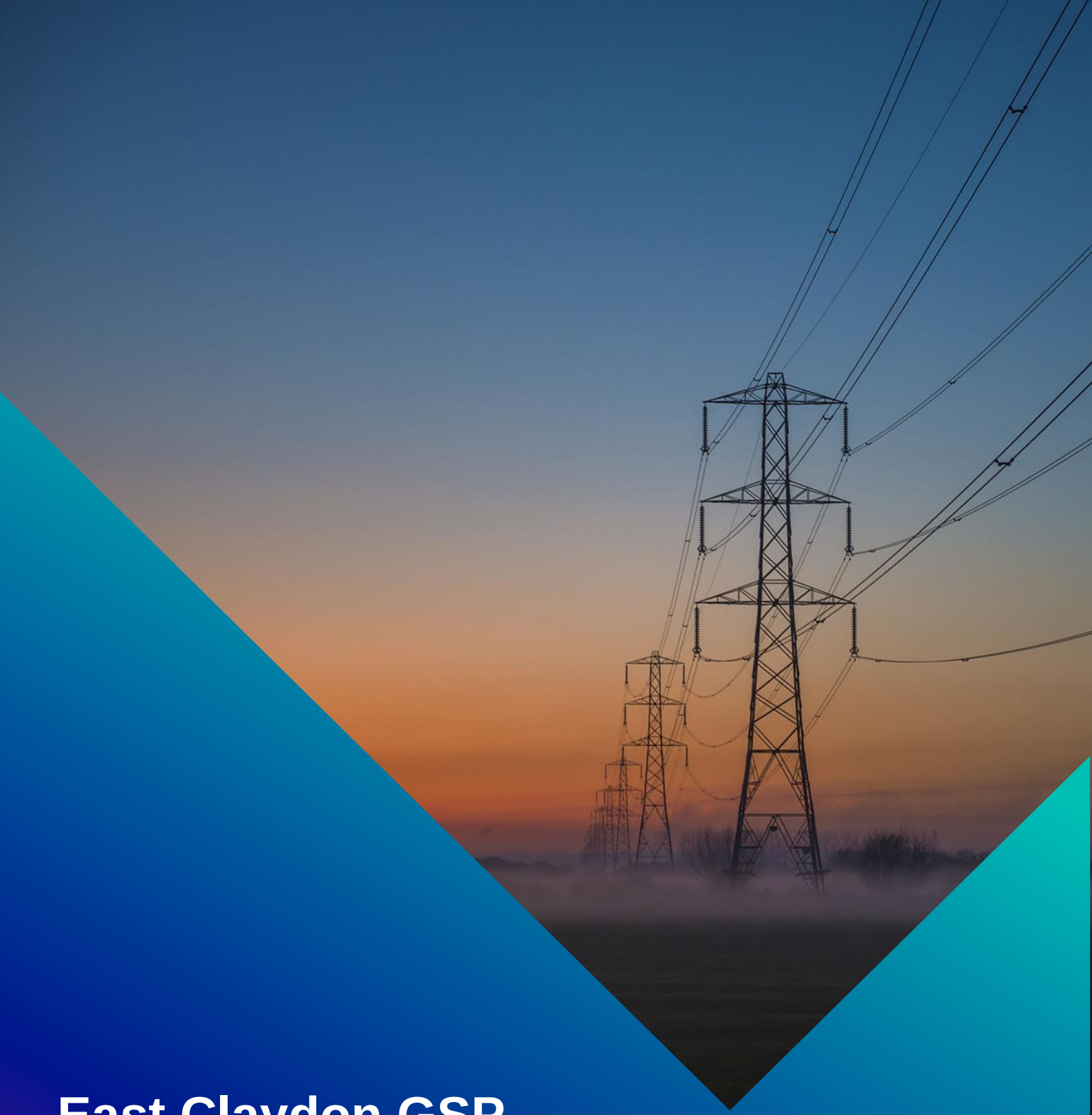

East Claydon GSP

Network Development Report – East Midlands

May 2024

Electricity Distribution

nationalgrid

Contents

East Claydon 132 kV

1. Network Overview

East Claydon Grid Supply Point (GSP) supplies five Bulk Supply Points in National Grid Electricity Distribution's (NGED's) East Midlands licence area (Bletchley, Brackley, Bradwell Abbey, Stony Stratford), one in the West Midlands licence area (Brackley) and one in Scottish and Southern Electricity Networks (SSEN) Southern licence area (Bicester North).

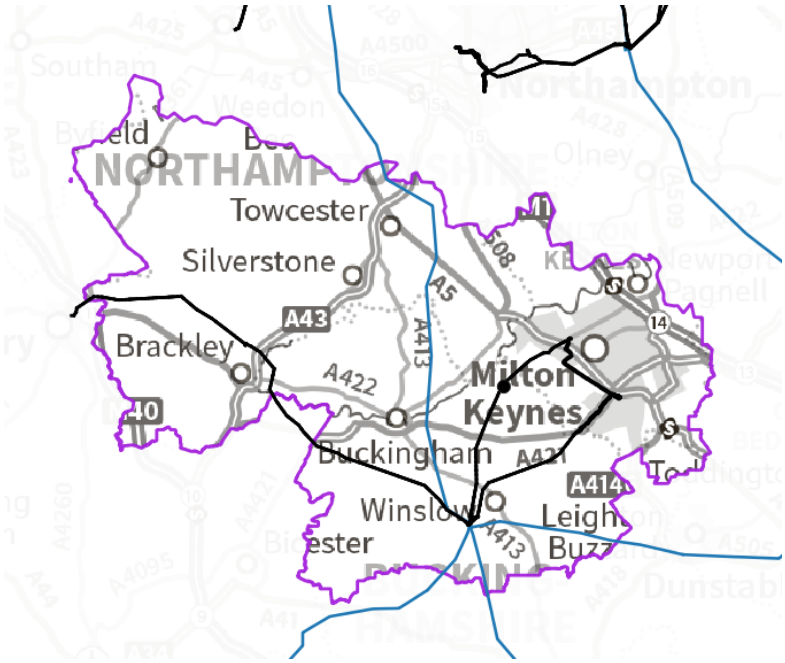

Figure 1.1 East Claydon GSP geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon identified on the 132 kV network supplied from Berkswell GSP. This uses the methodology outlined in the Network Development Plan Methodology Report with Network Operability Modelling applied as outlined below.

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

1.1 Network Topology

East Claydon GSP is a 400/132 kV substation comprising of four 400/132 kV, 240 MVA Super Grid Transformers (SGTs). The site is normally run as a 2 + 2 arrangement, with bus-section circuit breakers closed and bus-coupler circuit breakers open. Running the site with more than two SGTs on a busbar is not possible currently due to fault level constraints.

The Milton Keynes ring contains three BSPs fed by four circuits. The DF route feeds Bletchley BSP, and the CJ route feeds Stony Stratford BSP. The AH route feeds Bradwell Abbey BSP from Stony Stratford BSP, and a 132 kV cable interconnects Bradwell Abbey and Bletchley BSPs.

The CV route feeds Banbury BSP (NGED West Midlands), and Brackley BSP via a tee. The group demand is anticipated to exceed 100 MW, which triggers a third infeed in to the group so that Engineering Recommendation P2 compliance can be maintained. This third circuit is discussed in more detail in the Berkswell 132 kV report.

SSEN's Bicester North BSP is fed via a pair of 132 kV cables.

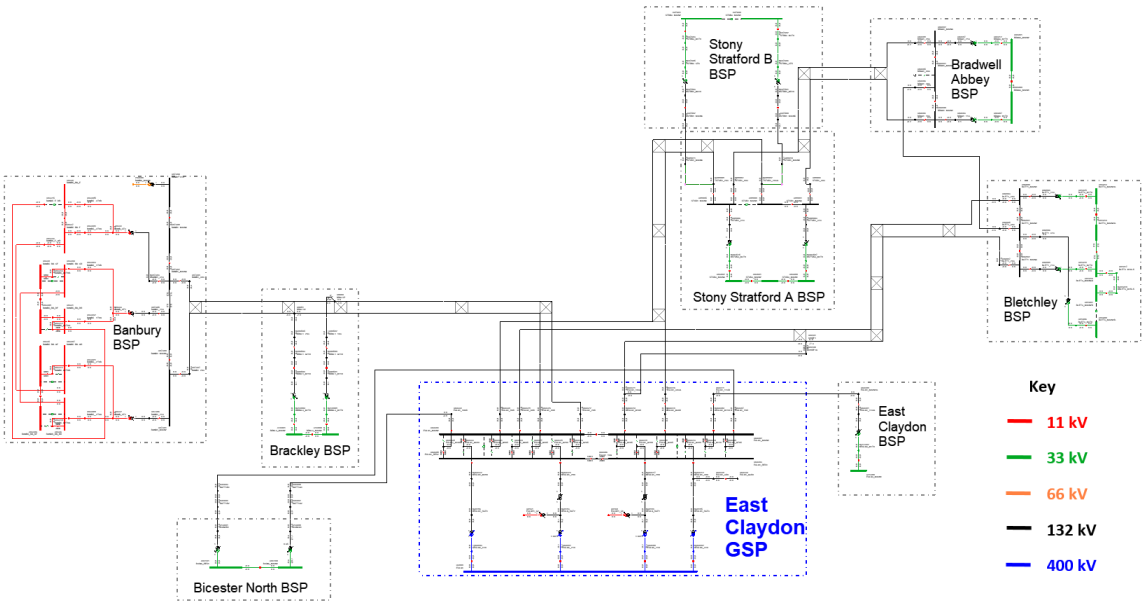

Figure 1.1.1 East Claydon GSP 132 kV network single line diagram

1.2 Network Operability Modelling

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

- Arranged outages on the 132 kV busbars at East Claydon GSP are modelled such that circuits are secured onto available and useful busbars.
- There are a number of loose couples within the Bletchley, Bradwell Abbey, Brackley and Stony Stratford BSP group. For arranged outage affecting infeeds to any Grid Transformer (GT), loose couples are split by opening the 11 kV bus section circuit breaker at Childs Way, Fox Milne, Tattenhoe and Towcester primaries.

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:

- Overloads are projected on the Milton Keynes 132 kV ring by 2034 for N-2 outages.
- The GTs at Bradwell Abbey BSP are projected to overload for the loss of the other infeed (by 2028 for all seasons).
- Bletchley BSP GT overloads are forecast for both N-1 and N-2 outages (with N-2 constraints being more onerous, with overloads seen by 2028).
- The GTs at Stony Stratford BSP are projected to overload for the loss of the other infeed (by 2028 for all seasons).

2.2 Milton Keynes 132 kV ring 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
East Claydon – Milton Keynes 132 kV infeed overloads	Arranged outage of any one out of the four circuits in to the ring	Fault outage of any of the three remaining circuits	2034	2034	2034	2034
Bradwell Abbey – Bletchley 132 kV interconnector overloads	Arranged outage of any one out of the four circuits in to the ring	Fault outage of any of the three remaining circuits	2034	2034	2034	2034

Uncertainty under other Distribution Future Energy Scenarios: Under higher growth scenarios (Consumer Transformation and Leading the Way), the constraint is worse and may occur sooner.

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 all circuits within the ring	✓	×	×	**Viable**
2	New 132 kV circuit in to the ring	✓	✓	✓	**Viable**
Operational Mitigation					
3	Various operational mitigations	×	×	×	**Discounted**
Flexibility services					
4	Procure flexibility services under the BSPs on the ring	✓	×	✓	**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 all circuits within the ring

Capacity Released for constraint(s) considered: Dependent upon circuit construction

Discounted

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

Detailed description: Uprate all 132 kV circuits within the ring. Whilst this solves the constraint, it does not provide long term capacity in to Milton Keynes and further intervention would be required to meet the long-term forecast demand growth within the Milton Keynes ring.

Option 2 – New 132 kV circuit in to the ring

Capacity Released for constraint(s) considered: Dependent upon circuit construction

Viable

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

Detailed description: Construct a new dual 132 kV circuit from East Claydon GSP in to the Milton Keynes ring. The new circuit should pick up Bradwell Abbey BSP, as this would give each BSP a direct feed from East Claydon GSP. This would resolve the constraint, and provide sufficient capacity for the long-term forecast demand growth within the Milton Keynes ring.

Option 3 – Various operational mitigations

Capacity released for constraint(s) considered: Dependant on mitigation

Discounted

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

Detailed description: Various operational mitigations have been considered, such as alternative running arrangements, but have been discounted due to security of supply and thermal issues.

Option 4 – Procure flexibility services under the BSPs on the ring

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

The optimum reinforcement solution for the Milton Keynes 132 kV ring constraint is the construction of a new 132 kV dual circuit from East Claydon GSP in to the Milton Keynes ring, which will alleviate the constraint and provide sufficient capacity for the long-term forecast demand growth in the area.

In the interim, the use of flexibility services could be used to manage this constraint until reinforcement works can be carried out.

2.3 Bradwell Abbey BSP grid transformer overloads

Constraint Overview

Generation **Demand**

The table below outlines the nature of the network constraints identified in the network analysis. Arranged outages which trigger the transfer of demand into Bradwell Abbey from Bletchley can exacerbate this constraint. This is not included in the table below as it could likely be managed operationally and does not affect the overall reinforcement strategy.

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
Bradwell Abbey BSP GT overloads	Arranged or fault outage on the other GT or 132 kV infeed	None	2028	2028	2028	2028

Uncertainty under other Distribution Future Energy Scenarios: Under higher growth scenarios (Consumer Transformation and Leading the Way), the constraint is worse and may occur sooner.

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	Install a third GT at Bradwell Abbey BSP	✓	✓	✓	Viable
2	Establish a new BSP in Milton Keynes	✓	✓	×	Discounted
Operational Mitigation					
3	Various operational mitigations	×	×	×	Discounted
Flexibility services					
4	Procure flexibility under Bradwell Abbey BSP	✓	×	✓	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 – Install a third GT at Bradwell Abbey BSP

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

New limiting factor for constraint(s) considered: 132 kV circuit capacity (AH, CJ and DF routes)

Detailed description: Install a third 132/33 kV GT at Bradwell Abbey BSP, in a 2 + 1 configuration. The third GT would be connected to a new 33 kV busbar such that it supports the existing switchboard or the new one for faults or arranged outages. This solution would create sufficient GT capacity and alleviate the constraint.

Option 2 – Establish a new BSP in Milton Keynes

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

Discounted

New limiting factor for constraint(s) considered: 132 kV circuit capacity (AH, CJ and DF routes)

Detailed description: If a new BSP were to be established within Milton Keynes or the surrounding area, existing primary substations could be transferred to the new BSP. This would de-load Bradwell Abbey BSP and resolve this constraint. The significantly higher costs of this option compared to option 1 means that it has been discounted.

Option 3 – Various operational mitigations

Capacity released for constraint(s) considered: Dependant on mitigation

Discounted

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

Detailed description: There some operational mitigations that have been considered, such as alternative running arrangements. This has been discounted as the alternative running arrangements do not solve the constraint and exacerbates other constraints.

Option 4 – Procure flexibility under Bradwell Abbey BSP

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

The optimal reinforcement strategy to alleviate the projected constraints on the GTs at Bradwell Abbey BSP is to install a third GT.

In the interim, the use of flexibility services could be used to manage this constraint until reinforcement works can be carried out.

2.4 Bletchley BSP grid 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
Bletchley BSP GT overloads	Fault outage on the 132 kV infeed	None	-	2034	2034	-
Bletchley BSP GT overloads	Arranged outage on the other GT or 132 kV infeed	Fault outage on the other GT or 132 kV infeed	2028	2028	2028	2028

Uncertainty under other Distribution Future Energy Scenarios: Under higher growth scenarios (Consumer Transformation and Leading the Way), the constraint is worse and may occur sooner.

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	Install a fourth GT at Bletchley BSP	✓	✓	✓	**Viable**
2	Establish a new BSP in Milton Keynes	✓	✓	×	**Discounted**
Operational Mitigation					
3	Various operational mitigations	×	×	×	**Discounted**
Flexibility services					
4	Procure flexibility under Bletchley BSP	✓	×	✓	**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 – Install a fourth GT at Bletchley BSP

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

New limiting factor for constraint(s) considered: 132 kV circuit capacity (AH, CJ and DF routes)

Detailed description: Install a fourth 132/33 kV GT at Bletchley BSP, along with associated 132 kV busbar, such that the site runs in a 2+2 configuration. This solution would create sufficient GT capacity and alleviate the constraint.

Option 2 – Establish a new BSP in Milton Keynes

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

Discounted

New limiting factor for constraint(s) considered: 132 kV circuit capacity (AH, CJ and DF routes)

Detailed description: If a new BSP were to be established within Milton Keynes or the surrounding area, existing primary substations could be transferred to the new BSP. This would de-load Bletchley BSP and resolve this constraint. The significantly higher costs of this option compared to option 1 means that it has been discounted.

Option 3 – Various operational mitigations

Capacity released for constraint(s) considered: Dependant on mitigation

Discounted

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

Detailed description: A number of operational mitigations have been considered for mitigating this constraint. A review of seasonal transformer ratings could potentially alleviate the intermediate cool and intermediate warm N-1 overloads in 2034, and restricting outage seasons could potentially be used to manage the N-2 constraint. As N-2 constraints are seen in all seasons in 2028 this is not a long term solution (but could be utilised in the interim before reinforcement is carried out).

Option 4 – Procure flexibility under Bletchley BSP

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

The optimal reinforcement strategy to alleviate the projected constraints on the GTs at Bletchley BSP is to install a fourth GT.

In the interim, the use of flexibility services and/or operational mitigation (as discussed above) could be used to manage this constraint until reinforcement works can be carried out.

2.5 Stony Stratford BSP grid transformer overloads

Constraint Overview

Generation **Demand**

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads seen at winter peak demand.

Table 2.5.1 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
Stony Stratford BSP GT overloads	Arranged or fault outage on the other GT or 132 kV infeed	None	2028	2028	2028	2028

Uncertainty under other Distribution Future Energy Scenarios: Under higher growth scenarios (Consumer Transformation and Leading the Way), the constraint is worse and may occur sooner.

Solution Options

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

Table 2.5.2 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	Install a third GT at Stony Stratford BSP	✓	✓	✓	**Viable**
2	Install two banked GTs at Stony Stratford BSP	✓	✓	✓	**Viable**
3	Establish a new BSP in Milton Keynes	✓	✓	×	**Discounted**
Operational Mitigation					
4	Various operational mitigations	×	×	✓	**Discounted**
Flexibility services					
5	Procure flexibility under Stony Stratford BSP	✓	×	✓	**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 – Install a third GT at Stony Stratford BSP

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

New limiting factor for constraint(s) considered: 132 kV circuit capacity (AH, CJ and DF routes)

Detailed description: Install a third 132/33 kV GT at Stony Stratford BSP. This would resolve the constraint and provide long term capacity, but would result in imbalanced load between 132 kV circuit infeeds (options for adding circuit capacity to the group are discussed in Section 2.2 of this report).

Option 2 – Install two banked GTs at Stony Stratford BSP

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

New limiting factor for constraint(s) considered: 132 kV circuit capacity (AH, CJ and DF routes)

Detailed description: Install a two banked 132/33 kV GTs at Stony Stratford BSP. This would resolve the constraint and provide long term capacity.

Option 3 – Establish a new BSP in Milton Keynes

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

New limiting factor for constraint(s) considered: 132 kV circuit capacity (AH, CJ and DF routes)

Detailed description: If a new BSP were to be established within Milton Keynes or the surrounding area, existing primary substations could be transferred to the new BSP. This would de-load Stony Stratford BSP and resolve this constraint. The significantly higher costs of this option compared to option 1 means that it has been discounted.

Option 4 – Various operational mitigations

Capacity released for constraint(s) considered: Dependant on mitigation Discounted

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

Detailed description: A number of operational mitigations that have been considered to mitigate this constraint, such as alternative running arrangements. This has been discounted as the alternative running arrangements do not solve the constraint and exacerbates other constraints.

Option 5 – Procure flexibility under Stony Stratford BSP

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

The optimal reinforcement strategy to alleviate the projected constraints on the GTs at Stony Stratford BSP is to install two banked GTs.

In the interim, the use of flexibility services could be used to manage this constraint until reinforcement works can be carried out.

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