Ratcliffe GSP

Network Development Report – East Midlands

May 2024

Electricity Distribution

nationalgrid

Contents

Ratcliffe 132 kV

1. Network Overview

Ratcliffe Grid Supply Point (GSP) supplies six Bulk Supply Points (BSPs) in National Grid Electricity Distribution's (NGED's) East Midlands licence area in South Nottinghamshire and North Leicestershire. These six BSPs are: Clifton Fairham, Loughborough, Nottingham, Nottingham North 11 kV, Toton and Willoughby.

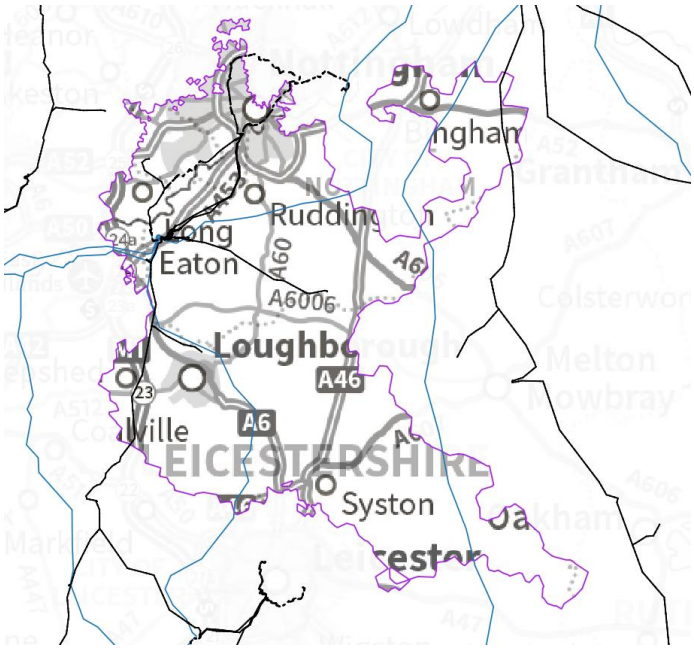

Figure 1.1 Ratcliffe GSP geographic network coverage

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

Loughborough, Toton and Willoughby BSPs are each fed from Ratcliffe GSP via three separate 132 kV dual circuits. The dual circuits to Loughborough and Toton have tees off which continue on to Coalville and Nottingham BSPs respectively. All three BSPs have two 132/33 kV Grid Transformers (GTs) feeding two 33 kV busbars. Loughborough BSP also has two 132/11 kV GTs.

Nottingham BSP is supplied via two 132 kV dual circuits from Ratcliffe (one of which Clifton Fairham BSP is teed off). There are three other 132 kV dual circuits from Nottingham BSP; one which feeds the 132/11 kV GTs at Nottingham North, one to Nottingham East, and the circuits which supply Toton BSP mentioned above. Nottingham North has also has two 132/33 kV GTs which are supplied from Stoke Bardolph GSP. Nottingham BSP itself has four 132/33 kV GTs feeding onto five 33 kV busbars.

Ratcliffe is interconnected with two other GSPs at 132 kV via the aforementioned circuits to Coalville, Nottingham North and Nottingham East BSPs (which interconnect Ratcliffe with Enderby in the case of Coalville, and Stoke Bardolph in the case of Nottingham North and Nottingham East). All of these points of interconnection are via normal open points at the three BSPs (Ratcliffe is not run in parallel with any other GSPs). Ratcliffe itself has four 400/132 kV super grid transformers (SGTs) feeding onto four 132 kV busbars. The site is run on a 2 + 2 section split under normal running arrangements. There are also two 132/11 kV GTs at Ratcliffe itself supplying the power station.

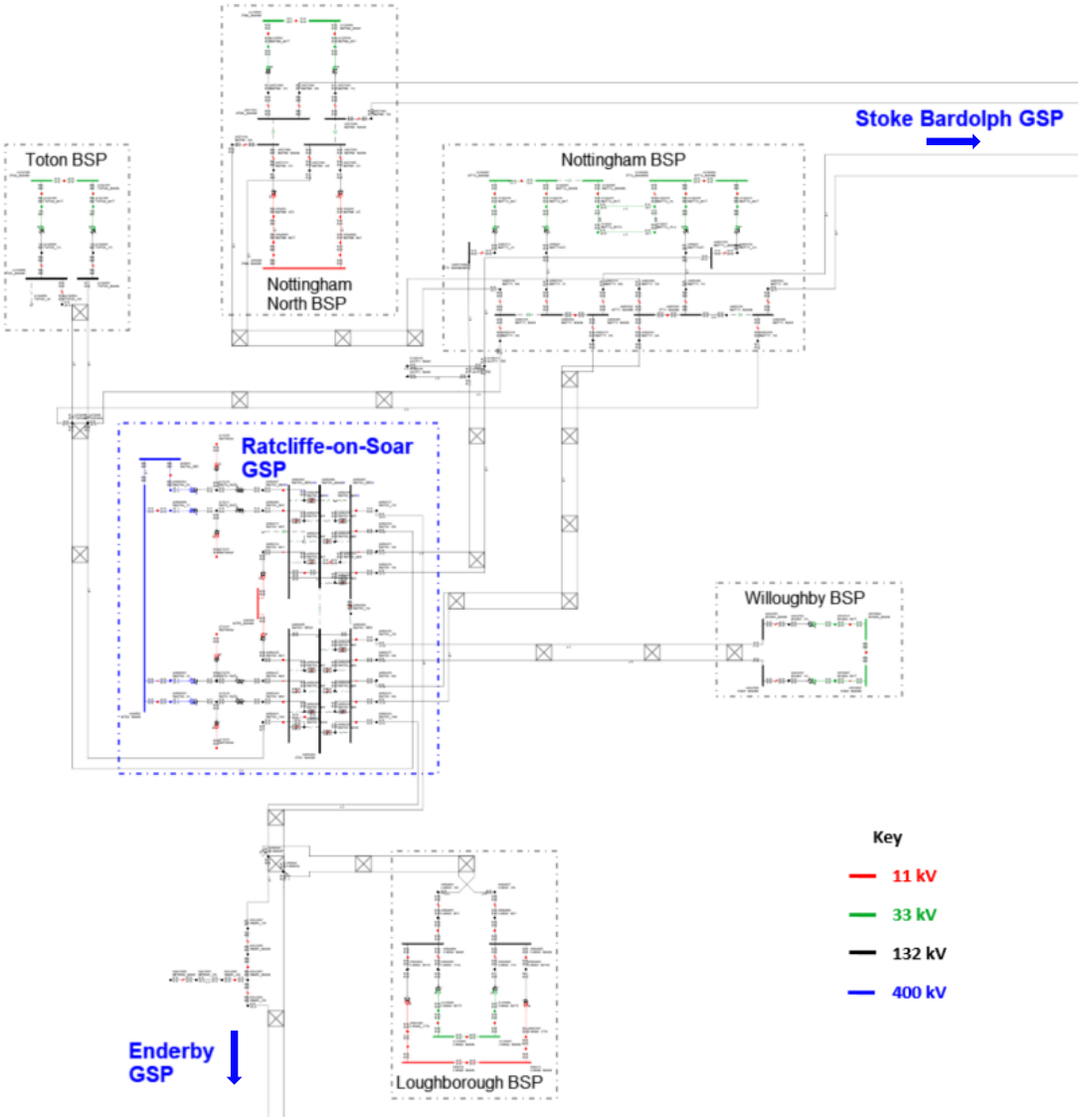

Figure 1.1.1 Ratcliffe 132 kV network single line diagram

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.

- Arranged outages on the 132 kV busbars at Ratcliffe GSP are modelled such that circuits are secured onto in service busbars.
- Coalville BSP and Hinckley 11 kV are transferred to Ratcliffe GSP for arranged outages on any of the SGTs at Enderby GSP.
- For various arranged outages on the Stoke Bardolph network, both of its BSPs are transferred into Ratcliffe GSP. Nottingham North is transferred by paralleling the 33 kV side with the 11 kV side fed from Ratcliffe, and Nottingham East is transferred by closing the 132 kV normal open points to Nottingham BSP. Nottingham North 33 kV is also transferred to Ratcliffe for outages on either 132 kV circuit between Nottingham East and Nottingham North.
- For arranged outages on any SGT at Ratcliffe, the site is moved to a coupler split by closing CB120 and disconnector 169, and opening CB130 and CB230.
- The 33 kV and 11 kV networks downstream of the BSPs fed from Ratcliffe 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 Ratcliffe GSP under arranged outages, the lower voltage side circuit breaker is opened to prevent back-energisation. For Loughborough BSP, this also involves opening the LV circuit breaker for the 132/11 kV GT for outages on the 132/33 kV GT on the same side of Loughborough (and vice versa).

2. Network Constraints and Solution Options

2.1 Summary of Network Constraints

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

- Various N-2 outages at Nottingham BSP could lead to overloads on the GTs at Nottingham BSP. These can be managed operationally, but the configuration of the 33 kV network restricts growth, and by 2034 overloads are projected for N-1 outages.
- The GTs at, and 132 kV circuits to Willoughby BSP are projected to be constrained for both demand and generation by 2028 (for arranged or fault outages on either GT).
- For an arranged outage on any of the SGTs at Enderby GSP, which triggers the transfer of Coalville and Hinckley 11 kV BSPs into Ratcliffe GSP, followed by a fault on either 132 kV circuit from Ratcliffe, sections of the remaining circuit could overload.
- Overloads are projected on the SGTs at Ratcliffe GSP for various N-1 and N-2 outage conditions.

2.2 Nottingham BSP GT overloads

Constraint Overview

Generation **Demand**

The table below outlines the nature of the network constraints identified in the network analysis. Constraints are also observed on the 33 kV interconnecting circuits between the two halves of Nottingham for various N-2 outages.

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
Nottingham BSP GT overloads	Arranged outage on a Nottingham GT	Fault on a second GT	Baseline	Baseline	Baseline	2028
Nottingham BSP GT1 or GT2 overloads	Arranged or fault outage on GT1 or GT2	None	2034	2034	2034	-
Nottingham BSP GT3 or GT4 overloads	Arranged or fault outage on GT3 or GT4	None	-	2034	-	-

Uncertainty under other Distribution Future Energy Scenarios: Demand growth at Nottingham BSP is high enough to trigger intervention regardless of scenario. Under the higher growth scenarios (Leading the Way and Consumer Transformation), very high long term growth is forecast at Nottingham which could necessitate reinforcement beyond that which is proposed in the options below.

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	Rationalise Nottingham BSP.
2	Build a new BSP.
Operational Mitigation	
3	Various operational mitigations.
Flexibility Services	
4	Procure flexibility under Nottingham BSP.

Solution Development

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

Option 1 – Rationalise Nottingham BSP

Viable

Capacity released for constraint(s) considered: Dependent on the load balance at Nottingham BSP

New limiting factor for constraint(s) considered: GT ratings on either half of Nottingham BSP

Detailed description: The existing 33 kV configuration of Nottingham BSP restricts the capacity of the site to less than the full rating of the four 132/33 kV GTs. This is due to both how the 33 kV network is configured and demand split across the BSP, and the ratings of the 33 kV interconnecting circuits between the two halves of the BSP.

In order to be able to fully utilise the ratings of the GTs at Nottingham BSP, the site would need to be rationalised, with circuits moved to create two separate BSPs. Each side would have two GTs and a firm capacity of 114 MVA. The new configuration of the outgoing 33 kV circuits would be chosen to balance load between the two halves of Nottingham BSP (both at present and based on future demand projections).

Rationalising Nottingham BSP would not only free up demand capacity at the site, it would also significantly improve network operability, and allow the site to better support nearby BSPs (most notably Nottingham East BSP as discussed in the Stoke Bardolph 132 kV and Nottingham Group 33 kV reports). However, this option alone is insufficient to fully accommodate the long term demand growth projected for the area.

Option 2 – Build a new BSP

Viable

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

New limiting factor for constraint(s) considered: Dependent on primaries transferred to the new BSP (potentially Clifton and West Bridgford primaries)

Detailed description: A new BSP could be built nearby to deload Nottingham BSP and help alleviate this constraint. A new BSP to the north of Nottingham BSP is likely not feasible due to how difficult it would be to find a viable site in the centre of Nottingham (aside from the 132 kV circuit works that would also be required to supply it). A new BSP to the south of Nottingham BSP is discussed as a possibility in the Nottingham Group 33 kV report. This new BSP would be able to significantly deload Nottingham BSP by picking up West Bridgford and Clifton primaries, both of which are highly loaded and projected to grow substantially in the future. A new primary substation could also be established local to the new BSP, to deload Clifton and West Bridgford primaries.

A new BSP to the south of Nottingham would create much needed capacity to the south of the river Trent. It could be supplied from one of the dual 132 kV circuits from Ratcliffe GSP (being located either at the circuits or nearby). By transferring a sizeable amount of demand away from Nottingham, this option would support the area on an enduring basis. It would also allow Nottingham BSP to further support the other two BSPs in the Nottingham group. This option is contingent on a suitable site being located.

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: In order to mitigate against constraints for N-2 outages there are a number of ways the 33 kV network downstream of Nottingham can be split. The network can be managed at present in this way, with the potential to also restrict outages to certain seasons also an option to alleviate constraints for N-2 conditions. A review of seasonal transformer ratings could also defer this constraint slightly (as the most onerous constraints identified are for intermediate cool peak demand).

As demand at Nottingham grows it will become more difficult to manage the network, with a particular restriction being the ratings of the 33 kV circuits between the two halves of Nottingham BSP (as noted in option 1 above). These circuits, along with the overall configuration of the 33 kV network mean that managing the network operationally will not be sufficient in the long term.

Option 4 – Procure flexibility under Nottingham 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 Nottingham BSP. This could be used in conjunction with the operational mitigation options discussed above. Flexibility would, however, not provide the network operability benefits conferred by rationalising Nottingham BSP, or the benefits for the 33 kV network conferred by a new BSP. The possibility of utilising flexibility will be assessed as part of the DNOA process.

Solution Recommendation

The optimal initial reinforcement solution to this constraint, to add capacity to Nottingham BSP, would be to rationalise the site and effectively create two BSPs, each with two 132/33 kV GTs, by moving 33 kV circuits. This would also improve network operability. In the longer term, a new BSP in the area is likely to be required, which could be located to the south of Nottingham to support growth the other side of the river Trent. In the shorter term, various operational mitigation strategies have been discussed, as the most onerous constraints are for a number of N-2 outage conditions.

By adding capacity to Nottingham BSP, it would be better placed to support Nottingham East BSP (which is also projected to be constrained as discussed in the Stoke Bardolph 132 kV report). The three BSPs which supply Nottingham should be considered together to ensure the optimal method of adding capacity to the area is progressed (which is likely to begin with the rationalisation of Nottingham BSP, the benefits of which are highlighted above).

2.3 Willoughby BSP GT and 132 kV circuit overloads

Constraint Overview

Generation Demand

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

Table 2.3.1 constraint(s) and conditions under which constraint(s) occur

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
Demand			**Winter**	**Int Cool**	**Int Warm**	**Summer**
Willoughby GT1 or GT2 overload	Fault or arranged outage on either GT at Willoughby	None	2028	2028	2028	2028
Ratcliffe to Willoughby 132 kV circuit overloads	Fault or arranged outage on either 132 kV circuit	None	2028	2028	2028	2028
Generation			**Summer**			
Willoughby reverse power flow GT overload	Fault or arranged outage on either GT at Willoughby	None	2028			
Ratcliffe to Willoughby 132 kV circuit overloads	Fault or arranged outage on either 132 kV circuit	None	2028			

Uncertainty under other Distribution Future Energy Scenarios: Under every scenario, both demand and generation constraints are projected for Willoughby by 2028. In the short term, a large amount of this growth is driven by storage, but in the long term, high demand growth of all types is projected for every scenario.

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	Install additional GTs at Willoughby BSP.
2	Build a new BSP.
Operational Mitigation	
3	Load transfers.
4	Active Network Management.
Flexibility Services	
5	Procure flexibility under Willoughby 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 additional GTs at Willoughby BSP

Discounted

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

New limiting factor for constraint(s) considered: N-2 restoration capacity and 33 kV circuit capacity

Detailed description: Installing additional GTs at Willoughby BSP could be used to alleviate the constraints on the existing GTs for both demand and generation. A third 132/33 kV GT would be preferable to installing 132/11 kV GTs. The local 11 kV demand at Willoughby is not projected to grow to a level that would warrant the installation of 132/11 kV GTs, and they would not be suitable to add capacity to the primaries far from Willoughby, where most of the demand growth in the area is forecast (including Syston and Mountsorrel primaries).

New GTs at Willoughby BSP would not add any capacity to the site without also reinforcing the 132 kV circuits to the BSP (which are around 13 km in length). Even if this were carried out, the site would still be constrained for demand by both N-2 restoration capacity, and the severe thermal and voltage constraints on the 33 kV network to the south of Willoughby outlined in the Willoughby 33 kV report.

In the case of N-2 restoration capacity at Willoughby, some demand could be restored via interconnection to Hawton, Loughborough and Coalville BSPs. However, this interconnection is insufficient to support the site long term, based on the high demand growth for the area. New 33 kV circuits could be built to add interconnection, but this would require a significant length of new circuit. The only way to add enough N-2 restoration capacity to fully support Willoughby in the long term would be to build a new 132 kV infeed. This would be very difficult to achieve, as the site is over 12 km from Ratcliffe GSP, which itself does not have room to add any more 132 kV bays, and hardly any closer to any other 132 kV network.

The thermal and voltage constraints on the 33 kV circuits to the south of Willoughby would also be very expensive to resolve, as the majority of the demand growth on the BSP is located well over 10 km to the south. This, combined with the issues highlighted above, make it unlikely that adding capacity to Willoughby BSP is the most strategic choice for the area.

Option 2 – Build a new BSP

Viable

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

New limiting factor for constraint(s) considered: 33 kV transfer capacity to the new BSP

Detailed description: If a new BSP were built to the south of Willoughby, it could be used to deload the existing site, as well as help resolve the 33 kV constraints in the area. A new BSP anywhere to the north of Leicester would be far closer to the centre of the high demand growth forecast for the area than Willoughby itself. It would be hugely beneficial for adding much needed capacity to the area, with potential to also support Loughborough BSP and the Leicester group.

While there are clear network benefits to establishing a new BSP in the area around Mountsorrel or Syston, it would be very difficult to supply this BSP at 132 kV (as there is no existing 132 kV network in the area).

A new GSP in the area would have a number of benefits as discussed in the Enderby 132 kV report and Section 2.5 of this report. If these works were carried out, the new GSP could then be used to feed the new BSP. This option is early in the optioneering process, and the location of a potential new GSP would determine how feasible or expensive it would be to supply a new BSP in the appropriate location to properly support Willoughby.

Option 3 – Load transfers

Discounted

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

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

Detailed description: There is some 33 kV interconnection to other BSPs from Willoughby to Loughborough, Hawton and Melton Mowbray BSPs. No demand could be transferred into Loughborough without compromising security of supply (as there is only a single 33 kV circuit interconnecting the two BSPs). Moving the normal open points at Bingham and/or Old Dalby primaries would confer minimal benefit (as they would still need to be transferred back in for outages, and the demand at both primaries is relatively low). In the case of Bingham, any capacity moved into Hawton BSP would exacerbate the projected constraint on the GTs there (which is outlined in the Staythorpe 132 kV report). Any possible transfers of generation out of Willoughby would be equally insufficient to manage this constraint.

Option 4 – Active Network Management

Viable

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

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

Detailed description: Any additional connections downstream of Willoughby BSP could be included in an Active Network Management (ANM) scheme. ANM schemes are used to manage constraints on over-committed networks. This option could help manage the projected generation constraint at Willoughby, but not the projected thermal demand constraint (or the 33 kV voltage and N-2 restoration constraints).

Option 5 – Procure flexibility under Willoughby BSP

Viable

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

Detailed description: Flexibility services could be procured on the network supplied from Willoughby BSP to alleviate the projected demand overloads seen on the GTs. Flexibility would not be suitable for managing the reverse power flow constraint projected at Willoughby. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

While the most enduring and strategic reinforcement solution to support the area would be to build a new BSP to the south of Willoughby, this would be contingent on a number of factors (including finding an appropriate site and the location of a potential GSP in the area, which would be required to supply the new BSP). Even if this reinforcement is progressed without issue, it would be a lengthy process, meaning Willoughby would need to support itself in the short and medium term. This could potentially be aided by ANM on the generation side, and the use of flexibility on the demand side. A CBA could also need to be carried out with regards to the security of supply requirements for Willoughby BSP, as some of the demand growth is driven by storage.

2.4 Ratcliffe to Coalville 132 kV circuit overloads

Constraint Overview

Generation **Demand**

The table below outlines the nature of the network constraints identified in the network analysis. By 2034 slight generation overloads are also seen on one circuit. This has been excluded as it is far less onerous than the demand constraint, it does not change the overall reinforcement strategy and it could likely be mitigated using ANM.

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
Ratcliffe CB505 to the Loughborough tee 132 kV circuit overload	Arranged outage on any SGT at Enderby GSP	Fault on the 132 kV circuit from Ratcliffe CB705	Baseline	Baseline	Baseline	2028
Ratcliffe CB705 to the Loughborough tee 132 kV circuit overload	Arranged outage on any SGT at Enderby GSP	Fault on the 132 kV circuit from Ratcliffe CB505	2028	Baseline	2028	2028
Loughborough tee to Coalville 132 kV circuit overload	Arranged outage on any SGT at Enderby GSP	Fault on either Ratcliffe to Coalville 132 kV circuit	2028	2028	2028	2034

Uncertainty under other Distribution Future Energy Scenarios: High demand growth is forecast for all three of the BSPs which contribute to this constraint (Loughborough, Coalville and Hinckley 11 kV). Overall demand growth at Enderby GSP is also projected to be high, and as such the requirement for the transfer which triggers this constraint is not expected to disappear.

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 132 kV circuits between Ratcliffe to Coalville.
Operational Mitigation	
2	Alternative running arrangements.
Flexibility Services	
3	Procure flexibility under Loughborough, Coalville and Hinckley 11 kV BSPs.

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 132 kV circuits between Ratcliffe to Coalville

Viable

Capacity released for constraint(s) considered: Subject to an overhead line survey

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

Detailed description: The 132 kV circuits from Ratcliffe to the Loughborough tee, and from the Loughborough tee to Coalville, could be uprated to alleviate this constraint and allow this transfer to be carried out. The lowest rated section of these circuits is a section of 132 kV cable out of Ratcliffe GSP, which is limited by the fact that it is ducted in a number of places. Uprating these circuits would require around 2 km of new 132 kV cable, as well as directional drilling in a number of places and new cable sealing ends.

Even with the 132 kV cables between Ratcliffe and Loughborough uprated, the 132 kV overhead lines would become the next limiting factor. Assessments have been carried out to determine the viability of reconductoring the overhead lines, but this may necessitate significant tower works to avoid too much sag with heavier conductors. The ratings of the existing overhead lines could potentially be increased while retaining the existing conductors, but not by as much. A full rebuild of the 132 kV tower lines between Ratcliffe and Coalville would allow capacity to be increased substantially, but would be very expensive.

Option 2 – Alternative running arrangements

Viable

Capacity released for constraint(s) considered: Dependent on running arrangement utilised

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

Detailed description: A number of alternative running arrangements have been considered to mitigate this constraint. None are suitable to fully alleviate this constraint in the long term, but could potentially be utilised in the shorter term:

- Hinckley 11 kV could instead be transferred into Coventry GSP during outages at Enderby GSP (meaning its demand would not be added to the constrained circuits from Ratcliffe). The feasibility of this option is reduced by the fact that Coventry and Enderby GSPs are currently in different access groups. This transfer is also insufficient alone to manage this constraint, as studies show that overloads would still occur with only Coalville BSP transferred into Ratcliffe GSP.
- A small amount of demand could potentially be transferred out of Coalville BSP during this outage at 33 kV to Hinckley, Gresley and/or Spondon BSPs. These transfers become harder to achieve as demand at the primaries supplied from Coalville increases, and would not in isolation be sufficient to manage this constraint. Having to transfer demand at 33 kV in order to facilitate a BSP transfer is also not ideal from a network operability perspective.
- Coalville, Hinckley 11 kV and Loughborough BSPs could all be split during this transfer (either at 33 kV or their respective GTs) to prevent overloads for a subsequent fault. This would however significantly reduce security of supply for these BSPs, putting a large number of customer at single circuit risk.

Option 3 – Procure flexibility under Loughborough, Coalville and Hinckley 11 kV BSPs

Viable

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

Detailed description: Flexibility services are currently being procured in this area to support the network and facilitate this transfer. More information on this can be found in relevant scheme page published alongside the latest DNOA report.

Solution Recommendation

In the short term, the use of flexibility procurement and/or various alternative running arrangements could be used to manage the network until a more permanent reinforcement solution can be implemented. This reinforcement would likely involve uprating the existing 132 kV circuits between Ratcliffe and Coalville, starting with the limiting section of 132 kV cable coming out of Ratcliffe GSP.

In the long term, the requirement for this transfer could be alleviated by reinforcement at Enderby GSP and/or a new GSP being established in the area. Even considering this, the reinforcement of the 132 kV circuits would not be wasted, as it would ensure the network can be operated in the short to medium term and, in the long term, will still strengthen the interconnection between the two GSPs.

2.5 Ratcliffe GSP SGT 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
Ratcliffe GSP SGT overloads	Ratcliffe SGT arranged outage	Ratcliffe SGT fault	Baseline	Baseline	2028	2028
Ratcliffe GSP SGT overloads	Stoke Bardolph SGT arranged outage	Ratcliffe SGT fault	Baseline	Baseline	2028	2028
Ratcliffe GSP SGT3 or SGT4 overloads	Ratcliffe SGT4 or SGT3 fault	None	2028	2028	2034	-

Uncertainty under other Distribution Future Energy Scenarios: Demand growth for Ratcliffe GSP is much higher for Leading the Way and Consumer Transformation than for Best View. It should be noted that a major driver for investment in the area is to facilitate the connection of a number of large storage and generation sites.

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	Install a fifth 240 MVA SGT.
2	Install 460 MVA SGTs.
3	Establish a new GSP.
4	Reinforce Stoke Bardolph GSP.
Operational Mitigation	
5	Restrict outage seasons.
6	Utilise the short term ratings of the SGTs at Ratcliffe GSP.
Flexibility Services	
7	Procure flexibility under Ratcliffe GSP.

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.

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 (NGESO) to ensure the optimal solution for the whole system (considering both the distribution and transmission systems) is taken forward.

Option 1 – Install a fifth 240 MVA SGT

Viable

Capacity released for constraint(s) considered: 240 MVA

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

Detailed description: If a fifth SGT were installed at Ratcliffe GSP, rated to 240 MVA to match the existing units, it could support the existing SGTs during outages and faults, adding significant demand and generation capacity to the site. Due to fault levels at the site, it could not be run in parallel with the existing SGTs.

If it were set up on a swing arrangement, it would allow the new SGT to support both sides of Ratcliffe GSP, replacing any existing SGT for arranged or fault outages to maintain the 2 + 2 running arrangement and prevent overloads. If the installation of a new SGT at Ratcliffe GSP is possible, it would not be sufficient alone to add the capacity required long term for the area.

Option 2 – Install 460 MVA SGTs

Discounted

Capacity released for constraint(s) considered: Up to 440 MVA

New limiting factor for constraint(s) considered: Fault level

Detailed description: Replacing the 240 MVA SGTs at Ratcliffe GSP with 460 MVA units would add significant thermal capacity and resolve this constraint. However, it would significantly increase fault levels at the site (which already limits the GSP to running 2 + 2 with the existing 240 MVA units). The issue of increased fault levels from 460 MVA SGTs is consistent across the distribution network.

Option 3 – Establish a new GSP

Viable

Capacity released for constraint(s) considered: Dependent on the number of SGTs at the new GSP and what can be transferred over from Ratcliffe GSP

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

Detailed description: If a new GSP were built in the area, it could be used to deload Ratcliffe GSP and resolve this constraint. The requirement for a new GSP in the area is triggered by a combination of general load growth and a number of large new connections. The location of this new GSP will determine how it can be stitched into the existing 132 kV network, and therefore to what extent it can deload Ratcliffe GSP.

There are a number of other benefits to establishing a new GSP (specifically one to the south of the existing Ratcliffe GSP). 132 kV and 33 kV constraints at Willoughby BSP, Loughborough BSP and within the Leicester group could all be alleviated with a new GSP in the appropriate location. The location of a new GSP would be subject to detailed optioneering by NGED, NGET and NGESO, and would naturally involve some trade-off between how readily the various constraints in the area could be resolved.

Potential locations for a new GSP are being considered, with there being a clear strategic advantage to establishing a new GSP somewhere between Ratcliffe and Enderby GSPs (where there is a significant load centre and insufficient 132 kV network to support it in the long term).

Option 4 – Reinforce Stoke Bardolph GSP

Viable

Capacity released for constraint(s) considered: Demand at Nottingham North 11 kV and Nottingham BSP

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

Detailed description: With a number of investment drivers for a new GSP to the south of Ratcliffe GSP as outlined in option 3 above, reinforcing Stoke Bardolph GSP is unlikely to be the optimal initial reinforcement strategy to resolve this constraint.

There could however be strategic advantages in the long term to developing Stoke Bardolph GSP. With an additional SGT or SGTs, the site would be able to support itself for N-2 outage conditions (new infrastructure could be accommodated at the existing site to facilitate this).

Reinforcing Stoke Bardolph GSP itself would not be sufficient to allow it to better support the area and increase security of supply. This is due to the fact that there are only two 132 kV circuits out of the GSP, and as such the entire group would be left at single circuit risk without utilising the interconnection with Ratcliffe GSP. Building new 132 kV circuits would therefore be required to allow Stoke Bardolph to accept additional demand. While not required in the short term, in the long term this would allow Stoke Bardolph to support the high demand growth forecast for Nottingham. A new BSP supplied from Stoke Bardolph GSP is also considered as a potential option in the Stoke Bardolph 132 kV report. The rationalisation of Nottingham BSP discussed in Section 2.2 of this report could also allow a portion of the site to, at some point, be transferred into Stoke Bardolph (either under normal running arrangements or to support Ratcliffe during outages).

Option 5 – Restrict outage seasons

Viable

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

New limiting factor for constraint(s) considered: Access period demand

Detailed description: Outages on SGTs are normally taken during the access period when demand is generally lower. N-2 overloads during winter and intermediate cool would be avoided by this. In the longer term, as both peak demand and access period peak demand increases, this option will become insufficient alone to manage this constraint.

Option 6 – Utilise the short term ratings of the SGTs at Ratcliffe GSP

Viable

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

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

Detailed description: The SGTs at Ratcliffe 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 (which could include transferring load away on the 132 kV network to other GSPs) before the equipment can be damaged. This may help to mitigate this constraint but is not a long term solution.

Option 7 – Procure flexibility under Ratcliffe GSP

Viable

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

Detailed description: Flexibility services could be used to help manage the constraint on the SGTs at Ratcliffe GSP. While deferral of reinforcement using flexibility may not be possible, it could potentially be utilised in the interim to help manage the network. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

Ratcliffe GSP is currently compliant with its security of supply obligations based on analysis carried out by both NGET and NGED. SGT outages can be safely taken during the access period and short-term SGT ratings are available to provide headroom when needed. A combination of high underlying load growth and a number of large new connections is expected to trigger reinforcement. Further studies are required to determine what can be achieved at the existing Ratcliffe GSP, but it is clear that a new GSP will be required to support the area in the long term.

Potential locations for a new GSP are discussed above, with a new GSP to the south of Ratcliffe likely to provide the most network benefits. The location of any new GSP, as well as the strategy for stitching it into the existing 132 kV network would be subject to further optioneering (including a siting strategy), as well as extensive engagement with NGET and NGESO.

The reinforcement of Stoke Bardolph GSP has been noted as a possible method of supporting the northern part of the Ratcliffe 132 kV network. This option is likely not required in the short term, but should be considered as a possibility further into the future and kept in mind as the 132 kV network in the area develops.

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