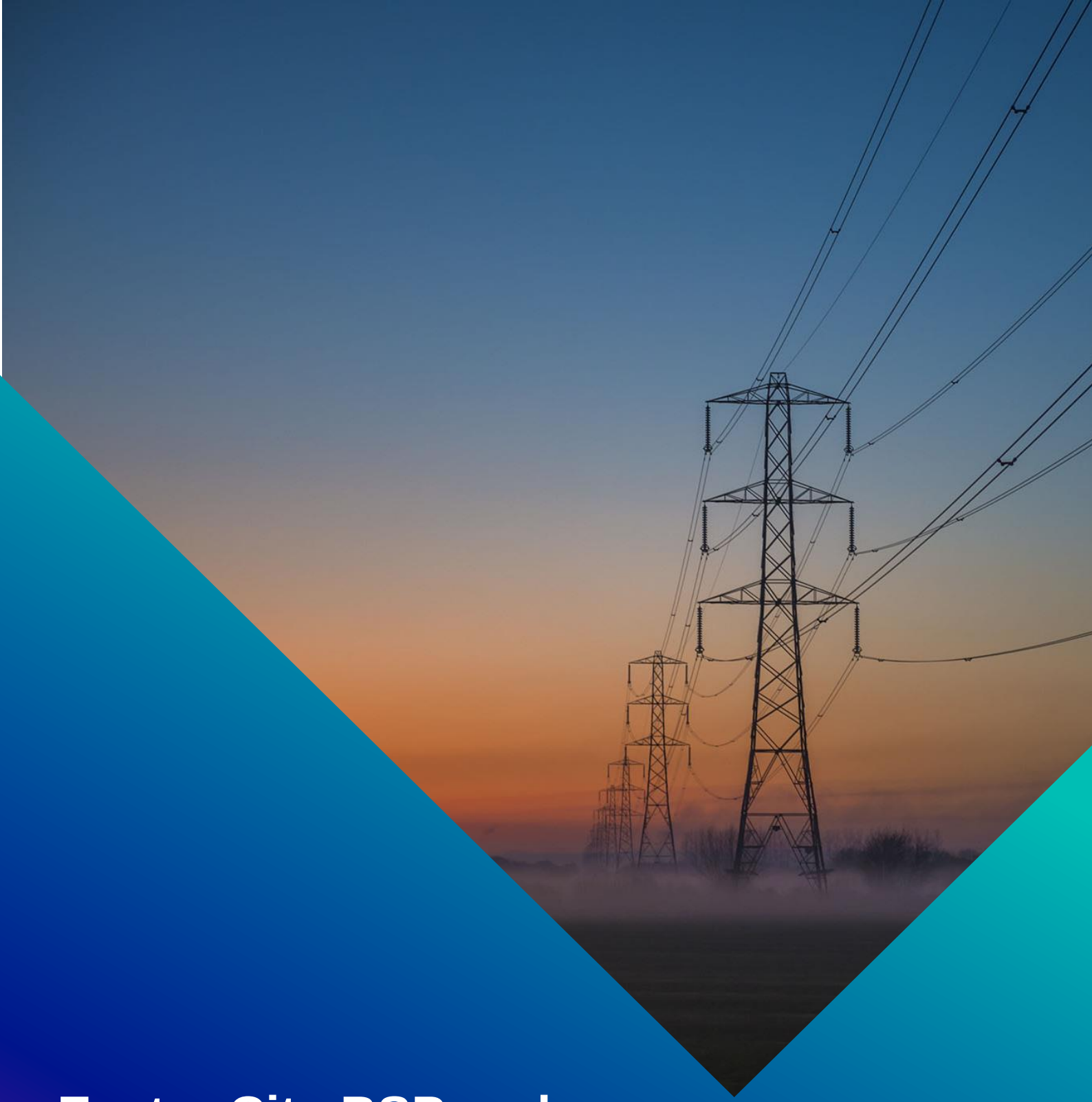

Exeter City BSP and Associated 33 kV Network

Network Development Report – South West

May 2024

Electricity Distribution

nationalgrid

Contents

Exeter City BSP and Associated 33 kV Network

1. Network Overview

Exeter City Bulk Supply Point (BSP) supplies a mixture of rural & urban 33 kV network from two 132/33kV Grid Transformers (GTs) and feeds approximately 52,400 customers in parts of Exeter & Central Devon.

Figure 1.1 ExeterCity BSP geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon associated with the 33/11 kV transformers, 33 kV circuits and 132/33 kV transformers which supply Exeter City 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

The Exeter City BSP network is arranged as follows:

- Marsh Barton, St Thomas, Athelstan Road and Cowley Road Primaries are each supplied via two transformer feeders. A 33 kV connected customer is also fed from one of the Marsh Barton feeders.
- Haven Road Primary supplied by three transformer feeders.
- A 33 kV three legged ring supplying Crediton, Newton St Cyres, Exminster and Folly Bridge Primaries.
- A 33 kV switching station at Folly Bridge supplying Witheridge and Lapford Primaries, along with a 33 kV connected generator, with normally open interconnection with North Tawton BSP and Barnstaple BSP through Lapford Primary.
- A 33 kV connected customer as a radial feed
- A Normal Open Point 33kV interconnection towards Sowton BSP.

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.

- Hard wired intertrip schemes between the Exeter City BSP and its Primaries.
- For the conditions where there is a busbar split at Exeter City BSP 33 kV to avoid 11 kV throughflows primaries are vertically split, this is a particularity of three busbar sections fed from two transformers.
- For conditions where arranged outages of the three legged ring through Folly Bridge are taken, split the other two legs to keep network integrity and transfer Lapford to Barnstaple.
- Arranged outages of the 33 kV busbar at Exeter City result in the transfer of Lapford to Barnstaple and a 33 kV.
- DOC protection was also modelled at Haven Road.
- Curtailment of 33 kV connected generators within the group are modelled are a variety of arranged outages, as outlined in customer connection agreements.

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.

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:

- Exeter City BSP 132/33 kV Grid Transformer overloads
- Exminster 33/11 kV T2 overload
- Witheridge 33/11 kV T1 & T2 overloads
- Exeter City BSP to Folly Bridge 33 kV circuit overload
- Exeter City BSP to Exminster 33 V circuit overload

3. Network Constraint Details and Solution Options

3.1 Exeter City BSP 132/33 kV GT Overloads

Generation Demand

Constraint Overview

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 3.1.1 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
Exeter City GT2 overload	Exeter City GT3 outage	None	Baseline	Baseline	2028	2034
Exeter City GT3 overload	Exeter City GT2 outage	None	Baseline	Baseline	2028	2034

Uncertainty under other Distribution Future Energy Scenarios: As this constraint occurs under baseline, there is no uncertainty about future forecasts. There is a risk that demand reduces, however this is not forecast under any scenario so mitigation against this constraint is required.

Solution Options

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

Table 3.1.2 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	Application of an increased rating following checks on ancillaries	✓	×	✓	Viable
2	Establish a new 132/33 kV substation (South West Exeter) to enable demand transfers	✓	✓	✓	Viable
3	Install a 3rd 132/33 kV transformer at Exeter City BSP & new 132 kV cable circuit	✓	×	×	Viable
Operational Mitigation					
4	Transfer demand to another BSP	✓	✓	✓	Viable
Load Management Schemes					
-	*None Identified*	-	-	-	-
Flexibility services					
5	Procure flexibility under Exeter City BSP at 33 kV or below	✓	×	✓	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 Distribution Network Operator (DNO) to determine the optimal reinforcement solution, which will then be tested against market provided flexibility by the Distribution System Operator (DSO) as part of the Distribution Network Options Assessment (DNOA) process.

Option 1 – Application of an increased rating following checks on ancillaries

Capacity released for constraint(s) considered: 24 MVA (Winter cyclic) ↑ **Viable**

Detailed description: Uprate the existing GTs at Exeter City via use of cyclic ratings in accordance with British Standard 171/IEC60076 and NGED Standard Technique SD8C. This requires a capability assessment of all ancillaries, such as busbars, isolators, Current Transformers (CTs), cables (including cabling within the substation), switchgear, tap changer, transformer bushings, conservator and earthing transformer. In addition, an assessment of the cyclic profile of the load is required to determine if transformer temperature and ageing is within acceptable limits. However by 2030 studies indicate the increased transformer capacity will be insufficient. An additional grid transformer or new BSP will be required by 2032 based upon the P2 requirement for supply restoration requirements in the event of an arranged outage followed by a fault on both grid transformers.

New limiting factor for constraint(s) considered: 114 MVA (33 kV GT circuit breakers).

Option 2 – Establish a new 132/33 kV substation in South West Exeter

Capacity released for constraint(s) considered: 114 MVA ↑ **Viable**

Detailed description: Studies indicate there will be insufficient transformer capacity at Exeter City BSP by 2030. It may be possible to defer further reinforcement at Exeter City by establishing a new 132/33 kV substation in South West Exeter (connected to D route 132 kV circuit) to accommodate additional demand growth in the area and enable the loading on Exeter City BSP to be reduced to within the transformer ratings.

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

Option 3 – Install a 3rd 132/33 kV transformer and lay an additional 132 kV circuit to Exeter City BSP

Capacity released for constraint(s) considered: more than 57 MVA ↑ **Viable**

Detailed description: Install a 3rd 132/33 kV transformer at Exeter City BSP to be connected to a new 132 kV cable circuit from a suitable tower on the AE route. In addition it will be necessary to lay a 132 kV cable between the AE and AB route.

New limiting factor for constraint(s) considered: New BSP capacity with three GTs.

Option 4 – Transfer demand to another BSP

Capacity released for constraint(s) considered: TBC ↑ **Viable**

Detailed description: It may be possible to transfer demand from Exeter City BSP to Sowton BSP by laying new 33 kV circuits from Sowton BSP to Athelstan Road and/or Cowley Road substations. In addition to provide additional capacity at Sowton BSP it will be necessary to transfer demand to Exeter Main BSP with the option of a new BSP at Ottery St Mary should further capacity be required.

New limiting factor for constraint(s) considered: TBC

Option 5 – Procure flexibility under Exeter City BSP at 33 kV or below

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

Detailed description: Flexibility services could be procured to alleviate projected overloads seen on a Grid Transformer at Exeter City. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

It is recommended to undertake an assessment using NGED Standard Technique SD8C to achieve the full rating of both grid transformers (option 1) which should be adequate until 2030. The feasibility of transferring demand to Sowton BSP should be further evaluated along with the establishment of a new BSP in South West Exeter (Options 2 & 4).

3.2 Exminster T2 overloads

Generation Demand

Constraint Overview

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 3.2.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Exminster T2 overload	Intact	None	2028	2028	2028	2028

Uncertainty under other Distribution Future Energy Scenarios: Constraints may be triggered earlier for higher growth scenarios

Solution Options

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

Table 3.2.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	**Discounted**
Reinforcement					
1	Review transformer rating	✓	×	✓	**Viable**
Operational Mitigation					
2	Install a 2nd 33/11 kV transformer	✓	✓	×	**Viable**
3	Transfer demand to a new Primary in South West Exeter	✓	✓	✓	**Viable**
Load Management Schemes					
-	*None Identified*	-	-	-	
Flexibility services					
-	*None Identified*	-	-	-	

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 – Review transformer rating

Capacity released for constraint(s) considered: 2.7 MVA (with forced cooling) **Viable**

Detailed description: Uprate the existing transformers at Exminster via use of cyclic ratings in accordance with British Standard 171/IEC60076 and NGED Standard Technique SD8C. This requires a capability assessment of all ancillaries, such as busbars, isolators, CTs, cables (including cabling within the substation), switchgear, tap changer, transformer bushings and conservator. In addition, an assessment of the cyclic profile of the load is required to determine if transformer temperature and ageing is within acceptable.

But as the transformer is

New limiting factor for constraint(s) considered: 7.7 MVA (with forced cooling)

Option 2 – Install a 2nd 33/11 kV transformer

Capacity released for constraint(s) considered: 18 MVA

Viable

Detailed description: Install a 2nd 12/24 MVA 33/11 kV transformer at Exminster and replace the existing transformer to match the new unit.

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

Option 3 – Transfer demand to a new Primary substation in South West Exeter

Capacity released for constraint(s) considered: 23 MVA

Viable

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

Detailed description: The additional demand on Exminster is mainly due to the proposed new development in South West Exeter. The establishment of a new Primary substation In South West Exeter (associated with a new BSP) may be a more cost effective solution compared to increasing the transformer capacity at Exminster

Solution Recommendation

It is recommended to undertake an assessment using NGED Standard Technique SD8C to achieve the full rating of the transformer (Option 1).

3.3 Witheridge T1 Overload

Generation | Demand

Constraint Overview

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

Table 3.3.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Witheridge T1 overload	Intact	None	-	-	-	Baseline
11kV backfeeds	Witheridge T1 outage	None	Baseline	-	-	-

Uncertainty under other Distribution Future Energy Scenarios: As this constraint occurs under baseline, there is no uncertainty about future forecasts. There is a risk that demand reduces, however this is not forecast under any scenario so mitigation against this constraint is required.

Solution Options

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

Table 3.3.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Up-rate transformer	×	×	×	Discounted
2	Install a 2nd 33/11 kV Transformer & new 33 kV circuit from Lapford to Witheridge	✓	✓	✓	Viable
Operational Mitigation					
-	*None Identified*	-	-	-	-
Load Management Schemes					
-	*None Identified*	-	-	-	-
Flexibility services					
3	Procure flexibility under Witheridge at 11 kV or below	✓	×	✓	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 – Up-rate transformer

Capacity released for constraint(s) considered: N/A

Discounted

Detailed description: Investigate increasing the reverse powerflow rating of the transformer to resolve the generation related constraint. However, this will not address the lack of 11 kV network capacity to backfeed supplies in the event of a transformer outage.

New limiting factor for constraint(s) considered: N/A

Option 2 – Install a 2nd 33/11 kV Transformer & new 33 kV circuit from Lapford to Witheridge

Capacity released for constraint(s) considered: 9 MVA

Viable

Detailed description: Install a second 33/11 kV transformer (7.5/15 MVA unit) along with a new 11 kV switchboard and 33 kV Busbar extension. In addition to providing an increase in installed transformer capacity, this will resolve the issue of limited 11 kV backfeeds to maintain supplies for a single transformer outage. It will be necessary to build a new 33 kV circuit from Lapford to Witheridge to provide an alternative 33 kV feed and in addition resolve the restricted 33 kV backfeed capacity to Lapford from the Barnstaple BSP network. The protection and CT limits on the 33 kV circuit from Folly Bridge to Witheridge will require increasing to above the conductor rating.

New limiting factor for constraint(s) considered: New primary and circuit capacity.

Option 3 – Procure flexibility under Witheridge at 11 kV or below

Flexibility service type: Generation turn down/up

Viable

Detailed description: Flexibility services could be procured to alleviate projected overloads seen on Witheridge T1. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

It is recommended to install a 2nd 33/11 kV transformer at Witheridge and a new 33 kV circuit from Lapford to Witheridge (Option 2).

3.4 Exeter City BSP to Folly Bridge 33 kV circuit Overload

Generation Demand

Constraint Overview

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

Table 3.4.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Exeter City BSP to Folly Bridge 33 kV cct overload	Exeter City BSP 2L5 to Exminster 33 kV cct outage	None	-	2025	2028	2032

Uncertainty under other Distribution Future Energy Scenarios: Constraints may be triggered earlier for higher growth scenarios.

Solution Options

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

Table 3.4.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	**Discounted**
Reinforcement					
1	Re-conductor 33 kV circuit with either 150 sq.mm Cu or 200 sq.mm AAAC	✓	×	×	**Viable**
2	Build a new 33 kV circuit from Exeter City BSP to Folly Bridge	✓	✓	✓	**Viable**
3	Connect additional demand allocated on Exminster to a new Primary in South West Exeter	✓	✓	✓	**Viable**
Operational Mitigation					
-	*None Identified*	-	-	-	-
Load Management Schemes					
-	*None Identified*	-	-	-	-
Flexibility services					
4	Procure flexibility under Newton St Cyres, Crediton, Witheridge, Folly Bridge, Lapford or Exminster at 11kV or below	✓	×	✓	**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 – Re-conductor 33 kV circuit with either 150 sq.mm Cu or 200 sq.mm AAAC

Capacity released for constraint(s) considered: 14.4 MVA (winter cyclic) **Viable**

Detailed description: Re-conductor the overhead sections of the circuit along with the sections of 33 kV cable that are potentially overloaded. This will resolve the overload in the short term, however by 2032 it will be insufficient due to the addition of new demand.

New limiting factor for constraint(s) considered: 37.1 MVA (winter cyclic)

Option 2– Construct a new 33 kV circuit from Exeter City BSP to Folly Bridge

Capacity released for constraint(s) considered: TBC **Viable**

Detailed description: Construct a new 33 kV circuit from Exeter City BSP to Folly Bridge to avoid the outage condition causing this overload, which should be adequate to beyond 2034.

New limiting factor for constraint(s) considered: TBC

Option 3 – Connect additional demand allocated to Exminster to a new Primary substation in South West Exeter

Capacity released for constraint(s) considered: TBC **Viable**

Detailed description: The increase in demand at Exminster is mainly due to the addition new demand associated in South West Exeter. The establishment of a new Primary substation in South West Exeter to accommodate addition demand may be more cost effective since it will defer the need to either circuit re-conductor or establish a new 33 kV circuit between Exeter City BSP and Folly Bridge (for this outage condition).

New limiting factor for constraint(s) considered: TBC

Option 4 – Procure flexibility under Newton St Cyres, Crediton, Witheridge, Folly Bridge, Lapford or Exminster at 11 kV or below

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

Detailed description: Flexibility services could be procured to alleviate projected overloads seen on an Exeter City to Folly Bridge 33 kV circuit. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

It is recommended to construct a new 33 kV circuit from Exeter City BSP to Folly Bridge (Option 2).

3.5 Exeter City BSP to Exminster 33 kV circuit overload

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 intermediate cool peak demand.

Table 3.5.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Exeter City BSP to Exminster 33kV cct overload	Folly Bridge 1S0 or Main 2 33kV busbar outage	None	2030	2030	2032	-

Uncertainty under other Distribution Future Energy Scenarios: Constraints may be triggered earlier for higher growth scenarios

Solution Options

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

Table 3.5.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Re-conductor 33 kV circuit with either 150sq.mm Cu or 200 sq.mm AAAC	✓	✓	✓	Viable
2	Build a new 33 kV circuit from Exeter City BSP to Folly Bridge	×	✓	✓	Viable
3	Connect additional demand allocated to Exminster to a new Primary in South West Exeter	×	×	×	Viable
Operational Mitigation					
-	*None Identified*	-	-	-	-
Load Management Schemes					
-	*None Identified*	-	-	-	-
Flexibility services					
4	Procure flexibility under Newton St Cyres, Credition, Witheridge, Folly Bridge, Lapford or Exminster at 11 kV or below	✓	×	✓	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 – Re-conductor 33 kV circuit with either 150sq.mm Cu or 200 sq.mm AAAC

Capacity released for constraint(s) considered: 14.4 MVA (winter cyclic) Viable

Detailed description: Re-conductor the overhead sections of the circuit along with the sections of 33 kV cable that are potentially overloaded. This will resolve the overload in the short term, however by 2032 it will be insufficient due to the addition of new demand.

New limiting factor for constraint(s) considered: 37.1 MVA (winter cyclic)

Option 2 – Build a new 33 kV circuit from Exeter City BSP to Folly Bridge

Capacity released for constraint(s) considered: TBC

Viable

Detailed description: Build a new 33 kV circuit from Exeter City BSP to Folly Bridge to avoid the outage condition causing this overload, which should be adequate to beyond 2034.

New limiting factor for constraint(s) considered: TBC

Option 3 – Connect additional demand allocated to Exminster to a new Primary substation in South West Exeter

Capacity released for constraint(s) considered: TBC

Viable

Detailed description: The increase in demand at Exminster is mainly due to the additional new demand in South West Exeter. The establishment of a new Primary substation in South West Exeter may be a more cost effective solution compared to either circuit re-conductoring and/or building new 33 kV circuits.

New limiting factor for constraint(s) considered: TBC

Option 4 – Procure flexibility under Newton St Cyres, Crediton, Witheridge, Folly Bridge, Lapford or Exminster at 11 kV or below

Flexibility service type: Demand turn down or generation turn up

Viable

Detailed description: Flexibility services could be procured to alleviate projected overloads seen on an Exeter City to Folly Bridge 33 kV circuit. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

It is recommended to construct a new 33 kV circuit from Exeter City BSP to Folly Bridge (Option 2)

DSO | nationalgrid electricity distribution

Registered Office: Avonbank, Feeder Road, Bristol BS2 0TB
nationalgrid.co.uk