area. 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

Chesterfield BSP has two 33 kV busbars fed by two 132/33 kV GTs both rated to 45/90/117 MVA. Chesterfield BSP feeds six primary substations: Biwater, Bolsover, Danesmoor, Grassmoor, Robert Hyde and Sheepbridge. Biwater and Danesmoor are supplied via Grassmoor, with all other primaries being fed directly from Chesterfield BSP. All of the primaries fed from Chesterfield BSP have two 33/11 kV transformers, with the exception of Biwater which is a single transformer primary.

Chesterfield BSP is interconnected with Whitwell, Alfreton and Goitside BSPs. The interconnection with Whitwell is via a normal open point at Bolsover primary, and the interconnection with Alfreton is via normal open points at Wessington primary. Chesterfield and Goitside are interconnected via three primaries: Robert Hyde, Sheepbridge and Wingerworth (all of this interconnection is normally run open).

Goitside BSP has two 33 kV busbars fed by two 132/33 kV GTs both rated to 45/90/117 MVA. Goitside BSP feeds seven primary substations: Eyam TA, Goitside, Queens Park, Robin Hood, Sheffield Road, Walton and Wingerworth. Goitside primary is located at the same site as Goitside BSP. Robin Hood and Wingerworth are both single transformer primaries with one 33/11 kV transformer at each site, with both being fed via Walton primary. Eyam TA is fed via Robin Hood primary. Sheffield Road primary has four primary transformers (two 33/11 kV and two 33/6.6 kV). The remaining primary substations all have two 33/11 kV transformers each, with the exception of Goitside primary which has two 33/6.6 kV transformers.

Goitside BSP is interconnected with Buxton BSP via a normal open point at Eyam primary and with Chesterfield BSP as described above.

Buxton BSP is owned and operated by Electricity North West (ENWL), but feeds three primary substations within NGED's East Midlands licence area. These three primaries are:

- Eyam TB (the other 33/11 kV transformer at Eyam is supplied from Goitside BSP as described above).
- Hindlow primary, which has two 33/11 kV transformers both of which are supplied directly from Buxton.
- Flagg primary, which has one 33/11 kV transformer and is fed via Hindlow primary.

Buxton BSP is interconnected with Winster BSP via normal open points at Flagg and Hindlow primaries, and with Goitside BSP as described above.

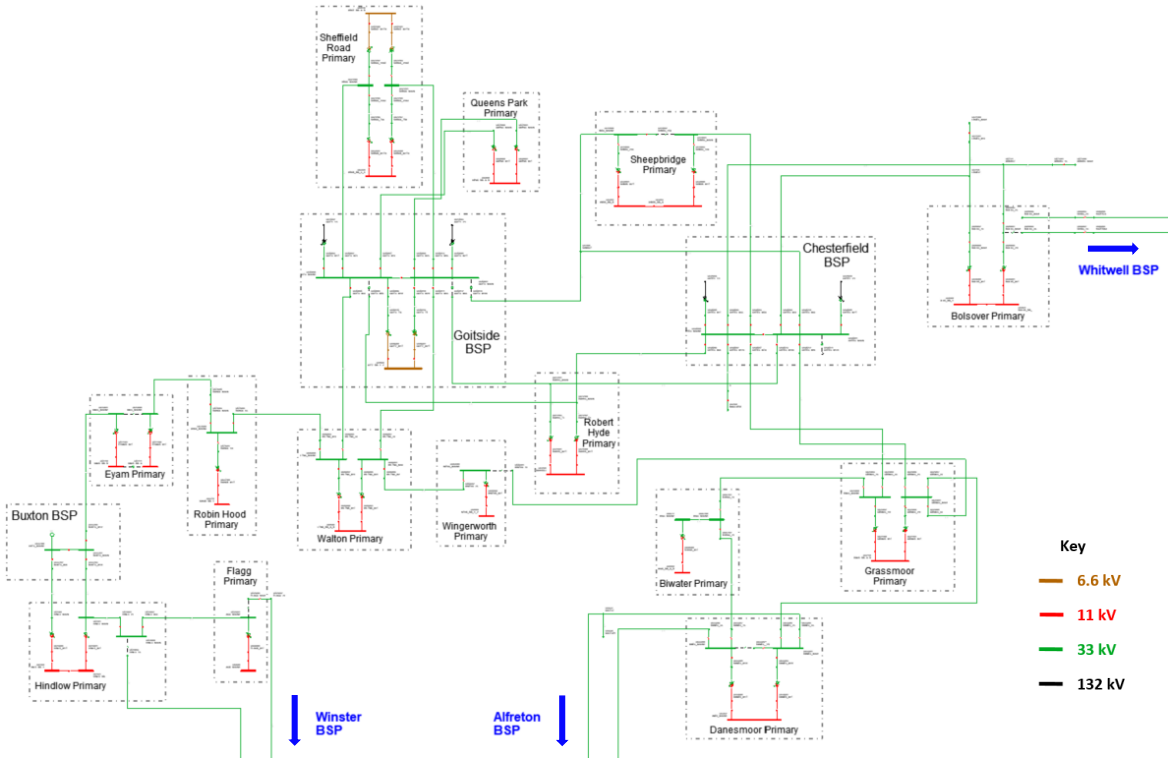

Figure 1.1.1 Chesterfield, Goitside and Buxton 33 kV network single line diagram

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 Chesterfield, Goitside or Buxton BSPs under arranged outages, the lower voltage side circuit breaker is opened to prevent back-energisation.
- The 33 kV network downstream of Chesterfield, Goitside and Buxton BSPs are split for an arranged outage on their respective 33 kV bus section breakers to prevent loose couples. For Chesterfield this involves splitting Grassmoor, Danesmoor, Robert Hyde, Sheepbridge and Bolsover primaries at 11 kV. For Goitside this involves splitting Goitside and Sheffield Road primaries at 6.6 kV and splitting Walton, Queens Park and Sheffield Road primaries at 11 kV. For Buxton this involves splitting Hindlow primary at 11 kV, in addition to any actions taken within Electricity North West's network.
- For an arranged outage on the 33 kV infeed to or the 33/11 kV transformer at Biwater primary, the load is transferred on the 11 kV network to Danesmoor primary.
- For arranged outages on the 33 kV circuits from Chesterfield to Grassmoor, or the 33 kV circuits from Grassmoor to Danesmoor, Danesmoor is paralleled at 33 kV.
- For arranged outages on either 33 kV busbar at Chesterfield BSP, Robert Hyde primary is transferred into Goitside BSP.
- For an arranged outage on the 33 kV infeed to Wingerworth, the primary is transferred into Chesterfield BSP via Grassmoor primary.
- For an arranged outage on the 33 kV infeed to (past the point at which the primary can be backfed at 33 kV) or the 33/11 kV transformer at Wingerworth primary the load is transferred on the 11 kV network to Queens Park, Walton and Grassmoor primaries.
- For an arranged outage on the 33 kV infeed to, or the 33/11 kV transformer at Robin Hood primary, the load is transferred on the 11 kV network to Sheepbridge primary.
- For an arranged outage on the 33 kV infeed to Flagg, the primary is transferred into Winster BSP.
- For an arranged outage on the 33 kV infeed to (past the point at which the primary can be backfed at 33 kV) or the 33/11 kV transformer at Flagg primary the load is transferred on the 11 kV network to Bakewell primary.
- For an outage on the infeed from Goitside or Buxton BSP, Eyam primary is paralleled at 11 kV and fed fully from the other BSP (i.e. for an outage on the circuit from Goitside BSP the site is fed fully from Buxton 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 observed on T1 and T2 at Grassmoor primary for an arranged or fault outage on either transformer or 33 kV infeed circuit by 2028. This constraint is exacerbated for the N-2 condition of the transformer at Wingerworth being on arranged outage followed by a fault on either Grassmoor infeed.
- The 33 kV circuit from Chesterfield BSP to Grassmoor primary main 1 is projected to overload for an N-2 constraint of an arranged outage on an infeed to Wingerworth followed by a fault on the circuit to Grassmoor main 2 by 2028. By 2034 both circuits also overload for N-1 outages on either circuit.
- Overloads are observed on T1 and T2 at Walton primary for an arranged or fault outage on either transformer or 33 kV infeed circuit by 2034. In 2028 an N-2 constraint is also seen for an arranged outage on the infeed to Wingerworth followed by a fault on either Walton infeed.
- The Goitside to Walton main 1 33 kV circuit overloads in 2034 for an N-2 outage condition (an arranged outage on the infeed to Eyam from Buxton followed by a fault on the Goitside to Walton main 2 33 kV circuit).
- The Goitside to Walton main 2 33 kV circuit overloads in 2034 for an arranged or fault outage on the 33 kV circuit from Goitside to Walton main 1.
- Overloads are seen on both transformers at Goitside primary for arranged or fault outages on the other infeed or transformer in 2034.
- The demand at Wingerworth primary is projected to exceed the 11 kV backfeed capacity of the site by 2034.
- Overloads are seen on both transformers at Eyam primary for arranged or fault outages on the other infeed or transformer in 2034.
- The GTs at Chesterfield BSP are projected to be overloaded in 2034 for an N-2 outage condition (an arranged outage at Goitside followed by a fault on either Chesterfield GT).
- The GTs at Goitside BSP are projected to be overloaded in 2034 for an N-2 outage condition (an arranged outage at Chesterfield followed by a fault on either Goitside GT).

2.2 Grassmoor 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
Grassmoor primary transformer overloads	Arranged or fault outage on the other infeed or transformer	None	2034	2028	2034	2034
Grassmoor primary transformer overloads	Arranged outage on the transformer at Wingerworth primary	Fault on either 33 kV circuit to Grassmoor	2034	Baseline	2028	2034

Uncertainty under other Distribution Future Energy Scenarios: Overloads are observed on both transformers for N-1 outage conditions for every scenario by 2034. Under the Leading the Way and Consumer Transformation scenarios overloads are observed in additional 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 at Grassmoor to 20/40 MVA units.
2	Install a second transformer at Wingerworth primary.
Operational Mitigation	
3	Various operational mitigations.
Flexibility Services	
4	Procure flexibility under Grassmoor 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 at Grassmoor to 20/40 MVA units

Viable

Capacity released for constraint(s) considered: Minimal until circuit works are complete

New limiting factor for constraint(s) considered: Chesterfield to Grassmoor 33 kV circuits

Detailed description: Uprating both transformers at Grassmoor primary to 20/40 MVA units would resolve this constraint. Significant capacity would not be released unless the constraints on the 33 kV infeed circuits are also resolved (as discussed in Section 2.3 of this report).

Option 2 – Install a second transformer at Wingerworth primary

Viable

Capacity released for constraint(s) considered: A portion of the demand of Wingerworth primary

New limiting factor for constraint(s) considered: Transformer ratings for N-1 outages

Detailed description: Installing a second transformer at Wingerworth primary (such that demand does not need to be backfed at 11 kV from Grassmoor for outages) would resolve the N-2 constraint seen on the transformers at Grassmoor. This reinforcement would also resolve a number of other constraints as discussed in Section 2.4, Section 2.6 and Section 2.8 of this report (and depending on where Wingerworth was then fed from, would have implications for the loadings seen at Chesterfield and Goitside BSPs as discussed in Section 2.10 and Section 2.11 respectively). This option alone is insufficient to fully alleviate this constraint as by 2028 N-1 constraints are also forecast to occur.

Option 3 – Various operational mitigations

Viable

Capacity released for constraint(s) considered: Dependent on mitigation

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

Detailed description: There are a number of operational mitigations which have been considered, some of which could defer this constraint:

- As this constraint is only present under N-2 outages in the baseline for intermediate cool, restricting outage seasons could be used to alleviate this constraint. This option alone would not be a long term solution as by 2028 overloads are observed for N-1 constraints and by 2034 constraints are observed in all seasons. Another disadvantage of this solution is that it reduces network operability.
- Overloads during N-1 outage conditions 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, but could be utilised alongside the restriction of outage seasons as discussed above.
- Splitting Grassmoor primary during outages where Wingerworth primary is backfed at 11 kV would alleviate the N-2 constraints observed, but as with the two options described above would not be an enduring solution. This option also reduces security of supply.

Option 4 – Procure flexibility under Grassmoor 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 Grassmoor primary. This could be carried out alongside the operational mitigations discussed in option 3 above. This flexibility may overlap with any flexibility procured to manage the constraints identified on the 33 kV circuits between Chesterfield and Grassmoor discussed in Section 2.3 of this report. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

The reinforcement of Wingerworth primary and a number of operational mitigations could help manage this constraint in the short term, but by 2034 as overloads are observed for N-1 constraints in all seasons a more enduring and strategic solution will be required. The optimal reinforcement solution identified is to uprate both transformers at Grassmoor primary to 20/40 MVA units (the highest rating of primary transformer utilised as standard by NGED). Any solution to this constraint will need to be carried out alongside intervention to resolve the circuit constraint discussed in Section 2.3 of this report.

2.3 Chesterfield to Grassmoor 33 kV circuit overloads

Constraint Overview

Generation **Demand**

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

Table 2.3.1 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
Chesterfield to Grassmoor main 1 33 kV circuit overload	Arranged outage on the infeed to Wingerworth primary	Fault on the 33 kV circuit to Grassmoor main 2	2034	2028	2034	2034
Chesterfield to Grassmoor main 1 33 kV circuit overload	Arranged our fault outage on the 33 kV circuit to Grassmoor main 2	None	2034	2034	2034	-

Uncertainty under other Distribution Future Energy Scenarios: This constraint is exacerbated most significantly under the Leading the Way and Consumer Transformation scenarios (with constraints also being observed in other seasons for N-2 outages in 2028 and for N-1 outages in summer in 2034). Overloads are observed for some outage combinations and seasons in all scenarios 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)

Reinforcement	
1	Uprate the existing 33 kV circuits to Grassmoor primary.
2	Build two new 33 kV circuits to Grassmoor primary.
Operational Mitigation	
3	Transfer Danesmoor primary to Alfreton BSP.
Flexibility Services	
4	Procure flexibility under Grassmoor, Danesmoor and Biwater 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 existing 33 kV circuits to Grassmoor primary

Viable

Capacity released for constraint(s) considered: Dependent on sections uprated

New limiting factor for constraint(s) considered: Other sections of the existing 33 kV circuits

Detailed description: Uprating the existing 33 kV circuits would alleviate this constraint, however uprating the full circuits would not be economical given the similar cost to installing new 33 kV circuits as discussed in option 2 below (which confers additional network benefits). Some sections of 33 kV circuit could however be uprated at a lower cost to add some capacity (there is less than 50 m of 38 MVA rated cable across both circuits that is currently the limiting factor, which if uprated would release 4 MVA of capacity).

While this would not provide a permanent solution to the constraint it could defer the need for or be utilised alongside the other options discussed below.

Option 2 – Build two new 33 kV circuits to Grassmoor primary

Viable

Capacity released for constraint(s) considered: The demand of Grassmoor primary

New limiting factor for constraint(s) considered: Existing 33 kV circuit ratings

Detailed description: If two new 33 kV circuits were built from Chesterfield BSP to Grassmoor primary the new circuits could feed Grassmoor primary alone initially, and the existing circuits would continue to feed Biwater and Danesmoor. This solution would not only free up significant circuit capacity for all three primaries mentioned above; it would also increase operability and reduce network complexity. Another benefit of this option is that it would allow Wingerworth primary to be transferred onto these new circuits as well. This could facilitate feeding a second transformer at Wingerworth (as discussed as an option in Section 2.8 of this report).

This transfer would also have implications for one of the 33 kV circuits to Walton, and for the GTs at both Chesterfield and Goitside (as demand would be shifted between the two BSPs) as discussed in Section 2.6, Section 2.10 and Section 2.11 of this report respectively. Overall this solution provides significant additional benefits compared with option 1, but one disadvantage is that it does use up two extra 33 kV circuit breakers at Chesterfield BSP.

Option 3 – Transfer Danesmoor primary to Alfreton BSP

Discounted

Capacity released for constraint(s) considered: The demand of Danesmoor primary

New limiting factor for constraint(s) considered: Circuit complexity

Detailed description: Transferring Danesmoor into Alfreton BSP would reduce the loading on the Chesterfield to Grassmoor 33 kV circuits and help mitigate this constraint. This option has been discounted as it would increase complexity on the Alfreton – Wessington – Ambergate – Ravensdale Park 33 kV circuits by adding an address, creating a breach of Engineering Recommendation P18. There are also thermal and voltage constraints on these circuits already (as discussed in the Alfreton 33 kV report) which would only be exacerbated by the addition of Danesmoor.

Option 4 – Procure flexibility under Grassmoor, Danesmoor and Biwater 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 Chesterfield BSP and Grassmoor primary. This flexibility may overlap with any flexibility procured to manage the constraints identified on the transformers at Grassmoor primary discussed 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 long term reinforcement solution for the constraint on the 33 kV Chesterfield to Grassmoor circuits is to build two additional circuits which will then feed Grassmoor (and possibly pick up Wingerworth as well at some point). This reinforcement could be deferred by reinforcing sections of the existing circuits, but uprating them fully would not be economical.

2.4 Walton 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
Walton TB overload	Arranged or fault outage on Walton TA	None	-	2034	2034	-
Walton TB overload	Arranged outage on the transformer at Wingerworth primary	Fault on TA at Walton primary	2034	2028	2034	2034
Walton TA overload	Arranged outage on the transformer at Wingerworth primary	Fault on TB at Walton primary	-	2034	2034	2034

Uncertainty under other Distribution Future Energy Scenarios: Under the two higher growth scenarios (Leading the Way and Consumer Transformation) overloads are seen in additional seasons, on TA and for N-1 outages earlier than under Best View. Under System Transformation and Falling Short no overloads are seen even in 2034. There are no scenarios under which the proposed new transformer ratings are exceeded by 2050.

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 transformers at Walton primary.
2	Install a second transformer at Wingerworth primary.
Operational Mitigation	
3	Various operational mitigations.
Flexibility Services	
4	Procure flexibility under Walton 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 Walton primary

Viable

Capacity released for constraint(s) considered: Minimal unless circuit constraints are also resolved

New limiting factor for constraint(s) considered: Goitside to Walton 33 kV circuits

Detailed description: Uprating both transformers at Walton to 12/24 MVA units would resolve this constraint and provide sufficient headroom for growth out to 2050. 20/40 MVA units could be considered if demand grows faster than expected (or an economic opportunity to transfer load from another primary is identified) but to free up the extra capacity circuit works would be required.

Option 2 – Install a second transformer at Wingerworth primary

Viable

Capacity released for constraint(s) considered: A portion of the demand of Wingerworth primary

New limiting factor for constraint(s) considered: Transformer ratings for N-1 outages

Detailed description: Installing a second transformer at Wingerworth primary (such that demand does not need to be backfed at 11 kV to Walton for outages) would resolve the N-2 constraint seen on the transformers at Walton. This reinforcement would also resolve a number of other constraints as discussed in Section 2.2, Section 2.6 and Section 2.8 of this report (and depending on where Wingerworth was then fed from would have implications for the loadings seen at Chesterfield and Goitside BSPs as discussed in Section 2.10 and Section 2.11 respectively). This option alone is insufficient to fully alleviate this constraint as by 2034 N-1 constraints are also forecast to occur.

Option 3 – Various operational mitigations

Viable

Capacity released for constraint(s) considered: Dependent on mitigation

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

Detailed description: There are a number of operational mitigations which have been considered, some of which could defer this constraint:

- As this constraint is only present under N-2 outages in 2028 for intermediate cool, restricting outage seasons could be used to alleviate this constraint. This option alone would not be a long term solution as by 2034 overloads are observed for N-1 constraints and N-2 constraints are observed in all seasons. Another disadvantage of this solution is that it reduces network operability.
- Overloads during N-1 outage conditions are only seen in 2034 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, but could be utilised alongside the restriction of outage seasons as discussed above.
- The configuration of the 11 kV network supplied from Walton primary is such that splitting the network during outages which cause Wingerworth to be backfed to Walton may not be possible (without first carrying out reinforcement at 11 kV).

Option 4 – Procure flexibility under Walton 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 Walton primary. This could be carried out alongside the operational mitigations discussed in option 3 above. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

The reinforcement of Wingerworth primary and a number of operational mitigations could help manage this constraint in the short term. In the long term the optimal reinforcement solution identified is to uprate both transformers to 12/24 MVA units (20/40 MVA units would not be required based on the current forecasts). Any solution to this constraint will need to be considered in conjunction with the intervention chosen to resolve the circuit constraints discussed in Section 2.5 and Section 2.6 of this report. The 11 kV network downstream of Walton primary would also need developing to accommodate this additional demand and allow new 12/24 MVA transformers to be fully utilised.

2.5 Goitside to Walton Main 1 33 kV circuit overload

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
Goitside to Walton main 1 33 kV circuit overload	Arranged outage on the 33 kV circuit from Buxton to Eyam or on Eyam TB	Fault on the 33 kV circuit to Walton main 2	2034	2034	2034	-

Uncertainty under other Distribution Future Energy Scenarios: This constraint is exacerbated most significantly under the Leading the Way and Consumer Transformation scenarios. However, there are no scenarios under which the demand of Walton alone exceeds the rating of this circuit. Intervention is not triggered in 2034 under either of 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 2.5.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Uprate the 33 kV circuit from Goitside to Walton main 1.
2	Install a new 33 kV circuit from Goitside to Walton.
3	Transfer Robin Hood and Eyam TA into Buxton BSP.
Operational Mitigation	
4	Restrict outage seasons.
Flexibility Services	
5	Procure flexibility under Walton, Robin Hood and Eyam 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 from Goitside to Walton main 1

Discounted

Capacity released for constraint(s) considered: Dependent on growth at Eyam and Robin Hood primaries

New limiting factor for constraint(s) considered: Growth at Walton still limited by primary transformer ratings

Detailed description: Uprating this circuit would resolve this constraint and prevent the projected thermal overloads. This would require uprating most of the cable which makes up the circuit (around 3 km in total).

Given the similar cost of this option to installing a new 33 kV circuit as in option 2 (which confers additional network benefits) this solution has been discounted.

Option 2 – Install a new 33 kV circuit from Goitside to Walton

Viable

Capacity released for constraint(s) considered: The demand of Robin Hood primary and Eyam TA

New limiting factor for constraint(s) considered: Ratings of the existing 33 kV circuit and the transformers at Walton

Detailed description: Installing a new 33 kV circuit from Goitside to Walton would allow Robin Hood and Eyam primaries to be unstitched from Walton. This would free up significant circuit capacity and has the added benefits of increasing network operability (but requires an additional 33 kV circuit breaker at Goitside BSP). If a new circuit to Walton were selected as the optimal solution for the constraint on the other circuit described in Section 2.6 of this report, then there is additional benefit from installing the two cables together (reducing the total expenditure and resources required).

Option 3 – Transfer Robin Hood and Eyam TA into Buxton BSP

Discounted

Capacity released for constraint(s) considered: The demand of Robin Hood primary and Eyam TA

New limiting factor for constraint(s) considered: Ratings of the existing 33 kV circuit and the transformers at Walton

Detailed description: Transferring Robin Hood and Eyam TA out of Goitside would be dependent on sufficient capacity being available at Buxton BSP. The capacity at and any current or future constraints affecting Buxton BSP are managed by ENWL (so engagement would be required to determine the feasibility of this option). This option would also necessitate a second circuit being built from Buxton to Eyam. This would require around 17 km of circuit works, making it significantly more expensive than the options discussed above involving reinforcing the network between Goitside and Walton. This option has therefore been discounted, but if demand growth at Eyam is high enough it could trigger the installation of a new circuit which would make this option viable.

Option 4 – Restrict outage seasons

Viable

Capacity released for constraint(s) considered: The demand of Eyam TB

New limiting factor for constraint(s) considered: Circuit capacity for N-1 constraints

Detailed description: As this constraint is only present under N-2 outages in 2034 for three seasons, restricting outage seasons to summer could be used to alleviate this constraint. This solution could be sufficient to manage this constraint in 2034 but likely wouldn't be an enduring solution. One disadvantage of this solution is that it reduces network operability.

Option 5 – Procure flexibility under Walton, Robin Hood and Eyam 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 circuit from Goitside to Walton main 1. This could be carried out alongside the restriction of outage seasons as discussed in option 4 above. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

This constraint may be manageable in 2034 by restricting outage seasons as it is only present for N-2 outages. In the longer term the optimal reinforcement strategy identified is to install a new 33 kV circuit from Goitside to Walton (to allow Robin Hood and Eyam to be unstitched from Walton).

2.6 Goitside to Walton Main 2 33 kV circuit overload

Constraint Overview

Generation Demand

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

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
Goitside to Walton main 1 33 kV circuit overload	Arranged or fault outage on the Goitside to Walton main 2 33 kV circuit	None	2034	2034	2034	-

Uncertainty under other Distribution Future Energy Scenarios: This constraint is exacerbated most significantly under the Leading the Way and Consumer Transformation scenarios. However, as with the constraint on the other Goitside-Walton 33 kV circuit discussed in Section 2.5 of this report there are no scenarios under which the demand of Walton alone exceeds the rating of this circuit. Intervention is not triggered in 2034 under either of 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 2.6.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Uprate the 33 kV circuit from Goitside to Walton main 2.
2	Install a new 33 kV circuit from Goitside to Walton.
3	Transfer Wingerworth into Chesterfield BSP.
Flexibility Services	
4	Procure flexibility under Walton and Wingerworth 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 from Goitside to Walton main 2

Viable

Capacity released for constraint(s) considered: Minimal unless transformer constraints are also resolved

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

Detailed description: Uprating this circuit would resolve this constraint and prevent the projected thermal overloads. Only around 20 m of cable would need to be uprated to increase the capacity of this circuit by 5 MVA. While uprating only this section of the circuit alone may not be sufficient to fully alleviate this constraint in the long term, it could be used to defer, or alongside one of the other options discussed below. Uprating this existing circuit further would require significantly more circuit works.

Option 2 – Install a new 33 kV circuit from Goitside to Walton

Viable

Capacity released for constraint(s) considered: The demand of Wingerworth primary

New limiting factor for constraint(s) considered: Ratings of the existing 33 kV circuit and the transformers at Walton

Detailed description: Installing a new 33 kV circuit from Goitside to Walton would allow Wingerworth primary to be unstitched from Walton. This would free up significant circuit capacity and would require an additional 33 kV circuit breaker at Goitside. As discussed in Section 2.5 of this report two cables could be laid together from Goitside to Walton. This reinforcement would become largely redundant if Wingerworth were transferred into Chesterfield as discussed in option 3 below.

Option 3 – Transfer Wingerworth into Chesterfield BSP

Viable

Capacity released for constraint(s) considered: The demand of Wingerworth primary

New limiting factor for constraint(s) considered: Ratings of the existing 33 kV circuit and the transformers at Walton

Detailed description: Transferring Wingerworth primary into Chesterfield BSP via Grassmoor would resolve this constraint. This transfer would require new 33 kV circuits from Chesterfield to Grassmoor to be built (as discussed as an option in Section 2.3 of this report). This transfer would reduce the demand at Goitside BSP and increase the demand at Chesterfield BSP (impacting the GT constraints discussed in Section 2.10 and Section 2.11). A new 33 kV circuit from Grassmoor to Wingerworth could also supply a second transformer at Wingerworth, resolving the 11 kV backfeed restriction projected in Section 2.8.

Option 4 – Procure flexibility under Walton and Wingerworth 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 circuit from Goitside to Walton main 2. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

The optimal reinforcement solution to this constraint will be determined by the synergies with the constraints described in Section 2.5 and Section 2.3 of this report (as laying a new cable from Goitside to Walton would provide an economic opportunity to keep Wingerworth fed from Walton, whereas the reinforcement of the Chesterfield – Grassmoor network would provide an opportunity to transfer Wingerworth into Chesterfield). Uprating sections of the existing circuit could alleviate this constraint in the short term but is not an economical long term solution.

2.7 Goitside primary transformer overloads

Constraint Overview

Generation Demand

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

Table 2.7.1 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
Goitside primary transformer overloads	Arranged or fault outage on the other infeed or transformer	None	-	2034	-	-

Uncertainty under other Distribution Future Energy Scenarios: This constraint is also triggered in other seasons in 2034 under both of the higher growth scenarios (Leading the Way and Consumer Transformation). Overloads are not observed in any season in 2034 under the System Transformation and Falling Short scenarios.

Solution Options

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

Table 2.7.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Uprate the transformers to 33/6.6 kV 20/40 MVA units.
2	Install a third 33/6.6 kV transformer at Goitside primary.
Flexibility Services	
3	Procure flexibility under Goitside 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 to 20/40 MVA units

Viable

Capacity released for constraint(s) considered: 10 MVA released by uprating the transformers alone and a further 5 MVA released by uprating the 33 kV cables within Goitside

New limiting factor for constraint(s) considered: 33 kV cables within Goitside substation initially and then the new transformer ratings

Detailed description: Uprating both transformers at Goitside primary to 20/40 MVA would resolve this constraint. The primary is currently a 33/6.6 kV site, and would need converting to a 33/11 kV site in order to utilise the capacity of the 20/40 MVA transformers. This is because the highest rated switchgear used as standard on the network (2000 A) only provides 23 MVA of capacity when run at 6.6 kV. The 6.6 kV network supplied by Goitside primary would also all need converting to 11 kV.

Uprating the 6.6 kV network fed from Goitside primary would have significant implications for the other 33/6.6 kV site in the area (Sheffield Road). The two sites are heavily interconnected at 6.6 kV, so Sheffield Road's 6.6 kV network would be left mostly islanded (except for a single 6.6 kV circuit to Sheepbridge primary) unless a large number of 11/6.6 kV transformers were installed. Uprating the 6.6 kV Goitside network may therefore trigger doing the same for Sheffield Road.

Sheffield Road already has two 33/11 kV transformers which may be sufficient to sustain the site in the short to medium term (removing the 33/6.6 kV transformers would not reduce the capacity of the site by much as the 33 kV circuits to the primary currently limit the site). In the long term the 33/11 kV transformers and 33 kV infeeds could then be uprated as required. The small section of 6.6 kV network fed from Sheepbridge primary would also need uprating to 11 kV as well. The implications of converting 6.6 kV network to 11 kV are discussed in more detail in the NDP Introduction and Methodology.

To release the full capacity of the new transformers, a small amount of 33 kV cable would also need to be uprated (within the substation itself). While this would not need to be carried out at the same time as uprating the transformers, it could be done if deemed optimal to reduce the additional outages and resources required to carry out two separate projects.

Option 2 – Install a third 33/6.6 kV transformer at Goitside primary

Discounted

Capacity released for constraint(s) considered: None

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

Detailed description: Installing a third 33/6.6 kV transformer at Goitside would not materially increase the site's capacity as there are only two 33 kV busbars at Goitside, so two transformers would need to be fed from a single busbar at Goitside (which would both be lost for a busbar outage). If a third GT were required at Goitside BSP (which is discussed as an option in Section 2.11 of this report) then this option could potentially become viable.

Even with a third busbar to connect to, this solution would not facilitate converting the Goitside 6.6 kV network to 11 kV as option 1 does. Creating a three transformer primary would also add network operability complexity (such as needing to split the 6.6 kV network for an arranged outage on any transformer). This option has been discounted.

Option 3 – Procure flexibility under Goitside 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 33/6.6 kV transformers at Goitside primary. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

The only economically and technically viable reinforcement strategy to resolve the projected constraint on the 33/6.6 kV transformers at Goitside is to uprate both to 20/40 MVA units. This would also trigger upgrading the Goitside 6.6 kV network to 11 kV, which would in turn impact the surrounding 6.6 kV network as discussed above.

2.8 Wingerworth primary 11 kV backfeed overloads

Constraint Overview

Generation Demand

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

Table 2.8.1 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
Insufficient 11 kV backfeed capacity to Wingerworth	Outage on the primary transformer at Wingerworth	None	2034	2034	-	-

Uncertainty under other Distribution Future Energy Scenarios: Even under the higher growth scenarios (Leading the Way and Consumer Transformation) the 11 kV backfeed capacity is not exceeded by 2028. Under the System Transformation and Falling Short scenarios intervention is not triggered in 2034 (as the 11 kV backfeed capacity is not exceeded in any season).

Solution Options

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

Table 2.8.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Install a second transformer and a 33 kV circuit from Walton to Wingerworth.
2	Install a second transformer and a 33 kV circuit from Grassmoor to Wingerworth.
3	Upgrade the 11 kV backfeeds to Wingerworth.
Flexibility Services	
4	Procure flexibility under Wingerworth 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 – Install a second transformer and a 33 kV circuit from Walton to Wingerworth

Viable

Capacity released for constraint(s) considered: 14 MVA

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

Detailed description: A second transformer at Wingerworth would mean that the site would not need to be backfed on the 11 kV network to maintain supply for N-1 outages. The constraint on the 11 kV backfeeds to the primary would therefore be resolved. This new transformer could be fed from Goitside via Walton primary.

To facilitate this a new circuit would need to be built between Walton and Wingerworth. This would require around 5 km of circuit works, subject to detailed route investigation and land rights. It would also require a new 33 kV circuit between Goitside BSP and Walton primary, and a new 33 kV circuit breaker at Goitside BSP (which is discussed as an option Section 2.5 and Section 2.6 of this report), in order to avoid becoming non-compliant with Engineering Recommendation P18 on the 33 kV network.

Option 2 – Install a second transformer and a 33 kV circuit from Grassmoor to Wingerworth

Viable

Capacity released for constraint(s) considered: 14 MVA

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

Detailed description: As in option 1 a second transformer could be added to Wingerworth primary to resolve this constraint. In this option the site would be transferred into Chesterfield BSP by building a second 33 kV circuit from Grassmoor to Wingerworth. This would require around 4 km of circuit works (assuming the new circuit approximately followed the path of the existing circuit). It would also require upgrades to the 33 kV network between Chesterfield and Grassmoor (which is discussed in Section 2.3 of this report).

This option would reduce the demand on Goitside BSP and increase the demand on Chesterfield BSP (impacting the GT constraints at both BSPs described in Section 2.10 and Section 2.11 of this report).

Option 3 – Upgrade the 11 kV backfeeds to Wingerworth

Viable

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

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

Detailed description: Enhancing the 11 kV backfeeds between Wingerworth and the surrounding primaries could be used to increase the firm capacity of the site and manage this constraint. The viability and costs associated with this option will need to be assessed as part of a full 11 kV study. It is likely that if this option is viable it will not provide sufficient capacity to be a long term solution. Needing to backfeed additional demand to Grassmoor and Walton primaries would also exacerbate the constraints described in Section 2.2 and Section 2.4 of this report.

Option 4 – Procure flexibility under Wingerworth 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 11 kV backfeeds to Wingerworth primary. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

While there could potentially be scope to upgrade the 11 kV backfeeds at Wingerworth, this would not provide a long term solution to this constraint. A second transformer will therefore need to be installed at the site, which could be fed from either Goitside or Chesterfield (with the advantages and disadvantages of each being discussed above).

As with the constraint described in Section 2.6 of this report, the solution to this constraint will need to be considered in conjunction with the development of the Chesterfield – Grassmoor and Goitside – Walton 33 kV networks, as well as the demands at Goitside and Chesterfield BSPs (due to the implications of where Wingerworth is fed from on the GT constraints described in Section 2.10 and Section 2.11).

2.9 Eyam primary transformer overloads

Constraint Overview

Generation Demand

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

Table 2.9.1 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
Eyam primary transformer overloads	Arranged or fault outage on the other infeed or transformer	None	2034	2034	2034	2034

Uncertainty under other Distribution Future Energy Scenarios: This constraint is exacerbated most significantly under the Leading the Way and Consumer Transformation scenarios. Falling Short is the only scenario under which intervention is not required by 2034.

Solution Options

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

Table 2.9.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Uprate both transformers at Eyam to 12/24 MVA units.
2	Uprate both transformers at Eyam to 20/40 MVA units.
Flexibility Services	
3	Procure flexibility under Eyam 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 Eyam to 12/24 MVA units

Viable

Capacity released for constraint(s) considered: 11 MVA

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

Detailed description: Uprating both 33/11 kV transformers at Eyam to 12/24 MVA units would resolve this constraint in the short and medium term, but may not provide sufficient capacity alone for the forecast demand out to 2050.

Option 2 – Uprate both transformers at Eyam to 20/40 MVA units

Viable

Capacity released for constraint(s) considered: 12 MVA

New limiting factor for constraint(s) considered: Buxton to Eyam 33 kV circuit

Detailed description: Uprating both 33/11 kV transformers at Eyam to 20/40 MVA units would resolve this constraint but would not free up significantly more capacity than the 12/24 MVA units as the 33 kV circuits to the primary would still be a limiting factor. To free up additional capacity the existing 33 kV circuits to the primary would need to be uprated (or new circuits built). This option therefore requires significantly more expenditure than option 1.

If new circuits were built this could facilitate the transfer of Eyam TA and Robin Hood into Buxton (dependent on capacity being available at Buxton) as discussed as an option in Section 2.5 of this report to manage the constraint on one of the Goitside to Walton 33 kV circuits. It would also reduce demand at Goitside BSP, reducing the GT constraint discussed in Section 2.11.

Option 3 – Establish a new single transformer primary at Tideswell

Viable

Capacity released for constraint(s) considered: 12 MVA

New limiting factor for constraint(s) considered: Buxton to Eyam 33 kV circuit

Detailed description: A new primary substation could be built at Tideswell (which is around 9 km along the 33 kV circuit from Buxton to Eyam). This new primary would initially be built with a single 33/11 kV transformer fed from this circuit, and would be used to deload Eyam and alleviate this constraint. A primary substation at this location would also provide significant benefit to the 11 kV network, which is currently constrained on voltage (with some existing 11 kV circuits from Eyam being around 17 km in length).

The new limiting factor for the two primaries would become the existing Buxton to Eyam 33 kV circuit, which would not feed both primaries for an outage on the infeed to Eyam from Goitside. The possibility of adding a second transformer at Tideswell could then be explored if future capacity is required. This would require less 33 kV circuit works than taking a new circuit (or reinforcing the existing circuits) to Eyam. This option could be progressed alongside option 1 if required, but the load growth projected in the area is not high enough to justify a new primary at Tideswell as well as 20/40 MVA transformers at Eyam as suggested in option 2.

Option 4 – Procure flexibility under Eyam 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 33/11 kV transformers at Eyam primary. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

Uprating the transformers at Eyam would free up significant capacity at the site. The decision on the size required for these transformers would be dependent on how the demand at the site evolves (which will be continually reassessed in future DFES publications and NDP reports). To fully unlock the capacity of the 20/40 MVA units 33 kV circuit works would also be required.

Another option considered to increase capacity in the area is a new primary substation at Tideswell to deload Eyam. As discussed above, this would also resolve constraints on the 11 kV network. The decision on whether to reinforce Eyam or build a new substation at Tideswell will be dependent on the development of the 11 kV network, as well as where future load growth in the area materialises.

2.10 Chesterfield Grid Transformer overloads

Constraint Overview

Generation **Demand**

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

Table 2.10.1 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
Chesterfield GT overloads	Goitside 33 kV main 2 busbar arranged outage	Fault on either GT at Chesterfield BSP	-	2034	-	-

Uncertainty under other Distribution Future Energy Scenarios: Under the higher growth scenarios (Leading the Way and Consumer Transformation) overloads are observed in other seasons. In these scenarios overloads are also seen for N-1 faults which cannot be managed operationally. Under the lower growth scenarios (System Transformation and Falling Short) no intervention is required by 2034.

Solution Options

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

Table 2.10.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Install a third GT at Chesterfield BSP.
2	Establish a second Chesterfield BSP.
Operational Mitigation	
3	Restrict outage seasons.
4	Review seasonal ratings.
5	Transfer demand out of Chesterfield BSP.
Flexibility Services	
6	Procure flexibility under Chesterfield 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 – Install a third GT at Chesterfield BSP

Viable

Capacity released for constraint(s) considered: Up to 114 MVA

New limiting factor for constraint(s) considered: GT ratings for N-2 outages

Detailed description: Installing a third GT (and associated 33 kV busbar) at Chesterfield BSP would add significant capacity to the site and resolve this constraint. The exact capacity freed up would be dependent on the load balance between the 33 kV busbars (as this will determine how the site can be split during arranged outages on one of the GTs).

Studies have shown that installing a third GT at Chesterfield BSP would create fault level constraints for certain running arrangements. To allow a third GT to be installed at Chesterfield the existing GTs would need to be replaced with higher impedance units.

If the GTs at Chesterfield can be successfully redeployed elsewhere on the network this option is economically preferable to establishing a whole new BSP as discussed as an option below. Adding this capacity to Chesterfield could also create opportunities to deload other BSPs which the site is interconnected with (most notably Goitside BSP which is also projected to have a constraint on its GTs by 2034 as discussed in Section 2.11 of this report).

Option 2 – Establish a second Chesterfield BSP

Viable

Capacity released for constraint(s) considered: Up to 114 MVA

New limiting factor for constraint(s) considered: The GTs at either the existing or the new Chesterfield BSP (depending on which primaries are transferred over)

Detailed description: By establishing a second BSP at Chesterfield some of the primaries fed from the existing BSP could be transferred over to free up capacity. This option is technically feasible, although if required in the near future there would not be 132 kV bays available for the new BSP (so it would need to be teed off the circuits to an existing BSP which could create a demand group with N-2 restoration requirements).

This option carries many of the same benefits as option 1 (resolving the constraint and freeing up capacity to deload other BSPs if required). This option would be more expensive than adding a third GT to the existing Chesterfield BSP, but could also be used to support Goitside BSP (which is also constrained as described in Section 2.11 of this report).

Option 3 – Restrict outage seasons

Viable

Capacity released for constraint(s) considered: The demand of Wingerworth primary

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

Detailed description: As this constraint is only present under N-2 outages in 2034 for intermediate cool, restricting outage seasons could be used to alleviate this constraint. The viability of this strategy will be dependent on the solution progressed for the reinforcement of Wingerworth primary (as discussed in Section 2.8 of this report). One disadvantage of this solution is that it reduces network operability.

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 2034 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.

Option 5 – Transfer demand out of Chesterfield BSP

Discounted

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

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

Detailed description: Chesterfield is interconnected with a number of other BSPs, all of which have been considered as possible candidates for load transfers to alleviate this constraint.

Most of these transfers have been deemed non-viable as discussed below:

- Danesmoor primary could not be transferred into Alfreton BSP for two reasons as noted in Section 2.3 of this report; it would increase complexity on the Alfreton – Wessington – Ambergate – Ravensdale Park 33 kV circuits by adding an address, creating a breach of Engineering Recommendation P18 and it would exacerbate thermal and voltage constraints discussed in the Alfreton 33 kV report.
- Bolsover primary could not be transferred to Whitwell due to both the feeder distances involved and the ratings of the 33 kV circuits from Whitwell not being high enough to accept Bolsover on a permanent basis.
- As there is only one 33 kV circuit from Goitside to Sheepbridge it could not be transferred without compromising security of supply for the primary. Transfers to Goitside would also exacerbate the GT constraint there (outlined in Section 2.11 of this report).
- Transferring Robert Hyde primary into Goitside under normal running arrangements would reduce demand at Chesterfield but is not sufficient alone to fully manage this constraint (and would reduce security of supply if the primary were left in Goitside for arranged busbar outages).

Option 6 – Procure flexibility under Chesterfield 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 Chesterfield BSP. This could be carried out alongside the operational mitigations discussed in options 3 and 4 above. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

The restriction of outage seasons and/or the review of seasonal transformer ratings could be sufficient to manage this constraint in 2034 (as it is only present for N-2 outages in intermediate cool) but neither operational mitigations are long term solutions. Of the two enduring reinforcement solutions considered installing a third GT is the significantly cheaper option (but requires the replacement of the existing GTs due to fault levels at the site).

2.11 Goitside Grid Transformer overloads

Constraint Overview

Generation Demand

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

Table 2.11.1 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
Goitside GT overloads	Arranged outage on either 33 kV busbar at Chesterfield	Fault on either GT at Goitside BSP	-	2034	-	-

Uncertainty under other Distribution Future Energy Scenarios: Under the higher growth scenarios (Leading the Way and Consumer Transformation) overloads are observed in other seasons. In these scenarios overloads are also seen for N-1 faults which cannot be managed operationally. Under the lower growth scenarios (System Transformation and Falling Short) no intervention is required by 2034.

Solution Options

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

Table 2.11.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Install a third GT at Goitside BSP.
2	Establish a new BSP.
Operational Mitigation	
3	Restrict outage seasons.
4	Review seasonal ratings.
5	Transfer demand out of Goitside BSP.
Flexibility Services	
6	Procure flexibility under Goitside 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 – Install a third GT at Goitside BSP

Viable

Capacity released for constraint(s) considered: 52 MVA

New limiting factor for constraint(s) considered: 132 kV circuit capacity

Detailed description: Installing a third GT (and the required associated 33 kV switchgear to be able to fully utilise it) at Goitside BSP would add significant capacity to the site and resolve this constraint. The new limiting factor would become the capacity of the 132 kV circuits between Chesterfield GSP and Goitside BSP (unless a third 132 kV circuit was built). Due to space limitations at Goitside BSP it may not be possible to create a 132 kV cross-bay (in which case a third 132 kV circuit would be required to supply the new GT). A new 132 kV circuit to Goitside BSP would be quite costly, but would provide long term capacity for the area (both circuit capacity and N-2 restoration capacity).

If a third GT at Goitside BSP were required before intervention is triggered on the GTs at Chesterfield BSP, then demand could be shifted into Goitside to utilise the new capacity created and defer the constraint at Chesterfield. For example, Robert Hyde primary could be transferred into Goitside under normal running arrangements (which is discussed as an option in Section 2.10 of this report).

Option 2 – Establish a new BSP

Viable

Capacity released for constraint(s) considered: Up to 114 MVA

New limiting factor for constraint(s) considered: 33 kV transfer capacity

Detailed description: One other option for adding significant capacity to the area is building a new BSP. While this option is likely to be significantly more expensive than reinforcing the existing sites, it could provide an opportunity to deload both Goitside and Chesterfield BSPs (the constraint as Chesterfield BSP is highlighted in Section 2.10 above). This option would be subject to a suitable site being located, with the location of any new BSP determining how easily load could then be transferred over from Goitside.

Option 3 – Restrict outage seasons

Viable

Capacity released for constraint(s) considered: The demand of Robert Hyde primary

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

Detailed description: As this constraint is only present under N-2 outages in 2034 for intermediate cool, restricting outage seasons could be used to alleviate this constraint. One disadvantage of this solution is that it reduces network operability. Another option could be to not transfer Robert Hyde primary into Goitside for arranged outages at Chesterfield BSP (this would however reduce security of supply). Alternatively, Wingerworth primary could be transferred into Chesterfield while Robert Hyde primary is in Goitside. This could happen on a more permanent basis as discussed as an option in Section 2.6 and Section 2.8 of this report (and in option 4 below), but could exacerbate the constraints on the Chesterfield to Grassmoor circuits described in Section 2.3 of this report.

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 2034 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.

Option 5 – Transfer demand out of Goitside BSP

Viable

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

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

Detailed description: Transfers out of Goitside will be dependent on capacity being available at the two BSPs it is interconnected with (Buxton and Chesterfield):

- Transferring Eyam TA and Robin Hood primaries into Buxton would reduce demand at Goitside, and would also resolve the circuit constraint discussed in Section 2.5 of this report. This option would however require capacity at Buxton and additional circuit capacity into Eyam primary (the building of which may not be economical).
- The transfer of Wingerworth into Chesterfield BSP has been discussed as an option to resolve a number of constraints (including the circuit constraint in Section 2.6 of this report and as a way of feeding a second transformer to resolve the 11 kV backfeed restriction outlined in Section 2.8). This transfer would increase demand at Chesterfield so may only be possible if the GT constraint described in Section 2.10 is addressed before intervention is required at Goitside.

Option 6 – Procure flexibility under Goitside 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 Goitside BSP. This could be carried out alongside the operational mitigations discussed in options 3, 4 and 5 above. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

The restriction of outage seasons and/or the review of seasonal transformer ratings could be sufficient to manage this constraint in 2034 (as it is only present for N-2 outages in intermediate cool) but neither operational mitigations are long term solutions.

Installing a third GT at Goitside could resolve this constraint in the long term but these works should be considered in conjunction with any intervention triggered to resolve the constraint on the GTs at Chesterfield (as discussed in Section 2.10 of this report) as there are a number of options which have been discussed to transfer demand between the two BSPs. A new BSP has also been considered as a possible strategy to deload both sites.

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