Bradwell Abbey and Bletchley BSPs

Network Development Report – East Midlands

May 2024

Electricity Distribution

nationalgrid

Contents

Bradwell Abbey and Bletchley 33 kV

1. Network Overview

Bradwell Abbey Bulk Supply Point (BSP) and Bletchley BSP is supplied from East Claydon Grid Supply Point (GSP) in National Grid Electricity Distribution's (NGED's) East Midlands licence area.

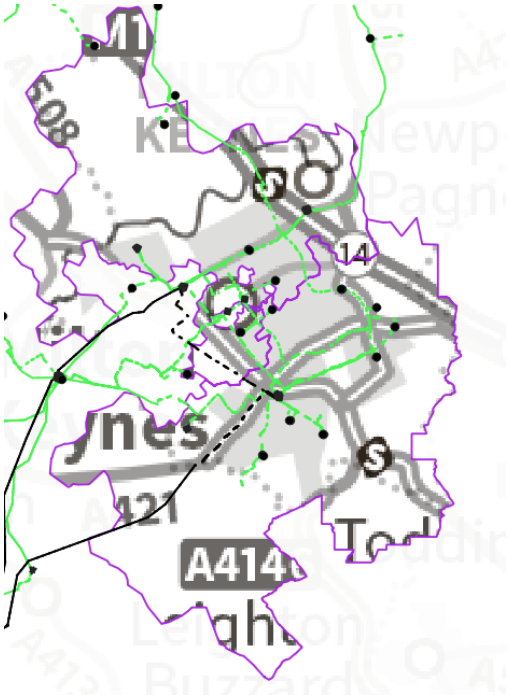

Figure 1.1 Bradwell Abbey BSP and Bletchley BSP geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon identified on the 33 kV network supplied from Bradwell Abbey BSP and Bletchley BSP. 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

Bradwell Abbey BSP is fed from East Claydon GSP via 132 kV dual circuits (the CJ and AH routes). A 132 kV cable interconnects Bradwell Abbey BSP and Bletchley BSP.

The site has two 33 kV busbars fed by two 132/33 kV Grid Transformers (GTs). Both transformers are rated to 90/117 MVA. Bradwell Abbey BSP feeds five primary substations: Campbell Park, Childs Way, Fox Milne, Hanslope Park, Marlborough Street, Newport Pagnell, Portway and Wolverton. All of the primaries fed from Bradwell Abbey BSP have two 33/11 kV transformers, with the exception of Childs Way, which has three 33/11 kV transformers.

There is interconnection with Bletchley BSP, Stony Stratford BSP and Northampton East BSP. Interconnection with Bletchley BSP is via loose couples at the 11 kV busbar at Childs Way and Fox Milne primaries and a normally open point at Portway primary. Interconnection with Stony Stratford BSP is via normally open points at Portway and Kiln Farm primaries. Interconnection with Northampton East BSP is via a normally open points at Hanslope Park and Newport Pagnell primaries.

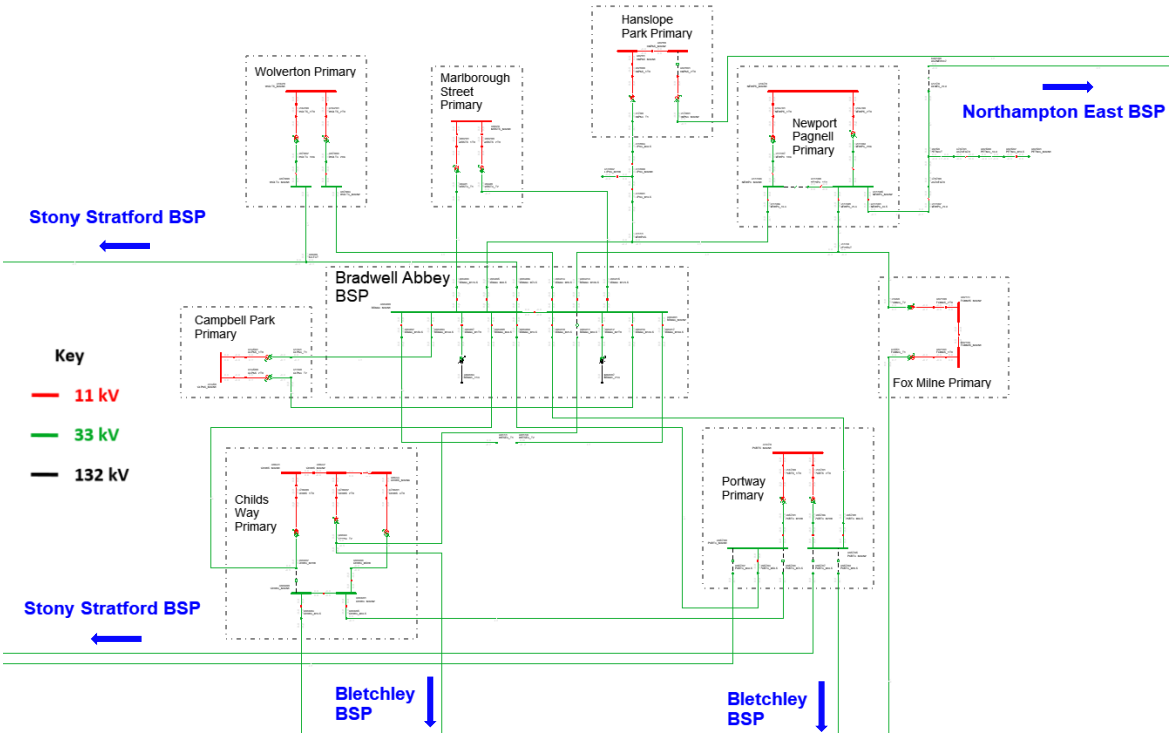

Figure 1.1.1 Bradwell Abbey BSP 33 kV network single line diagram

Bletchley BSP is fed directly from East Claydon GSP via a 132 kV dual circuit (DF route). A 132 kV cable interconnects Bradwell Abbey BSP and Bletchley BSP.

The site has four 33 kV busbars fed by three 132/33 kV GTs. Two GTs are rated at 120/143 MVA with the remaining transformer rated to 90/117 MVA. The site is run split in a 2 + 1 configuration due to fault level limitations. Bletchley BSP feeds nine primary substations: Childs Way, Fen Farm, Fox Milne, Kingston, Newton Road, Secklow Gate, Tattenhoe, Victoria Road and Wavendon Gate. All of the primaries fed from Bradwell Abbey BSP have two 33/11 kV transformers, with the exception of Childs Way and Wavendon Gate, which have three 33/11 kV transformers and Secklow Gate which is a single transformer primary.

There is interconnection with Bradwell Abbey BSP and Stony Stratford BSP. Interconnection with Bradwell Abbey BSP is via loose couples at the 11 kV busbar at Childs Way and Fox Milne primaries and a normally open point at Portway primary. Interconnection with Stony Stratford BSP is via a loose couple at the 11 kV busbar at Tattenhoe primary and normally open points at Portway and Kiln Farm primaries.

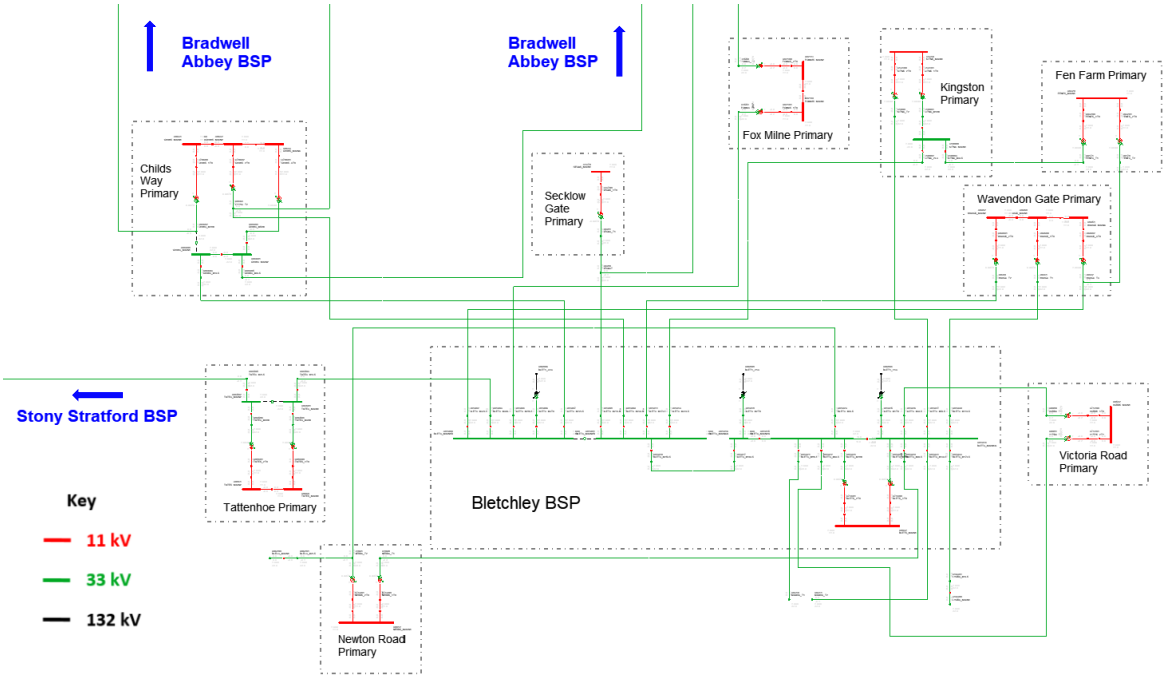

Figure 1.1.2 Bletchley BSP 33 kV network single line diagram

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.

- There are a number of loose couples within the Bletchley, Bradwell Abbey, Brackley and Stony Stratford BSP group. For any arranged outage affecting infeed in to any grid transformer, loose couples are split by opening the 11 kV bus section circuit breaker at Childs Way, Fox Milne, Tattenhoe and Towcester primaries.
- For any arranged outage affecting infeed in to any of the GTs at Bletchley BSP, the 33 kV bus section circuit breaker between the Main 1B and Main 2B busbar is closed to secure against a fault outage.
- For any arranged outage affecting the infeed in to Secklow Gate primary, the demand is transferred to Childs Way.
- For any arranged outage affecting the infeed in to Hanslope Park, the normally open low voltage circuit breaker for the second transformer is closed to transfer Hanslope Park in to Northampton East BSP.

2. Network Constraint Details 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:

- The primary transformers at (and the 33 kV circuits to) Marlborough Street primary are projected to overload for N-1 outages on either infeed by 2028 (and by 2034 for all seasons).
- For every season by 2028 the primary transformers at Newport Pagnell primary and the 33 kV circuits from Bradwell Abbey BSP are both projected to overload for arranged or fault outages on either side.
- At Victoria Road primary both of the primary transformers are forecast to overload in intermediate cool by 2028 (and by 2034 for intermediate warm and summer) for N-1 outages.

2.2 Marlborough Street primary transformers and 33 kV circuit overloads

Constraint Overview

Generation Demand

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

Table 2.2.1 constraint(s) and condition under which constraint occurs

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
Marlborough Street primary transformers and 33 kV circuits	Fault or arranged outage affecting the other transformer or infeed	None	2034	2028	2034	2034

Uncertainty under other Distribution Future Energy Scenarios: Under the higher growth scenarios, Consumer Transformation and Leading the way, the constraint is worse, and may occur sooner. Under the lower growth scenarios (Falling Short and System Transformation), the constraint occurs between 2034 and 2050.

Solution Options

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

Table 2.2.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Uprate both transformers at Marlborough Street with upgraded 33 kV circuits	✓	×	×	Viable
2	Uprate both transformers at Campbell Park	✓	✓	✓	Viable
3	Construct a new primary within Milton Keynes	✓	✓	×	Viable
Operational Mitigation					
4	Review seasonal ratings	✓	×	✓	Viable
5	Transfer demand to other primaries	✓	×	✓	Viable
Flexibility services					
6	Procure flexibility under Marlborough Street primary	✓	×	✓	Viable

Solution Development

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

Option 1 – Uprate both transformers at Marlborough Street with upgraded 33 kV circuits

Capacity Released for constraint(s) considered: Up to new ratings — Viable

New limiting factor for constraint(s) considered: Rating of the primary transformers

Detailed description: Uprate both transformers at Marlborough Street to 20/40 MVA units, along with upgraded 33 kV circuits. This would alleviate the constraint and provide long term capacity.

Option 2 – Uprate both transformers at Campbell Park

Capacity Released for constraint(s) considered: Dependent on 11 kV transfers ↑ **Viable**

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

Detailed description: Uprate both transformers at Campbell Park to 20/40 MVA units, and transfer demand from Marlborough Street to Campbell Park. No 33 kV circuit works are required in order to utilise the full capacity of 20/40 MVA primary transformers at Campbell Park. This would alleviate the constraint and provide long term capacity (subject to an 11 kV study to assess the viability of transfers).

Option 3 – Construct a new primary within Milton Keynes

Capacity Released for constraint(s) considered: Up to 38 MVA ↑ **Viable**

New limiting factor for constraint(s) considered: Total primary capacity

Detailed description: Construct a new primary with two 20/40 MVA transformers within Milton Keynes and transfer demand. This would alleviate the constraint and provide long term capacity.

Option 4 – Review seasonal ratings

Capacity Released for constraint(s) considered: Dependent on review ↑ **Viable**

New limiting factor for constraint(s) considered: Rating of the primary transformers

Detailed description: Overloads are only seen by 2028 for intermediate cool. It is therefore possible that this constraint could be delayed slightly by reviewing NGED's internal policy regarding transformer ratings, which does not currently distinguish between summer and intermediate cool ratings (which may be overly pessimistic).

This solution is dependent on an internal review and would not be a long-term solution; by 2034 transformer overloads are seen in other seasons.

Option 5 – Transfer demand to other primaries

Capacity Released for constraint(s) considered: Dependent on demand transfers ↑ **Viable**

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

Detailed description: Transferring approximately 1 MVA of demand to another primary will alleviate constraint seen by 2028. However, this option is unlikely to be a long term solution, as demand continues to grow both at Marlborough Street, and the nearby primaries where demand could being transferred to.

Option 6 – Procure flexibility under Marlborough Street primary

Flexibility service type: Generation turn up/demand turn down. ↑ **Viable**

Detailed description: Flexibility services could be procured to alleviate projected overloads. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

It is recommended to assess the feasibility of reviewing the seasonal transformer ratings and transferring demand from Marlborough Street primary to other primaries via the existing 11kV circuits. If the 11kV circuits do not offer sufficient capacity then flexibility could be procured at Marlborough Street to defer the reinforcement requirements, subject to a CBA confirmation through the DNOA process.

The optimum long term reinforcement option is dependent upon the demand growth seen at Marlborough Road. The demand growth will be monitored to assess the most suitable and cost-effective option to provide capacity within Milton Keynes.

2.3 Newport Pagnell primary transformer and 33 kV circuit overloads

Constraint Overview

Generation | **Demand**

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

Table 2.3.1 constraint(s) and condition under which constraint occurs

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
Newport Pagnell primary transformers and Bradwell Abbey – Newport Pagnell 33 kV circuits	Fault or arranged outage affecting the other transformer or infeed	None	2028	2028	2028	2028

Uncertainty under other Distribution Future Energy Scenarios: Under the higher growth scenarios, Leading the Way and Consumer Transformation, the constraint is worse, and may occur sooner. Constraint are present across all scenarios and seasons by 2050.

Solution Options

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

Table 2.3.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	**Discounted**
Reinforcement					
1	Uprate both transformers at Newport Pagnell with upgraded 33 kV circuits	✓	✓	✓	**Viable**
Operational Mitigation					
2	Transfer demand to other primaries	×	×	✓	**Discounted**
Flexibility services					
3	Procure flexibility under Newport Pagnell primary	✓	×	✓	**Viable**

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 Newport Pagnell with upgraded 33 kV circuits

Capacity Released for constraint(s) considered: Up to new ratings — **Viable**

New limiting factor for constraint(s) considered: Rating of primary transformers

Detailed description: Uprate both transformers at Newport Pagnell to 20/40 MVA units, along with upgraded 33 kV circuits (approximately 6 km). This would alleviate the constraint and provide long term capacity.

Option 2 – Transfer demand to other primaries

Capacity Released for constraint(s) considered: Dependent on demand transfers

Discounted

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

Detailed description: This option has been discounted due to the lack of capacity at nearby primaries.

Option 3 – Procure flexibility under Newport Pagnell primary

Flexibility service type: Generation turn up/demand turn down

Viable

Detailed description: Flexibility services could be procured to alleviate projected overloads. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

Flexibility could be procured at Newport Pagnell to defer the reinforcement requirements, subject to a CBA confirmation through the DNOA process.

The uprating of both transformers at Newport Pagnell primary, along with upgraded 33 kV circuits has been identified as the optimal long term reinforcement solution.

2.4 Victoria Road primary transformer overloads

Constraint Overview

Generation **Demand**

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

Table 2.4.1 constraint(s) and condition under which constraint occurs

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
Victoria Road primary transformers	Fault or arranged outage affecting the other transformer or infeed	None	-	2028	2034	2034

Uncertainty under other Distribution Future Energy Scenarios: Under the higher growth scenarios, Leading the Way and Consumer Transformation, the constraint is worse, and may occur sooner. Constraint are present across all scenarios and seasons by 2050.

Solution Options

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

Table 2.4.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Uprate both transformers at Victoria Road	✓	✓	✓	Viable
Operational Mitigation					
2	Review seasonal ratings	✓	×	✓	Viable
3	Transfer demand to other primaries	✓	×	✓	Viable
Flexibility services					
4	Procure flexibility under Victoria Road primary	✓	×	✓	Viable

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 Victoria Road

Capacity Released for constraint(s) considered: Up to new ratings ↑ Viable

New limiting factor for constraint(s) considered: Bradwell Abbey – Victoria Road 33 kV circuits

Detailed description: Uprate both transformers at Victoria Road to 20/40 MVA units. This would alleviate the constraint and provide long term capacity.

Option 2 – Review seasonal ratings

Capacity Released for constraint(s) considered: Dependent on review ↑ **Viable**

New limiting factor for constraint(s) considered: Rating of the primary transformers

Detailed description: Overloads are only seen in 2028 for intermediate cool. It is therefore possible that this constraint could be delayed slightly by reviewing NGED's internal policy regarding transformer ratings, which does not currently distinguish between summer and intermediate cool ratings (which may be overly pessimistic).

This solution is dependent on an internal review and would not be a long term solution; by 2034 transformer overloads are seen in other seasons.

Option 3 – Transfer demand to other primaries

Capacity Released for constraint(s) considered: Dependent on demand transfers ↑ **Viable**

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

Detailed description: Transferring approximately 1 MVA of demand to another primary will alleviate constraint seen by 2028. However, this option is unlikely to be a long term solution, as demand continues to grow both at Victoria Road, and the primaries where demand could be transferred to.

Option 4 – Procure flexibility under Victoria Road primary

Flexibility service type: Generation turn up/demand turn down ↑ **Viable**

Detailed description: Flexibility services could be procured to alleviate projected overloads. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

It is recommended to assess the feasibility of reviewing the seasonal transformer ratings and transferring demand from Victoria Road primary to other primaries via the existing 11kV circuits. If the 11kV circuits do not offer sufficient capacity then flexibility could be procured at Victoria Road to defer the reinforcement requirements, subject to a CBA confirmation through the DNOA process.

The optimal long term reinforcement solution has been identified as the uprating of both transformers at Victoria Road primary.

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