Willington GSP

Network Development Report – East Midlands

May 2024

Electricity Distribution

nationalgrid

Contents

Willington 132 kV

1. Network Overview

Willington Grid Supply Point (GSP) supplies eight Bulk Supply Points (BSPs) in National Grid Electricity Distribution's (NGED's) East Midlands licence area in and around Derbyshire. These eight BSPs are: Uttoxeter, Burnaston, Winster, Derby, Derby South, Spondon B, Stanton and Heanor.

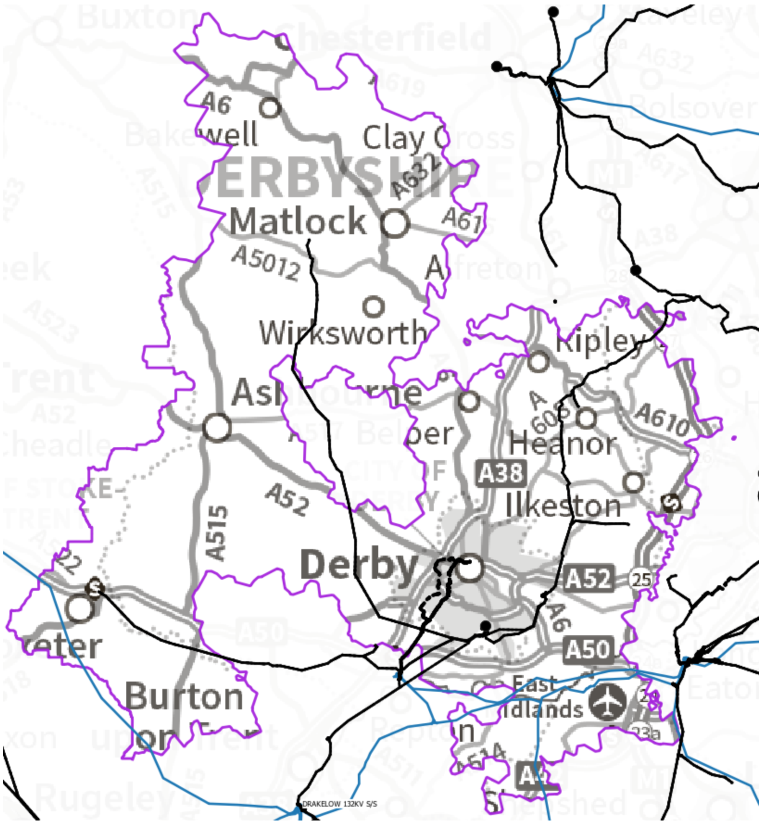

Figure 1.1 Willington GSP geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon identified on the 132 kV network fed from Willington GSP. 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

Winster BSP is fed from Willington GSP via a 132 kV dual circuit (the AR route), with a tee off to Burnaston and Uttoxeter BSPs (the DS and DSA routes). Winster and Uttoxeter BSPs each have two Grid Transformers (GTs). Derby BSP (both 33 kV and 11 kV) is fed directly from Willington GSP via another 132 kV dual circuit (the HS route) and has four GTs (two 132/33 kV and two 132/11 kV).

Derby South BSP is split into two sections, each with two GTs run separately from the other half. Both halves are fed directly from Willington GSP by 132 kV dual circuits (the AW and AY routes). The two halves of Derby South are fed from opposite sides of Willington GSP (the AY route feeds GT1 and GT2 from the main 1/reserve 1 side of Willington, and the AW route feeds GT3 and GT4 from the main 2/reserve 2 side).

Spondon A is set up with a dual 132 kV busbar, fed via three circuits (two via the main 1/main 2 side of Derby South BSP and one via a circuit directly from Willington GSP, with the direct circuit also having a tee off to Burton BSP). Spondon B BSP has two GTs and is fed directly from Spondon A. Stanton and Heanor BSPs each have two GTs and are fed from Spondon A via a dual circuit (the CL route). Loscoe Switching Station provides a location to split the network between Heanor and Stanton BSPs (with Stanton teed off before Loscoe and Heanor teed off after).

Willington GSP is interconnected at 132 kV with Drakelow GSP via Burton BSP and with Chesterfield and Staythorpe GSPs via Annesley BSP. Willington itself has four 400/132 kV Super Grid Transformers (SGTs) each feeding onto a section of 132 kV busbar. Willington is run on a 2 + 2 arrangement (and is unable to run with three SGTs solid due to fault levels). Running Willington 4 solid is not currently possible but has been studied for future years as discussed in this report.

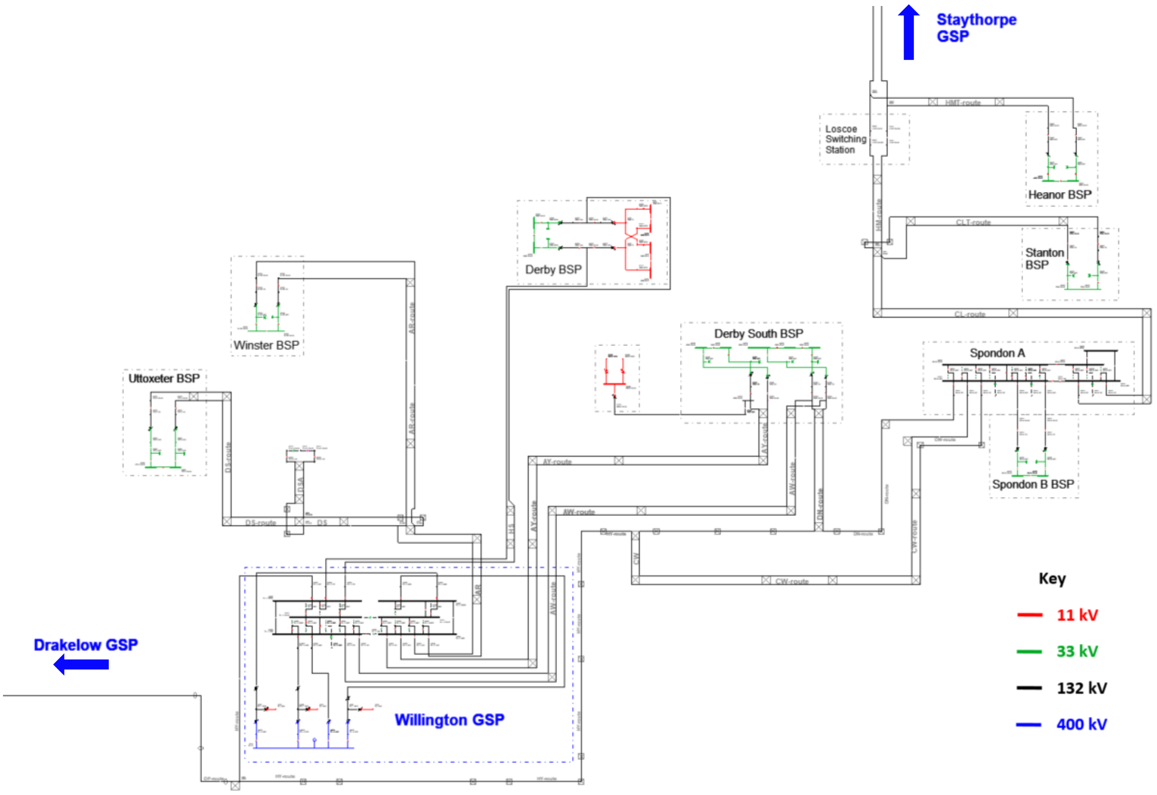

Figure 1.1.1 Willington 132 kV network single line diagram

1.2 Network Operability Modelling

The following network automation and manual switching schemes have been modelled in the analysis of this area, aligning to how the network is currently operated, as well as proposed actions to manage some constraints identified operationally or to account for proposed network changes.

- Arranged outages on the 132 kV busbars at Willington GSP or Spondon A are modelled such that circuits are secured onto in service busbars.
- When running 2 + 2, for an arranged outage on any of the SGTs at Willington GSP the site is moved to a 2 + 1 arrangement.
- When running 3 solid (which was studied but is not possible due to fault levels as discussed above), SGT6 is switched in for an arranged outage on any other SGT.
- For an arranged outage on any SGT or busbar at Willington GSP, on any of the three 132 kV feeders to Spondon A, or on CB605/CB705 at Spondon A, Heanor and Stanton BSPs are transferred into Staythorpe GSP. In future studies the possibility of transferring just Heanor, or taking no transfers at all are modelled as well.
- When running 4 solid in some future studies the parallel is maintained for any busbar or SGT outage with no actions required via CB120 and/or the new CB160.
- For an arranged outage on either 132 kV circuit on the CL route to Stanton BSP, Heanor BSP is transferred into Staythorpe GSP by opening the breakers at Loscoe Switching Station (for studies where Heanor is not transferred permanently to Staythorpe GSP).
- Intertripping schemes are modelled on GT1 and GT2 at Heanor BSP to trip the LV circuit breaker (CB) for a fault which opens the HV CB.
- The breakers at Loscoe Switching Station are modelled without fault tripping.
- For arranged outages on either 132 kV infeed to GT1 or GT3 at Burnaston BSP, the 132 kV bus section breaker 120 is closed to maintain supply to the transformers.
- For arranged outages on GT1 or GT3 at Burnaston BSP, GT2 is switched in to maintain security of supply.
- For future years Spondon 132 kV is split for an arranged outage on either Willington – Derby South – Spondon circuit, or the Willington – Burton Tee – Spondon circuit, separating Derby South GT1/2, Spondon B and Stanton BSPs to prevent overloads for a subsequent fault (these splits are not required for studies including a fourth circuit to Spondon 132 kV).
- The 33 kV and 11 kV networks downstream of the BSPs fed from Willington GSP are split for arranged outages on the 33 kV bus section couplers (see relevant 33 kV network reports for more details).
- For the loss of an infeed to a transformer at any of the BSPs fed from Willlington GSP under arranged outages, the lower voltage side CB is opened to prevent back-energisation.

2. Network Constraints and Solution Options

2.1 Summary of Network Constraints

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

- SGT1 or SGT7 at Willington GSP overloads for a fault on the other SGT or main 1/reserve 1 (M1/R1) busbar (when Willington GSP is run on a 2 + 2 section split).
- Overloads are observed on the Willington - Derby South main 2 – Spondon A circuits for a fault on the main 1 busbar at Willington GSP, and on the Willington – Derby South main 1 – Spondon A circuits for a fault on the main 1 busbar at Spondon A.
- Overloads are seen in 2028 on the GTs at Winster BSP for arranged and fault N-1 outages on the incoming circuits/transformers.
- Overloads are seen in 2034 on GT2 at Uttoxeter BSP for arranged outages on GT1.
- The group load of Winster, Burnaston and Uttoxeter BSPs is forecast to grow to around 141 MW by 2034, meaning significant N-2 restoration capacity will be required.
- An arranged or fault outage on either GT at Derby 33 kV leads to overloads on the remaining GT by 2028. This constraint is exacerbated by the transfer of a primary into Derby BSP for an arranged outage at Derby South BSP.
- An arranged or fault outage on either GT at Derby 11 kV leads to overloads on the remaining GT by 2034.
- The group load of Derby BSP (33 kV and 11 kV) is forecast to grow to around 164 MW by 2034, meaning significant N-2 restoration capacity will be required.
- The group load of Stanton and Heanor BSPs is forecast to grow to around 144 MW by 2034, meaning significant N-2 restoration capacity will be required.
- There is a potential future P18 complexity issue on one of the 132 kV circuits from Spondon A to Stanton and Heanor BSPs due to the number of addresses with CBs required to operate for a fault (under the existing running arrangement with a number of accepted generation connections).

2.2 Willington SGT1 or SGT7 Overload

Generation | Demand

Constraint Overview

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
Willington SGT1 overload	Willington SGT7 or R1 busbar fault	None	Baseline	Baseline	Baseline	2028
Willington SGT7 overload	Willington SGT1 or M1 busbar fault	None	Baseline	Baseline	Baseline	2028

Uncertainty under other Distribution Future Energy Scenarios: As this constraint is present in the baseline intervention is required regardless of scenario, but the constraint is exacerbated most significantly under the higher growth scenarios for future years (Leading the Way and Consumer Transformation).

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	Install a fifth SGT at Willington GSP.
2	Establish a new GSP.
Operational Mitigation	
3	Utilise the short term ratings of the SGTs at Willington GSP.
4	Utilise a more secure running arrangement at Willington GSP.
5	Shift demand away from the M1/R1 side of Willington GSP.
Flexibility Services	
6	Procure flexibility under Willington GSP.

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.

A number of the options discussed below involve works on the transmission network and will therefore require a modification application and discussions with National Grid Electricity Transmission (NGET) and National Grid ESO to ensure the optimal solution for the whole system (considering both the distribution and transmission systems) is taken forward.

Option 1 – Install a fifth SGT at Willington GSP

Viable

Capacity released for constraint(s) considered: 240 MVA

New limiting factor for constraint(s) considered: All five SGT ratings

Detailed description: A fifth SGT could be installed at Willington GSP to alleviate any constraints on the existing SGTs and provide extra capacity for the group. This SGT would ideally be installed on a swing arrangement and run on hot standby so that it can be closed in to either side of Willington GSP. The existing auto-close scheme could also be expanded to include closing the new SGT in for a fault on any of the existing four SGTs. For the capacity of this fifth SGT to be fully utilised the works to uprate the fault level of the switchgear at Willington will need to have been completed (so that the site can be run 4 solid, with the 5th SGT ready to switch in for arranged or fault outages and maintain four SGTs in parallel).

This solution would free up significant capacity for both demand and generation at Willington GSP. Installing a fifth SGT would be expensive and is likely unnecessary in the short term given the possibility of utilising some of the options listed below but may become necessary further in the future as demand grows in the area (once N-1 and N-2 constraints are identified even with Willington run 4 solid). Given the length of time required to install a new SGT this option would also not be suitable to manage this constraint in the short term.

The overall load at Willington will continue to be monitored and published as part of future DFES reports, as well as in reporting by NGET and NGESO to help identify when the 5th SGT at Willington will need to be triggered.

Option 2 – Establish a new GSP

Viable

Capacity released for constraint(s) considered: The demand of Stanton and Heanor BSPs

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

Detailed description: By establishing a new GSP geographically between Willington and Chesterfield GSPs, Stanton and Heanor BSPs could be transferred out of Willington GSP. This would significantly deload the GSP, and confers a number of other network benefits for Chesterfield and Staythorpe GSPs.

The possibility of creating a new GSP in this area is likely to be a good strategic choice for the network if it can be achieved. This option would also alleviate a number of other constraints as discussed in Section 2.3, Section 2.11 and Section 2.12 of this report. This option, while strategically advantageous for the network as a whole, could not be utilised in the short to medium term to manage this constraint and would not be sufficient alone to fully alleviate constraints at Willington GSP forever.

Option 3 – Utilise the short term ratings of the SGTs at Willington GSP

Viable

Capacity released for constraint(s) considered: Dependent on short term ratings

New limiting factor for constraint(s) considered: SGT1 and SGT7 ratings

Detailed description: The SGTs at Willington GSP are equipped with short-term ratings which allow them to run above their nameplate rating for a short period of time. This allows the control engineers to reconfigure the network (e.g. transferring demand and/or switching to a more secure running arrangement if permissible with the fault levels) before the equipment can be damaged. This helps to mitigate this constraint but is not a solution alone as there are issues with some of the options discussed below.

Additionally, loadings over the short term ratings of the SGTs are projected which will necessitate transfers under normal running arrangements as well (as discussed in option 5).

- Switching to 3 SGTs in parallel creates a fault level constraint on the 132 kV CBs at Willlington.
- The main 132 kV transfers available out of the Willington group are Stanton and Heanor BSPs (or just Heanor BSP). These transfers are limited due to thermal and voltage constraints on the 132 kV circuits from Staythorpe GSP (between 2028 and 2034 the option of utilising the transfer of both BSPs is projected to be lost for every season). These transfers are further limited by SGT capacity at Staythorpe (even the transfer of Heanor alone creates a constraint as discussed in the Staythorpe 132 kV report).
- Various primaries can be transferred out of Willington at 33 kV, including Sandiacre, Westwood and Denby primaries to Toton, Annesley and Alfreton BSPs respectively.
- Some transfers between the two halves of Willington GSP are possible, the largest of which is achieved by paralleling Derby South BSP using the 33 kV interconnectors between main 1 and main 4 and between main 3 and main 5. This would allow the site to be run fully from GT3 and GT4, transferring the demand of half of Derby South away from the SGT1/7 side of Willington GSP.

Option 4 – Utilise alternative running arrangements at Willington GSP

Capacity released for constraint(s) considered: Dependent on demand on the other side of Willington

Viable

New limiting factor for constraint(s) considered: All SGT ratings

Detailed description: Moving to a four solid normal running arrangement (all four SGTs in parallel) at Willington GSP would alleviate this constraint but is not currently possible due to fault levels. Once the planned replant of Willington GSP is carried out this running arrangement will be made possible, but this constraint will require mitigation before that point.

Maintaining a three solid running arrangement (with SGT6 left on hot standby) would also alleviate this constraint but is not viable due to the fault levels as noted above in option 3.

Moving to a horizontal 2 + 2 split at Willington GSP (main 1 and main 2 paralleled, and reserve 1 and reserve 2 paralleled) would allow the load at Willington GSP to be balanced and alleviate this constraint (but only in the short term). However, as there is no circuit breaker between the reserve bars a fault on either bar would take out both, leading to possible backfeeding through BSPs and leaving Willington fed from only two SGTs for a fault which could occur at any time. This running arrangement is therefore not a viable way of mitigating this constraint.

Option 4 – Shift demand away from the M1/R1 side of Willington GSP

Viable

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

New limiting factor for constraint(s) considered: SGT1 and SGT7 ratings

Detailed description: At present the M1/R1 side of Willington GSP (fed by SGT1 and SGT7) feeds GT1 and GT2 at Derby South BSP and the entirety of Derby, Spondon, Stanton and Heanor BSPs. The M2/R2 side of Willington (fed by SGT2 and SGT6) feeds GT3 and GT4 at Derby South BSP and the entirety of Burnaston, Uttoxeter and Winster BSPs.

If the current 2 + 2 section split running arrangement needs to be maintained long term then the post fault transfers discussed in option 2 alone would not be sufficient in managing this constraint as the demand exceeds the short term ratings of the SGTs. Shifting demand from the M1/R1 side of Willington to the other side (or to any other GSPs) would help alleviate this constraint.

Some of the transfers discussed in option 2 could be utilised under normal running arrangements as discussed below.

- The transfer of Heanor and Stanton BSPs is limited by SGT capacity at Staythorpe GSP as noted in option 3 and discussed in more detail in the Staythorpe 132 kV report.
- Paralleling Derby South at 33 kV and running it from GT3 and GT4 would not be preferable under normal running arrangements as it would reduce the security of supply of the site.
- Of the primary transfers mentioned in option 3 only Sandiacre could be carried out without putting the primary at single circuit risk and breaching the security of supply obligations under Engineering Recommendation P2/8. The implications of the transfer of Sandiacre are discussed in Section 2.10 of this report and in the Toton 33 kV report.
- Melbourne primary could be fed fully from T2 (which is fed from Derby South GT3/4) with T1 left on standby.

Option 5 – Procure flexibility under Derby South, Derby, Spondon, Stanton and Heanor BSPs

Viable

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

Detailed description: Flexibility services could be procured to alleviate the projected overloads seen for a fault on SGT1 or SGT7 (or on the M1/R1 busbars). The viability of utilising flexibility will be further investigated as part of the DNOA process. Flexibility may not be economic as the replant works which will resolve this constraint are triggered by fault levels so reinforcement cannot be deferred using flexibility. Flexibility could however be used to support the network in the interim along with some of the operational mitigations discussed in options 3 and 5.

Solution Recommendation

Once the planned works to replant Willington GSP are carried out this constraint will be alleviated as the GSP will be capable of running with four SGTs in parallel. Some demand transfers (along with the other operational mitigation options discussed above) should be sufficient in the interim to manage this constraint. In the long term a fifth SGT may be required to provide adequate capacity for the projected load growth (and/or the establishment of a new GSP).

Sufficient permanent transfers will be required to keep the demand on the SGT1/7 side of Willington below the short term ratings of the SGTs under normal running arrangements in every season (as described in option 3). Sufficient post fault transfers will then also need to be available to reduce the demand on the SGT1/7 side of Willington to below the nameplate rating of the SGTs (as described in option 5). These transfers will need to large enough to meet both of these conditions up the point when the replant of Willington GSP is planned to be completed.

2.3 Willington - Derby South - Spondon Overload

Constraint Overview

Generation | **Demand**

The table below outlines the nature of the network constraints identified in the network analysis. Constraints caused by N-2 outages on the circuits which can be managed operationally (by transferring Stanton and Heanor in the short term and by splitting the 132 kV at Spondon A in the long term as described in the Network Operability Modelling section of this report) have been omitted. Overloads seen only on the circuit breakers at Willington or Spondon in 2034 have also been omitted as works to replant both substations will have been completed by that point, which will involve replacing the CBs with new units with thermal ratings higher than their associated circuits.

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
Willington CB105 overload	Willington M1 busbar fault	None	Baseline	Baseline	Baseline	2028
Spondon CB505 overload	Willington M1 busbar fault	None	Baseline	Baseline	Baseline	Baseline
Willington – Derby South M2 circuit overload	Willington M1 busbar fault	None	Baseline	Baseline	Baseline	Baseline
Derby South M2 – Spondon A circuit overload	Willington M1 busbar fault	None	Baseline	Baseline	Baseline	Baseline
Willington CB505 overload	Spondon A M1 busbar fault	None	2028	2028	2028	2028
Spondon A CB405 overload	Spondon A M1 busbar fault	None	Baseline	Baseline	Baseline	2028
Willington – Derby South M1 circuit overload	Spondon A M1 busbar fault	None	2028	2028	2028	2028
Derby South M1 – Spondon A circuit overload	Spondon A M1 busbar fault	None	Baseline	Baseline	Baseline	2028
Willington – Burton Tee circuit overload	Either Willington – Derby South – Spondon arranged or fault outage	None	2034	2028	-	-
Spondon CB305 overload	Either Willington – Derby South – Spondon arranged or fault outage	None	2034	2034	-	-
Willington CB105 and Willington – Derby South M2 circuit overloads	Willington – Derby South M1 – Spondon arranged or fault outage	None	2034	2034	2034	-
Willington CB505 overload	Willington – Derby South M2 – Spondon arranged or fault outage	None	2034	2034	-	-

Uncertainty under other Distribution Future Energy Scenarios: As this constraint is present in the baseline intervention is required regardless of scenario, but the constraint is exacerbated most significantly under the higher growth scenarios for future years (Leading the Way and Consumer Transformation).

Solution Options

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

Table 2.3.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Uprate all three Willington to Spondon 132 kV circuits.
2	Build an additional 132 kV circuit between Derby South and Spondon A.
3	Uprate a number of limiting sections of 132 kV circuit.
4	Reconfigure the 132 kV circuits at Willington GSP and Spondon BSP.
5	Establish a new GSP.
Operational Mitigation	
6	Utilise the transfer of Heanor BSP into Staythorpe GSP.
Flexibility Services	
7	Procure flexibility under Derby South, Spondon, Stanton or Heanor BSPs.

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full CBA. This CBA will be subsequently carried out by the DNO to determine the optimal reinforcement solution, which will then be tested against market provided flexibility by the DSO as part of the DNOA process.

Option 1 – Uprate all three Willington to Spondon 132 kV circuits

Discounted

Capacity released for constraint(s) considered: Over 200 MVA

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

Detailed description: Uprating the entirety of the 132 kV circuits from Willington GSP to Derby South and from Derby South to Spondon A (as well as the circuit breakers at each end), along with the circuit and CBs on the direct circuit via the Burton Tee could alleviate these constraints (both for the busbar faults and the N-1 circuit outages). However, the existing steel towers making up the circuits cannot accommodate any higher rated conductors so uprating the circuits would require full rebuilds of the circuits. This solution would release significant capacity (over 200 MVA if large enough circuits were installed) but would likely be an unnecessarily expensive solution given the possibility of utilising some of the options discussed below.

Option 2 – Build an additional 132 kV circuit between Derby South and Spondon A

Viable

Capacity released for constraint(s) considered: 130 MVA

New limiting factor for constraint(s) considered: Lowest rated existing 132 kV circuits

Detailed description: A potential fourth circuit could be built from Derby South BSP to Spondon BSP. This fourth circuit could be built from the main 3 132 kV busbar at Derby South, and connect to the main 2 / reserve 2 side of Spondon. As there are already four 132 kV infeeds to Derby South this would provide four 132 kV circuits from Willington GSP to Spondon. Two circuit configurations have been modelled:

- A full 7 km of 132 kV underground cable (1000 mm^2 XLPE in trefoil).
- 2 km of 132 kV tower overhead line (500 mm^2 AAAC AL3), with the remaining 5 km as underground cable as specified above.

Both of these circuits have been studied in 2028 and 2034, confirming that either configuration would resolve all existing constraints on the Willington – Derby South – Spondon 132 kV circuits if carried out in conjunction with the reconfigurations discussed in option 4 (no thermal or voltage constraints are seen for any N-1 or N-2 condition in any season up to 2034). The advantage of the circuit configuration with 2 km of tower overhead line is that it increases the impedance of the circuit, putting it closer in line with the impedances of the existing circuits (although the effect of this is minimal). The main disadvantage of including a section of overhead line is that it would be significantly harder to find a viable route for from a wayleaves and consents perspective than full underground cable.

This solution also provides options for future operability as with four 132 kV circuits if needed Derby South and Spondon BSPs can be fed via two circuits, with the remaining two circuits feeding Stanton and Heanor BSPs by splitting at Spondon 132 kV.

Building a new overhead line for the full 7 km was initially deemed unachievable due to specific restrictions between Derby South and Spondon. If following further investigation a feasible route were identified for overhead line then it would be economical to make this a dual circuit (this is not significantly more expensive than a single circuit as most of the costs of wayleaves, building the steel towers, etc. are incurred regardless). This would leave the network with two dual circuits fed from Willington GSP to Derby South and on to Spondon A, and a fifth circuit via the Burton Tee. This would provide even more demand and generation capacity for the network than a single cable, but could create problems with the circuit on the AY-route to Derby South main 4 becoming a limiting factor as it is lower rated than the other AY-route circuit.

Option 3 – Uprate a number of limiting sections of 132 kV circuit

Viable

Capacity released for constraint(s) considered: 32 MVA for Derby South and 7 MVA for the Willington – Burton Tee circuit

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

Detailed description: Although uprating the entirety of the 132 kV circuits between Willington, Derby South and Spondon is not economical as described in option 1 there are two sections of 132 kV circuit which have been identified as limiting factors, the uprating of which could free up significant capacity:

- At Derby South BSP there is a short section of 132 kV cable at the end of the Willington CB105 – Derby South main 2 circuit which derates the entire circuit. Uprating this section of cable would help alleviate this constraint by providing additional thermal capacity on that Willington – Derby South circuit. This section of cable is only 56 m in length.
- The capacity of the circuit between Willington and the Burton Tee is limited by around 500 m of cable from Willington GSP. If this cable were uprated to match or exceed the 132 kV overhead line (for example to 1000mm^2 XLPE Cu) then rating of the circuit would be increased.

Uprating these sections of circuit would not be sufficient alone to resolve this constraint but could be used in conjunction with some of the other options discussed to prevent overloads.

Option 4 – Reconfigure the 132 kV circuits at Willington GSP and Spondon BSP

Viable

Capacity released for constraint(s) considered: Busbar fault constraint resolved

New limiting factor for constraint(s) considered: Lowest rated two 132 kV circuits

Detailed description: With the existing configuration at Willington GSP all three circuits to Spondon A are fed from the same side of Willington. This is mirrored at Spondon A, where all three incoming 132 kV circuits are on the same side of Spondon A.

Consequently, at least two of the three circuits must be fed from a single busbar at both ends which leads to the overloads observed when that busbar (main 1 at both Willington and Spondon under current normal running arrangements) faults as this leaves the whole group fed from a single circuit. If one of these circuits were moved to the other side of Willington and Spondon (fed from either the main 2 or reserve 2 busbar) then all three circuits could be secured onto separate bars, preventing the loss of two circuits for a fault on a single busbar.

As Willington GSP is being replanted to uprate its fault level capabilities this should provide an opportunity to carry out this reconfiguration at a relatively low cost at Willington. A similar replant has been triggered at Spondon BSP, providing the same opportunity at the other end of the circuits. This will also uprate the thermal capacity of the circuit breakers/bays. Although the busbar fault constraints will be alleviated by these replants they may still require mitigation before these works are carried out.

At Willington GSP CB160 will also need to be installed during the replant, as if it is not a fault on the main 1 busbar could still cause overloads. This is due to that fact that although only one circuit would be lost for this fault, it also splits Willington in two. One half of Willington GSP would be supplied by two SGTs in this scenario, and the lower impedance seen on this side of Willington would force the Willington – Derby South – Spondon 132 kV circuit to pick up significantly more load and cause a thermal overload. This constraint is an issue regardless of how the three circuits are configured at Willington GSP, as there will always be a busbar fault which either takes out more than one circuit or splits Willington in this manner. Installing CB160 between the reserve 1 and reserve 2 busbars at Willington would resolve this issue as the GSP could be paralleled at both CB120 and CB160, meaning the parallel would be maintained for any busbar fault. This could not be done without CB160 as paralleling the reserve busbars would risk losing both for a fault on either without a circuit breaker to separate the fault. Installing CB160 also improves the operability of the site for switching and outages.

These reconfiguration works would resolve the busbar constraints identified as no busbar fault could take out two circuits at once. However, the N-1 circuit constraints identified in 2028 and 2034 would not be resolved. This option alone is therefore not sufficient to maintain network integrity.

Option 5 – Establish a new GSP

Capacity released for constraint(s) considered: The demand of Stanton and Heanor BSPs

Viable

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

Detailed description: By establishing a new GSP geographically between Willington and Chesterfield GSPs, Stanton and Heanor BSPs could be transferred out of Willington GSP. This would significantly deload the 132 kV circuits between Willington, Derby South and Spondon BSPs (and provide a number of other network benefits).

The possibility of creating a new GSP in this area is likely to be a good strategic choice for the network if it can be achieved. This option would also alleviate a number of other constraints as discussed in Section 2.11 and Section 2.12 of this report. This option, while strategically advantageous for the network as a whole, could not be utilised in the short to medium term to manage this constraint (but would free up enough capacity on these circuits that a fourth circuit would not be required between Willington and Spondon for the foreseeable future).

Option 6 – Utilise the transfer of Heanor BSP into Staythorpe GSP

Viable

Capacity released for constraint(s) considered: Demand of Heanor BSP

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

Detailed description: As this constraint occurs for an N-1 fault condition transferring Heanor post-fault would not help alleviate the constraint. Transferring Heanor BSP permanently into Staythorpe GSP would alleviate this constraint in the short term (in conjunction with option 4 this option resolves all N-1 constraints until at least 2034, and as discussed all N-2 constraint can be managed operationally).

To facilitate the permanent transfer of Heanor BSP (without building a new GSP) additional SGT capacity at Staythorpe GSP is required (either by installing a third SGT at Staythorpe GSP, transferring demand out of the group, or both, as discussed in the Staythorpe 132 kV report). This also breaks up the Stanton and Heanor demand group (preventing a requirement for N-2 restoration requirements) and alleviates a potential future P18 issue. These effects are discussed in Section 2.11 and Section 2.12 of this report.

Option 7 – Procure flexibility under Derby South, Spondon, Stanton or Heanor BSPs

Viable

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

Detailed description: Flexibility services could be procured to alleviate the projected overloads seen for the various outage conditions described. Due to the fact that the replanting of Willington GSP and Spondon BSP is being triggered regardless and overloads are seen for multiple seasons, deferral of reinforcement using flexibility is unlikely to be economical, but could be used help to help manage the constraint in the interim. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

As discussed Willington GSP and Spondon BSP are being replanted regardless, which will provide an opportunity to mitigate the busbar constraints at a relatively low cost by reconfiguring the 132 kV circuits. This solution in conjunction with transferring Heanor BSP to Staythorpe GSP will resolve all N-1 busbar and circuit constraints up to 2034.

For an arranged outage on any of the three circuits the network can be split at Spondon 132 kV to prevent overloads for a subsequent N-2 fault (as described in the Network Operability Modelling section of this report). This strategy is effective up to at least 2034, so no N-2 constraints should be an issue before this time. Beyond this point, as the demand on Spondon and Stanton BSPs (and half of Derby South BSP) grows constraints may be seen again (the circuits are close to their ratings for some N-1 conditions in 2034). At this point it may be necessary to install a fourth circuit from Derby South to Spondon as discussed in option 2. To prepare for this eventuality a 132 kV bay is being left available at Spondon 132 kV to facilitate this circuit. Building a new GSP would alleviate this requirement (for at least the foreseeable future) by also transferring away the demand from Stanton BSP.

The uprating works described in option 3 (at Derby South and on the Willington – Burton Tee 132 kV circuit) will be employed as required to provide capacity and prevent overloads in the short term. These works will not go unexploited once replant works are completed as the extra capacity will still be required to prevent N-1 circuit constraints (and further into the future will prevent bottlenecks if a fourth circuit is installed as the limiting factor then will become the existing circuits).

2.4 Winster BSP GT Overloads

Constraint Overview

Generation | Demand

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

Table 2.4.1 constraint(s) and conditions under which constraint(s) occur

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Winster BSP GT1 or GT2 Overload	Either Willington – Winster/Uttoxeter 132 kV circuit fault	None	2034	2034	2034	2034
Winster BSP GT1 Overload	Winster GT2 arranged outage	None	2034	2034	2034	2034
Winster BSP GT2 Overload	Winster GT1 arranged outage	None	2034	2028	2034	2034

Uncertainty under other Distribution Future Energy Scenarios: This constraint occurs for other seasons and for fault conditions in 2028 for the higher growth scenarios (Leading the Way and Consumer Transformation). The only scenario under which overloads are not observed by 2034 is Falling Short.

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 GTs at Winster BSP.
2	Install a third GT at Winster BSP.
Operational Mitigation	
3	Various operational mitigations.
Flexibility Services	
4	Procure flexibility under Winster BSP.

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.

Option 1 – Uprate the GTs at Winster BSP

Viable

Capacity released for constraint(s) considered: 39 MVA

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

Detailed description: Uprating the GTs at Winster BSP to 60/90/117 MVA units would release significant capacity and resolve this constraint. The GTs at Winster are due to be replaced in the near future due to their condition, at which point they could be uprated. This means this solution will likely be very cost effective, as the works to replace the transformers would be carried out regardless. The 132 kV circuits to Winster BSP are already rated higher than the proposed GT size, so will not need to be uprated and will not be a limiting factor.

Option 2 – Install a third GT at Winster BSP

Discounted

Capacity released for constraint(s) considered: 78 MVA

New limiting factor for constraint(s) considered: Rating of two GTs

Detailed description: Installing a third GT at Winster would add significant capacity and resolve this constraint. This third GT could be fed by a cross-bay or a new 132 kV circuit from Willington. A new 132 kV circuit would require around 35 km of circuit works (subject to detailed route investigation and land rights), making it a prohibitively expensive option. This solution would not be a good strategic investment even if a cross-bay were used given the fact that the existing GTs would soon need replacing based on their condition regardless as outlined in option 1.

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:

- Transfer demand out of Winster BSP at 33 kV or 11 kV: Winster BSP has limited interconnectivity with other BSPs, meaning the possibility of transferring demand out of the group permanently is restricted. The BSP is also very isolated geographically, so any possible 33 kV or 11 kV works to facilitate transfers would require lengthy circuits and therefore be very expensive. The 33 kV interconnection which does exist (with Alfreton and Buxton BSPs) is made up of single circuits, so transferring primaries such as Ashbourne would put them at single circuit risk and would leave the network non-compliant with the security of supply obligations under Engineering Recommendation P2. One exception to this is Bakewell primary which is a single transformer primary with sufficient 11 kV backfeed capacity to be restored for a fault or arranged outage in its infeed. Transferring Bakewell primary to Buxton if it were possible (the implications of this transfer on the Buxton network have not been studied) would regardless not reduce the loading at Winster BSP significantly (the demand at Bakewell primary is currently under 4 MW).
- Restrict outage seasons: as this constraint is only present in 2028 for arranged outages at intermediate cool peak demand, restricting outage seasons to any of the other three seasons would mitigate this constraint in the short term.
- Review seasonal ratings: as this constraint is only present in intermediate cool in 2028 (the ratings for which may be overly pessimistic as they align to the summer rating), an internal review of transformer seasonal ratings may conclude that this constraint is not present in 2028.

As the GTs at Winster BSP are being replaced due to their condition these operational mitigations would not be able to defer these works. However, if these works were delayed for any reason some of these strategies could be employed to prevent overloads in the short term.

Option 4 – Procure flexibility under Winster BSP

Discounted

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

Detailed description: Flexibility services could be procured to alleviate the projected overloads seen for an outage on an infeed to Winster BSP. As replacing the GTs at Winster is being triggered by their condition flexibility is unsuitable for deferring this constraint. The possibility of utilising flexibility has already been assessed and discounted for Winster BSP as part of the DNOA process.

Solution Recommendation

As discussed the GTs at Winster BSP are being replaced due to their condition. This will provide an ideal opportunity for the GTs to be uprated, which will resolve the constraint and add significant capacity to Winster BSP in a cost effective manner.

2.5 Uttoxeter BSP GT2 Overloads

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
Uttoxeter BSP GT2 Overload	Uttoxeter BSP GT1 arranged outage	None	-	2034	-	-

Uncertainty under other Distribution Future Energy Scenarios: This constraint occurs for other seasons in 2034 for the higher growth scenarios (Leading the Way and Consumer Transformation). Under these scenarios there is also significantly higher demand forecast to materialise by 2050, which could necessitate higher rated GTs (the possibility of installing higher rated GTs is discussed in option 2 below). Overloads are also seen for GT1 and for fault outages in these scenarios. This constraint is not seen in any season in 2034 for the Falling Short or System Transformation scenarios (and higher rated GTs would not be required by 2050 as in Best View).

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 GTs at Uttoxeter BSP to 30/60/78 MVA.
2	Uprate the GTs at Uttoxeter BSP to 60/90/117 MVA.
Operational Mitigation	
3	Restrict outage seasons.
4	Review seasonal ratings.
Flexibility Services	
5	Procure flexibility under Uttoxeter BSP.

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full CBA. This CBA will be subsequently carried out by the DNO to determine the optimal reinforcement solution, which will then be tested against market provided flexibility by the DSO as part of the DNOA process.

Option 1 – Uprate the GTs at Uttoxeter BSP to 30/60/78 MVA

Viable

Capacity released for constraint(s) considered: 20 MVA

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

Detailed description: Uprating the GTs at Uttoxeter BSP to 30/60/78 MVA units would release significant capacity (enough to supply the demand of the three primaries currently fed from Uttoxeter in 2050 under Best View) and resolve this constraint. The 132 kV circuits to Uttoxeter BSP are already rated higher than this proposed GT size, so will not need to be uprated and will not be a limiting factor. This would also benefit the condition of the GTs as the existing units are around 55 years old.

Option 2 – Uprate the GTs at Uttoxeter BSP to 60/90/117 MVA

Viable

Capacity released for constraint(s) considered: 40 MVA

New limiting factor for constraint(s) considered: Ratings of 132 kV feeder circuits

Detailed description: Uprating the GTs at Uttoxeter BSP to 60/90/117 MVA units would release significant capacity and resolve this constraint. The new limiting factor for Uttoxeter BSP would be the incoming 132 kV circuits. Most but not all of the capacity of the new GTs would be available, provided the works to unstitch Winster BSP are carried out as discussed in Section 2.6 of this report.

The total demand of the three primaries fed from Uttoxeter BSP at present (Church Street, Rocester and Marchington) is not forecast to exceed 78 MVA by 2050, indicating this capacity may not be required. However, a new primary is being built fed from Uttoxeter BSP, with demand being transferred from Hatton primary into this new primary. This additional demand may mean higher rated GTs are required in the future. Subsequent DFES forecasts will be assessed to confirm if this capacity is needed nearer to the constraint appearing.

If 60/90/117 MVA units were installed at Uttoxeter BSP then spare GT capacity would be created, but there are limited opportunities for this capacity to be utilised by transferring primaries from other BSPs. The only existing 33 kV interconnection into the Uttoxeter 33 kV network is a single circuit between Marchington and Hatton primaries. Hatton could not be transferred into the Uttoxeter for a number of reasons. Firstly, as there is only a single circuit from Uttoxeter a second circuit would need to be built to transfer Hatton permanently and retain its required security of supply. Secondly, there are a number of generators connected to the circuit between the two primaries which would lead to a P18 issue if the normal open point were moved to Hatton. Thirdly, the 33 kV circuits feeding Marchington from Uttoxeter are not sufficient to pick up Hatton primary as well (even in the short term).

There are no locations where the 33 kV network fed from Uttoxeter is in close enough proximity with the 33 kV network fed from another BSP to allow the possibility of building interconnection economically. 11 kV transfers have not been considered as part of this report, but would likely not be of sufficient magnitude to significantly deload any other BSP (other than the transfers from Hatton primary already discussed).

Option 3 – Restrict outage seasons

Viable

Capacity released for constraint(s) considered: A few MVA

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

Detailed description: As this constraint is only present under arranged outages in 2034 for intermediate cool, restricting outage seasons could be used to alleviate this constraint. This solution is viable in 2034 and could be used in conjunction with options 4 and 5 described below, but would likely not be an enduring solution far beyond 2034. 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 – Procure flexibility under Uttoxeter BSP

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 GTs at Uttoxeter BSP. The viability of utilising flexibility will be further investigated as part of the DNOA process. Flexibility will likely not be economical in 2034 due to the viability of utilising some of the low cost operational mitigations discussed in options 3 and 4 (but could be used in conjunction with these options if demand growth is higher than expected or the demand transferred into Uttoxeter via the new primary means these operational mitigations aren't sufficient alone).

By 2034 the GTs at Uttoxeter BSP will be around 65 years old. If the replacement of the GTs is triggered by their condition by then or soon after then flexibility would not be viable for deferring expenditure for this constraint. NGED periodically assesses the condition of the assets on the distribution network, including the GTs at Uttoxeter BSP. Future NDP and DNOA reports will consider the most up-to-date data collected on the condition of the GTs to inform whether flexibility will be viable or not.

Solution Recommendation

A number of viable short term strategies have been identified to manage this constraint in 2034 (restricting outage seasons, reviewing the transformer ratings and procuring flexibility services). Over the long term the optimal solution identified is to uprate the existing GTs at Uttoxeter BSP, with the size of the new units subject to further review as forecasts evolve.

2.6 Winster / Burnaston / Uttoxeter BSPs N-2

Constraint Overview

Generation | **Demand**

The table below shows the projected growth in group load between now and 2034 under the Best View scenario.

Table 2.6.1 N-2 condition and group load forecasts

Constraint	N-1 Condition	Subsequent N-2 Condition	Group load			
			Baseline	2025	2028	2034
N-2 restoration requirements	Arranged outage on either 132 kV circuit to Uttoxeter and Winster BSPs	Fault on the remaining 132 kV circuit to Uttoxeter and Winster BSPs	96 MW	99 MW	112 MW	140 MW

Uncertainty under other Distribution Future Energy Scenarios: The group load is set to grow faster for the higher growth scenarios (Leading the Way and Consumer Transformation). The slowest demand growth is seen under Falling Short, but even under this scenario the group load is projected to exceed 100 MW by 2034.

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	Install a third 132 kV circuit from Willington GSP to Winster or Uttoxeter BSP.
2	Unstitch the 132 kV circuits to Winster BSP.
Operational Mitigation	
3	Utilise the 33 kV interconnection at Winster and Uttoxeter BSPs.
Flexibility Services	
4	Procure flexibility under Winster and Uttoxeter BSPs.

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 132 kV circuit from Willington GSP to Winster or Uttoxeter BSP

Discounted

Capacity released for constraint(s) considered: Demand of Winster or Uttoxeter BSP

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

Detailed description: Installing a third 132 kV circuit to Winster or Uttoxeter BSPs from Willington GSP would allow one of the BSPs to be kept on supply for an N-2 outage on the existing two circuits. The existing 132 kV circuits to Uttoxeter BSP are around 23 km and the existing 132 kV circuits to Winster BSP are around 35 km, so taking a third circuit to either BSP would be prohibitively expensive given the viability of a number of cheaper options discussed below.

Option 2 – Unstitch the 132 kV circuits to Winster BSP

Viable

Capacity released for constraint(s) considered: Demand of Winster BSP

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

Detailed description: The 132 kV circuits from Willington GSP to the Winster BSP tee are only around 150 m in length. It would therefore be relatively inexpensive to build a new dual circuit for this length which would feed Winster BSP, unstitching it from Uttoxeter and Burnaston BSPs. This would split the group such that there are no N-2 restoration requirements as neither group exceeds 100 MW in the near future (in 2034 Winster BSP's group demand is forecast to be 84 MW and Uttoxeter/Burnaston's group demand is forecast to be 56 MW). This solution also creates additional circuit capacity for both BSPs and reduces network capacity, facilitating 132 kV connections on the circuits to each BSP. To facilitate this solution two additional 132 kV bays will need to be reserved at Willington GSP which should be considered in the replant discussed in previous sections of this report.

Option 3 – Utilise the 33 kV interconnection at Winster and Uttoxeter BSPs

Viable

Capacity released for constraint(s) considered: Demand of various primaries

New limiting factor for constraint(s) considered: 33 kV interconnection to various BSPs

Detailed description: Winster BSP is interconnected at 33 kV with Buxton BSP via Flagg and Hindlow primaries, and with Alfreton BSP via Ashbourne primary. Uttoxeter BSP is interconnected at 33 kV with Burton BSP via Marchington primary. These interconnectors can be utilised to restore demand for an N-2 outage which takes out the two BSPs. This solution is suitable to provide the N-2 restoration capacity required under Engineering Recommendation P2 in the short term but is not an enduring solution and is dependent on capacity being available at Buxton, Alfreton and Burton BSPs (see relevant 33 kV reports).

Option 4 – Procure flexibility under Winster and Uttoxeter BSPs

Viable

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

Detailed description: Flexibility is not suitable to manage this constraint directly as it is a security of supply requirement. Flexibility cannot be used to reduce the class of supply of a group, and the level of flexibility required would not be economical regardless. Flexibility could however be used to facilitate transfers at 33 kV which are used to restore demand for N-2 outages.

Solution Recommendation

Unstitching Winster BSP from Uttoxeter and Burnaston BSPs and creating two demand groups is a viable and cost effective long term solution, but in the short term the 33 kV interconnection will be required to support the group for N-2 outages.

2.7 Derby BSP 132/33 kV GT 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
Derby BSP GT1A or GT2A Overload	Either Willington – Derby 132 kV circuit fault	None	-	2028	2034	-
Derby BSP GT1A or GT2A Overload	Either Derby 132/33 kV GT arranged outage	None	-	2028	2034	-
Derby BSP GT1A or GT2A Overload	Derby South GT3/4 arranged outage	Either Willington – Derby 132 kV circuit fault	2028	2028	2028	-

Uncertainty under other Distribution Future Energy Scenarios: This constraint occurs for other seasons for N-1 conditions in 2028 for the higher growth scenarios (Leading the Way and Consumer Transformation). The lowest growth is seen under Falling Short, but even under this scenario overloads are observed for some seasons/outage conditions.

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 132/33 kV GTs at Derby BSP.
2	Install a third 132/33 kV GT at Derby BSP.
Operational Mitigation	
3	Transfer demand away from Derby BSP 33 kV.
4	Restrict outage seasons.
5	Review seasonal ratings.
Flexibility Services	
6	Procure flexibility under Derby BSP.

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full CBA. This CBA will be subsequently carried out by the DNO to determine the optimal reinforcement solution, which will then be tested against market provided flexibility by the DSO as part of the DNOA process.

Option 1 – Uprate the 132/33 kV GTs at Derby BSP

Discounted

Capacity released for constraint(s) considered: N/A

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

Detailed description: Uprating the 132/33 kV GTs at Derby BSP would alleviate this constraint. This option is not viable as the GTs are already the highest rating NGED uses on the network as standard. Utilising non-standard equipment creates a number of issues, such as finding replacements if serious faults occur.

Option 2 – Install a third 132/33 kV GT at Derby BSP

Viable

Capacity released for constraint(s) considered: Dependent on N-2 restoration

New limiting factor for constraint(s) considered: N-2 group capacity

Detailed description: Installing a third 132/33 kV GT at Derby BSP (rated to match the existing GTs) would free up significant GT capacity for the 33 kV network at Derby BSP. One option for accommodating this new GT would be to build a cross-bay, leaving the option to feed the new GT from a new 132 kV circuit into Derby BSP if that was built at some point in the future (as discussed in Section 2.9 of this report). The new limiting factor becomes the N-2 restoration capacity of the group from Derby South BSP.

Option 3 – Transfer demand away from Derby BSP 33 kV

Viable

Capacity released for constraint(s) considered: Dependent on primary transferred

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

Detailed description: Transferring demand out of Derby BSP's 33 kV network could be used to resolve this constraint in the short term. This could be done in two ways; using the existing interconnection or by building new circuits to one of the three primaries (Chaddesden, Darley Abbey and Mackworth).

The only existing interconnection out of the 33 kV network fed from Derby BSP is to Derby South via two primaries. Of these two the circuits via the second primary are more suitable for potential transfers as less of the circuit capacity is taken up by the primary (around 2.5 MW split across the two circuits for one of the primaries as opposed to 10 MW rising to 16 MW by 2034 for the other primary). The circuits from Derby South via the first primary could be joined to the circuits to one of the primaries currently fed from Derby to pick it up. This would only require some 33 kV cable within Derby substation, so would be relatively inexpensive. However, by 2034 the demands Chaddesden and Darley Abbey are both projected to be 22 MW which puts them near to the capacity of the interconnection so this transfer may not be a long term solution unless forecasts change (the demand at Mackworth is projected to grow even faster to 28 MW by 2034).

Building new 33 kV interconnection would be a more costly but more permanent method of transferring a primary out of Derby BSP. Mackworth and Chaddesden are both possible candidates for transfer as they are 5.5 km and 3.5 km from Derby South and Spondon BSPs respectively (both of which have headroom to accept the additional demand). Mackworth is much less suitable than Chaddesden as the circuits required would need to be significantly longer, and its 33 kV circuits are already rated high enough to allow the capacity of its 20/40 MVA transformers to be fully utilised (so building new 33 kV circuits to the primary would serve limited benefit for the primary itself). This leaves Chaddesden as the only real option (although no constraints have been identified in the Derby and Derby South 33 kV report, the site is near to its firm capacity by 2034).The additional cost of laying cables back to Spondon to transfer Chaddesden would need to be weighed against the value of deferring the reinforcement of Derby BSP. Darley Abbey primary is not as suitable for transfer as it is significantly further from any other BSP and has ample capacity on the existing infeeds. New circuits to any primary would need to be underground cable as the area is very urban (near Derby city centre) and would be dependent on finding suitable cable routes.

Transferring demand permanently out of Derby BSP would reduce the group load, reducing the N-2 restoration requirements for the group. If the existing interconnection were utilised for transfers then this would have either no benefit or would be detrimental as it would use up two of the 33 kV circuits to Derby South which are the main method of restoration (as discussed in Section 2.9 of this report). 11 kV transfers have not been considered as part of this study, but could possibly be used to deload Derby 33 kV slightly or to deload one of the primaries enough that it could be transferred using the existing interconnection for longer. Building new 33 kV circuits would also benefit the security of supply for the transferred primaries as they could be kept on two circuits for an arranged outage on the infeed from one BSP (likely only possible for outages in certain seasons as otherwise the original constraint would be recreated).

Option 4 – Restrict outage seasons

Viable

Capacity released for constraint(s) considered: The demand of a primary fed from Spondon BSP which can be transferred into Derby BSP

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

Detailed description: Restricting any outages which transfer a primary into Derby BSP to summer (or leaving this primary on single circuit risk within Derby South BSP for outages in other seasons) would help in managing this constraint in 2028. This solution would not be sufficient alone to manage the constraint in 2028 as there are overloads seen for N-1 faults in intermediate cool. By 2034 these N-1 faults also cause overloads in intermediate warm, meaning this is not a long term solution.

Option 5 – Review seasonal ratings

Viable

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

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

Detailed description: N-1 fault outages are only seen in 2028 for intermediate cool, and in 2034 for intermediate warm and 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/warm ratings (which may be overly pessimistic). This solution is dependent on an internal review and would not be a long term solution.

Option 6 – Procure flexibility under Derby BSP

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 132/33 kV GTs at Derby BSP. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

A number of viable short term strategies have been identified to manage this constraint in 2028 and 2034 (demand transfers using the existing or new 33 kV interconnection, restricting outages, reviewing the transformer ratings and procuring flexibility services). Over the long term the optimal solution identified is to install a third 132/33 kV GT at Derby BSP.

2.8 Derby BSP 132/11 kV GT 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
Derby BSP GT1B or GT2B Overload	Either Willington – Derby 132 kV circuit fault	None	-	2034	-	-
Derby BSP GT1B or GT2B Overload	Either Derby 132/11 kV GT arranged outage	None	-	2034	-	-

Uncertainty under other Distribution Future Energy Scenarios: This constraint occurs for other seasons in 2034 for Consumer Transformation. Intervention is not triggered by 2034 for the other three DFES scenarios (Leading the Way, System Transformation and Falling Short).

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	Uprate the 132/11 kV GTs at Derby BSP.
2	Install a third 132/11 kV GT at Derby BSP.
Operational Mitigation	
3	Demand transfers.
4	Review seasonal ratings.
Flexibility Services	
5	Procure flexibility under Derby 11 kV.

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 132/11 kV GTs at Derby BSP

Discounted

Capacity released for constraint(s) considered: N/A

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

Detailed description: Uprating the 132/11 kV GTs at Derby BSP would alleviate this constraint. This option is not viable as the GTs are already the highest rating NGED uses on the network as standard. Utilising non-standard equipment creates a number of issues, such as finding replacements if serious faults occur.

Option 2 – Install a third 132/11 kV GT at Derby BSP

Viable

Capacity released for constraint(s) considered: Dependent on N-2 restoration

New limiting factor for constraint(s) considered: N-2 group capacity

Detailed description: Installing a third 132/11 kV GT at Derby BSP (rated to match the existing GTs) would free up significant GT capacity for the 11 kV network at Derby BSP. One option for accommodating this new GT would be to build a cross-bay, leaving the option to feed the new GT from a new 132 kV circuit into Derby BSP if that was built at some point in the future (as discussed in Section 2.9 of this report). The new limiting factor becomes the N-2 restoration capacity of the group from Derby South BSP (on the 33 kV side of Derby BSP).

Option 3 – Demand transfers

Discounted

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

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

Detailed description: Demand transfers are likely not possible as any transfers at 11 kV would need to be onto one of the primaries fed from Derby 33 kV which would exacerbate the constraint described in Section 2.7 of this report. However, by installing a third 132/11 kV capacity could be created which could be used to deload the 33 kV network. The inverse is also possible, with the installation of a new 132/33 kV potentially creating capacity which could be used to deload the 11 kV. A full 11 kV study would be required to assess the viability and magnitude of any possible transfers.

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 – Procure flexibility under Derby 11 kV

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 132/11 kV GTs at Derby BSP. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

A number of viable short term strategies have been identified to manage this constraint in 2034 (reviewing the transformer ratings and procuring flexibility services). Over the long term the optimal solution identified is to install a third 132/11 kV GT at Derby BSP.

2.9 Derby BSP N-2

Constraint Overview

Generation | **Demand**

The table below shows the projected growth in group load between now and 2034 under the Best View scenario.

Table 2.9.1 N-2 condition and group load forecasts

Constraint	N-1 Condition	Subsequent N-2 Condition	Group load			
			Baseline	2025	2028	2034
N-2 restoration requirements	Arranged outage on either 132 kV circuit to Derby BSP	Fault on the remaining 132 kV circuit to Derby BSP	80 MW	137 MW	150 MW	164 MW

Uncertainty under other Distribution Future Energy Scenarios: The group load is set to grow faster for the higher growth scenarios (Leading the Way and Consumer Transformation) and slower under the lower growth scenarios (System Transformation and Falling Short). The group load exceeds 100 MW by 2034 under every scenario, but the N-2 restoration requirements vary in magnitude.

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	Install a third 132 kV circuit from Willington GSP to Derby BSP.
2	Install a third 132 kV circuit from Derby South or Spondon BSP to Derby BSP.
Operational Mitigation	
3	Utilise the 33 kV interconnection to Derby South BSP.
Flexibility Services	
4	Procure flexibility under Derby 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 132 kV circuit from Willington GSP to Derby BSP

Viable

Capacity released for constraint(s) considered: 210 MVA of N-2 restoration

New limiting factor for constraint(s) considered: 132 kV circuit and GT ratings

Detailed description: Installing a third 132 kV circuit to Derby BSP from Willington GSP would allow the group to be kept on supply for an N-2 condition on two of the 132 kV circuits (up to a group demand of around 210 MW assuming a unity power factor, as the limiting factor becomes the rating of the existing 132 kV circuits). This would require at least 11 km of 132 kV circuit to be installed (subject to detailed route investigation and land rights), which will likely be predominantly underground cable as the route will need to be through a significant length of urban area in Derby city centre. This solution would likely be high cost but releases significant capacity and would help facilitate the third 132/33 kV GT at Derby BSP.

Option 2 – Install a third 132 kV circuit from Derby South or Spondon BSP to Derby BSP

Viable

Capacity released for constraint(s) considered: 190 MVA of N-2 restoration

New limiting factor for constraint(s) considered: 132 kV circuit to Derby South GT3

Detailed description: The two closest BSPs to Derby BSP are Derby South and Spondon (around 4.5 km and 5.5 km respectively). A third circuit to Derby BSP could be built from either of these two BSPs to support Derby South under N-2 conditions. This would require significantly less circuit works than a circuit all the way from Willington GSP (but would still be dependent on finding a viable route through Derby city centre).

Of the two BSPs Derby South is a better candidate for 132 kV interconnection with Derby BSP than Spondon, as it is around 1 km closer and there is less network between Willington GSP and Derby South. Additionally, a cable from Derby South would not have to cross the river Derwent. The circuit from Derby South BSP would ideally connect to the main 3 132 kV busbar as the circuit to GT3 is rated higher than the circuit to GT4 on the AY-route (190 MVA in winter), and connecting to this side of Derby South is preferable as the GT1/2 side is constrained as discussed in Section 2.3 of this report).

Interconnection with Derby South would be cheaper than building a new circuit all the way back to Willington GSP but has two drawbacks:

- This interconnection would be unsuitable for feeding possible third GTs at Derby BSP which may be required as discussed as an option in Section 2.7 and Section 2.8 of this report (but this may not be an issue if a cross-bay were used).
- 20 MVA less of N-2 restoration capacity would be created, however this may not be an issue as along with the existing 33 kV interconnection (described in option 3 below) the group load all the way to 2050 under Best View could likely still be restored.

Option 3 – Utilise the 33 kV interconnection to Derby South BSP

Viable

Capacity released for constraint(s) considered: Up to around 60 MVA

New limiting factor for constraint(s) considered: 33 kV interconnection to Derby South BSP

Detailed description: The only 33 kV interconnection to Derby BSP is with Derby South BSP. Two primary substations are fed from Derby South BSP and have two 33 kV feeds from Derby BSP as well. Each of these circuits is rated to around 25 MVA (winter cyclic). If run parallel this would provide roughly 75 MVA of circuit capacity minus the load on the two primaries (which currently totals around 12 MVA). There is sufficient capacity on both sides of Derby South BSP to facilitate this restoration. This solution is sufficient to provide the N-2 restoration capacity required by Engineering Recommendation P2 at Derby BSP up to 2034 (55 MW) but is not an enduring solution.

If Chaddesden primary were transferred to Spondon BSP as suggested as an option in Section 2.8 of this report this would create even more 33 kV interconnection out of Derby BSP which could be utilised for restoration for an N-2 outage on the two 132 kV circuits to Derby BSP.

Option 4 – Procure flexibility under Derby BSP

Viable

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

Detailed description: Flexibility is not suitable to manage this constraint directly as it is a security of supply requirement. Flexibility cannot be used to reduce the class of supply of a group, and the level of flexibility required would not be economical regardless. Flexibility could however be used to facilitate transfers at 33 kV (such as those outlined in option 3) which are used to restore demand for N-2 outages. Any flexibility used to manage constraints on the GTs at Derby BSP could affect the timelines for the solutions to this constraint by deferring those reinforcement works.

Solution Recommendation

Up to 2034 the group load of Derby BSP should be manageable using the existing network as described in option 3 above. Beyond then the option which adds the most capacity is to install a third 132 kV circuit into the group (from either Willington or Derby South, with a direct circuit from Willington GSP being the more expensive option but having a number of network benefits over a circuit from Derby South BSP). Either of these circuits would need to be 132 kV cable (with the possible exception of the first stretch out of Willington GSP) and would be subject to finding a suitable route into Derby city centre. This option may be the required solution in the very long term but there are a number of more cost effective potential solutions for the short-medium term, namely transferring Chaddesden primary as discussed as an option in Section 2.7 of this report.

The solutions for the constraints on the 132/33 kV GTs, the 132/11 kV GTs and the N-2 restoration of Derby BSP will all need to be considered together because as discussed the options for resolving each constraint overlap and in some cases contradict each other.

2.10 Stanton BSP GT 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
Stanton BSP GT1 or GT2 Overload	Either Spondon – Stanton 132 kV circuit fault	None	-	2034	-	-
Stanton BSP GT1 or GT2 Overload	Either Stanton GT arranged outage	None	-	2034	-	-

Uncertainty under other Distribution Future Energy Scenarios: This constraint occurs for other seasons in 2034 for the higher growth scenarios (Leading the Way and Consumer Transformation). Overloads are not observed by 2034 for 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 2.10.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Uprate the GTs at Stanton BSP.
2	Install a third GT at Stanton BSP.
Operational Mitigation	
3	Transfer Sandiacre primary into Toton BSP.
4	Review seasonal ratings.
Flexibility Services	
5	Procure flexibility under Stanton BSP.

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full CBA. This CBA will be subsequently carried out by the DNO to determine the optimal reinforcement solution, which will then be tested against market provided flexibility by the DSO as part of the DNOA process.

Option 1 – Uprate the GTs at Stanton BSP

Viable

Capacity released for constraint(s) considered: 39 MVA

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

Detailed description: Uprating the GTs at Stanton BSP to 60/90/117 MVA units would release significant demand and generation capacity at the BSP and resolve this constraint. The 132 kV circuits to Stanton BSP are already rated higher than the proposed GT size, so will not need to be uprated and will not be a limiting factor (provided Heanor BSP is transferred to Staythorpe GSP as discussed in Section 2.3 of this report). This would also benefit the condition of the GTs as the existing units are almost 60 years old.

Option 2 – Install a third GT at Stanton BSP

Discounted

Capacity released for constraint(s) considered: Up to 78 MVA

New limiting factor for constraint(s) considered: Existing GT ratings

Detailed description: Installing a third GT at Stanton BSP would free up significant GT capacity. This would require either a new 132 kV circuit to be built to Stanton BSP, or a cross-bay to be set up (both of which would be expensive solutions). As the existing GTs are almost 60 years old they will likely need replacing in the near future regardless, making this option a strategically poor decision compared with option 1.

Option 3 – Transfer Sandiacre primary into Toton BSP

Viable

Capacity released for constraint(s) considered: Demand of Sandiacre primary

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

Detailed description: Transferring Sandiacre primary to be fed from Toton BSP permanently would reduce the loading on Stanton BSP by about 14 MVA in 2034, deferring this constraint. This would not reduce the 33 kV circuit capacity or demand security at Sandiacre primary as there are two circuits from Toton BSP to Sandiacre primary. The implications of this transfer are discussed in the Toton 33 kV 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 – Procure flexibility under Stanton BSP

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 GTs at Stanton BSP. If Sandiacre primary were transferred into Toton BSP (as suggested as a possibility in option 3) and this created a constraint at Toton BSP then that constraint could then be managed using flexibility. The viability of utilising flexibility at either Stanton or Toton BSP will be further investigated as part of the DNOA process.

Solution Recommendation

A number of viable short term strategies have been identified to manage this constraint in 2034 (transferring Sandiacre primary, reviewing the transformer ratings and procuring flexibility services). Over the long term the optimal solution identified is to uprate the existing GTs at Stanton BSP to 60/90/117 MVA units.

2.11 Stanton / Heanor N-2

Constraint Overview

Generation | Demand

The table below shows the projected growth in group load between now and 2034 under the Best View scenario.

Table 2.11.1 N-2 condition and group load forecasts

Constraint	N-1 Condition	Subsequent N-2 Condition	Group load			
			Baseline	2025	2028	2034
N-2 restoration requirements	Arranged outage on either 132 kV circuit to Stanton and Heanor BSPs	Fault on the remaining 132 kV circuit to Stanton and Heanor BSPs	105 MW	111 MW	123 MW	144 MW

Uncertainty under other Distribution Future Energy Scenarios: The group load is set to grow faster for the higher growth scenarios (Leading the Way and Consumer Transformation) and slower under the lower growth scenarios (System Transformation and Falling Short). The group load exceeds 100 MW by 2034 under every scenario, but the N-2 restoration requirements vary in magnitude.

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 132 kV circuit from Spondon BSP to Stanton and Heanor BSPs.
2	Establish a new GSP.
Operational Mitigation	
3	Utilise the 33 kV interconnection at Stanton and Heanor BSPs.
4	Split the demand group by transferring Heanor BSP to Staythorpe GSP.
Flexibility Services	
5	Procure flexibility under Stanton and Heanor BSPs.

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 132 kV circuit from Spondon BSP to Stanton and Heanor BSPs

Discounted

Capacity released for constraint(s) considered: Demand of Heanor or Stanton BSP

New limiting factor for constraint(s) considered: 132 kV circuits from Derby South to Spondon

Detailed description: Installing a third 132 kV circuit to Stanton or Heanor BSPs from Stanton GSP would create additional N-2 restoration capacity for this group, ensuring security of supply is maintained. The existing 132 kV circuits to Stanton BSP are around 10 km and the existing 132 kV circuits to Heanor BSP are around 17 km, so taking a third circuit to either BSP would be prohibitively expensive given the viability of a number of cheaper options discussed below.

Option 2 – Establish a new GSP

Viable

Capacity released for constraint(s) considered: The demand of Stanton and Heanor BSPs

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

Detailed description: By establishing a new GSP geographically between Willington and Chesterfield GSPs, Stanton and Heanor BSPs could be transferred out of Willington GSP. This would significantly increase security of supply for the area. N-2 restoration capacity for the new GSP (even with only two SGTs) would not be a limiting factor as it would have significant interconnection at 132 kV to three existing GSPs (Willington, Chesterfield and Staythorpe).

The possibility of creating a new GSP in this area is likely to be a good strategic choice for the network if it can be achieved. This option would also alleviate a number of other constraints as discussed in Section 2.3 and Section 2.12 of this report.

Option 3 – Utilise the 33 kV interconnection at Stanton and Heanor BSPs

Viable

Capacity released for constraint(s) considered: Demand of various primaries

New limiting factor for constraint(s) considered: 33 kV interconnection to various BSPs

Detailed description: Heanor BSP is interconnected at 33 kV with Alfreton BSP via Denby primary, with Annesley BSP via Westwood primary and with Spondon BSP via Belper and Morley primaries. Stanton BSP is interconnected with Toton BSP via Sandiacre primary. These interconnectors can be utilised to restore demand for N-2 outages. This option is suitable to provide N-2 restoration capacity in the short term but is dependent on capacity being available at Alfreton, Annesley, Spondon and Toton BSPs (see relevant 33 kV reports). The permanent transfer of Sandiacre primary to Toton BSP which is discussed as an option in Section 2.10 of this report would reduce the group load of Stanton and Heanor but would also use up some of the transfer capacity out of the group so the benefits of this option with regards to N-2 restoration are limited.

Option 4 – Split the demand group by transferring Heanor BSP to Staythorpe GSP

Viable

Capacity released for constraint(s) considered: Demand of Stanton BSP

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

Detailed description: A normal open point could be created at Loscoe Switching Station, transferring Heanor BSP into Staythorpe GSP. This would split the group such that there are no N-2 restoration requirements as neither group exceeds 100 MW in the near future (in 2034 Stanton BSP’s group demand is forecast to be 64 MW and Heanor’s group demand is forecast to be 80 MW). This solution also creates additional circuit capacity for both BSPs. This solution is triggered by a constraint on the Willington – Derby South – Spondon 132 kV circuits as discussed in Section 2.3 of this report so will be the long term solution for this group, but is not possible without freeing up SGT capacity at Staythorpe GSP (see Staythorpe 132 kV report for more details on how this could be achieved). Other options may therefore be required to manage the N-2 restoration capacity of the group in the interim.

At present the network can be split at Loscoe Switching Station during arranged outages on the 132 kV circuits from Spondon BSP, with Heanor BSP fed from Staythorpe GSP. This allows Heanor BSP to be kept on supply for the N-2 loss of both 132 kV circuits from Spondon, but is dependent on SGT capacity being available at Staythorpe GSP as for the permanent transfer discussed above.

Option 5 – Procure flexibility under Stanton and Heanor BSPs

Viable

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

Detailed description: Flexibility is not suitable to manage this constraint directly as it is a security of supply requirement. Flexibility cannot be used to reduce the class of supply of a group, and the level of flexibility required would not be economical regardless. Flexibility could however be used to facilitate transfers at 33 kV which are used to restore demand for N-2 outages.

Solution Recommendation

Splitting the group by transferring Heanor BSP into Staythorpe GSP is the optimal long term solution (which is strategically advantageous as this solution is being triggered by another constraint regardless), unless a new GSP is established. 33 kV transfers could be used to support the group for N-2 events (whether the group is split or not).

2.12 Spondon – Stanton 132 kV Circuit Complexity

Constraint Overview

Generation | Demand

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

Table 2.12.1 ends and addresses with accepted schemes

Constraint	Asset	Making dead		Protection clearance		Isolating	
		Sites	Ends	Sites	Ends	Sites	Ends
Complexity of 132 kV circuit under P18 (Heanor in Willington)	132 kV circuit from Spondon CB605 to Stanton and Heanor BSPs	4	4	5	5	4	4
Complexity of 132 kV circuit under P18 (Heanor in Staythorpe)	132 kV circuit from Spondon CB605 to Stanton and Heanor BSPs	4	4	4	4	4	5

Uncertainty under other Distribution Future Energy Scenarios: The level of load growth seen in each scenario will not affect this constraint as it is a complexity issue.

Solution Options

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

Table 2.12.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Install a 132 kV circuit from Spondon A to one of the generators.
2	Establish a new GSP.
Operational Mitigation	
2	Transfer Heanor BSP into Staythorpe GSP.
Other	
3	P18 derogation.

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full CBA. This CBA will be subsequently carried out by the DNO to determine the optimal reinforcement solution.

Option 1 – Install a 132 kV circuit from Spondon A to one of the generators

Discounted

Capacity released for constraint(s) considered: Resolves P18 issue

New limiting factor for constraint(s) considered: None

Detailed description: Installing a dedicated 132 kV circuit from Spondon A to one of the accepted generator sites would resolve this constraint by removing a site from one of the existing circuits, bringing the total sites for protection clearance under P18 to four. This would maintain compliance, but would require significant 132 kV circuit works. This makes this option prohibitively expensive given the viability of option 2 discussed below.

Option 2 – Establish a new GSP

Viable

Capacity released for constraint(s) considered: The demand of Stanton and Heanor BSPs

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

Detailed description: By establishing a new GSP geographically between Willington and Chesterfield GSPs, Stanton and Heanor BSPs could be transferred out of Willington GSP. This would also allow nearby connections to be transferred directly into a new GSP. It would also free up addresses by splitting the existing circuits into three outgoing 132 kV dual circuits.

The possibility of creating a new GSP in this area is likely to be a good strategic choice for the network if it can be achieved. This option would also alleviate a number of other constraints as discussed in Section 2.3 and Section 2.11 of this report.

Option 3 – Transfer Heanor BSP into Staythorpe GSP

Viable

Capacity released for constraint(s) considered: Resolves P18 issue

New limiting factor for constraint(s) considered: None

Detailed description: By transferring Heanor BSP into Staythorpe GSP and creating a normal open point at Loscoe the number of sites with circuit breakers required to operate would be reduced to four. The number of points of isolation would increase to five as Loscoe would now be included, but the total sites for isolation would remain four as one of the generators is within walking distance of Loscoe and is therefore considered as one site.

Option 4 – P18 derogation

Discounted

Capacity released for constraint(s) considered: N/A

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

Detailed description: If all of the accepted generators were connected without any intervention (and Heanor BSP was still being fed from Staythorpe GSP under normal running arrangements) then the total sites for protection clearance would be five. This would put NGED in breach of restriction A2 under Engineering Recommendation P18, necessitating a derogation. As this would put NGED in breach if its licence conditions, this option is not viable.

Solution Recommendation

As the transfer of Heanor BSP into Staythorpe GSP has been triggered by a number of other constraints outlined in Section 2.3 and Section 2.11 of this report this option is deemed the most strategic solution (unless a new GSP in the area is progressed), obviating the need for the large expenditure required under option 1 and the breach of licence condition incurred under option 3.