Grantham and Sleaford BSPs

Network Development Report – East Midlands

May 2024

Electricity Distribution

nationalgrid

Contents

Grantham and Sleaford 33 kV

1. Network Overview

Grantham and Sleaford Bulk Supply Points (BSPs) are fed from Bicker Fen Grid Supply Point (GSP) in National Grid Electricity Distribution's (NGED's) East Midlands licence area. Both BSPs are fed via the same 132 kV dual circuit, which has a tee off to Sleaford and continues on to Grantham North BSP.

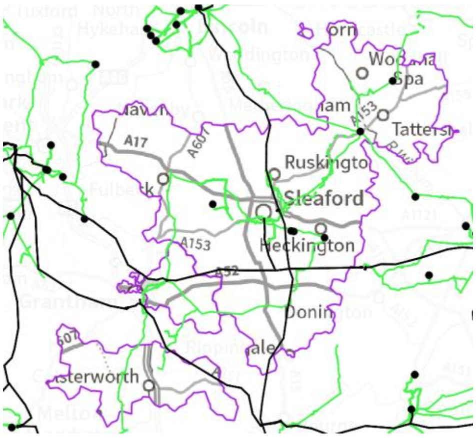

Figure 1.1 Grantham and Sleaford geographic network coverage

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 Grid Transformers (GTs) at Grantham and Sleaford 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

Grantham BSP has two 33 kV busbars fed by two 132/33 kV GTs both rated to 60/90/117 MVA. Grantham BSP feeds six primary substations: Billingborough T2, Easton, Market Overton T2, New Beacon Road, Skillington and Leadenham T2. Two of the primaries fed from Grantham are single transformer sites (Easton and Skillington), with the remaining all having two 33/11 kV transformers each. Market Overton T2 is fed via Skillington primary. Grantham is interconnected with Oakham BSP via Market Overton primary (which is normally run open at both 33 kV and 11 kV) and with Sleaford BSP via Leadenham and Billingborough primaries (with the former being run open and the latter being run closed at 11 kV, forming a loose couple between the two BSPs).

Sleaford BSP has two 33 kV busbars fed by two 132/33 kV GTs both rated to 45/90/117 MVA. Sleaford BSP feeds ten primary substations: Billingborough T1, Horncastle T2, Cranwell, Great Hale, Leadenham T1, Ruskington, Sleaford, Tattershall, Woodhall Spa and Metheringham T2. Sleaford primary is located at the same site as Sleaford BSP. Great Hale and Woodhall Spa primaries are both single transformer sites. Leadenham T1 is fed via Cranwell primary, and Billingborough T1 is fed via Great Hale primary. Woodhall Spa, Horncastle T2 and Metheringham T2 are all fed via Tattershall primary. Sleaford is interconnected with Boston BSP via Tattershall primary, with Skegness BSP via Horncastle primary, with Lincoln BSP via Metheringham primary and with Grantham BSP as described above. Horncastle primary is normally run closed at 11 kV, forming a loose couple with Skegness BSP. The interconnection with Boston and Lincoln is via normal open points (so Sleaford is not loose coupled with either BSP).

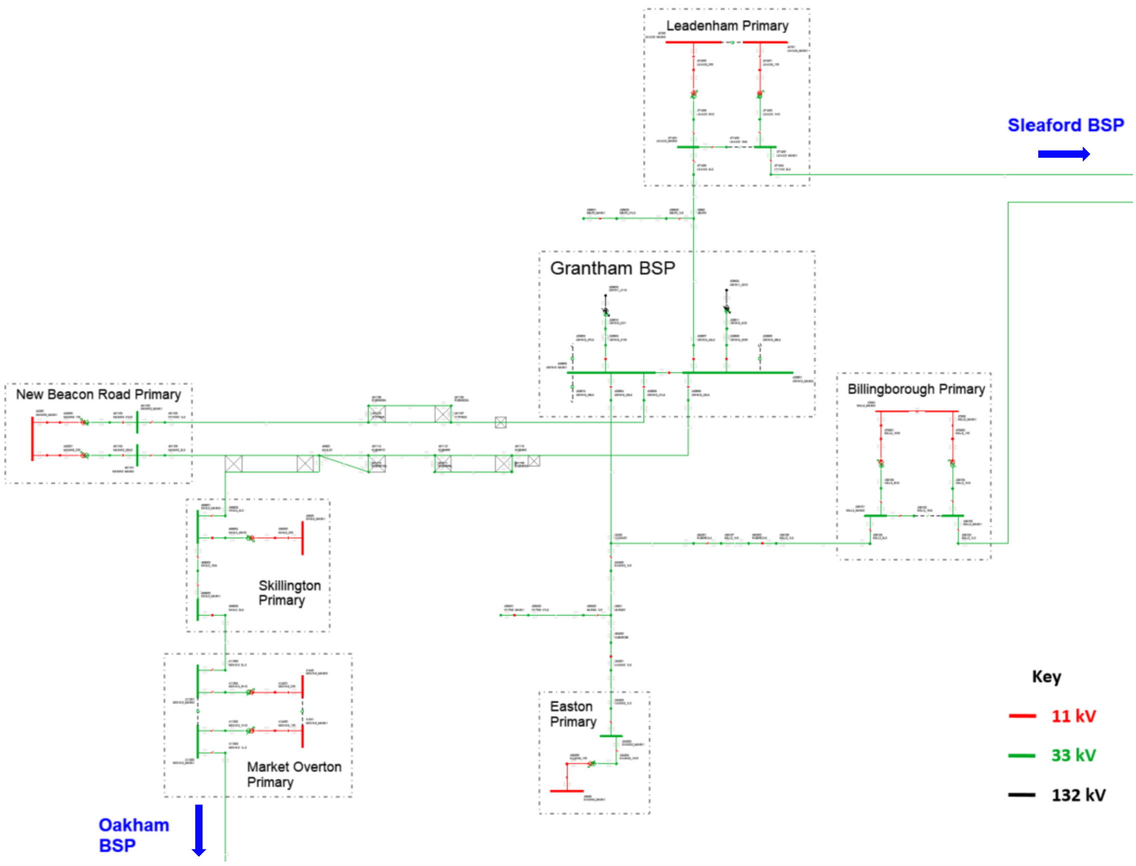

Figure 1.1.1 Grantham 33 kV network single line diagram

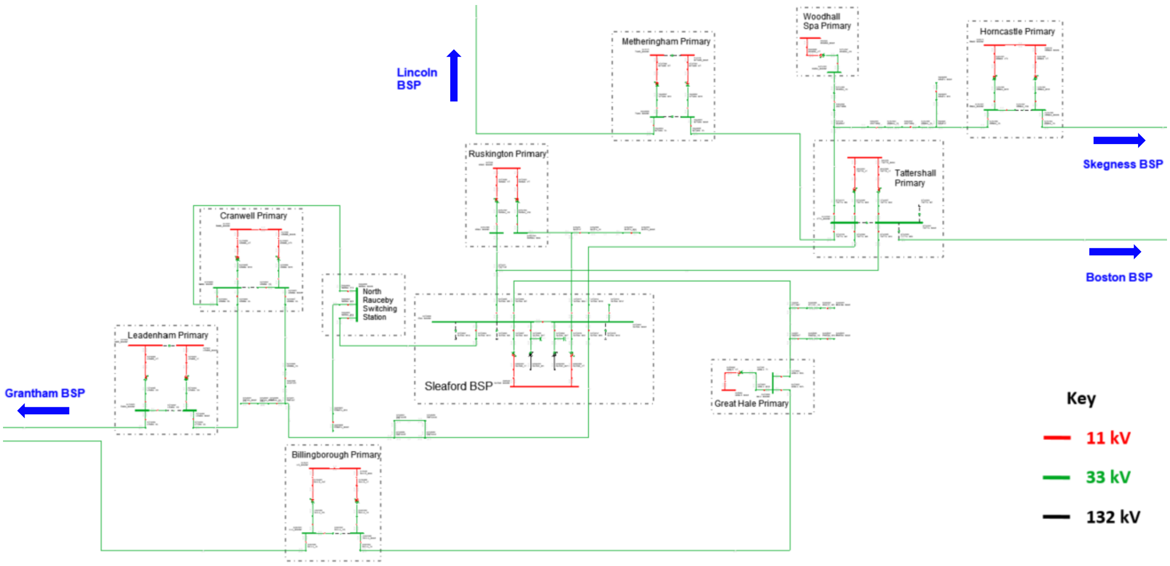

Figure 1.1.2 Sleaford 33 kV network single line diagram

1.2 Network Operability Modelling

The following network automation and manual switching schemes have been modelled in the analysis of this area, aligning to how the network is currently operated.

- For the loss of an infeed to a transformer at any of the primaries fed from Grantham and Sleaford BSPs under arranged outages, the lower voltage side circuit breaker is opened to prevent back-energisation.
- The 33 kV networks downstream of Grantham and Sleaford BSPs are split for arranged outages on their respective 33 kV bus section breakers to prevent loose couples. For Grantham this involves splitting New Beacon Road and Billingborough primaries at 11 kV, and for Sleaford this involves splitting Sleaford, Ruskington, Cranwell, Tattershall, Horncastle and Billingborough primaries at 11 kV.
- For arranged outages on any of the infeeds to Grantham or Sleaford BSP, the 11 kV bus section breaker at Billingborough primary is opened.
- For arranged outages on either infeed to Sleaford BSP, the 11 kV bus section breaker at Horncastle primary is opened.
- For outages on the 33 kV infeed to or the 33/11 kV transformer at Easton primary, its load is backfed on the 11 kV network to Skillington primary (and vice versa, with Easton picking up the demand from Skillington at 11 kV for outages on its infeed or transformer).
- For outages on the 33 kV infeed to or the 33/11 kV transformer at Great Hale primary, its load is backfed on the 11 kV network to Billingborough and Langrick primaries.
- For outages on the 33 kV infeed to or the 33/11 kV transformer at Woodhall Spa primary, its load is backfed on the 11 kV network to Tattershall primary.
- For arranged outages on either infeed to Tattershall, the primary can be paralleled at 33 kV by closing the bus section breaker between its main 1 and main 2 33 kV busbars.
- For an outage on the infeed from Grantham or Sleaford BSP, Leadenham primary is paralleled at 11 kV and fed fully from the other BSP (i.e. for an outage on the circuit from Grantham BSP the site is fed fully from Sleaford BSP and vice versa).

2. Network Constraints and Solution Options

2.1 Summary of Network Constraints

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

- Both voltage and thermal constraints are projected for Horncastle primary (initially for N-1 outages, with low volts eventually being forecast under intact network running arrangements).
- A reverse power flow constraint is projected on the transformers at Billingborough in 2034 (for the loss of either infeed to the primary). The 33 kV circuit from Sleaford BSP to Great Hale primary is also expected to overload for an outage at Great Hale or Billingborough (also in 2034).
- For an arranged or fault outage on the 33 kV circuit to New Beacon Road T1, the circuit to T2 is projected to overload in 2034 at intermediate cool peak demand.
- A protection limitation on the 33 kV circuit from Sleaford to the Ruskington/Tattershall tee currently restricts the circuit’s capacity to 28 MVA.
- For both demand and generation the GTs at Sleaford BSP are forecast to be constrained in 2034 (for an arranged or fault outage on either GT).

2.2 Horncastle primary thermal overloads and low volts

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**
Low volts at Horncastle and the surrounding 33 kV network	Arranged or fault outage on either infeed to the primary	None	Baseline	Baseline	Baseline	Baseline
Low volts at Horncastle and the surrounding 33 kV network	None	None	2034	2034	-	-
Tattershall to Woodhall Spa tee 33 kV circuit overload	Arranged or fault outage on the infeed to Horncastle T1	None	2028	2028	2028	2034
Woodhall Spa tee to Horncastle 33 kV circuit overload	Arranged or fault outage on the infeed to Horncastle T1	None	2034	2034	2034	2034
Spilsby to Horncastle 33 kV circuit overload	Arranged or fault outage on the infeed to Horncastle T2	None	2034	2034	2034	2034
Horncastle primary transformer overloads	Arranged or fault outage on either infeed to the primary	None	2034	2034	2034	-

Uncertainty under other Distribution Future Energy Scenarios: Low volts are observed in the baseline so intervention is required regardless of scenario. Thermal constraints are projected to occur by 2034 for all scenarios (circuit overloads only for Falling Short and System 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	Uprate the transformers at Horncastle primary.
2	Uprate the existing 33 kV circuits to Horncastle primary.
3	Build new 33 kV circuits to the area.
4	Install a voltage regulator.
Flexibility Services	
5	Procure flexibility under Horncastle primary.

Solution Development

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

Option 1 – Uprate the transformers at Horncastle primary

Discounted

Capacity released for constraint(s) considered: Minimal

New limiting factor for constraint(s) considered: Voltage regulation, 33 kV circuit capacity and voltage step change

Detailed description: Uprating the transformers at Horncastle primary would resolve the thermal constraint on the existing transformers. If the transformers were uprated to 20/40 MVA units it would provide enough thermal capacity for the demand growth forecast up to 2050.

20/40 MVA units would not free up significant capacity as the site would still be limited by the 33 kV circuit capacity and voltage regulation. Even with new 33 kV circuits 20/40 MVA are not expected to keep the network compliant with voltage step change requirements (and reducing impedance to aid this could create downstream fault level issues). The only way 20/40 MVA units could be installed at Horncastle (and properly utilised) would be if a new BSP were built in the area such that shorter 33 kV circuits could be used to feed the primary.

Option 2 – Uprate the existing 33 kV circuits to Horncastle primary

Viable

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

New limiting factor for constraint(s) considered: Voltage regulation or transformer capacity

Detailed description: Uprating the existing 33 kV circuits to Horncastle primary would help alleviate both the thermal and voltage constraints outlined above. To free up significant capacity extensive 33 kV circuit works are required. The 33 kV circuit between Tattershall and Horncastle is around 22 km in length, and the 33 kV circuit between Spilsby and Horncastle is around 17 km in length. The 33 kV network between Skegness and Spilsby also need uprating (there are a number of other triggers for this as outlined in the Skegness 33 kV report), as would the Sleaford to Tattershall circuits (eventually beyond that which is already outlined in Section 2.5 of this report).

Uprating these circuits would involve mostly reconductoring overhead lines (which make up the majority of the circuits). Reconductoring with 300 mm All Aluminium Conductor (AAC) would add thermal capacity and improve voltage regulation. Uprating sections of underground cable would also be required. These circuit works would allow more of the capacity of the 12/24 MVA transformers at Horncastle to be utilised but would not create sufficient capacity for all of the demand growth forecast for the area.

Option 3 – Build new 33 kV circuits to the area

Viable

Capacity released for constraint(s) considered: Up to 23 MVA

New limiting factor for constraint(s) considered: Total circuit capacity and voltage regulation

Detailed description: Two new 33 kV circuits into the area could be used to add significant capacity (although installing 20/40 MVA units at Horncastle is not viable as noted in option 1 above they could instead be used to feed a new 12/24 MVA primary site). A new primary site could be located near to Horncastle at a location to be determined. This location would ideally be located close to the centre of load growth in the area (subject to a viable site being identified).

A new primary site would improve security of supply in the area and would provide the capacity required for long term demand growth forecast in the area. It could also be interconnected with the existing network at 33 kV to further improve security of supply, and create options such as potentially creating a second infeed to Woodhall Spa primary (subject to detailed network design and voltage regulation studies). It could also provide an opportunity to add N-2 restoration capacity to Skegness BSP (which is expected to become a limiting factor for the site as discussed in the Skegness 33 kV report).

While this option would be a long term solution for this constraint and confers a number of additional network benefits, it would be very expensive to carry out. The three nearest BSPs to Horncastle primary (Lincoln, Sleaford and Skegness) are all around 30 km away. New circuits to Horncastle would therefore need to be very long (making this a high cost reinforcement project, and subject to significant deliverability risks).

All three BSPs are projected to be constrained as outlined in Section 2.6 and the Skegness 33 kV and Lincoln 33 kV reports. If a new BSP were built to deload Skegness that was located to the west of the existing site it could reduce the length required for new circuits (but this is early on in the optioneering process and runs into the same issue of long circuits being required, just at 132 kV). Looking into potential routes from the three existing BSPs would be required to properly assess whether this option is viable (and if it is, which BSP new infeeds could be created from at the lowest cost).

Another option which could be considered is adding a third transformer at Horncastle primary (rated to 12/24 MVA to match the existing units). This option would still require a new 33 kV circuit into the area. This option could likely be carried out at a lower cost than a new primary, as a new site would not need to be established and only a single new 33 kV circuit would need to be built. While this would not confer as many network benefits as a new primary it could be sufficient as demand growth in the area is not forecast to be as high as in more urban areas.

Option 4 – Install a voltage regulator

Discounted

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

New limiting factor for constraint(s) considered: Thermal capacity

Detailed description: Installing a voltage regulator at or near Horncastle primary could be used to improve the volts on this section of network. Even if the voltage constraint could be fully alleviated in this way, thermal constraints would be observed soon after (necessitating further intervention). This option has therefore been discounted.

Option 5 – Procure flexibility under Horncastle primary

Discounted

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

Detailed description: Flexibility services could be procured to help manage the thermal constraints on the transformers and circuits to Horncastle primary. However, flexibility is not suitable to manage the voltage constraint also observed on this section of network. Reinforcement can therefore not be deferred using flexibility in this case.

Solution Recommendation

In the first instance uprating the existing circuits to Horncastle primary (from Sleaford and Skegness BSPs) would add thermal capacity and improve voltage regulation. This would allow more of the capacity of the 12/24 MVA transformers at Horncastle to be utilised.

If further intervention is required (which demand forecasts indicate will be the case) then new 33 kV circuits may need to be built into the area (to feed either a third transformer at Horncastle or a new primary at a location to be determined following a siting strategy). This option would be very expensive given the lengths of circuit required but may be the only way to add capacity to the area. The viability, costs and timescales associated with this option would be subject to detailed route investigations and further detailed network design.

If a new BSP were built in the area this would free up a number of options, allowing shorter 33 kV circuits to be built to supply either Horncastle or a new site. This possibility needs to be weighed against the need for a new BSP in other nearby parts of the network (such as to support Skegness BSP), and would still encounter the same problem of extensive circuit lengths being required (just at 132 kV, which would improve voltage regulation but would increase costs dramatically).

2.3 Billingborough 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 2.3.1 constraint(s) and conditions under which constraint(s) occur

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed under Best View
			Summer (generation)
Billingborough transformers reverse power flow overloads	Fault or arranged outage on the other circuit	None	2034
Sleaford to Great Hale 33 kV circuit overloads	Outage at either Billingborough or Great Hale primaries	None	2034

Uncertainty under other Distribution Future Energy Scenarios: Very high generation growth is forecast for Billingborough under every scenario except Falling Short (for which relatively high growth is still seen). On the demand side growth is projected to be lower, with the highest being seen for System Transformation (under which 12/24 MVA transformers at Billingborough would still be sufficient to accommodate the demand in 2050).

Solution Options

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

Table 2.3.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Uprate the transformers at Billingborough primary.
2	Uprate the existing 33 kV circuits.
3	Unstitch 33 kV generation.
Operational Mitigation	
4	Active Network Management.
Flexibility Services	
5	Procure flexibility under Billingborough 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.

Option 1 – Uprate the transformers at Billingborough primary

Viable

Capacity released for constraint(s) considered: 4 MVA

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

Detailed description: Uprating the 33/11 kV transformers at Billingborough primary would alleviate this constraint, adding both demand and generation capacity. 12/24 MVA units would provide the capacity required to meet the demand requirements for the area up to 2050 based on current forecasts. However, on the generation side very high growth is forecast which could necessitate more investment (based on current projections even 20/40 MVA transformers would be insufficient in the long term). Generation growth in the area can be monitored to determine what transformer size should be installed.

The replacement of the transformers at Billingborough would also confer an asset condition benefit (the existing units are over 55 years old). Whichever rating of transformer is installed 33 kV circuit works will also be required at some point (options for which are discussed in option 2 below).

Option 2 – Uprate the existing 33 kV circuits

Viable

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

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

Detailed description: If the 33 kV circuit from Sleaford to Great Hale primary were uprated the projected circuit overloads would be resolved. Based on the generation growth projections at Billingborough primary other sections of 33 kV circuit will also need uprating in the future.

Option 3 – Unstitch 33 kV generation

Viable

Capacity released for constraint(s) considered: Export of 33 kV generators

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

Detailed description: A large portion of the existing generation on the Sleaford to Billingborough 33 kV network is connected at 33 kV. If a new 33 kV circuit were built to pick up some of this generation the existing circuit could be deloaded. This would also reduce network complexity, and the new circuit could also be used to create a second infeed to Great Hale primary at some point if required (which it may not be, as demand growth at Great Hale is forecast to be relatively low).

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 at Billingborough 11 kV could be included in an Active Network Management (ANM) scheme. ANM schemes are used to manage constraints on over-committed networks.

Option 5 – Procure flexibility under Billingborough primary

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 33 kV circuits to Billingborough and the transformers at the primary itself could be uprated to alleviate this constraint. An alternative method of deloading the existing circuits that could also be explored is building a new circuit to deload 33 kV generation (though this is likely to be more expensive than utilising the existing network). ANM may potentially be capable of deferring this constraint in the shorter term.

2.4 Grantham to New Beacon Road T2 33 kV circuit overloads

Constraint Overview

Generation Demand

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

Table 2.4.1 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
Grantham to New Beacon Road T2 33 kV circuit overload	Arranged or fault outage on the 33 kV circuit to Beacon Road T1	None	-	2034	-	-

Uncertainty under other Distribution Future Energy Scenarios: Higher growth at New Beacon Road is forecast under Consumer Transformation and Leading the Way (triggering overloads for other seasons in 2034). Growth at New Beacon Road primary should be considered in conjunction with growth at Grantham North and Grantham South BSPs (which both also feed the area). Under Leading the Way and Consumer Transformation overloads are projected for Grantham South by 2034.

Solution Options

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

Table 2.4.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Uprate the 33 kV circuits to New Beacon Road primary.
2	Create a second 33 kV infeed to Skillington primary.
Flexibility Services	
3	Procure flexibility under New Beacon Road 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 circuits to New Beacon Road primary

Viable

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

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

Detailed description: A large portion of the 33 kV circuits to New Beacon Road primary is made up of 33 kV tower line. By installing a new cable between two sections of tower line (on the infeed to T2) two circuits could be created. This would allow Skillington primary to be unstitched from New Beacon Road, freeing up capacity at both sites (as well as at Market Overton which is also fed via this circuit) and reducing network complexity.

If a similar project were also carried out on the infeed to T1, three dedicated 33 kV infeeds to New Beacon Road could be created. This could then facilitate installing a third transformer. To feed a third transformer a new 33 kV busbar would also be required at Grantham BSP.

The transformers at New Beacon Road primary are forecast to be close to their firm capacity by 2034. Additionally, reinforcing New Beacon Road would add capacity to the centre of Grantham. This would have the added benefit of potentially allowing Grantham South and/or Grantham North BSPs to be deloaded (Grantham South in particular is also expected to be close to its firm capacity by 2034). Reinforcing the 33 kV circuits to New Beacon Road therefore not only resolves the constraint outlined above, it would also facilitate future increases in capacity and create significant option value for the area. Another significant benefit of this reinforcement option is that it would increase the capacity of the 33 kV interconnection between Grantham and Oakham BSPs. Doing so increases network operability, as well as security of supply (this circuit could be utilised to restore demand for an N-2 event at either BSP, which is especially important for Oakham BSP as this is its only interconnection at 33 kV).

Finally, this reinforcement could be used to create a second 33 kV infeed to Easton primary via Skillington in the future. There is an existing 33 kV construction circuit between the two sites, as well as space for a new transformer at Easton and for the required 33 kV switchgear at Skillington. An 11 kV study would need to be conducted to ensure the backfeed capacity at both sites would still be sufficient without this circuit.

Option 2 – Create a second 33 kV infeed to Skillington primary

Discounted

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

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

Detailed description: There is a 33 kV construction circuit between Easton and Skillington primaries which is currently run at 11 kV. This circuit could be used to create a new 33 kV infeed to Skillington primary (which could then be used to deload the circuit to New Beacon Road T2 which currently supplies it). This option has been discounted for a number of reasons:

- There are no available addresses on the 33 kV circuit from Grantham BSP to Easton and Billingborough primaries. To achieve this reinforcement without breaching Engineering Recommendation P18 a new circuit would therefore need to be built at least to the Easton tee (requiring over 5 km of circuit works).
- The circuit between Skillington and Easton primaries would be lost at 11 kV, reducing the backfeed capacity of both sites. As with creating a second infeed to Skillington as mentioned in option 1 above, a full 11 kV study would be required to ensure both sites would still be compliant with Engineering Recommendation P2 without this circuit.
- A second transformer at Skillington would not be as advantageous as a second transformer at Easton (based on the load distribution in the area and the fact that Easton has higher demand than Skillington).
- This option does not confer the additional benefits discussed in option 1 above.

Option 3 – Procure flexibility under New Beacon Road primary

Discounted

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

Detailed **description:** Flexibility services could be procured to alleviate the projected overloads on the 33 kV circuit to New Beacon Road T2. Due to the low cost of this reinforcement (and the other network drivers) flexibility is likely not economical. Flexibility could however be utilised in deferring further reinforcement. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

By installing a new 33 kV cable on the infeed to New Beacon Road primary two circuits could be created, adding capacity and allowing Skillington primary to be unstitched. This would not only resolve this constraint, it would also confer a number of network benefits as discussed above (including the possibility of creating additional capacity in the centre of Grantham).

2.5 Sleaford to the Ruskington tee 33 kV circuit protection restriction

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
Sleaford to the Ruskington tee 33 kV circuit overload	Sleaford main 2 33 kV busbar arranged or fault outage	None	2034	2034	-	-

Uncertainty under other Distribution Future Energy Scenarios: Higher demand growth at both primaries is forecast under Leading the Way and Consumer Transformation. Even under the lower growth scenarios there is a clear requirement for the works outlined below to support network operability and prevent any unnecessary tripping.

Solution Recommendation

The 33 kV circuit between Sleaford and the tee point between Ruskington T1 and Tattershall T1 is currently restricted by the relay setting. This setting is only 28 MVA, compared to the overall circuit rating being 43 MVA. This is due to the fact that fault levels are relatively low, and there is no additional HV overcurrent protection on the Ruskington side. By installing an HV overcurrent protection scheme at Ruskington the full rating of the 33 kV circuit would be released (increasing capacity on the circuit by 17 MVA and facilitating further growth at both Tattershall and Ruskington). This is likely to involve the installation of additional 33 kV switchgear (there are no HV current transformers in the existing transformers at Ruskington).

This reinforcement is not suitable for deferral using flexibility as it is low cost and protection related. Aside from preventing the overloads outlined above, these works will improve network security by preventing any unnecessary tripping and increase operability. A CBA is not required due to the low cost and the fact that there are no feasible alternative schemes.

2.6 Sleaford BSP GT 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 year constraint is observed in each season under Best View			
Demand			**Winter**	**Int Cool**	**Int Warm**	**Summer**
Sleaford GT1 or GT2 overload	Fault or arranged outage on either GT at Sleaford	None	-	2034	2034	-
Generation			**Summer**			
Sleaford reverse power flow GT overload	Fault or arranged outage on either GT at Sleaford	None	2034			

Uncertainty under other Distribution Future Energy Scenarios: On the demand side under System Transformation overloads are only projected for intermediate cool (and for Falling Short no overloads are forecast to occur for any season). Conversely under Consumer Transformation and Leading the Way higher growth is forecast than under Best View. This is broadly mirrored on the generation side, with the highest and lowest growth being forecast for Consumer Transformation and Falling Short respectively.

Solution Options

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

Table 2.6.2 solution options to solve constraint(s)

Option	Description
Reinforcement	
1	Uprate the GTs at Sleaford BSP.
2	Install a third GT at Sleaford BSP.
Operational Mitigation	
3	Review seasonal ratings.
4	Active Network Management.
Flexibility Services	
5	Procure flexibility under Sleaford 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 Sleaford 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 Sleaford 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 GT at Sleaford BSP

Viable

Capacity released for constraint(s) considered: Dependent on growth at Grantham BSP

New limiting factor for constraint(s) considered: 132 kV circuit capacity and N-2 restoration capacity

Detailed description: A third 132/33 kV GT (and the associated 33 kV switchgear required to fully utilise it) would resolve the constraint on the existing GTs for both demand and generation. For both demand and generation in order to free up the full capacity of the new GTs 132 kV circuit works will also be required (which is discussed in the Bicker Fen 132 kV report). On the demand side although there is a reasonable amount of 33 kV interconnection to Sleaford BSP, N-2 restoration capacity may eventually become a limiting factor. When this occurs the potential to connect to the 132 kV circuit from Bourne BSP to Lincoln BSP could be explored (which at its closest point passes within 2 km of Sleaford BSP).

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 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, would not be a long term solution and would only affect the demand 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 Sleaford 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 on the GTs at Sleaford, but not the projected demand constraint.

Option 5 – Procure flexibility under Sleaford BSP

Viable

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

Detailed description: Flexibility services could be procured on the network supplied from Sleaford BSP to alleviate the projected demand overloads seen on the GTs (and could be used in conjunction with a review of seasonal transformer ratings as discussed in option 3). Flexibility would not be suitable for managing the reverse power flow constraint projected at Sleaford. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

Installing a third 132/33 kV GT at Sleaford BSP (and the associated 33 kV switchgear required to fully utilise it) is likely the optimal reinforcement solution for this constraint, adding significant capacity for both demand and generation. Further works will also be required at 132 kV, which will be considered alongside the overall development of the 132 kV network. In the short term the use of ANM, a review of seasonal transformer ratings and/or the use of flexibility could be used to manage this constraint.

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