Wellingborough and Irthlingborough BSPs

Network Development Report – East Midlands

May 2024

Electricity Distribution

nationalgrid

Contents

Wellingborough and Irthlingborough 33 kV

1. Network Overview

Wellingborough and Irthlingborough are two Bulk Supply Points (BSPs) fed from Grendon Grid Supply Point (GSP) in National Grid Electricity Distribution’s (NGED’s) East Midlands licence area. Both BSPs have two 132/33 kV Grid Transformers (GTs) rated to 45/90/117 MVA. Wellingborough BSP also has two 132/11 kV GTs feeding the local 11 kV network.

Figure 1.1 Wellingborough and Irthlingborough geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon identified on the 33 kV network fed from, and the 132/33 kV GTs at Wellingborough and Irthlingborough BSPs. This uses the methodology outlined in the Network Development Plan Methodology Report with Network Operability Modelling applied as outlined below.

For the purposes of this analysis the NGED Best View Distribution Future Energy Scenario (DFES) has been used to study the years 2022 (baseline), 2028 and 2034, with consideration given to how proposals could change under the other scenarios. Five representative days have been studied across the four seasons: Winter Peak Demand, Intermediate Warm Peak Demand, Intermediate Cool Peak Demand, Summer Peak Demand and Summer Peak Generation.

1.1 Network Topology

Wellingborough BSP feeds five primary substations: Cannon Street, Park Farm, Little Irchester, Harrold and Sharnbrook. Harrold and Sharnbrook are both single transformer primaries fed via Little Irchester. Wellingborough BSP is interconnected at 33 kV with Northampton East BSP via Little Irchester primary and with Irthlingborough BSP via Rushden primary.

Irthlingborough BSP feeds six primary substations: Irthlingborough, Rushden, Raunds, Thrapston, Oundle T2 and Burton Latimer T2. Irthlingborough primary is located at the same site as Irthlingborough BSP. Oundle T2 is fed via Thrapston primary. Irthlingborough BSP is interconnected at 33 kV with Corby BSP via Thrapston primary, and with Kettering BSP via Pytchley Road and Burton Latimer primaries.

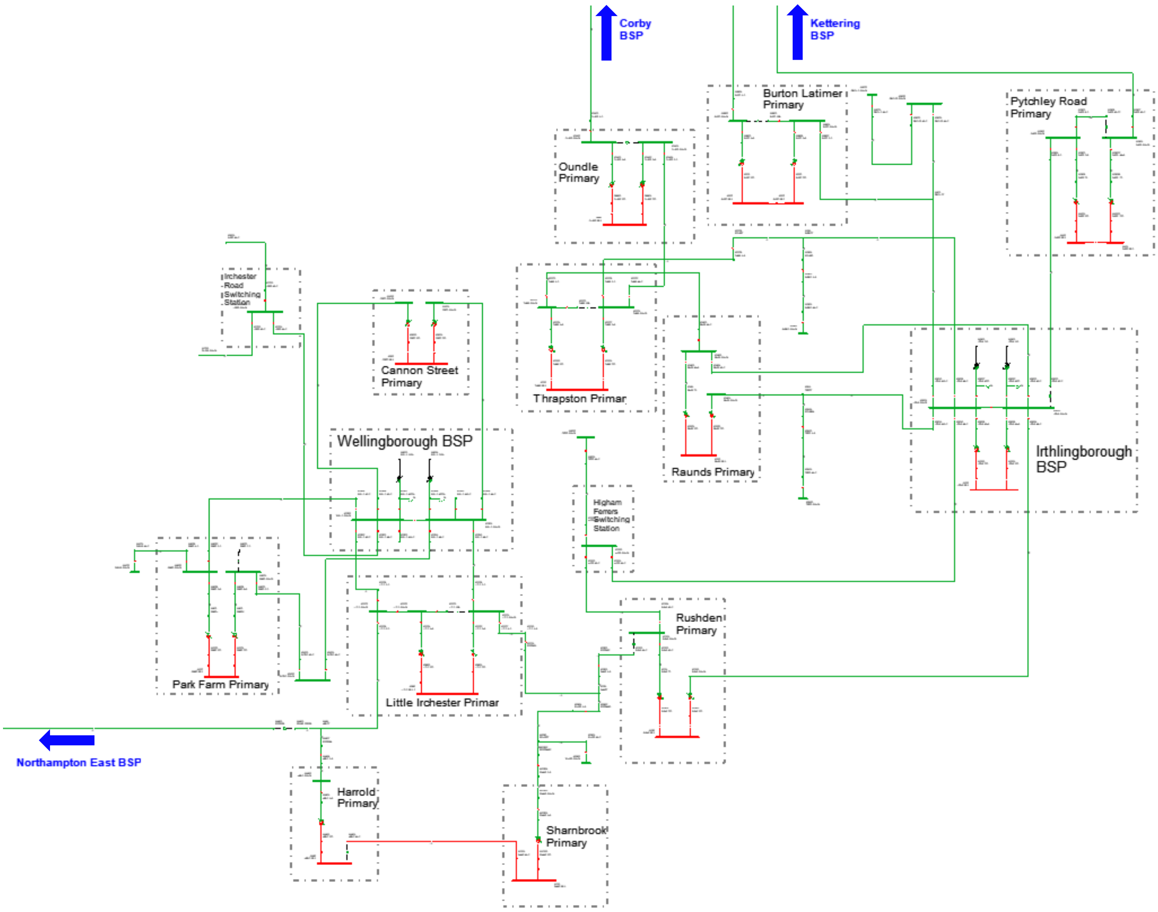

Figure 1.1.1 Wellingborough and Irthlingborough 33 kV network single line diagram

1.2 Network Operability Modelling

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

- The 33 kV busbars at Little Irchester are paralleled for an arranged outage on one of the infeeds from Wellingborough BSP.
- The Wellingborough and Irthlingborough 33 kV networks are both split for an arranged outage on their 33 kV bus section breakers to prevent loose couples. For Wellingborough, this involves splitting Cannon Street, Park Farm and Little Irchester (which are all fed from both bars) at 11 kV. For Irthlingborough, this involves splitting Rushden, Irthlingborough primary, Raunds and Thrapston (all of which are fed from both bars), Oundle (which loose couples with Corby) and Burton Latimer (which loose couples with Kettering) at 11 kV.
- Harrold and Sharnbrook backfeed each other at 11 kV for an arranged outage on either of their infeeds.
- For the loss of an infeed to a transformer at most of the primaries fed from Irthlingborough and Wellingborough BSPs under arranged outages, the lower voltage side circuit breaker is opened to prevent back-energisation (including Sharnbrook primary when its second transformer is modelled).
- With a third GT at Irthlingborough BSP, for arranged outages on GT1 or GT2, the new GT is switched in to supply the relevant half of the BSP (splitting the site in half). For arranged outages on the new GT, the existing GTs continue to supply each half of Irthlingborough.

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:

- Demand growth at Sharnbrook primary is expected to take the site beyond the capacity of its 11 kV backfeeds to Harrold primary by 2028.
- Overloads are seen on the primary transformers at Burton Latimer primary for some seasons by 2028 under N-1 outages.
- The 33 kV circuit between Irthlingborough BSP and Higham Ferrers Switching Station is projected to overload by 2028 for N-1 outages and by 2034 under intact network running.
- Both the 33 kV circuits to, and the primary transformers at Cannon Street are projected to overload for N-1 outages by 2034.
- Overloads are seen on the transformers at Irthlingborough primary by 2034 under N-1 outages.
- Both demand and generation constraints are projected on the GTs at Irthlingborough BSP for N-1 outages (by 2028 and 2034 respectively).
- Under intact network running, there are overloads seen on the 33 kV circuit to Little Irchester T2 at summer peak generation in 2034.

2.2 Sharnbrook 11 kV backfeed overload

Constraint Overview

Generation Demand

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

Table 2.2.1 constraint(s) and conditions under which constraint(s) occur

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Sharnbrook – Harrold 11 kV backfeed overload	Transformer or circuit arranged or fault outage to Sharnbrook primary	None	2028	2028	2028	2034

Uncertainty under other Distribution Future Energy Scenarios: Similar overloads are projected under the Leading the Way and Consumer Transformation scenarios as under Best View. While lower growth is observed under System Transformation and Falling Short, overloads are still observed across multiple seasons by 2034 in both of these scenarios.

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 second transformer and circuit to Sharnbrook primary.
2	Uprate the 11 kV circuit between the two primaries.
Flexibility Services	
3	Procure flexibility under Sharnbrook primary.

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full Cost Benefit Analysis (CBA). This CBA has been carried out for this constraint as part of the RIIO-ED2 Business Plan. The optimal reinforcement solution identified will be periodically tested against market provided flexibility by the DSO as part of the Distribution Network Options Assessment (DNOA) process.

Option 1 – Install a second transformer and circuit to Sharnbrook primary

Viable

Capacity released for constraint(s) considered: Up to 14 MVA

New limiting factor for constraint(s) considered: Existing 33 kV infeed ratings or primary transformer at Sharnbrook depending on solution chosen

Detailed description: Installing a second transformer and 33 kV circuit to Sharnbrook primary would mean that, for arranged or fault outages at Sharnbrook, supply could be maintained without having to rely on the 11 kV interconnection with Harrold primary. The new transformer would be rated to match the existing transformer (a 12/24 MVA unit).

There are a number of methods which have been considered to add a second 33 kV infeed to Sharnbrook:

- Install a second 33 kV circuit directly from Wellingborough BSP to Sharnbrook primary. This option would create a dedicated infeed to Sharnbrook, increasing the capacity of Sharnbrook up to 23 MVA (now limited by the transformer capacity). If the new infeed were suitably rated, it would also create the option of adding a second transformer at Harrold (fed via this new circuit then along the existing 33 kV construction circuit between the two primaries which is currently run at 11 kV). This option has been discounted as it would require over 12 km of 33 kV circuit works (subject to detailed route investigation and land rights) making it prohibitively expensive. The option of creating a second transformer at Harrold primary will likely never be utilised either, based on the very low existing and projected future loading at the site.
- A second 33 kV circuit from Little Irchester primary to Sharnbrook primary would require almost as much 33 kV circuit works as going all the way back to Wellingborough (less than 1 km less), would require additional works at Little Irchester, and could create future constraints on the Wellingborough to Little Irchester 33 kV circuits (on top of those described in Section 2.8 of this report). As this option is a similar cost to a 33 kV circuit back to Wellingborough, this has also been discounted.
- There are two 33 kV generators each around 3 km away from Sharnbrook primary, which are both fed from Wellingborough BSP. Building a new 33 kV circuit to one of these sites would allow a second infeed to Sharnbrook to be created with significantly less 33 kV circuit works required than a new 33 kV circuit back to Wellingborough or Little Irchester. Additionally, this would not require an additional 33 kV circuit breaker at Wellingborough BSP, and would not reduce capacity on the Wellingborough to Little Irchester 33 kV circuits. This option has been discounted as it would still require some 33 kV circuit works (making it more expensive than the option discussed below) and would limit generation growth at Sharnbrook as the 33 kV circuits from Wellingborough would be near or above the upper statutory voltage limit (and the thermal capacity of the 33 kV circuit to Irchester Road Switching Site would also become a constraining factor).
- A second 33 kV circuit to Sharnbrook primary could be created using the 33 kV circuit to Harrold and the aforementioned 33 kV construction circuit between the two primaries by installing a three panel 33 kV board at Harrold. This would require minimal 33 kV circuit works and would provide up to 22 MVA of capacity between the two primaries (now limited by the 33 kV circuit to Harrold). This capacity would be sufficient to provide the load growth forecast in the short and medium term at the two primaries. This capacity could be further increased by uprating only approximately 38 m of cable, which currently limits the capacity of the 33 kV circuit from Little Irchester to the Harrold tee. This would increase the capacity of the two primaries to approximately 26 MVA (now limited by the existing 33 kV circuit to Sharnbrook T1), 23 MVA for Sharnbrook itself (now limited by the transformer rating), with Harrold limited by the 11 kV backfeeds to Sharnbrook. The 11 kV backfeed capacity to Sharnbrook for Harrold would be reduced by this option (as the main existing 11 kV interconnecting circuit would be converted to 33 kV). Some reinforcement works would be required to ensure Harrold could still be backfed at 11 kV, but this solution is still likely economical compared to the other options considered.

Option 2 – Uprate the 11 kV circuit between the two primaries

Discounted

Capacity released for constraint(s) considered: Dependent on 11 kV works carried out

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

Detailed description: Carrying out reinforcement at 11 kV could increase the backfeed capacity of Sharnbrook primary, helping to alleviate this constraint. This option has been discounted as the load growth forecast for Sharnbrook is high enough that this would not be an enduring solution. 11 kV reinforcement could potentially be used to defer more permanent reinforcement, but this is likely not economical either (one possible 11 kV reinforcement option considered would have required over 6 km of cable overlay as well as replacing the 11 kV board at Harrold primary for example).

Option 3 – Procure flexibility under Sharnbrook primary

Viable

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

Detailed description: Flexibility services could be procured to alleviate the projected overloads seen on the 11 kV circuit between Sharnbrook and Harrold primaries. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

Adding a second transformer at Sharnbrook primary (rated to 12/24 MVA) would resolve this constraint and create sufficient capacity for the demand growth forecast for the area up to 2050. A number of options for creating a new 33 kV infeed to Sharnbrook have been considered, with the lowest cost being utilising the existing 33 kV construction circuit between Sharnbrook and Harrold. Utilising this interconnector would reduce the 11 kV backfeed capacity of Harrold, triggering some additional works.

2.3 Burton Latimer primary transformer overloads

Constraint Overview

Generation | **Demand**

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

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

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Burton Latimer primary transformer overloads	Arranged or fault outage on either transformer or 33 kV circuit to Burton Latimer primary	None	-	2028	2028	-

Uncertainty under other Distribution Future Energy Scenarios: Similar overloads are projected under the Leading the Way and Consumer Transformation scenarios as under Best View. Lower growth is forecast under the other two scenarios (System Transformation and Falling Short), but overloads are still projected by 2034 at intermediate cool peak demand.

Solution Options

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

Table 2.3.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Uprate both transformers at Burton Latimer primary.
Operational Mitigation	
2	Transfer demand to other primaries.
3	Review seasonal ratings.
Flexibility Services	
4	Procure flexibility under Burton Latimer primary.

Solution Development

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

Option 1 – Uprate both transformers at Burton Latimer primary

Discounted

Capacity released for constraint(s) considered: 2 MVA

New limiting factor for constraint(s) considered: Ratings of 33 kV circuits from Kettering and Irthlingborough BSPs

Detailed description: Uprating both of the transformers at Burton Latimer primary to 20/40 MVA units would help alleviate this constraint, but would not free up significant capacity without 33 kV circuit works being carried out as well. This option has therefore been discounted given the viability of a number of options listed below (but may still be required in the longer term).

Option 2 – Transfer demand to other primaries

Viable

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

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

Detailed description: By transferring demand at 11 kV to other nearby primaries the loading at Burton Latimer could be reduced, deferring this constraint. In particular demand could be transferred to the newly established Hayfield primary which has the headroom to accept additional demand and is located around 2.5 km away from Burton Latimer primary. Another nearby primary which could be considered to accept demand is Pytchley Road (which is even closer to Burton Latimer).

Option 3 – Review seasonal ratings

Viable

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

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

Detailed description: Overloads are only seen in 2028 and 2034 for intermediate cool and intermediate warm. It is therefore possible that this constraint could be delayed slightly by reviewing NGED's internal policy regarding transformer ratings, which does not currently distinguish between summer and intermediate cool or intermediate warm ratings (which may be overly pessimistic). This solution is dependent on an internal review and would not be a long term solution. This solution could be used in conjunction with the transfer of demand to Hayfield and/or Pytchley Road primaries as discussed in option 2 above.

Option 4 – Procure flexibility under Burton Latimer primary

Viable

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

Detailed description: Flexibility services could be procured to alleviate the projected overloads on the transformers at Burton Latimer primary. This could be carried out alongside the operational mitigations discussed in options 2 and 3 above. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

In the first instance the lower cost solutions discussed in options 2 and 3 (transferring demand at 11 kV to Hayfield and/or Pytchley Road primaries and reviewing seasonal transformer ratings) could be employed to manage the constraint at Burton Latimer primary. Longer term to add significant capacity to Burton Latimer itself both primary transformers would need replacing along with 33 kV circuit works (which could provide an economic opportunity to rationalise Burton Latimer and Pytchley Road primaries).

2.4 Irthlingborough – Higham Ferrers 33 kV circuit overload

Constraint Overview

Generation | Demand

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

Table 2.4.1 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
Irthlingborough – Higham Ferrers 33 kV circuit overload	Arranged or fault outage on the Irthlingborough – Rushden T2 33 kV circuit	None	2028	2028	2028	2028
Irthlingborough – Higham Ferrers 33 kV circuit overload	None	None	-	2034	-	-

Uncertainty under other Distribution Future Energy Scenarios: Similar overloads are observed under the Leading the Way scenario as under Best View. Significantly higher growth is seen under Consumer Transformation. The demand forecast under the other two scenarios (System Transformation and Falling Short) triggers overloads, but not in every season by 2028.

Solution Options

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

Table 2.4.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Uprate the 33 kV circuit between Irthlingborough and Higham Ferrers.
Operational Mitigation	
2	Set up an Intertripping scheme.
Flexibility Services	
3	Procure flexibility under Rushden primary.

Solution Development

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

Option 1 – Uprate the 33 kV circuit between Irthlingborough and Higham Ferrers

Viable

Capacity released for constraint(s) considered: Up to 10 MVA or 18 MVA

New limiting factor for constraint(s) considered: Remaining 33 kV circuit capacity or transformer capacity at Rushden primary (depending on the sections of 33 kV circuit uprated)

Detailed description: By uprating the 33 kV circuit from Irthlingborough BSP to the Higham Ferrers Switching Station, this constraint would be alleviated. Uprating the lowest rated section of this circuit, which is around 1.5 km in length, would add approximately 10 MVA of capacity to the circuit and to Rushden primary. Further capacity could be released by uprating short sections of cable at each end of the circuit (around 50 m of cable in total), such that the full capacity of the 20/40 MVA primary transformers at Rushden could be utilised.

Option 2 – Set up an Intertripping scheme

Viable

Capacity released for constraint(s) considered: Half the demand of Rushden primary

New limiting factor for constraint(s) considered: 33 kV circuit rating under intact network conditions

Detailed description: Setting up an Intertripping scheme could be used to help alleviate this constraint for 33 kV circuit faults. If implemented, this would not be a long term solution for this constraint as, by 2034, overloads are observed under intact network conditions. If a significant length of pilot cable needs to be laid, this option may not be economical.

Option 3 – Procure flexibility under Rushden primary

Viable

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

Detailed description: Flexibility services could be procured at Rushden primary to alleviate the projected overloads seen on the 33 kV circuit between Irthlingborough BSP and the Higham Ferrers Switching Station. The use of flexibility may not be economical if the operational mitigation discussed in option 2 above is utilised. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

The optimal reinforcement solution identified is to uprate sections of the 33 kV circuit between Irthlingborough BSP and Higham Ferrers Switching Station. The possibility of utilising a load management scheme and/or procuring flexibility to potentially defer the need for this reinforcement will be explored in the short term.

2.5 Cannon Street primary transformer and circuit 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
Cannon Street primary transformer overloads	Arranged or fault outage on the other transformer or infeed	None	2034	2034	2034	-
Wellingborough to Cannon Street 33 kV circuit overloads	Arranged or fault outage on the other transformer or infeed	None	2034	2034	-	-

Uncertainty under other Distribution Future Energy Scenarios: Similar overloads are observed by 2034 under Consumer Transformation and Leading the Way. Under the lower growth scenarios (System Transformation and Falling Short), no overloads are projected on either the circuits or transformers before 2034.

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 both transformers and circuits to Cannon Street primary.
2	Install a third transformer and circuit to Cannon Street primary.
Operational Mitigation	
3	Transfer demand at 11 kV to other primary substations.
Flexibility Services	
4	Procure flexibility under Cannon Street primary.

Solution Development

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

Option 1 – Uprate both transformers and circuits to Cannon Street primary

Viable

Capacity released for constraint(s) considered: 1 MVA from transformer uprating and a further 2 MVA from 33 kV circuit uprating

New limiting factor for constraint(s) considered: 33 kV circuit or primary transformer ratings

Detailed description: Uprating both of the transformers at, and 33 kV circuits to Cannon Street primary would help alleviate this constraint (the transformers would be uprated to 20/40 MVA units), but would not add sufficient capacity to accommodate the long term growth forecast at the site. As the existing transformers are around 60 years old, their replacement may also be triggered based on their condition.

If both primary transformers were uprated to 20/40 MVA units, the firm capacity of the site would then be limited by the ratings of the 33 kV circuits to Cannon Street. Increasing the capacity of the site further would require uprating most of both 33 kV circuits (over 4.5 km of circuit works). These circuit works are likely not economical, based on the small amount of capacity that would be released.

Option 2 – Install a third transformer and circuit to Cannon Street primary

Discounted

Capacity released for constraint(s) considered: Minimal

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

Detailed description: Installing a third transformer and 33 kV circuit to Cannon Street primary would not free up significant capacity at the site. This is due to the fact that there are only two 33 kV busbars at Wellingborough BSP, so two of the primary transformers would need to be supplied from a single busbar and would consequently both be lost for a fault on that busbar. This solution would also not benefit the condition of the existing transformers, and would introduce additional network complexity by creating a three transformer primary (such as having to split the 11 kV network for arranged outages).

Option 3 – Transfer demand at 11 kV to other primary substations

Viable

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

New limiting factor for constraint(s) considered: Combined capacity of the two primaries

Detailed description: Given the fact that significantly increasing the firm capacity of Cannon Street primary itself may not be economical, transferring demand to other primaries at 11 kV could be considered. Two substations within Wellingborough, which could potentially accept additional demand, are Wellingborough 11 kV and Park Farm primary.

If required, the transformers at Park Farm could be uprated to 20/40 MVA units, which would free up significant capacity at the site with no 33 kV circuit works required outside of the primary itself (as both cables to the site are rated higher than 40 MVA already). This additional capacity could allow Cannon Street primary to be deloaded by picking up additional demand in the west of Wellingborough.

Cannon Street is around 1.5 km and 3.5 km from Wellingborough BSP and Park Farm primary respectively. Further 11 kV studies will be required to determine how much demand can feasibly be transferred to these primaries, and how much 11 kV works may be required to facilitate this.

Option 4 – Procure flexibility under Cannon Street primary

Viable

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

Detailed description: Flexibility services could be procured to alleviate the projected overloads on the transformers at Cannon Street primary. Flexibility will not however benefit the condition of the transformers at the primary. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

While replacing the transformers at Cannon Street to 20/40 MVA units may be required in the near future due to their age and condition regardless, this will not free up enough capacity to manage this constraint in the long term. Transferring demand at 11 kV to Park Farm and/or Wellingborough primaries is likely the most cost effective option for managing this constraint.

2.6 Irthlingborough primary transformer overloads

Constraint Overview

Generation | **Demand**

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

Table 2.6.1 constraint(s) and conditions under which constraint(s) occur

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Irthlingborough primary transformer overloads	Arranged or fault outage on the other transformer or 33 kV busbar at Irthlingborough BSP	None	2034	2034	2034	-

Uncertainty under other Distribution Future Energy Scenarios: Similar overloads are observed under the Leading the Way scenario as under Best View. Slightly lower growth is forecast under Consumer Transformation, but intervention is still triggered by 2034. Under the other two scenarios (System Transformation and Falling Short) no overloads are seen 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	Uprate both primary transformers at Irthlingborough primary.
2	Install a third transformer at Irthlingborough primary.
3	Install two 132/11 kV GTs at Irthlingborough BSP.
Flexibility Services	
4	Procure flexibility under Irthlingborough primary.

Solution Development

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

Option 1 – Uprate both primary transformers at Irthlingborough primary

Viable

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

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

Detailed description: Uprating both of the transformers at Irthlingborough primary would resolve this constraint in the short and medium term. The transformers would be uprated to 20/40 MVA units (the highest rating used by NGED as standard on the network). This replacement would also benefit the condition of the transformers, which are both around 60 years old. Minimal 33 kV circuit works will be required to free up this capacity, as Irthlingborough primary is located at the same site as Irthlingborough BSP.

Option 2 – Install a third transformer at Irthlingborough primary

Discounted

Capacity released for constraint(s) considered: 23 MVA

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

Detailed description: As there are currently only two 33 kV busbars at Irthlingborough BSP, a third transformer would not free up any additional capacity, as two of the transformers would need to be supplied from a single busbar (and as such would both be lost for a busbar fault or arranged outage). This would not be the case if a third 33 kV busbar were installed at Irthlingborough, which would be required if a third GT were installed (as discussed as an option in Section 2.7 of this report).

Even with a third 33 kV busbar to supply a third primary transformer from, this option has been discounted for a number of reasons. Firstly, the existing primary transformers will likely need replacing based on their condition in the near future regardless, making this option significantly less economical overall than option 1. Secondly, it would create additional network complexity by creating a three transformer primary (which would require splitting at 11 kV for arranged outages).

Demand forecasts indicate that in the long term (by around 2040) the capacity released by option 1 may be fully utilised, at which point the installation of a third transformer (rated to 20/40 MVA) may become the most economic option to facilitate further demand growth.

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

Discounted

Capacity released for constraint(s) considered: 52 MVA

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

Detailed description: Replacing the two primary transformers at Irthlingborough with 132/11 kV GTs would resolve this constraint, as well as reducing demand on the existing 132/33 kV GTs. This would defer the constraint seen on the existing Irthlingborough GTs as discussed in Section 2.7 of this report. While the high growth forecast at Irthlingborough will necessitate adding significant capacity, much of this growth is at the various primaries outside of Irthlingborough itself. In particular high demand growth is forecast at Raunds and Rushden primaries, as well as a number of large new demand connections. The installation of 132/11 kV GTs would not help accommodate this quite geographically dispersed demand growth, and has therefore been discounted.

Option 4 – Procure flexibility under Irthlingborough primary

Viable

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

Detailed description: Flexibility services could be procured to alleviate the projected overloads on the transformers at Irthlingborough primary. Flexibility will not however benefit the condition of the transformers at the primary. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

Uprating the 33/11 kV transformers at Irthlingborough primary to 20/40 MVA units has been identified as the optimal reinforcement strategy to resolve this constraint. This reinforcement would add significant capacity to accommodate the high demand growth forecast at Irthlingborough.

2.7 Irthlingborough BSP GT overloads

Constraint Overview

Generation | Demand

The table below outlines the nature of the network constraints identified in the network analysis. N-2 constraints were also identified for arranged outages at Kettering BSP, which transfer Burton Latimer and/or Pytchley Road primaries into Irthlingborough BSP. These N-2 constraint have been omitted as they could be managed operationally, and N-1 overloads are observed in 2028 regardless so the overall reinforcement strategy is unaffected.

Table 2.7.1 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**
Irthlingborough GT1 or GT2 overload	Fault or arranged outage on either GT at Irthlingborough	None	2028	2028	2028	2028
Generation			**Summer**			
Irthlingborough reverse power flow GT overload	Fault or arranged outage on either GT at Irthlingborough	None	2034			

Uncertainty under other Distribution Future Energy Scenarios: As under Best View, overloads are observed for N-1 outages in 2028 under Leading the Way and Consumer Transformation. Despite lower growth being forecast under System Transformation and Falling Short, there are no scenarios under which demand overloads are not observed by 2028.

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 GTs at Irthlingborough BSP.
2	Install a third 132/33 kV GT at Irthlingborough BSP.
3	Install two 132/11 kV GTs at Irthlingborough BSP.
Operational Mitigation	
4	Demand transfers.
5	Active Network Management.
Flexibility Services	
6	Procure flexibility under Irthlingborough 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 Irthlingborough 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 Irthlingborough 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 Irthlingborough BSP

Viable

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

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

Detailed description: A third GT could be installed at Irthlingborough to resolve both the demand and generation constraints forecast at the BSP. To allow the capacity of the new GT to be fully utilised, it would be set up such that it can feed onto either of two 33 kV boards (with an existing GT feeding onto each of those boards). This would allow each side to be loaded up to the full capacity of a GT, and the site to be easily split in half for arranged outages on any GT.

This solution would create sufficient GT capacity for the load growth forecast at Irthlingborough up to 2050. It could also create options for deloading other nearby BSPs. The two nearest BSPs to Irthlingborough are Kettering and Wellingborough. The existing 33 kV interconnection to both BSPs is insufficient to transfer in significant additional demand. However, the possibility of building new 33 kV network could be explored.

In the case of Kettering, due to the scale of demand growth forecast, additional capacity would be required even if some load could be transferred into Irthlingborough (significant GT constraints are observed by 2028 as outlined in the Kettering and Kibworth 33 kV report). Building new 33 kV network would therefore likely be wasted, as inevitably both Kettering and Irthlingborough would need uprating regardless.

In contrast to Kettering, load growth forecast at Wellingborough is slightly less aggressive. While no overloads are observed on the GTs by 2034 under the current forecasts, the site will be approaching its firm capacity by that time. Transferring demand into Irthlingborough could potentially defer the need for intervention at Wellingborough for a significant length of time. This would require new 33 kV circuits to be built, but may still be economical, as much of the demand growth is located between Irthlingborough and Wellingborough, so circuits back to either BSP to pick up this demand may be similar costs.

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

Discounted

Capacity released for constraint(s) considered: The 11 kV demand at Irthlingborough

New limiting factor for constraint(s) considered: Both demand and generation capacity on the existing 132/33 kV GTs

Detailed description: Replacing the two primary transformers at Irthlingborough with 132/11 kV GTs would alleviate the demand constraint on the existing GTs, and would also resolve the constraints seen on the existing primary transformers. As discussed in Section 2.6 of this report, this solution would not be suitable to accommodate the relatively geographically spread out growth forecast to materialise in the area.

This reinforcement would also not add significant generation capacity, as there is a relatively low amount of generation connected to Irthlingborough at 11 kV (so not much would be taken off the existing GTs with the installation of 132/11 kV GTs). Even if the new 132/11 kV GTs at Irthlingborough could be fully utilised, this would not provide as much demand or generation capacity as installing a third 132/33 kV GT as discussed in option 2.

Option 4 – Demand transfers

Discounted

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

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

Detailed description: There is not sufficient existing 33 kV interconnection with any of the nearby BSPs to significantly deload Irthlingborough and defer this constraint. The high demand and generation growth at Irthlingborough will trigger reinforcement even if some load can be transferred, so any 33 kV circuit works carried out facilitate transferring load away would be largely wasted in the long term (similarly to the transfers considered out of Kettering in option 2 above).

Option 5 – 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 Irthlingborough BSP would 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 Irthlingborough, but likely not the projected demand constraint in the long term.

Option 6 – Procure flexibility under Irthlingborough BSP

Viable

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

Detailed description: Flexibility services could be procured on the network supplied from Irthlingborough 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 Irthlingborough. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

In the short term the use of ANM and/or flexibility services could potentially help manage this constraint. However, the high load growth forecast will at some point necessitate reinforcement. The optimal reinforcement strategy identified is to install a third GT at Irthlingborough BSP, which will resolve this constraint and add significant demand and generation capacity to accommodate future growth.

2.8 Wellingborough to Little Irchester 33 kV circuit overload

Constraint Overview

Generation Demand

The table below outlines the nature of the network constraints identified in the network analysis. If a second 33 kV infeed to Sharnbrook were added as discussed as an option in Section 2.2 of this report, overloads would not be seen under intact network conditions, but would still be present for outages on the 33 kV circuit to Little Irchester T2 and Harrold primary (or on the 33 kV main 1 busbar at Wellingborough BSP itself).

Table 2.8.1 constraint(s) and conditions under which constraint(s) occur

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed under Best View
			Summer (generation)
Wellingborough BSP to Little Irchester primary 33 kV circuit overload	None	None	2034

Uncertainty under other Distribution Future Energy Scenarios: Slightly higher growth in generation is forecast at Sharnbrook and Little Irchester primaries under the Leading the Way and Consumer Transformation scenarios. The lowest growth in generation is forecast under Falling Short (which is the only scenario where overloads may not be observed by 2034).

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 existing 33 kV circuit to Little Irchester T2.
2	Build a new 33 kV circuit from Wellingborough to Little Irchester.
Operational Mitigation	
3	Active Network Management.
Flexibility Services	
4	Procure flexibility under Sharnbrook and Little Irchester primaries.

Solution Development

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

Option 1 – Uprate the existing 33 kV circuit to Little Irchester T2

Discounted

Capacity released for constraint(s) considered: 7 MVA

New limiting factor for constraint(s) considered: 33 kV circuit from Little Irchester to the Sharnbrook tee

Detailed description: Uprating the 33 kV circuit from Wellingborough BSP to Little Irchester T2 would resolve this constraint. To free up capacity, most of the existing circuit would need uprating. As this option requires a similar length of 33 kV circuit works as installing a new circuit as discussed in option 2, without some of the associated network benefits, this option has been discounted.

Option 2 – Build a new 33 kV circuit from Wellingborough to Little Irchester

Viable

Capacity released for constraint(s) considered: 7 MVA

New limiting factor for constraint(s) considered: 33 kV circuit from Little Irchester to the Sharnbrook tee

Detailed description: As with uprating the existing 33 kV circuit as discussed above, building a new circuit between Wellingborough and Little Irchester would resolve this constraint. This option would also allow Little Irchester to be unstitched from Sharnbrook primary. Doing so would simplify the network (improving operability) and would require a similar length of 33 kV circuit works (which would not be extensive as the two sites are within 1 km of each other). If two 33 kV circuits were built at the same time, Harrold primary could also be unstitched from Little Irchester.

With Little Irchester being the only site fed from the existing 33 kV circuits, it would have enough circuit capacity for demand growth forecast up to 2050. These works would also benefit Sharnbrook primary, which (as discussed in Section 2.2 of this report) is planned to be upgraded with a second transformer.

Option 3 – 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 at Sharnbrook or Little Irchester primaries could be included in an ANM scheme. ANM schemes are used to manage constraints on over-committed networks.

Option 4 – Procure flexibility under Sharnbrook and Little Irchester primaries

Discounted

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

Detailed description: Flexibility is not suitable to manage this constraint as it is generation driven. Managing generation constraints using flexibility procurement is technically feasible, but NGED's internal tools and processes for calculating flexibility requirements for generation constraints are still in development.

Solution Recommendation

The optimal long term reinforcement solution identified is to install a new 33 kV circuit (or ideally two 33 kV circuits) from Wellingborough BSP to Little Irchester to allow the primary to be unstitched from Sharnbrook (and Harrold), resolving this constraint. ANM may potentially be deployed to manage this constraint in the interim.

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