WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Network Development Report

South West

April 2022

Contents

Introduction

The Network Development Reports cover targeted areas of the extra high voltage (EHV) distribution networks where developments are expected on the 0-10 year window. For information on the methodology used to undertake the studies and how stakeholder feedback is taken into account, please refer to the Network Development Plan Methodology Report. Each section follows a consistent format, as outlined below.

Network Overview

A summary of the network area studied. This includes geographic area, load composition and schematic diagrams of the area of network supplied.

Network Operability Modelling

As part of the network analysis, actions undertaken by network automation schemes and manual switching schemes are modelled. This ensures that following any outage combination which could occur, the subsequent topology of the network most closely represents how the distribution network is operated in real time. The network operability actions are written as a series of Python scripts, and triggered as part of the load flow routine either as a pre-emptive action (i.e. prior to load flow calculation) or as a remedial action (i.e. post load flow calculation).

This section summarises the network automation and manual switching schemes that are modelled.

Network Constraint summary

Constraints identified on the area of network in focus are summarised in a concise way. Where a Bulk Supply Point or Grid Supply Point group is studied as a whole, each constraint within the group is captured as part of the same network group.

Constraint summary

Table which includes information about the nature of the constraint, including:

- **Constrained assets -** for the area in focus, this encompasses multiple parts of the network which are affected by the same underlying outage conditions. This could be summarised for multiple sections of a circuit or transformers operating as part of a group.
- **Type of constraint -** this could include thermal overloading of assets, voltages outside of statutory limits or demand disconnected for security of supply assessment;
- **Constrained condition** - prevailing load conditions whereby the constraint occurs, relating to the representative study periods which WPD cover in the Network Development Plan;
- **Limiting factor of constrained assets** – the rating of the asset which triggers the constraint; and
- **Outage combination which causes the constraint –** the combination of intact, first or second circuit outages that trigger the constraint. In areas of network with complex running arrangements the most critical outage combination is not evident, which necessitates the analysis methodology as outlined in the NDP Methodology Report.

Scenario Identification

A table to outline the trigger years for constraints on the network area studied. This captures the earliest year that a network investment decision needs to be taken.

Solution options

A summary of the solutions which have been considered to alleviate the projected constraint. These are modelled for their technical suitability and are summarised in a table under the following categories:

- Reinforcement, covering new-build solutions to increase the capacity of the network in focus. This could include new assets or the removal of ancillary rating limitations on existing assets.

In addition, the Network Development Plan analysis can highlight where additional substations could be established as an alternative solution for load growth as a more coordinated solution.

- Operational mitigation covers actions which WPD can take to mitigate constraints without the requirement for additional network capacity. This could include proposals to change running arrangements or limit access windows where arranged outages can be taken.
- Load Management Schemes cover plant, equipment and software systems that together manage network loading and voltages. This is achieved by either controlling demand and/or generation connected to the network, operating switchgear to change the topology of the network and/or controlling the settings of tap-change controllers, reactive compensation equipment and flexible power links. Load management schemes can be utilised to manage both demand and generation driven constraints, however this is dependent on the technical/contractual ability for customers to accept curtailment.
- Flexibility covers actions by network users (through contracts with the DNO) to reduce network loading for a given condition by increasing, reducing or shifting their net import or export.

Not all solution options are mutually exclusive to one another, a combination of different solutions can be utilised to undertake low regret investment. The appraisal of different solution options allows for a more coordinated assessment of future network developments to accommodate scenario projections.

Any solution options are analysed using the Common Evaluation Methodology (CEM) Cost Benefit Analysis tool to appraise the optimal solution for an identified constraint. The Distribution Network Options Assessment (DNOA) in summer 2022 will publish the chosen decision.

Feeder Road BSP

Network Overview

Feeder Road Bulk Supply Point (BSP) supplies a very dense area of 33 kV network covering the South of Bristol. It is supplied from two circuits from Iron Acton Grid Supply Point (GSP) of 275 kV construction operating at 132 kV and two other circuits from Iron Acton teed off from Lockleaze. There are four 60/90 MVA 132/33 kV grid transformers supplying the group. These are operated in a 2 and 2 arrangement connected to a 33 kV double busbar. The 33 kV network supplies the following Primary substations:

- Whitchurch Primary with two 132 kV construction oil filled cable operating at 33 kV.
- Broadweir Primary with two 33 kV circuits from Feeder Road and a 33 kV normally open interconnection to Avonmouth BSP through Stowbridge.
- Feeder Road A with four 33 kV circuits and Feeder Road B with two other circuits situated close to the BSP.
- Woodland Way Primary is supplied with four 33 kV circuits.
- Bishopsworth Primary is supplied with two 33 kV circuits.
- Bedminster Primary is supplied with three 33 kV circuits.
- Bower Ashton and Keynsham West Primaries are fed from two 33 kV circuits, supplied via a single 33 kV circuit direct from Feeder Road BSP and two teed connection to Bedminster and Bishopsworth.

In addition the 33 kV connected generation, there is currently a large amount of LV and 11 kV connected generation present in this group, with over 6.4 MW of domestic rooftop solar generation connected in the baseline year of study.

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.

- Most of Feeder Road BSP has radial feeds. Only intertrips were modelled using existing protection settings.
- Curtailment of 33 kV connected generators within the group are modelled are a variety of arranged outages, as outlined in customer connection agreements.

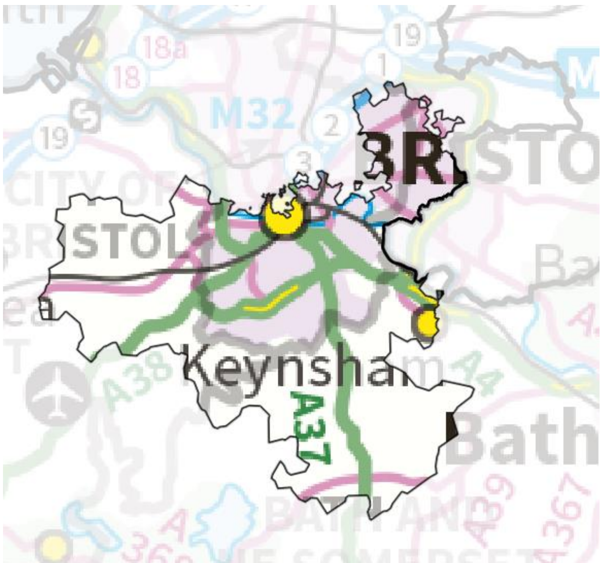

Figure 1: Feeder Road BSP geographic network coverage

A schematic diagram of the Feeder Road BSP group is included in the Appendix of this report.

Future network constraints

Bedminster Primary Transformer capacity

Constraint summary

Generation | **Demand**

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

Constrained assets	33/11 kV Primary Transformers at Bedminster	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand (from 2032)	
Limiting factor of constrained assets	Three 15/18.75 MVA Primary Transformers.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers, the remaining transformers in service overload.
	Second Circuit Outage	A transformer or circuit fault following the arranged outage of another transformer or incoming circuit would overload the remaining transformer in service.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Bedminster Primary is a three transformer site. The two reinforcement solutions are outlined below: • Install an auto-changeover scheme and split the 11 kV busbar into two sections. The auto-changeover would then close the 11 kV bus section circuit breaker for a fault of any of the three transformers. This reduces the risk of overloads on the remaining transformers whilst still maintaining demand security compliance. • Install a fourth transformer with an additional 33 kV circuit. Given the existing space limitations at Bedminster Primary substation, this solution may have risks of delivery.
Operational mitigation	As constraint occurs for a first circuit fault outage, limiting outage windows is not suitable mitigation. Permanent load transfers out of group are not possible due to unavailability of capacity in neighbouring substations in future study years.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an Active Network Management (ANM) scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout demand peak demand periods.

Bishopsworth Primary Transformer capacity

Constraint summary

Generation Demand

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

Constrained assets	33/11 kV Primary Transformers at Bishopsworth	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Two 12/24 MVA Primary Transformers between two primaries	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers, the remaining transformers in service overloads.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				✓
Leading the Way				✓
WPD Best View				✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Solutions could include establishment of a new Primary substation in the South Bristol area to transfer load from Bishopsworth. Alternative reinforcement solutions would be to replace the Primary transformers with larger units, with replacement of the existing 33 kV circuits to match the increased transformer rating.
Operational mitigation	As constraint occurs for a first circuit fault outage, limiting outage windows is not suitable mitigation. Permanent load transfers is not possible due to unavailability of capacity in neighbouring substations in future study years.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout demand peak demand periods.

Feeder Road A and B Primary Transformer capacity

Constraint summary

Generation | Demand

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

Constrained assets	33/11 kV Primary Transformers at Feeder Road and associated circuits	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	Six 12/24 MVA Primary Transformers between two Primary substations.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers, the remaining transformers in service overload.
	Second Circuit Outage	For Feeder Road A, a transformer or circuit fault following the arranged outage of another transformer or incoming circuit would overload the remaining two transformers in service.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline.

Feeder Road A Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation	✓	✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Feeder Road B Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	As Feeder Road A and B supply a dense and heavily loaded 11 kV network more 33/11 kV transformer capacity at Feeder Road B will be required, potentially in the form of two extra transformers. Further analysis is recommended to assess busbar ratings to determine the running arrangement for this solution.
Operational mitigation	As constraint occurs for a first circuit fault outage, limiting outage windows is not suitable mitigation. Permanent load transfers is not possible due to unavailability of capacity in neighbouring networks in future study years.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout demand peak demand periods.

Feeder Road Grid Transformer capacity

Constraint summary

Generation Demand

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

Constrained assets	132/33 kV Grid Transformers at Feeder Road BSP	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	Four 60/90 MVA Grid Transformers.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers, the remaining transformers in service overloads.
	Second Circuit Outage	For the arranged outage of a Grid Transformer, the remaining three in service are run in parallel. When this running arrangement is followed by a fault of any Grid Transformer the two remaining transformers in service overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

First Circuit Outage Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Second Circuit Outage Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation			✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	When the summer peak demand exceeds 192 MVA additional Grid Transformer capacity will be required. This is projected to occur under all scenarios in the 0-10 year period. One solution to solve the Feeder Road GT and Primary constraints mentioned in the ' Feeder Road A and B Primary Transformer capacity' section of this report would be to build a 132/11 kV substation at the existing Feeder Road site. This can deload the existing Grid Transformers to alleviate the projected overloads. An alternative strategic solution would be to establish a new 132/33 kV BSP in the South Bristol area. One potential solution could be to utilise the 132 kV construction cables from Feeder Road to Whitchurch to establish a Bulk Supply Point to transfer Primaries in the South of Bristol. This option also has the benefit of also deloading Radstock BSP, another group with projected constraints in the 5-10 year period. Both of the above solutions are likely to trigger the creation of a 132 kV switching station at Feeder Road BSP.
Operational mitigation	In the short term outages can be limited to summer to alleviate overloads following arranged outages in all scenarios. From 2025, as the constraint occurs for a first circuit fault outage limiting outage windows is not suitable mitigation. Permanent load transfers out of group is not possible due to unavailability of capacity in neighbouring BSPs in future study years.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout demand peak demand periods.

Whitchurch Primary Transformer capacity

Constraint summary

Generation | **Demand**

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

Constrained assets	33/11 kV Primary Transformers at Whitchurch	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	Two 19/38 MVA Primary Transformers, currently rated to 25.2 MVA by 1320 A Current Transformer (CT) ancillary rating limitation	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers, the remaining transformer in service overloads.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Assess existing CT ratings and undertake remedial works to allow Whitchurch transformers to operate at the full cyclic rating capability.
Operational mitigation	As constraint occurs for a first circuit fault outage, limiting outage windows is not suitable mitigation. Permanent load transfers is not possible due to unavailability of capacity in neighbouring substations in future study years.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout demand peak demand periods.

Woodland Way Primary Transformer capacity

Constraint summary

Generation **Demand**

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

<table>
<tr><td>Constrained assets</td><td colspan="2">33/11 kV Primary Transformers at Woodland Way Primary and associated circuits</td></tr>
<tr><td>Type(s) of constraint</td><td colspan="2">Thermal overload</td></tr>
<tr><td>Constrained condition(s)</td><td colspan="2">Winter Peak Demand
Intermediate Warm Peak Demand
Summer Peak Demand</td></tr>
<tr><td>Limiting factor of constrained assets</td><td colspan="2">Four 12/24 MVA Primary Transformers.</td></tr>
<tr><td rowspan="2">Outage combination which causes the constraint</td><td>First Circuit Outage</td><td>For the arranged or fault outage of one of the transformers, the remaining transformers in service overloads.</td></tr>
<tr><td>Second Circuit Outage</td><td>From 2028, a transformer or circuit fault following the arranged outage of another transformer or incoming circuit would overload the remaining two transformers in service. This occurs as for the arranged outage, the normally open 11 kV bus section circuit breaker is closed to run the substation in parallel.</td></tr>
</table>

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year.

<table>
<tr><th rowspan="2">Scenario</th><th colspan="4">Study year</th></tr>
<tr><th>Baseline</th><th>2025</th><th>2028</th><th>2032</th></tr>
<tr><td>Steady Progression</td><td rowspan="5">✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>System Transformation</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Consumer Transformation</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Leading the Way</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>WPD Best View</td><td>✓</td><td>✓</td><td>✓</td></tr>
</table>

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Additional substation capacity is required in the wider Bristol area in future years. This includes both 33 kV and 132 kV reinforcement works to unlock capacity for additional load growth. As mentioned in the Feeder Road Grid Transformer capacity section of this report, additional 132 kV capacity is required to deload Feeder Road BSP before establishing a new Primary substation is able to go ahead. As an interim solution, closing the normally open 11 kV bus section circuit breaker at Woodland Way for a First Circuit Outage would prevent overloads. However; as the overloads can also occur during fault conditions an auto-close scheme would need to be installed to maintain network integrity. This interim solution could defer reinforcement until 2028 through operational mitigation, where additional transformer or substation capacity is required. Woodland Way is a Primary close to the border between the WPD South West and WPD West Midlands licence areas. Constraints in the 0-10 year window are also triggered on neighbouring Cowhorn Primary in the WPD West Midlands licence area. A joint design approach to establish a new substation the area could help to alleviate constraints on Woodland Way and Cowhorn.
Operational mitigation	As constraint occurs for a first circuit fault outage, limiting outage windows is not suitable mitigation. Permanent load transfers is not possible due to unavailability of capacity in neighbouring substations in future study years.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout demand peak demand periods.

St Pauls BSP

Network Overview

St Pauls BSP (BSP) supplies a dense urban sections of 11 kV network, in the City of Bristol. It is supplied from two 132 kV circuits double banked with GT2 and GT3 at Feeder Road. It has two double bubble 132/11 kV transformer.

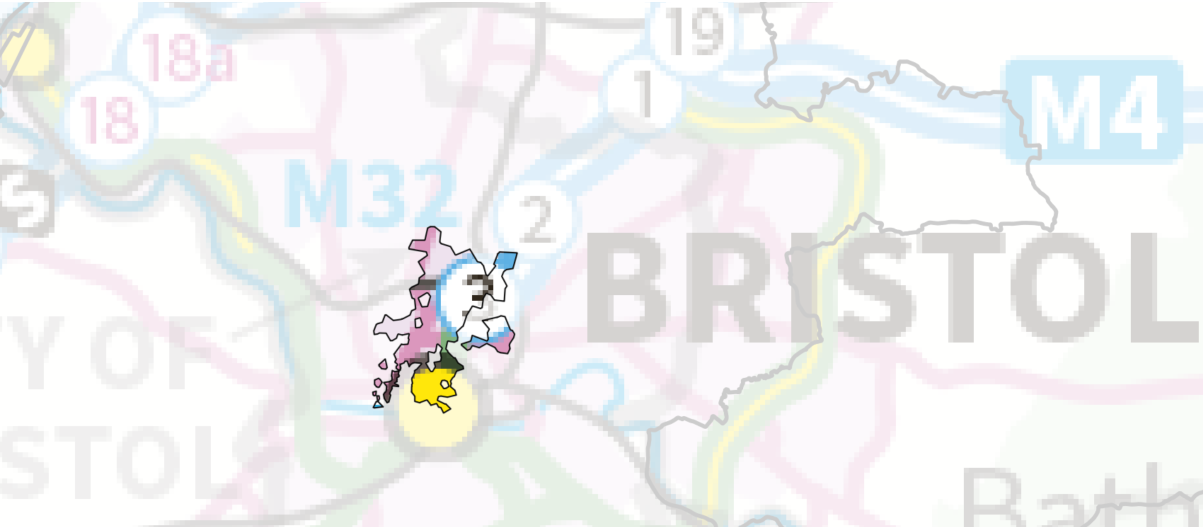

Figure 2: St Pauls BSP geographic network coverage

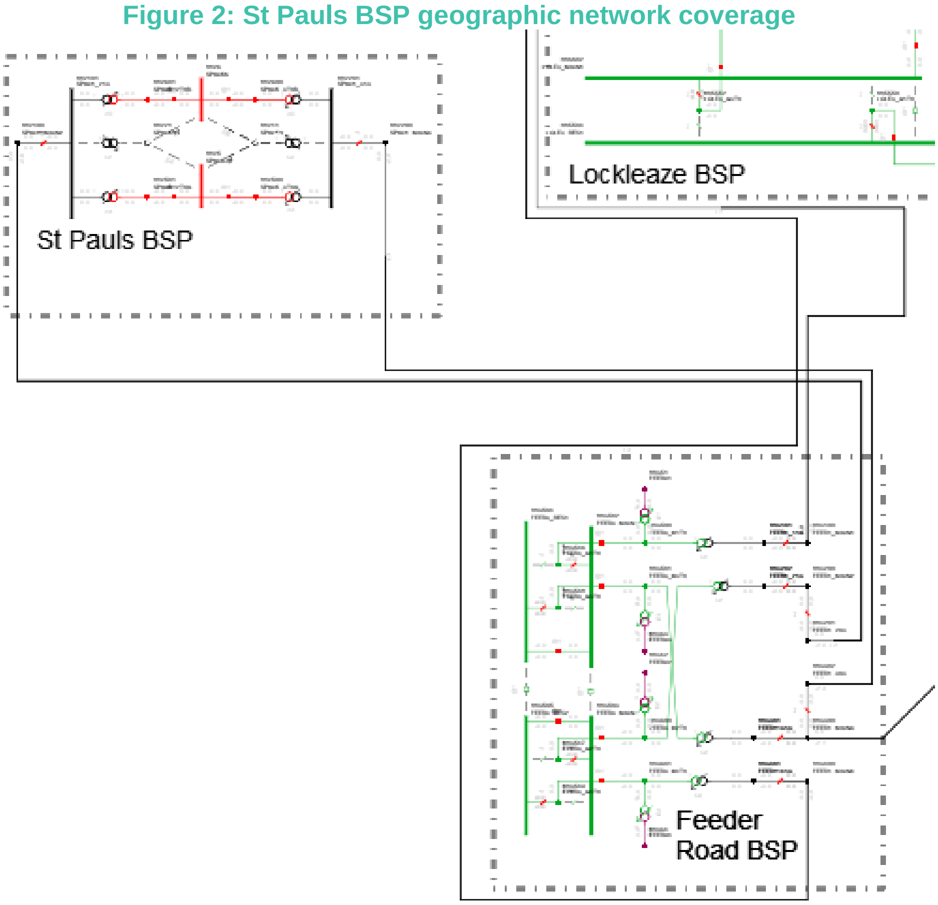

Figure 3: St Pauls BSP network schematic

St Pauls reverse power flow capacity

Constraint summary

Generation Demand

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

Constrained assets	132/11 kV Primary Transformer	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	Directional Over Current relay setting	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers which feeds into this group, the remaining transformers in service could trip due to reverse power flow. In later years, the same arranged or fault outage could result in transformer overloads for demand driven constraints.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year, and is affected by the large amount of small scale embedded generation installed in the area.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				✓
Leading the Way				✓
WPD Best View				✓

Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation	✓	✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	To alleviate the above constraint, load blinded relays could be installed to increase reverse power flow capabilities. Even in an urban centre the aggregate of small scale Distributed Energy Resources (DER) can contribute to generation constraints. From 2032 the 132/11 kV Feeder Road BSP referred to in the Feeder Road Grid Transformer capacity section of this report could solve transformer constraints at St Pauls BSP.
Operational mitigation	As constraint occurs during intact network running and first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down and/or demand turn up services could be procured to alleviate projected transformer overloads for generation driven constraints. Dispatch of services would be required for an extended period of time throughout the summer period. Similarly, generation turn up and/or demand turn down services could be procured to alleviate projected transformer overloads for demand driven constraints. Dispatch of services would be required for an extended period of time throughout the winter period.

Radstock BSP

Network Overview

Radstock Bulk Supply Point supplies a mixture of rural and urban sections of 33 kV network in North Somerset. It is supplied from the Y-route 132 kV circuit which is fed from Seabank GSP, with two 60/90 MVA 132/33 kV grid transformers supplying the group. The 33 kV network supplies the following Primary substations:

- Midsomer Norton Primary substation is supplied via two separate transformer feeders
- Peasedown Primary supplied by a single circuit, with normally open 33 kV interconnection with Bath BSP via Twerton
- A 33 kV ring supplying Paulton, High Littleton and Keynsham East Primaries, along with connections to two 33 kV connected generators and normally open 33 kV interconnection with Bath BSP via Twerton.
- A 33 kV ring supplying Foxhills, Whatley Quarry & Newbury Primaries, along a connection to one 33 kV connected generator.
- A 33 kV ring supplying Evercreech, Dinder, Shepton Mallet and Chewton Mendip Primary substations, along with connections to seven 33 kV connected generators, with normally open 33 kV interconnection with Bridgwater/Street BSP group via Wells.

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.

- The 33 kV busbar running arrangement at Radstock is altered for a variety of circuit and busbar outages to maintain network integrity.
- For arranged outages of the 1S0 circuit breakers at Foxhills and Newbury Primary substations, one of the Primary transformers is run with the 11 kV circuit breaker open (i.e. on 'hot standby'). This is to reduce the risk of through-flow for credible next faults on the network, where the 11 kV network at the Primary becomes a link to the wider 33 kV network and could overload transformers.
- Curtailment of 33 kV connected generators within the group are modelled are a variety of arranged outages, as outlined in customer connection agreements.

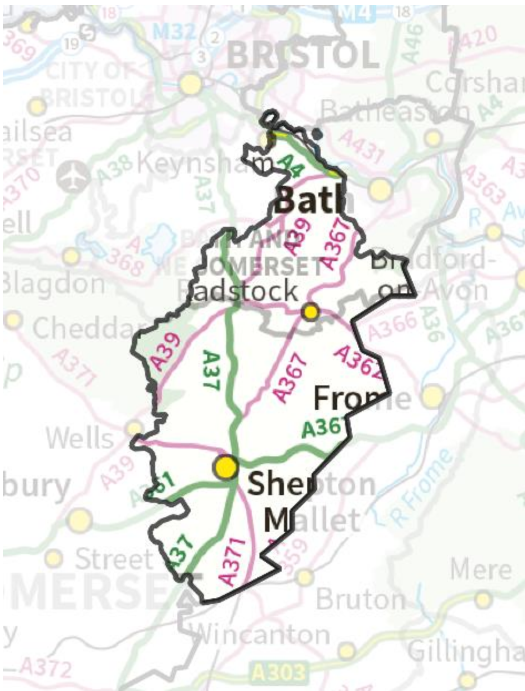

Figure 4: Radstock BSP geographic network coverage

A schematic diagram of the Radstock BSP group is included in the Appendix of this report.

Future network constraints

Radstock Grid Transformer capacity

Constraint summary

Generation | Demand

Constrained assets	132/33 kV Grid Transformers at Radstock BSP	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	60/90 MVA Grid Transformers, demand limited by ancillary rating limitation of 90 MVA. Generation limited by reverse power flow rating of 60 MVA	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025 and by 2028 are affected by the large amount of small scale embedded generation installed in the area.

Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Installation of a third 132/33 kV transformer or transfer of demand to a new BSP at Whitchuch (South Bristol) will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections (demand or generation) into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Foxhills/Newbury ring 33 kV circuit capacity

Constraint summary

Generation | **Demand**

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

Constrained assets	33 kV circuits between Radstock-Foxhills and Radstock-Newbury	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 Hard Drawn Copper (HDC)), CTs (440 A) and isolators (400 A).	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with $150mm^2$ Cu conductor along with CT and isolator replacement will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Not applicable.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Paulton/High Littleton/Keynsham East ring 33 kV circuit capacity

Constraint summary

Generation Demand

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

Constrained assets	33 kV circuits between High Littleton and Chelwood Tee	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.1 in^2 HDC)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads affected by the large amount of small scale embedded generation installed in the area.

Generation Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way		✓	✓	✓
WPD Best View				

Demand Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with $150mm^2$ Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections (demand or generation) into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Radstock/Chewton Mendip/Evercreech/Shepton Mallet ring 33 kV circuit capacity

Constraint summary

Generation Demand

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

Constrained assets	33 kV circuits between Radstock (11L5) and Chewton Mendip	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 HDC)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are affected by the large amount of small scale embedded generation installed in the area.

Generation Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression				
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Demand Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression				
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections (demand or generation) into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Constraint summary

Generation Demand

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

Constrained assets	33 kV circuits between Evercreech – Evercreech Tee	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 HDC), 33 kV underground cable (120 mm^2) & 400 A isolator	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025 and is affected by the large amount of small scale embedded generation installed in the area.

Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150mm^2 Cu conductor, overlaying the 33 kV underground cable section and replacement of the 400 A isolator will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Constraint summary

Generation | Demand

Constrained assets	33 kV circuits between Radstock– Evercreech Tee	
Type(s) of constraint	Thermal overload of 33 kV circuits	
Constrained condition(s)	Summer Peak Generation Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 HDC), 33 kV underground cable(120 mm^2) & 400 A isolator	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025, and is affected by the large amount of small scale embedded generation installed in the area.

Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm² Cu conductor, overlaying the 33 kV underground cable section and replacement of the 400 A isolator will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections (demand or generation) into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Constraint summary

Generation Demand

Constrained assets	33 kV circuits between Shepton Mallet– Evercreech Tee	
Type(s) of constraint	Thermal overload of 33 kV circuits	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 HDC), 33 kV underground cable (120 mm^2) & 400 A isolator	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are affected by the large amount of small scale embedded generation installed in the area.

Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way				
WPD Best View				

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor, overlaying the 33 kV underground cable section and replacement of the 400 A isolator will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections (demand or generation) into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Constraint summary

Generation Demand

Constrained assets	33 kV circuits between Chewton Mendip– Evercreech	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 HDC & 150 mm^2 ACSR), 33 kV underground cable (120 mm^2) & 400 A isolator	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are affected by the large amount of small scale embedded generation installed in the area.

Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way				
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor, overlaying the 33 kV underground cable section and replacement of the 400 A isolator will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Constraint summary

Generation Demand

Constrained assets	33 kV circuits between Radstock to Radstock Tee	
Type(s) of constraint	Thermal overload of 33 kV circuits	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 HDC) & 400 A isolator	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are affected by the large amount of small scale embedded generation installed in the area.

Generation Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Demand Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression				
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm² Cu conductor and replacement of the 400 A isolator will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections (demand or generation) into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Constraint summary

Generation | Demand

Constrained assets	33 kV circuits between Dinder to Radstock Tee	
Type(s) of constraint	Thermal overload of 33 kV circuits	
Constrained condition(s)	Summer Peak Generation Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 HDC), 400 A isolator/protection and 440 A CT	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are affected by the large amount of small scale embedded generation installed in the area.

Generation Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way				
WPD Best View				

Demand Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm² Cu conductor, replacement of the 400 A isolator/protection & 440 A CT will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections (demand or generation) into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Chewton Mendip Primary Transformer capacity

Constraint summary

Generation | **Demand**

Constrained assets	33/11 kV Primary Transformer at Chewton Mendip	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	5 MVA Primary Transformer, demand limited by ancillary rating limitation of 5 MVA	
Outage combination which causes the constraint	Intact	Due to projected demand growth in the area.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Replacement of the grid transformer with a larger 7.5/15 MVA units (including removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs during first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Midsomer Norton Primary Transformer capacity

Constraint summary

Generation Demand

Constrained assets	33/11 kV Primary Transformer at Midsomer Norton	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer peak generation	
Limiting factor of constrained assets	12/24 MVA Primary Transformers, demand limited by ancillary rating limitation of 22.9 MVA. Generation limited by reverse power flow rating of 9.12 MVA	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers, the remaining transformer in service overloads.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are affected by the large amount of small scale embedded generation installed in the area.

Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation				
Consumer Transformation				
Leading the Way				
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Application of an enhanced reverse power flow rating to both transformer units (including removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs during first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Whatley Quarry Primary Transformer capacity

Constraint summary

Generation Demand

Constrained assets	33/11 kV Primary Transformer at Whatley Quarry	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation	
Limiting factor of constrained assets	10 MVA Primary Transformers, demand limited by ancillary rating imitation of 10 MVA. Generation limited by reverse power flow rating of 7 MVA	
Outage combination which causes the constraint	Intact	Due to coincident output of large amount of small scale embedded generation.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year, and is affected by the large amount of small scale embedded generation installed in the area.

Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Application of an enhanced reverse power flow rating to the transformer (including removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs during first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Keynsham East Primary Transformer capacity

Constraint summary

Generation | **Demand**

Constrained assets	33/11 kV Primary Transformers at Keynsham East	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	10 MVA & 7.5/15 MVA Primary Transformers, demand limited by ancillary rating limitation of 10 MVA & 14 MVA respectively	
Outage combination which causes the constraint	First circuit outage	For the arranged or fault outage of one of the transformers, the remaining transformer in service overloads.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Removal of the ancillary rating limitation or replacement of the transformers with a larger 12/24 MVA units will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Shepton Mallet Primary Transformer capacity

Constraint summary

Generation | **Demand**

Constrained assets	33/11 kV Primary Transformers at Shepton Mallet	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	12/24 MVA Primary Transformers, demand limited by ancillary rating imitation of 18.9 MVA.	
Outage combination which causes the constraint	First circuit outage	For the arranged or fault outage of one of the transformers, the remaining transformer in service overloads.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

Demand Driven Constraints

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Removal of any ancillary rating limitations and/or installation of a third transformer will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Churchill BSP

Network Overview

Churchill Bulk Supply Point supplies a mixture of rural and urban sections of 33 kV network in North Somerset. It is supplied from the N-route 132 kV circuit which is fed from Seabank GSP, with two 60/90 MVA 132/33 kV grid transformers supplying the group. The 33 kV network supplies the following Primary substations:

- West Wick Primary substation is supplied via two transformer feeders with 33 kV connected generators teed-off both circuits, with normally open 33 kV interconnection with Weston BSP via isolators at West Wick
- A 33 kV ring supplying Winscombe, Axbridge, Cheddar and Churchill Gate Primaries, along with connections to one 33 kV connected generator and a demand connection. The ring has normally open 33 kV interconnection at Weston BSP via Brent Knoll switching station and Bridgwater BSP via Watchfield (with a tee-off to provide standby supply to Burnham).
- A 33 kV ring supplying Congresbury, Nailsea and Bristol Airport Primaries plus a 33 kV demand customer.
- A 33 kV circuit supplying Chewstoke, Blagdon and Compton Martin Primaries. A normal open point exists at Chewstoke providing an alternative feed from Churchill BSP to Bristol Airport circuit.
- A single 33 kV demand customer is connected directly to the 33 kV busbar.

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.

- The 33 kV busbar running arrangement at Churchill is altered for a variety of circuit and busbar outages to maintain network integrity.
- For arranged outages of the 33 kV 1S0 circuit breakers at Axbridge and Winscombe Primary substations, one of the Primary Transformers is run with the 11 kV circuit breaker open (i.e. on ’hot standby’). This is to reduce the risk of through flow for credible next faults on the network, where the 11 kV network at the Primary becomes a link to the wider 33 kV network and could overload transformers.
- For arranged outages on 9L5 circuit breaker at Churchill, 2L5 at Chewstoke is closed
- For arranged grid transformer outages at Churchill, West Wick and associated generators are transferred to Weston BSP.
- Curtailment of 33 kV connected generators within the group are modelled are a variety of arranged outages, as outlined in customer connection agreements.

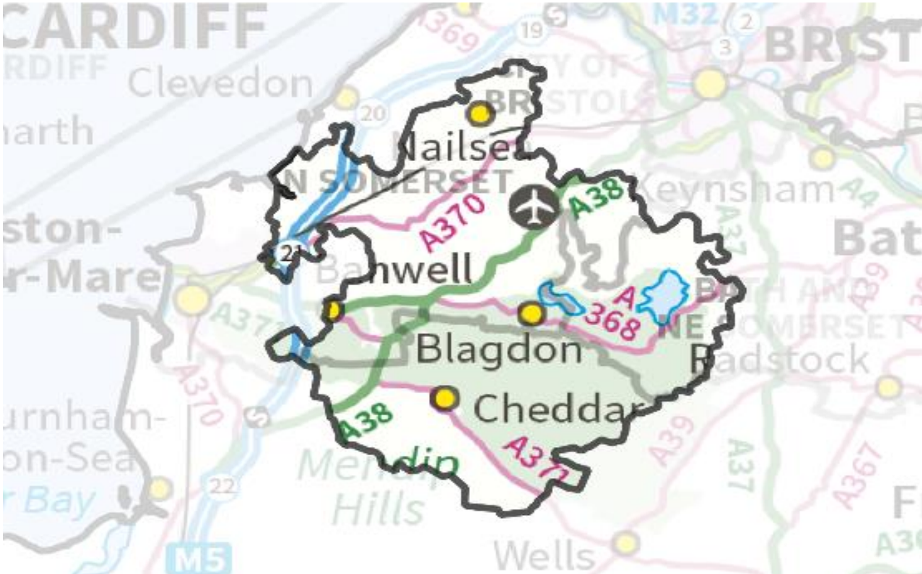

Figure 5: Churchill BSP geographic network coverage

A schematic diagram of the Churchill BSP group is included in the Appendix of this report.

Future network constraints

Churchill Grid Transformer capacity

Constraint summary

Generation Demand

Constrained assets	132/33 kV Grid Transformers at Churchill BSP	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	60/90 MVA Grid Transformers, demand limited by ancillary rating limitation of 75.5 MVA	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Application of the full cyclic transformer capacity by removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032. When the group demand exceeds 100 MW, there is currently sufficient demand transfer capacity out of the group to maintain demand security compliance.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down via the ‘Secure’ product. Dispatch of services may be required for an extended period given the constraint is present under a First Circuit Outage and across multiple seasons.

Congresbury Transformer capacity

Constraint summary

Generation **Demand**

Constrained assets	33/11 kV Transformers at Congresbury	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Intermediate Warm Peak Demand	
Limiting factor of constrained assets	12/24 MVA Grid Transformers, demand limited to 22.9 MVA (winter) & 18 MVA (Summer)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Application of the full cyclic transformer capacity by removal of any ancillary rating limitations will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down via the ‘Secure’ product. Dispatch of services may be required for an extended period given the constraint is present under a First Circuit Outage.

Nailsea Transformer capacity

Constraint summary

Generation Demand

Constrained assets	33/11 kV Transformers at Nailsea	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	12/24 MVA Primary Transformers, demand limited to 18.9 MVA (winter) & 18 MVA (summer)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Application of the full cyclic transformer capacity by removal of any ancillary rating limitations will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down via the 'Secure' product. Dispatch of services may be required for an extended period given the constraint is present under a First Circuit Outage and across multiple seasons.

Cheddar Transformer capacity

Constraint summary

Generation Demand

Constrained assets	33/11 kV transformer at Cheddar	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	5 MVA Primary Transformer, demand limited to 6.5 MVA (winter) & 5 MVA (summer)	
Outage combination which causes the constraint	Intact	Due to projected demand growth in the area.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Application of the full cyclic transformer capacity by removal of any ancillary rating limitations will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs during intact conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down via the 'Secure' product. Dispatch of services may be required for an extended period given the constraint is present under intact network conditions across multiple seasons.

Compton Martin Transformer capacity

Constraint summary

Generation Demand

Constrained assets	33/11 kV Transformer at Compton Martin	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation	
Limiting factor of constrained assets	5 MVA Primary Transformer, demand limited to 5 MVA & reverse power flow to 3 MVA.	
Outage combination which causes the constraint	Intact	Due to coincident output of large amount of small scale embedded generation.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Application of the full reverse power flow transformer rating by removal of any ancillary rating limitations will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs during intact conditions, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down via the ‘Secure’ product. Dispatch of services would be required for an extended period of time throughout the summer period.

Churchill/Winscombe/Axbridge ring 33 kV circuit capacity

Two 33 kV circuits from Churchill BSP form a ring supplying Winscombe, Axbridge, Cheddar and Churchill Gate Primaries, along with connections to one 33 kV connected generator and a demand connection. The ring has normally open 33 kV interconnection at Weston BSP via Brent Knoll switching station and Bridgwater BSP via Watchfield (with a tee-off to provide standby supply to Burnham). The constraints below account for different sections of the ring, which have different ratings and years where the constraint is triggered.

Constraint summary

Generation Demand

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

Constrained assets	33 kV circuits between Churchill 6L5 and Winscombe 1L3	
Type(s) of constraint	Thermal overload of 33 kV circuits	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (150 mm^2 All Aluminium Alloy Conductor - AAAC Al) and CT (440 A)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm² Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down via the ‘Secure’ product could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period throughout the winter period.

Constraint summary

Generation | **Demand**

Constrained assets	33 kV circuits between Axbridge 1L5 and ABSD 18ZH70	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV underground cable (0.2 in^2 HSL Cu)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Overlaying the relevant sections of 33 kV underground cable with 185 mm² Cu Ethylene Propylene Rubber (EPR) will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down via the 'Secure' product could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period throughout the winter period.

Constraint summary

Generation | **Demand**

Constrained assets	33 kV circuits between Churchill 7L5 and Churchill Gate 3L3T	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 Cu)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year, and is affected by the large amount of small scale embedded generation installed in the area.

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down via the 'Secure' product could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period throughout the winter period.

Churchill/Congresbury/Nailsea/Bristol Airport ring 33 kV circuit capacity

Four 33 kV circuits from Churchill BSP form an interconnected ring supplying Congresbury, Nailsea and Bristol Airport Primaries plus a 33 kV demand customer. The constraints below account for different sections of the ring, which have different ratings and years where the constraint is triggered.

Constraint summary

Generation Demand

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

Constrained assets	33 kV circuits between Churchill 3L5 and Nailsea 3L3	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 Cu)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm² Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down via the ‘Secure’ product could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period throughout the winter period.

Constraint summary

Generation | **Demand**

Constrained assets	33 kV circuits between Churchill –Iwood-Congresbury	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 Cu) and CT (440 A)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down via the 'Secure' product could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period throughout the winter period.

Constraint summary

Generation | **Demand**

Constrained assets	33 kV circuits between Churchill 10L5 and Congresbury 2L3	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 0.15 in^2 HDC overhead line and underground cable, limited by 0.3 in^2 and 185 mm^2 Cu sections.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Overlaying the relevant sections of 33 kV underground cable with 185 mm^2 Cu EPR and reconductoring the sections of 33 kV overhead line with 150 mm^2 Cu will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down via the ‘Secure’ product could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period as the First Circuit Outage occurs over multiple seasons.

Constraint summary

Generation | Demand

Constrained assets	33 kV circuit between Bristol Airport and Churchill tee	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV 0.1 in^2 Cu overhead conductor and 0.1 in^2 Cu H type underground cable	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	Baseline	2025	2028	2032
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solution options below could alleviate the projected constraint in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor and overlaying underground cable with 185 mm^2 Cu cable will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down via the ‘Secure’ product could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period as the First Circuit Outage occurs over multiple seasons.

Constraint summary

Generation | Demand

Constrained assets	33 kV circuit between Churchill 1L5 and Churchill tee	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV 0.1 in^2 Cu overhead conductor and 0.1 in^2 Cu H type underground cable	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor and overlaying underground cable with 185 mm^2 Cu cable will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down via the ‘Secure’ product could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period throughout the winter period.

Churchill to West Wick 33 kV circuit capacity

Constraint summary

Generation Demand

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

Constrained assets	33 kV circuits between Churchill 4L5 and West Wick, limited to tee-off connection to 33 kV generation customer.	
Type(s) of constraint	Thermal overload of 33 kV circuits	
Constrained condition(s)	Summer Peak Generation	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 HDC)	
Outage combination which causes the constraint	Intact	Due to coincident output of large amount of embedded generation
	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are affected by the large amount of small scale embedded generation installed in the area.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation				
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm² Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers.
Operational mitigation	As constraint occurs during intact and first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services via the 'Secure' product could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Landulph/Abham/Exeter (South Devon) 132 kV Network

Network Overview

The 132 kV South Devon network consists of the three Grid Supply Points, Landulph , Abham and Exeter which supply an interconnected 132 kV network feeding thirteen BSPs covering most of South Devon including the urban areas of Plymouth, Torbay & Exeter. The 132 kV network supplies the following BSPs:

- Tiverton, Exmouth, Exeter Main, Exeter City and Sowton are fed as radial feeds from Exeter Main GSP.
- Newton Abbot is fed via 132 kV circuits interconnecting Exeter Main and Abham GSPs.
- Torquay and Paignton are fed as radial feeds from Abham GSP.
- Totnes, Plympton, Plymouth, Milehouse and Ernesettle are fed via 132 kV circuits interconnecting between Landulph and Abham.
- A 132 kV generator is connected between Exeter Main and Exeter City.

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 an arranged outage of CB 1005 at Abham, the normal open point on CB 805 is closed.
- For an outage on either SGT at Abham CB 230 is closed.
- Following an outage of both SGTs at Abham, CB 1005 is closed.
- For an arranged outage on isolator 103 at Abham, CB 1T0 at Paignton and isolator 203 at Newton Abbot is opened to prevent a subsequent fault back feeding Newton Abbot via the 33 kV busbars at Paignton.
- For arranged outage on CB 305 at Abham, CB 2T) at Totnes is opened to prevent a subsequent fault back feeding Plympton via the 33 kV busbars at Totnes.

Figure 6: Landulph/Abham/Exeter GSP geographic coverage

A schematic diagram of the Landulph/Abham/Exeter GSP group is included in the Appendix of this report.

Future network constraints

Abham- Totnes Tee to Plympton/Plymouth circuit capacity

Constraint summary

Generation | Demand

Constrained assets	132 kV circuits between Abham and Totnes Tee to Plymouth and Plympton	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	Circuits limited by a section of 0.6 in^2 Cu 132 kV oil filled cable and 175 mm^2 Aluminium Conductor Steel Reinforced (ACSR) overhead line	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.
	Second Circuit Outage	For an arranged outage followed by a subsequent fault outage

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year, and is affected by the large amount of small scale embedded generation installed in the area.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation	✓	✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Circuit reconfiguration by removing the tee-off to Totnes on both of the Abham to Plymouth and Abham to Plympton circuits along with up-rating the overhead line section between Abham and Plymouth will remove this constraint beyond 2028.
Operational mitigation	As constraint occurs during first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected circuit overloads, and have been considered in previous tranches of flexibility procurement. Dispatch of services would be required for an extended period of time throughout the summer period.

Ernesettle to Milehouse 132 kV cable circuit capacity

Constraint summary

Generation | Demand

Constrained assets	132 kV circuit between Ernesettle and Milehouse	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	Circuits limited by a section of 0.6 in^2 Cu 132 kV oil filled cable, also 132 kV reactor	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.
	Second Circuit Outage	For an arranged outage followed by a subsequent fault outage

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year, and is affected by the large amount of small scale embedded generation installed in the area.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The proposed reinforcement works appear to resolve the issues in the immediate term, however in 2032 one scenario suggests the potential requirement for further reinforcement. The potential reinforcement options include load transfers on the Plymouth 33 kV network, overlaying the Ernesettle-Milehouse cable, establishment of a new GSP point close to Plymouth or an additional 132 kV circuit from Landulph GSP. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Removal of the parallel running arrangement between Landulph & Abham by splitting the 132 kV network at Plymouth BSP will resolve this overload. This will involve the installation of a fourth grid transformer, 33 kV switchboard and additional section of 132 kV busbar.
Operational mitigation	As constraint occurs during first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected circuit overloads, and have been considered in previous tranches of flexibility procurement. Dispatch of services would be required for an extended period of time throughout the summer period.

Plymouth to Milehouse 132 kV cable circuit capacity

Constraint summary

Generation Demand

Constrained assets	132 kV circuits between Plymouth and Milehouse	
Type(s) of constraint	Thermal overload of 132 kV cable	
Constrained condition(s)	Summer peak generation	
Limiting factor of constrained assets	Circuits limited by a section of 0.6 in^2 Cu 132 kV oil filled cable	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.
	Second Circuit Outage	For an arranged outage followed by a subsequent fault outage.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year, and is affected by the large amount of small scale embedded generation installed in the area.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation	✓	✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Removal of the parallel running arrangement between Landulph & Abham by splitting the 132 kV network at Plymouth BSP will resolve this overload. This will involve the installation of a fourth grid transformer, 33 kV switchboard and additional section of 132 kV busbar.
Operational mitigation	As constraint occurs during first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Exeter Main - Sowton - Exeter City 132 kV circuit capacity

Constraint summary

Generation Demand

Constrained assets	132 kV circuits between Exeter Main, Sowton & Exeter City	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand & Summer peak generation	
Limiting factor of constrained assets	Circuits limited by 175 mm^2 ACSR overhead line	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year, and is affected by the large amount of small scale embedded generation installed in the area.

Scenario	**Study year**			
	Baseline	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Re-profiling of the 175 mm^2 overhead lines to increase the operating temperature to 75° C. For the overhead line section between Sowton Tee & Exeter Generator there is an option to bunch the circuits.
Operational mitigation	As constraint occurs during first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

GT capacity at Newton Abbott BSP

Constraint summary

Generation | **Demand**

Constrained assets	132/33 kV Grid transformers	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	45/90 MVA transformers, demand limited to 90 MVA	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Application of a higher transformer rating (including removal of any ancillary rating limitations) or alternatively the installation of a third transformer will alleviate the projected overloads in all scenarios out to 2032. Note as group demand does not exceed 100 MW, there is no requirement to secure demand for a second circuit outage of loss of 132 kV infeed into the group.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout the winter period.

GT capacity at Tiverton BSP

Constraint summary

Generation | Demand

Constrained assets	132/33 kV Grid transformers	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	22.5/45 MVA transformers, demand limited to 45 MVA	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year.

Generation Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way				
WPD Best View				

Demand Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation	✓	✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Replacement of the grid transformer with a larger 60/90 MVA units (including removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032. Note as group demand does not exceed 100 MW, there is no requirement to secure demand for a second circuit outage of loss of 132 kV infeed into the group.
Operational mitigation	As constraint occurs during first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads for both demand and generation constraints. Dispatch of services would be required for an extended period across multiple seasons.

GT capacity at Totnes BSP

Constraint summary

Generation Demand

Constrained assets	132/33 kV Grid Transformers	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	60/90 MVA transformers, demand limited to 50.3 MVA	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Application of full transformer rating (including removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032. Note as group demand does not exceed 100 MW, there is no requirement to secure demand for a second circuit outage of loss of 132 kV infeed into the group.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout the winter period.

Newton Abbot to Paignton Tee 132 kV circuit capacity

Constraint summary

Generation | **Demand**

Constrained assets	132 kV circuit between Newton Abbot & Paignton Tee	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Circuits limited by rating of 175 mm^2 ACSR overhead line	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Re-profiling of the 175 mm^2 overhead lines to increase the operating temperature to 75° C will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period across multiple seasons.

GT capacity at Sowton BSP

Constraint summary

Generation Demand

Constrained assets	132/33 kV Grid transformers	
Type(s) of constraint	Thermal overload of 132/33 kV transformers	
Constrained condition(s)	Summer Peak Generation	
Limiting factor of constrained assets	60/90 MVA transformers, demand limited to 90 MVA and 45.76 MVA reverse power flow rating	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are affected by the large amount of small scale embedded generation installed in the area.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Application of full transformer rating (including removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032. Note as group demand does not exceed 100 MW, there is no requirement to secure demand for a second circuit outage of loss of 132 kV infeed into the group.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

GT capacity at Exmouth BSP

Constraint summary

Generation Demand

Constrained assets	132/33 kV Grid transformers	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation	
Limiting factor of constrained assets	22.5/45 MVA transformers, demand limited to 45 MVA and 18.32 MVA reverse power flow rating	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are affected by the large amount of small scale embedded generation installed in the area.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way				
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Application of full transformer rating (including removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Exeter City BSP

Network Overview

Exeter City Bulk Supply Point supplies a dense area of 33 kV network in Exeter. It is supplied from the AE-route 132 kV circuit from Exeter GSP, with two 60/90 MVA 132/33 kV grid transformers supplying the group and three 33 kV busbar sections normally run in parallel. The 33 kV network supplies the following Primary substations:

- Marsh Barton, St Thomas, Athelstan Road and Cowley Road Primaries supplied via two transformer feeders.
- Haven Road Primary supplied by three transformer feeders and a 33 kV connected customer.
- Three 33 kV circuits supplying Crediton, Newton St Cyres, Exminster and Folly Bridge Primaries.
- A 33 kV switching station at Folly Bridge supplying Witheridge and Lapford Primary substations, along with a 33 kV connected generator, with normally open interconnection with North Tawton BSP and Barnstaple BSP through Lapford Primary.
- A Normal Open Point 33 kV interconnection towards Sowton BSP.

In addition the 33 kV connected generation, there is currently a large amount of LV and 11 kV connected generation present in this group, with over 6.8 MW of domestic rooftop solar generation connected in the baseline year of study.

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.

- Intertrip schemes between the Exeter City BSP and its Primary substations.
- For the conditions where the 33 kV busbars are split at Exeter City BSP, the 11 kV busbars at Primary substations are run split. This is to reduce the risk of through-flows for any subsequent fault. This is a particularity of substations with three busbar sections fed from two Grid Transformers.
- For conditions where arranged outages on the three 33 kV circuits through Folly Bridge are taken, the remaining two circuits are run radially to maintain network integrity for any subsequent faults. In addition, Lapford Primary substation is transferred onto Barnstaple BSP.
- For arranged outages of the 33 kV busbar at Exeter City BSP, Lapford Primary substation and a 33 kV connected customer is transferred onto Barnstaple BSP.
- Directional Over Current (DOC) protection is modelled on Primary transformers 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.

Any modelling of schemes on the upstream 132 kV networks are reported as part of the Abham/Exeter/Landulph Network Development Report.

Figure 7: Exeter City BSP geographic network coverage

A schematic diagram of the Exeter City BSP group is included in the Appendix of this report.

Future network constraints

Exeter City Group Demand

Constraint summary

Generation | **Demand**

Constrained assets	Group Demand and transfer capacity	
Type(s) of constraint	Demand security of supply	
Constrained condition(s)	Demand security assessment made using annual group demand peak.	
Limiting factor of constrained assets	33 kV transfer capacity to neighbouring groups limited to 15 MW As Group D above 100 MW requires Group Demand minus 100 MW to be restored which in Exeter City the limit is its transfer capacity (15 MW).	
Outage combination which causes the constraint	Second Circuit Outage	For the loss of the two 132 kV circuits into Exeter City BSP the entire group would be disconnected.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				✓
System Transformation				✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Establish a new Bulk Supply Point in the area to deload Exeter City. Alternatively, an additional 132 kV circuit and 132/33 kV Grid Transformer at Exeter City BSP could alleviate the projected overloads in the 0-10 year period. Additional Grid Transformers would require further fault level studies to confirm running arrangements.
Operational mitigation	As the constraint occurs when the entire group is disconnected, all load transfer capacity is modelled. Due to the long distances to Barnstaple and Pyworthy/North Tawton BSPs, no permanent load transfers out of group are available.
Load Management Schemes	As the constraint occurs when the entire group is disconnected, no load management scheme solutions are applicable.
Flexibility services	Demand turn down and/or generation turn up services via a ‘Secure’ product could be procured to increase 33 kV transfer capacity onto neighbouring groups. The amount of flexibility services required is highly dependent on the location, as this has a high impact on the 33 kV transfer capacity for neighbouring groups.

Exeter City 11L5 to Folly Bridge 33 kV circuit capacity

Constraint summary

Generation | Demand

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

Constrained assets	33 kV circuits between Exeter City – Folly Bridge	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand, Intermediate Warm Peak Demand Summer Peak Demand (from 2028 Leading the Way)	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in² HDC at 50° C) and associated protection.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged outage of one of the 33 kV circuits of the ring, also triggered by an arranged busbar outage at Exeter City.
	Second Circuit Outage	For the arranged outage of resulting in the loss of one of the 33 kV circuits of the ring, followed by a subsequent circuit fault of a remaining 33 kV circuit.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the Baseline.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Changes to the protection settings to allow for the circuits to operate at their full rating would alleviate projected overloads to 2025. The circuit from Folly Bridge 1L5 to the Folly Bridge tee-off to North Tawton circuit is limited by protection and the overhead line 0.15 in² HDC at 50° C. The projected overloads could be alleviated by reconductoring the circuit with HDC 150 mm² at 50° C in 2025. The section from the North Tawton tee-off to Exeter City 11L5 also requires reconductoring, however only from 2025 onwards.
Operational mitigation	An outage window is available as the overload does not occur in the Summer Peak Demand representative day. Coordinating arranged outages on any of the three 33 kV circuits to Folly Bridge to occur in the summer period would alleviate the constraint until 2028 for all scenarios except Leading the Way.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected circuit overloads. Dispatch of services would be required during any outages on the 33 kV ring.

Crediton 2L3 to Newton St Cyres 2L3 circuit capacity

Constraint summary

Generation Demand

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

Constrained assets	33 kV circuits between Crediton 2L3 – Newton St Cyres 2L3	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand, Intermediate Warm Peak Demand Summer Peak Demand (from 2028 Leading the Way)	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in² HDC at 50° C) and associated protection.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged outage of one of the legs of the three legged ring or busbar fault.
	Second Circuit Outage	For the arranged outage of resulting in the loss of one of the 33 kV circuits of the three legged ring, followed by a subsequent circuit fault of a remaining 33 kV circuit.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring the overhead line sections with HDC 150 mm^2 at 50° C and overlaying a 300 m section of underground cable with 185 mm^2 CU conductor will alleviate the projected overloads.
Operational mitigation	An outage window is available as the overload does not occur in the Summer Peak Demand representative day. Coordinating arranged outages on any of the three 33 kV circuits to Folly Bridge to occur in the summer period would alleviate the constraint until 2028 for all scenarios except Leading the Way.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected circuit overloads. Dispatch of services would be required during any outages on the 33 kV ring.

Exeter City 7L5 to Newton St Cyres 1L3 circuit capacity

Constraint summary

Generation | Demand

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

Constrained assets	33 kV circuits between Exeter City – Newton St Cyres 2L3	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand, Intermediate Warm Peak Demand Summer Peak Demand (from 2028 Leading the Way)	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in² HDC at 50° C), associated protection and underground cable sections.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged outage of one of the legs of the ring or busbar fault.
	Second Circuit Outage	For the arranged outage of resulting in the loss of one of the 33 kV circuits of the ring, followed by a subsequent circuit fault of a remaining 33 kV circuit.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline.

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring the overhead line sections with HDC 150 mm² at 75° C and overlaying sections of underground cable with 240 mm² Cross-linked Polyethylene (XLPE) conductor will alleviate the projected overloads.
Operational mitigation	An outage window is available as the overload does not occur in the Summer Peak Demand representative day. Coordinating arranged outages on any of the three 33 kV circuits to Folly Bridge to occur in the summer period would alleviate the constraint until 2028 for all scenarios except Leading the Way.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected circuit overloads. Dispatch of services would be required during any outages on the 33 kV ring.

Exeter City to Exminster and Exminster to Folly Bridge circuit capacity

Constraint summary

Generation Demand

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

Constrained assets	33 kV circuits between Exeter City – Exminster and Exminster - Folly Bridge	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand, Intermediate Warm Peak Demand Summer Peak Demand (from 2028 Leading the Way)	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 HDC at 50° C), associated protection and underground cable sections.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged outage of one of the circuits of the ring or busbar fault.
	Second Circuit Outage	For the arranged outage of resulting in the loss of one of the 33 kV circuits of the ring, followed by a subsequent circuit fault of a remaining 33 kV circuit.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline.

Scenario	**Study year**			
	Baseline	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation	✓	✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Reconductoring the overhead line sections with HDC 150 mm^2 at 75° C and overlaying sections of underground cable with 240 mm^2 XLPE conductor will alleviate the projected overloads. This solution might not be necessary, as outlined in the 'Exminster Primary Transformer capacity' section of this report, the proposed additional circuit would remove the requirement for the reinforcement.
Operational mitigation	An outage window is available as the overload does not occur in the Summer Peak Demand representative day. Coordinating arranged outages on any of the three 33 kV circuits to Folly Bridge to occur in the summer period would alleviate the constraint until 2028 for all scenarios except Leading the Way.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected circuit overloads. Dispatch of services would be required during any outages on the 33 kV ring.

Exeter City Grid Transformer capacity

Constraint summary

Generation | Demand

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

Constrained assets	132/33 kV Grid Transformers at Exeter City BSP	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	60/90 MVA Grid Transformers, currently limited to 90 MVA as transformers not fully capable of operating to cyclic seasonal ratings.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers, the remaining transformer in service overloads.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Undertake remedial works to allow both Grid Transformers to operate at the full cyclic capability. Exeter City BSP has a small transfer capacity with neighbouring BSPs, permanent load transfers onto neighbouring BSPs could also alleviate the projected overloads.
Operational mitigation	As constraint occurs for a first circuit fault outage, limiting outage windows is not suitable mitigation. Permanent load transfers is not possible due to unavailability of capacity in neighbouring BSPs in future study years; however if the planned Matford Bulk Supply Point could be utilised to transfer load away from Exeter City BSP.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout the summer period for generation constraints, and during winter peak demand periods.

Witheridge Primary Transformer capacity

Constraint summary

Generation | Demand

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

Constrained assets	33/11 kV Primary Transformer at Witheridge	
Type(s) of constraint	Thermal overload Demand security of supply	
Constrained condition(s)	Winter Peak Demand Summer Peak Generation Demand security assessment made using annual group demand peak.	
Limiting factor of constrained assets	Single 5 MVA Primary Transformer with 5 MVA reverse power flow capability. 11 kV back feed capacity also a limiting factor.	
Outage combination which causes the constraint	Intact	Generation overloads driven on intact network due to the large amount of small scale embedded generation connected.
	First Circuit Outage	From 2028, following an arranged or fault outage of the transformer or incoming circuit, the entire Witheridge load is disconnected.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the Baseline.

Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				✓
Leading the Way			✓	✓
WPD Best View				✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Transformer rating to be confirmed and remedial works undertaken to allow transformer to operate at the full cyclic capability. In addition, construction of another 33 kV circuit from Lapford to create a ring and an additional transformer will alleviate the demand security constraints in future years.
Operational mitigation	Not applicable.
Load Management Schemes	Not applicable.
Flexibility services	Generation turn down and/or demand turn up services could be procured to alleviate projected transformer overloads for generation constraints. Dispatch of services would be required during any outages on the three legged ring.

Folly Bridge Primary Transformer capacity

Constraint summary

Generation Demand

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

Constrained assets	33/11 kV Primary Transformer	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Two 10 MVA Primary Transformers, limited by Current Transformer ancillary rating at 12.57 MVA (660 A at 11 kV).	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers, the remaining transformer in service overloads.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Scenario	**Study year**			
	Baseline	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Replacing transformers with 12/24 MVA units will alleviate the projected overloads. As an interim solution remedial works could be undertaken to allow both transformers to operate at the full cyclic capability.
Operational mitigation	Restricting outages to the summer period would lessen the probability of overloading the transformer for an arranged outage, however the constraint could still occur for a first circuit fault in the winter and intermediate warm seasons.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected transformer overloads. Dispatch of services would be required during any outages of the other transformer.

Cowley Road Primary Transformer capacity

Constraint summary

Generation Demand

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

Constrained assets	33/11 kV Transformers	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand, Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Two 10/14 MVA Primary Transformers, limited to 14 MVA as transformers not fully capable of operating to cyclic seasonal ratings.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers, the remaining transformer in service overloads.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Remedial works on the transformer are required to allow operation of the full cyclic rating capability.
Operational mitigation	As constraint occurs for a first circuit fault outage, limiting outage windows is not suitable mitigation. Permanent load transfers is not possible due to unavailability of capacity in neighbouring networks in future study years.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected transformer overloads. Dispatch of services would be required during any outages of the other transformer.

Exminster Primary Transformer capacity

Constraint summary

Generation Demand

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

Constrained assets	33/11 kV Primary Transformer and 11 kV transfer capacity	
Type(s) of constraint	Thermal overload Demand security of supply	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Demand security assessment made using annual group demand peak.	
Limiting factor of constrained assets	Single 5 MVA Primary Transformer and 11 kV back feed capacity.	
Outage combination which causes the constraint	Intact	Demand overloads driven on intact network due to the load growth in all scenarios.
	First Circuit Outage	From 2025, following an arranged or fault outage of the transformer or incoming circuit, the entire Exminster load is disconnected.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Build a new 12/24 MVA transformer at Exminster and replace existing transformer when demand exceed cyclic rating. When group demand of Exminster exceeds 5.7 MVA the group will require reinforcement to maintain demand security compliance. The above solution will solve the issue. If Matford BSP is built Exminster could be transferred onto it. If not an extra 33 kV circuit from Exeter City should be built to support the Folly Bridge ring and avoid overloads on the other legs.
Operational mitigation	Not applicable.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected transformer overloads. Dispatch of services would be required during extended periods as constraint occurs on intact network.

Haven Road Primary Transformer capacity

Constraint summary

Generation Demand

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

Constrained assets	33/11 kV Primary Transformer	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Substation limited by ancillary cable rating of 18 MVA on existing three Primary transformers.	
Outage combination which causes the constraint	First Circuit Outage	An arranged outage of one transformer. This forces another transformer to be out of the service too to avoid through flows on the 11 kV. It ends up overloading the remaining transformer in service.
	Second Circuit Outage	A transformer or circuit fault following the arranged outage of another transformer or incoming circuit would overload the remaining transformer in service.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Remedial works to allow full cyclic rating of transformers will alleviate the projected overloads. This includes remedial work to the cables, protection, circuit breaker and CT of the associated assets.
Operational mitigation	Reduce outage season to Summer, this should work for all scenarios until 2032.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected transformer overloads. Dispatch of services would be required during any outages of a transformer at Haven Road.

Paignton BSP

Network Overview

Paignton Bulk Supply Point supplies a mixture of rural and urban sections of 33 kV network, mostly in South Devon. It is supplied from the R-route 132 kV circuit which forms part of the interconnection between Abham and Exeter Grid Supply Points (GSP), with two 60/90 MVA 132/33 kV grid transformers supplying the group. The 33 kV network supplies the following Primary substations:

- Paignton, Colley End, Hollicombe & Churston Primaries are each supplied via two transformer feeders.
- A 33 kV ring supplying Laywell Brixham, Dartmouth, Blackawton and Stokenham Primaries, along with connections to a 33 kV demand customer and three 33 kV connected generators and normally open 33 kV interconnection with Totnes BSP teed off the Totnes-Salcombe circuit.
- A 33 kV circuit providing interconnection with Totnes BSP with a tee-off to a single transformer Primary at Marldon which is normally run open on circuit breaker 4L5 at Paignton.

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 arranged outage on either 33 kV busbar at Paignton the normal open point on 6L5 near Slade Farm is moved to isolator 2L3 at Blackawton, which transfers the demand at Blackawton and Stokenham to Totnes BSP.
- For an arranged outage of either grid transformer at Paignton, the normal open point on 6L5 near Slade Farm is moved to 4L5 at Dartmouth which transfers the demand at Blackawton and Stokenham along with two 33 kV connected generators to Totnes BSP.
- Curtailment of 33 kV connected generators within the group are modelled are a variety of arranged outages, as outlined in customer connection agreements.

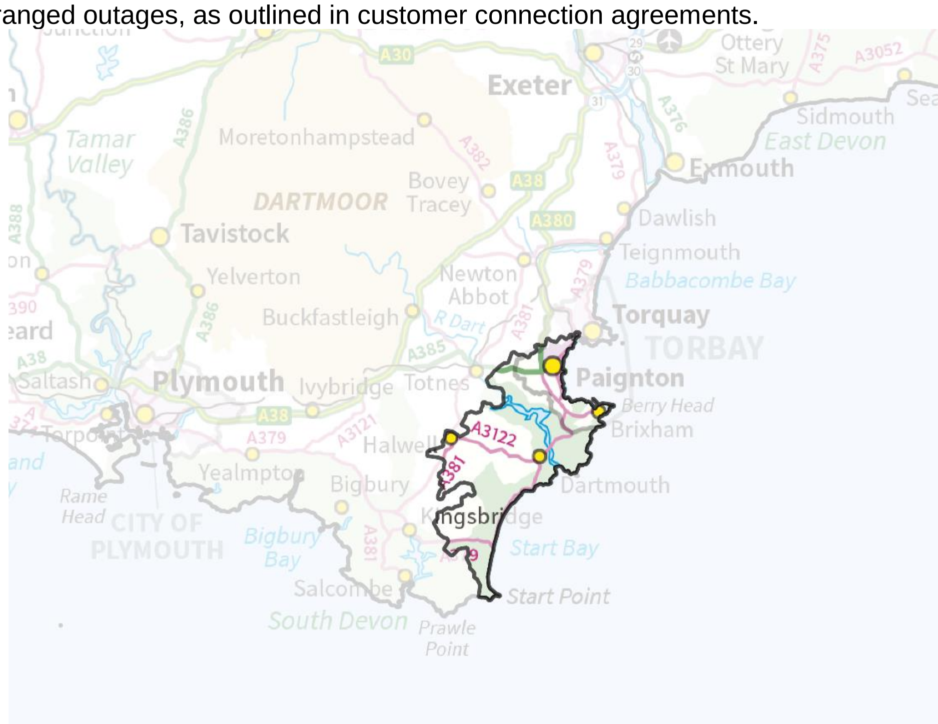

Figure 8: Paignton BSP geographic network coverage

A schematic diagram of the Paignton BSP group is included in the Appendix of this report.

Future network constraints

Paignton transformer capacity

Constraint summary

Generation Demand

Constrained assets	132/33 kV Grid Transformers	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Peak Demand	
Limiting factor of constrained assets	60/90 MVA transformers, demand limited to 90 MVA and 27.44 MVA reverse power flow rating.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformer or circuits which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

Scenario	**Study year**			
	Baseline	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis

Solution option	**Summary**
Reinforcement	Application of full transformer rating (including removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period across multiple seasons.

Paignton to Laywell Brixham 33 kV circuit capacity

Constraint summary

Generation | **Demand**

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

Constrained assets	33 kV circuit between Paignton 6L5 to Laywell Brixham 1L5	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in² HDC).	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm² Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period across multiple seasons.

Constraint summary

Generation Demand

Constrained assets	33 kV circuit between Paignton 7L5 to Laywell Brixham 4L5	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV underground cable (0.3 in² H & 185 mm² H Cu) and 440 A CT limitation	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Overlaying the relevant sections of 33 kV underground cable with adequately sized conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during intact network running and first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout the winter period.

Colley End Primary Transformer capacity

Constraint summary

Generation Demand

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

Constrained assets	33/11 kV Primary Transformers at Colley End	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	10/14 MVA Primary Transformers, demand limited by ancillary rating limitation of 14 MVA.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers, the remaining transformer in service overloads.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Replacement of the transformers with larger 12/24 MVA units (including removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032. Note as group demand does not exceed 100 MW, there is no requirement to secure demand for a second circuit outage of loss of 132 kV infeed into the group.
Operational mitigation	As constraint occurs for a first circuit fault outage, limiting outage windows is not suitable mitigation. Permanent load transfers is not possible due to unavailability of capacity in neighbouring BSPs in future study years.
Load Management Schemes	Any additional connections into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period across multiple seasons.

Laywell Brixham Primary Transformer capacity

Constraint summary

Generation **Demand**

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

Constrained assets	33/11 kV Primary Transformers at Laywell Brixham	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	10/14 MVA Primary Transformers, demand limited by ancillary rating limitation of 14 MVA.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers, the remaining transformers in service overloads.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Application of an enhanced rating or replacement of the transformers with larger 12/24 MVA units (including removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs for a first circuit fault outage, limiting outage windows is not suitable mitigation. Permanent load transfers is not possible due to unavailability of capacity in neighbouring BSPs in future study years.
Load Management Schemes	Any additional connections into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout the winter period.

Hollicombe Primary Transformer capacity

Constraint summary

Generation | **Demand**

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

Constrained assets	33/11 kV Primary Transformers at Hollicombe	
Type(s) of constraint	Thermal overload of 33/11 kV transformer	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	10 MVA Primary Transformers, demand limited by 10 MVA and reverse power flow limited to 9.12 MVA	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers, the remaining transformers in service overloads.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

Demand Driven Constraints

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way				
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Application of an enhanced transformer rating including forced cooling or replacement of the transformers with larger 12/24 MVA units (including removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs for a first circuit fault outage, limiting outage windows is not suitable mitigation. Permanent load transfers is not possible due to unavailability of capacity in neighbouring BSPs in future study years.
Load Management Schemes	Any additional connections into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout the winter period.

Paignton Grid Transformer Capacity

Constraint summary

Generation Demand

Constrained assets	132/3 kV grid transformers at Paignton	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation	
Limiting factor of constrained assets	60/90 MVA Grid Transformers, reverse power flow rating of 27.44 MVA	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers or circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028, and is affected by the large amount of small scale embedded generation installed in the area.

Generation driven constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Enhancement of the reverse power flow rating by replacing ancillaries will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Paignton to Colley End 33 kV circuit capacity

Constraint summary

Generation | **Demand**

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

Constrained assets	33 kV circuits between Paignton and Colley End	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV underground cable (0.2 in² H type Cu).	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

Demand driven constraints

Scenario	**Study year**			
	Baseline	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Overlaying the relevant sections of 33 kV underground cable with larger conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout the winter period.

Laywell Brixham to Noss Dart Marina 33 kV circuit capacity

Constraint summary

Generation Demand

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

Constrained assets	33 kV circuits between Laywell Brixham and Noss Dart Marina	
Type(s) of constraint	Thermal overload of 33 kV circuit	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV underground cable (185 mm^2 HSL & 0.3 in^2 HSL Cu).	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

Demand driven constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Overlaying the relevant sections of 33 kV underground cable with larger conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems where applicable.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout the winter period.

Plympton BSP

Network Overview

Plympton Bulk Supply Point supplies a mixture of rural and urban sections of 33 kV network in South West Devon. It is supplied from the H-route 132 kV circuit which is fed from Abham & Landulph Grid Supply Points (GSP), with two 40/60 MVA 132/33 kV grid transformers supplying the group. The 33 kV network supplies the following Primary substations:

- Langage Primary substation is supplied via two separate transformer feeders with a 33 kV generator connection teed off one of the circuits
- Linketty Lane Primary substation is supplied via two separate transformer feeders with 33 kV to Plymouth BSP with a normal open point on isolator 3L3 at Linketty Lane
- A 33 kV ring supplying Torycombe & two 33 kV demand customers, along with connections to one 33 kV connected generator.
- A 33 kV ring supplying Newton Ferrers, Modbury & Ivybridge Primary substations, a 33 kV IDNO and connections to two 33 kV connected generators. Interconnection to Plymouth BSP exists via a normal open point on circuit breaker 3L5 at Stentaway.
- A 33 kV circuit to a 33 kV generator connection.

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 an arranged outage of either grid transformer at Plympton, the normal open point at Linketty Lane is moved from isolator 3L3 to circuit breaker 19 and CB 2L5 at Plympton, which is available for operation with tele control. This allows for quicker restoration of customers in the event of a fault where the network needs to be reconfigured.
- The 33 kV busbar running arrangement at Plympton is altered for a variety of circuit and busbar outages to maintain network integrity.
- For arranged outage of the 2T0 circuit breaker at Langage, one of the Primary transformers is run with the 11 kV circuit breaker open (i.e. on 'hot standby'). This is to reduce the risk of through-flow for credible next faults on the network, where the 11 kV network at the Primary becomes a link to the wider 33 kV network and could overload transformers.
- Curtailment of 33 kV connected generators within the group are modelled are a variety of arranged outages, as outlined in customer connection agreements.

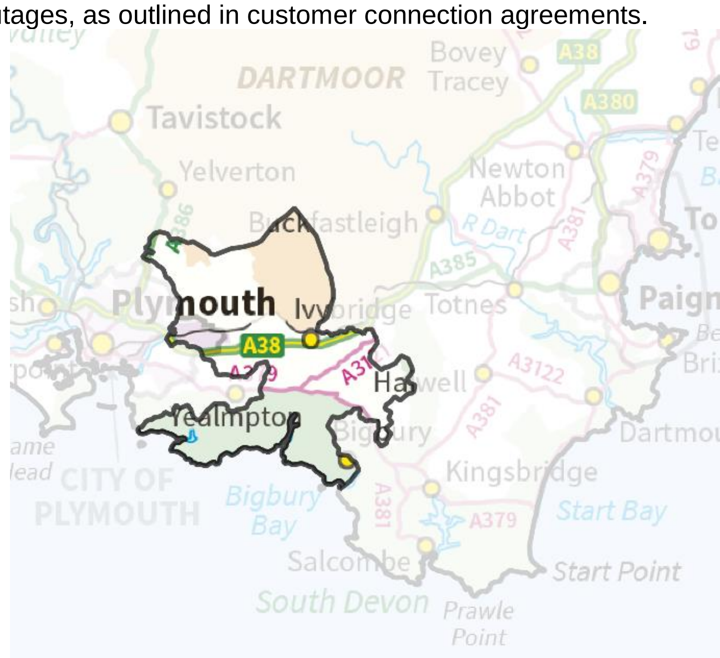

Figure 9: Plympton BSP geographic network coverage

A schematic diagram of the Plympton BSP group is included in the Appendix of this report.

Future network constraints

Plympton Grid Transformer capacity

Constraint summary

Generation | Demand

Constrained assets	132/33 kV Grid Transformers at Plympton BSP	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	40/60 MVA transformers, demand limited to 50.3 MVA	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers or circuits which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025. Recent connections activity in the area may bring forward the constraint to an earlier year, as the build-rate of large single accepted customers can be accelerated. Proposed developments to the WPD forecasting process will aim to improve on the accuracy of large accepted customer build-rates.

Generation Driven Constraints

Scenario	Baseline	Study year 2025	2028	2032
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way			✓	✓
WPD Best View		✓	✓	✓

Demand Driven Constraints

Scenario	Baseline	Study year 2025	2028	2032
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Replacement of the grid transformer with a larger 60/90 MVA units (including removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032. Note as group demand does not exceed 100 MW, there is no requirement to secure demand for a second circuit outage of loss of 132 kV infeed into the group.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up/down or demand turn up/down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout the summer and winter periods.

Langage Primary Transformer capacity

Constraint summary

Generation Demand

Constrained assets	33/11 kV Primary Transformers at Langage	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation	
Limiting factor of constrained assets	12/24 MVA transformers, 23 MVA winter, 18 MVA summer, 9.12 MVA reverse power flow	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers or circuits which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year, and is affected by the large amount of small scale embedded generation installed in the area.

Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation	✓	✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Uprating of the transformers to increase the reverse power flow rating (including removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs during first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Plympton to Torycombe 33 kV circuit capacity

Constraint summary

Generation Demand

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

Constrained assets	33 kV circuit between Plympton to Torycombe and Plympton to 33 kV connected customers	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation	
Limiting factor of constrained assets	Circuits limited by 0.1 in^2 Cu conductor	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year, and is affected by the large amount of small scale embedded generation installed in the area.

Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation	✓	✓	✓	✓
Leading the Way				
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm² Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Plympton to Sherford/Newton Ferrers/Modbury/Ivybridge 33 kV circuit capacity

Constraint summary

Generation Demand

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

Constrained assets	33 kV circuit between Plympton 12L5 to Sherford 2L5 & Sherford 2L5 to Stentaway 3L5 & Stentaway 3L5 to Newton Ferrers	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	Circuits limited by 100 mm^2 or 0.1 in^2 Cu conductor	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Demand Driven Constraints

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm² Cu conductor or building a new 33 kV circuit between Plympton & Torr Quarry tee will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout the winter period.

Constraint summary

Generation Demand

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

Constrained assets	33 kV circuit between Stentaway 3L5 to Newton Ferrers and Plympton 11L5 to Ivybridge	
Type(s) of constraint	Thermal overload of 33 kV circuits	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	Circuits limited by 0.15 in^2 or 0.1 in^2 Cu conductor	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View				

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with $150mm^2$ Cu conductor or building a new 33 kV circuit between Plympton & Torr Quarry tee will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period across multiple seasons.

Landulph St Germans BSP group

Network Overview

Landulph and St Germans Bulk Supply Point group supplies a sparse area of 33 kV network, mostly in Cornwall and South Devon. St Germans is BSP runs with a 'loose couple' parallel path between Indian Queens and Landulph Grid Supply Points (GSPs). Landulph BSP has one 132/33 kV transformer fed from Landulph GSP. Both Landulph and St Germans run in parallel at 33 kV, which supplies the following Primary substations:

- A 33 kV ring with Looe, Lanreath, Lostwithiel, St Neot and Liskeard Primaries and interconnection to St Austell through Lostwithiel;
- A larger 33 kV ring between St Germans and Landulph with Pensilva, Callington on one leg and on the other Torpoint Antony, Saltash Whity Cross, Torpoint Town and Saltash Dunheved Road Primaries.
- From Callington another extensive 33 kV ring has Gunnislake and Lifton Primaries and a 33 kV connected customer with 33 kV interconnection to Ernesettle BSP through Tavistock and towards Pyworthy BSP through Launceston.

In addition the 33 kV connected generation, there is currently a large amount of LV and 11 kV connected generation present in this group, with over 9.8 MW of domestic rooftop solar generation connected in the baseline year of study.

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 an arranged outage of any Grid Transformer (GT) at St Germans or Landulph, Lostwithiel, St Neot and Lanreath are transferred onto St Austell BSP, and Tamar Pumping Station, Gunnislake and Lifton is transferred via Tavistock onto Ernesettle BSP.
- Directional overcurrent schemes are modelled on 33/11 kV transformers at Lanreath Primary.
- For any outage on busbars at Looe, Lostwithiel, Lanreath or Liskeard that reduces the number of incoming 33 kV circuits to the ring, the network is split to maintain network integrity for any subsequent faults.
- For an arranged outage of the 33 kV busbar at Landulph, the network is split at Saltash Whity Cross.
- For arranged outages of the Callington, Gunnislake or Tamar Pumping Station busbars, Tavistock is transferred onto Ernesettle BSP.
- Curtailment of 33 kV connected generators within the group are modelled are a variety of arranged outages, as outlined in customer connection agreements.

Any modelling of schemes on the upstream 132 kV networks are reported as part of the Alverdiscott/Indian Queens and Abham/Landulph/Exeter Network Development Reports.

Figure 10: Landulph and St Germans BSP geographic network coverage

A schematic diagram of the Landulph St Germans BSP group is included in the Appendix of this report.

Future network constraints

Callington/Landulph/St Germans ring 33 kV circuit capacity

Constraint summary

Generation | Demand

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

Constrained assets	33 kV circuits between Callington 3L5 – St Germans, Callington – Pensilva, Saltash Whity Cross - Landulph	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in² HDC).	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	To alleviate the circuit constraints the following reinforcements would be required as a minimum: - Construct a new 33 kV circuit between Gunnislake and Landulph. The circuit capacity should also account for potential transfer capacity to Ernesettle BSP (at least a 300 mm^2 CU cable), - Overlay 300 mm^2 limiting section of 185 mm^2 HSL/0.3 in^2 HSL cable Callington to Gunnislake circuit to allow for full utilisation of the overhead line. Consideration should be given to the transfer capacity from Ernesettle when confirming 33 kV circuit sizes. - Reconductor 33 kV circuit between Callington and Landulph 10L5. The circuit capacity should also account for potential transfer capacity to Ernesettle BSP. - Installation of reactive compensation (such as a 4.5 MVAr statcom) at Lifton 11 kV. - 33 kV circuit works at Callington to move the circuit connected to circuit breaker 1L5 to the 4L5 and 5L5 side. - 33 kV circuit works to loop in Launceston into the Callington/ Lifton ring. This allows for the ring to be operated with no splits and also alleviates solid solving the circuit capacity issue at Pyworthy - Replace Landulph GT2 with unit to match the rating of Landulph GT1.Consideration should be given to the ratings of associated 33 kV circuit breakers for GT1, GT2 1S0. - Remedial works need to be done between the Callington 4L5 to Launceston circuit to allow for full utilisation of the cyclic rating for the overhead line, CT, protection and isolators. - From 2028, the Gunnislake to Tavistock 33 kV circuit requires reconductoring. Consideration should be given to the transfer capacity from Ernesettle when confirming 33 kV circuit sizes. Once the second GT at Landulph is commissioned the network can be split at 33 kV, which will negate the requirement to reinforce all of the above 33 kV circuits as loading would be reduced on the constrained circuits. If parallel running was to be continued the reinforcement of the constrained circuits in the Landulph-St Germans group would be required, however this does not alleviate the Launceston/Lifton ring low volts constraint. An alternative reinforcement option which will negate the requirement to reinforce the 33 kV circuits in the Lifton/Launceston ring would be to: • Build a 132 kV circuit from Landulph GSP to Callington BSP • Install a 132/33 kV transformer at Callington (instead of Landulph) and run both groups in parallel. This would help with 33 kV circuit capacity and low volts at Lifton/Launceston ring.
Operational mitigation	As constraint occurs under first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up/down and/or demand turn up/down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period across multiple seasons.

Low volts at Lifton and 33 kV customer

Constraint summary

Generation Demand

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

Constrained assets	Low volts at customers point of connection	
Type(s) of constraint	Voltage outside of statutory limits at customer point of connection	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	Low volts driven by long 33 kV circuits in rural area.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the 33 kV circuits of the ring, the remaining circuit in service would overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	This will be part of the larger Landulph St Germans split. Reactive compensation connected at 11 kV would improve the situation by providing voltage support at the end of the 33 kV circuit. Consideration should be given to the specifications of any reactive compensation, as voltage excursions occur for both peak demand and peak generation periods.
Operational mitigation	It is noted that there are limitations to the existing technique of voltage analysis. The reactive behaviour of load, in particular projected load, modelled at the 11 kV bars of Primary substations does not take detailed account of the reactive behaviour of individual customers nor the effects of secondary network impedance. Development of load survey and analysis techniques will enable the materiality of these effects to be better understood.
Load Management Schemes	Load management schemes are available to alter reactive circuit flows; however this has not been included in the assessment of this constraint.
Flexibility services	Flexibility services could be procured to alleviate projected low volts. Dispatch of services would be required for an extended period of time throughout winter peak demand periods.

St Germans/Liskeard 33 kV circuit capacity

Constraint summary

Generation | **Demand**

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

Constrained assets	33 kV circuits between Liskeard and St Germans	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing overhead conductor (HDC 150 mm² rated for 50° C operation).	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group or a fault of Main 1 and 2 at St Germans, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	To alleviate constraints caused by a busbar fault, installation of a circuit breaker 1S0 at Liskeard should be considered. Once Landulph St Germans BSP Group is split the 33 kV circuits between St Germans and Liskeard requires reconductoring, including removal of any protection and CT ancillary rating limitations. Permanent load transfer of Lostwithiel back to St Austell BSP could also be considered to further alleviate projected overloads on the Lanreath – Liskeard ring. This solution requires construction of a 33 kV circuit from Lostwithiel to a 33 kV generation customer north east of St Austell BSP.
Operational mitigation	As constraint occurs under first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time across multiple seasons.

Callington to St Germans 33 kV circuit capacity

Constraint summary

Generation | Demand

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

Constrained assets	33 kV circuits between Callington 3L5 and St Germans	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (HDC 0.1 in² rated for 50° C operation).	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation	✓	✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Reconductor overhead line section between Callington 3L5 and St Germans with 150 mm² HDC conductor.
Operational mitigation	As constraint occurs under a first circuit fault outage condition, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout multiple seasons.

St Neot/Liskeard 33 kV circuit capacity

Constraint summary

Generation Demand

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

Constrained assets	33 kV circuits between St Neot and Liskeard	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	Circuits limited by 7.1 km of existing overhead conductor (HDC 0.1 in^2 rated for 50° C operation).	
Outage combination which causes the constraint	First Circuit Outage	Busbar fault at Looe or fault of the 33 kV 1S0 circuit breaker at Lanreath.
	Second Circuit Outage	An arranged outage of any 33 kV circuit supplying the Lostwithiel ring, followed by a fault at Looe busbar fault.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductor overhead line sections between St Neot and Liskeard with 100 mm^2 HDC conductor.
Operational mitigation	As constraint occurs under first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout multiple seasons.

Liskeard to 33 kV generator circuit capacity

Constraint summary

Generation Demand

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

Constrained assets	33 kV circuits between Liskeard and generator customer	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation	
Limiting factor of constrained assets	Circuits limited by existing overhead conductor (HDC 150 mm² rated for 50° C operation).	
Outage combination which causes the constraint	First Circuit Outage	For Main 1 and Main 2 busbar fault at St Germans.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				✓
System Transformation				✓
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Reconductor the overhead line between Liskeard and 33 kV generation customer.
Operational mitigation	As constraint occurs under a first circuit fault outage, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Lostwithiel and Lanreath infeed 33 kV circuit capacity

Constraint summary

Generation | Demand

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

Constrained assets	33 kV circuits out of Lostwithiel and Lanreath	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	33 kV circuits limited by CT limitation of 200 A	
Outage combination which causes the constraint	Second Circuit Outage	For the arranged outage at St German resulting in the removal of a 33 kV circuit to the group, followed by a fault on the St Germans – Looe – Lanreath circuit.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				✓
System Transformation				✓
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Replacement of CTs on the affected circuits between Lostwithiel and Lanreath to allow full cyclic rating capabilities would alleviate the projected constraints. In addition, consideration should be given to permanent transfer of Lostwithiel back to St Austell BSP. This would necessitate construction of a 33 kV circuit from Lostwithiel to a 33 kV generation customer north east of St Austell BSP. The additional circuit would reduce overloads seen on the Lanreath to Liskeard circuit.
Operational mitigation	Arranged outage on the St Germans to Lostwithiel ring circuits can be limited to summer to alleviate the projected demand driven overloads. For generation overloads, constraining generation will stop circuits overloading.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads for generation driven constraints. Dispatch of services would be required for an extended period of time throughout the summer period. Similarly, generation turn down and/or demand turn up services could be procured to alleviate projected overloads for demand driven constraints. Dispatch of services would be required for an extended period of time throughout the winter period.

Saltash Whity Cross to St Germans 33 kV circuit capacity

Constraint summary

Generation Demand

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

Constrained assets	33 kV circuits between Torpoint Antony and Saltash Whity Cross	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand (from 2032)	
Limiting factor of constrained assets	33 kV circuit limited by 8.2 km overhead line with 100 mm^2 HDC conductor rated for 50° C operation.	
Outage combination which causes the constraint	Second Circuit Outage	For the arranged outage of Landulph bus section breaker followed by a fault on the St Germans circuit to Saltash Whity Cross

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				✓
System Transformation				✓
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductor overhead section of 33 kV circuit to 150 mm^2 HDC, including removal of any associated ancillary rating limitations.
Operational mitigation	Altering network running arrangements for the arranged outage by splitting the downstream networks fed from the 2L5 and 3L5 circuit breakers at St German would alleviate projected circuit overloads whilst maintaining demand security.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout multiple seasons.

Saltash Whity Cross to Landulph 33 kV circuit capacity

Constraint summary

Generation | Demand

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

<table>
<tr><td>Constrained assets</td><td colspan="2">33 kV circuits between Saltash Whity Cross and Landulph</td></tr>
<tr><td>Type(s) of constraint</td><td colspan="2">Thermal overload</td></tr>
<tr><td>Constrained condition(s)</td><td colspan="2">Winter Peak Demand
Intermediate Warm Peak Demand (from 2025)</td></tr>
<tr><td>Limiting factor of constrained assets</td><td colspan="2">Circuits limited by 2.8 km of existing overhead conductor (HDC 0.15 in² rated for 50° C operation) and associated CTs/protection.</td></tr>
<tr><td rowspan="2">Outage combination which causes the constraint</td><td>First Circuit Outage</td><td>A fault of the busbar Main 2 at Saltash Whity Cross will overload the constrained circuit.</td></tr>
<tr><td>Second Circuit Outage (from 2028)</td><td>For the arranged outage of Landulph bus section breaker followed by a fault on the St Germans circuit</td></tr>
</table>

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation	✓	✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

<table>
<tr><th>Solution option</th><th>Summary</th></tr>
<tr><td>Reinforcement</td><td>Reconductor line to 150 mm^2 HDC and undertake remedial works for protection, CT and isolators limitations. This line becomes overloaded when running an interconnected network between Landulph and St German on a generation and demand case. However, if the network is run split the constraint only becomes an issue in a winter demand case as shown in the table below:
<table>
<tr><th></th><th colspan="4">Study year</th></tr>
<tr><th>Scenario</th><th>Baseline</th><th>2025</th><th>2028</th><th>2032</th></tr>
<tr><td>Steady Progression</td><td></td><td></td><td></td><td></td></tr>
<tr><td>System Transformation</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Consumer Transformation</td><td></td><td></td><td></td><td>✓</td></tr>
<tr><td>Leading the Way</td><td></td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>WPD Best View</td><td></td><td></td><td>✓</td><td>✓</td></tr>
</table></td></tr>
<tr><td>Operational mitigation</td><td>Restricting outages of the bus section breaker at Landulph BSP to summer would defer reinforcement requirement until 2028. In 2032 no outage window exists, so a conventional solution or flexibility/load management scheme is required.</td></tr>
<tr><td>Load Management Schemes</td><td>Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.</td></tr>
<tr><td>Flexibility services</td><td>Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.</td></tr>
</table>

Gunnislake Primary Transformer capacity

Constraint summary

Generation | Demand

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

Constrained assets	Gunnislake 33/11 kV Primary transformers	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	5 MVA Primary transformer capacity	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers which feeds into this Primary, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Undertake remedial works to increase transformer ratings to the full cyclic capabilities, this will alleviate projected constraints until 2025. Post 2025 replacement of transformers will be required. Due to the age of the transformers replacement with 7.5/15 MVA units might be another option to consider.
Operational mitigation	As constraint occurs under first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads for generation driven constraints. Dispatch of services would be required for an extended period of time throughout the summer period. Similarly, generation turn down and/or demand turn up services could be procured to alleviate projected overloads for demand driven constraints. Dispatch of services would be required for an extended period of time throughout the winter period.

St Germans Grid Transformer capacity

Constraint summary

Generation | Demand

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

Constrained assets	St Germans 132/33 kV Grid Transformer capacity	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	Two 30/60 MVA Grid Transformers	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of GT1, the remaining transformer in service could overload. From 2025 GT1 also starts overloading

Scenario identification

The constraint exists pre and post St Germans/Landulph split. The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the Baseline year.

Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Replace SGTs with 60/90 MVA units. For this solution because the uneven load between the transformers a new 132 kV circuit from Landulph GSP should also be considered and flows re-assessed.
Operational mitigation	As constraint occurs under first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads for generation driven constraints. Dispatch of services would be required for an extended period of time throughout the summer period. Similarly, generation turn down and/or demand turn up services could be procured to alleviate projected overloads for demand driven constraints. Dispatch of services would be required for an extended period of time throughout the winter period.

Liskeard Transformer Capacity

Constraint summary

Generation Demand

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

Constrained assets	Liskeard 33/11 kV Transformer capacity	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Two 12/24 MVA Primary transformers	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Upgrade the 12/24 MVA units with larger 20/40 MVA units.
Operational mitigation	As constraint occurs under first circuit fault outage conditions, operational mitigation is not possible. Permanent load transfers is not possible due to unavailability of capacity in neighbouring substations in future study years.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout the intermediate warm period.

Pensilva Transformer Capacity

Constraint summary

Generation | **Demand**

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

Constrained assets	Pensilva 33/11 kV Primary Transformer capacity (T2 only)	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	5/6.25 MVA Primary Transformer, limited to 6 MVA by a CT ancillary rating (330 A at 11 kV).	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of transformer or incoming circuit supplying T1, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

Demand Driven Constraints

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression				✓
System Transformation				✓
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Assess existing CT ratings and undertake remedial works to allow Pensilva T2 to operate at the full cyclic rating capability.
Operational mitigation	As constraint occurs under first circuit fault outage conditions, operational mitigation is not possible. Permanent load transfers is not possible due to unavailability of capacity in neighbouring substations in future study years.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout the winter period.

Saltash Dunheved Transformer capacity

Constraint summary

Generation Demand

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

Constrained assets	Saltash Dunheved 33/11 kV transformer capacity	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Two 12/24 MVA Primary transformers, limited by Air break Isolator (ABI) ancillary ratings to 22.9 MVA (400 A at 33 kV).	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers or incoming circuits, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				✓
System Transformation				✓
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Assess existing ancillary rating limitations and undertake remedial works to allow transformers to operate at the full cyclic rating capability.
Operational mitigation	As constraint occurs under first circuit fault outage conditions, operational mitigation is not possible. Permanent load transfers is not possible due to unavailability of capacity in neighbouring substations in future study years.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time across multiple seasons.

Saltash Dunheved to Landulph circuit capacity

Constraint summary

Generation Demand

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

Constrained assets	Saltash Dunheved to Landulph 33 kV circuits.	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	33 kV circuits limited by ABI and CT ratings to 22.9 MVA (400 A at 33 kV).	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Undertake remedial works to upgrade Air Break Isolators (ABIs) and CTs to allow for utilisation of the existing rating of the 33 kV circuits.
Operational mitigation	As constraint occurs under first circuit fault outage conditions operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout the winter period.

Alverdiscott/Indian Queens (North Devon and Cornwall) 132 kV network

Network Overview

Alverdiscott/Indian Queens Grid Supply Point (GSP) supplies a sparse area of 132 kV network, mostly in Cornwall and North Devon. It is supplied from six 400/132 kV SGTs (two at Alverdiscott and four at Indian Queens), the two GSPs are interconnected at 132 kV via double circuit K-route, which includes an oil filled cable section underneath the River Torridge. The 132 kV network supplies the following Bulk Supply Points (BSP):

- East Yelland and Barnstaple BSPs group fed from three circuits off Alverdiscott via the K-route and subsequent J-route.
- The K-route has Pyworthy BSP, St Tudy BSP and a number of 132 kV generators connected.
- West Cornwall group has several BSPs which are: Camborne BSP, Hayle BSP, Rame BSP, Truro BSP, Fraddon BSP and it is fed from four circuits from Indian Queens double busbar.
- St Austell BSP is fed from two circuits off Indian Queens.
- St Germans is fed from a circuit teed-off from the circuit towards St Austell and it is loosely coupled at 33 kV with Landulph GSP.

In addition the 132 kV connected generation, there is currently a large amount of LV, 11 kV and 33 kV connected generation present in this group.

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 an arranged outage of any SGT at Indian Queens, the SGT4 transformer on hot standby is switched in.
- K-route is split for an arranged outage of any SGT at Alverdiscott.
- The Pyworthy-North Tawton 33 kV network is split to avoid overloading assets at North Tawton BSP when Pyworthy 132 kV is left at single-circuit risk.
- For an arranged outage of 132 kV circuit breaker 120 at Camborne, Camborne circuit breaker 1T0 and Hayle isolator 103 are opened to maintain network integrity for a subsequent fault on the A route into Camborne.
- The 132 kV busbars at East Yelland are coupled together for an outage of one of the incoming circuits.
- Curtailment of 132 kV connected generators within the group are modelled are a variety of arranged outages, as outlined in customer connection agreements.

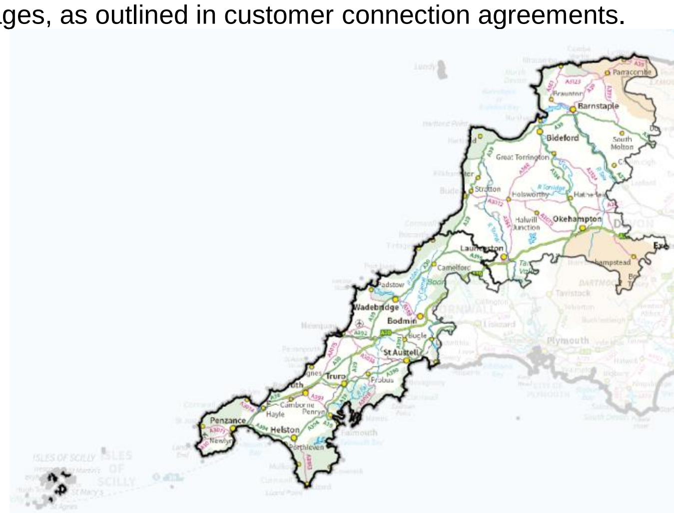

Figure 11: Alverdiscott/Indian Queens GSPs geographic network coverage

A schematic diagram of the Alverdiscott/Indian Queens GSP group is included in the Appendix of this report.

Future network constraints

Barnstaple/East Yelland group security of supply

Constraint summary

Generation Demand

The table below outlines the nature of the network constraints identified in the network analysis. The outage combination that causes the constraint is an arranged outage of the Main 2 busbar at Alverdiscott GSP, followed by a subsequent fault of the Alverdiscott 105 to East Yelland 403 circuit. ENA Engineering Recommendation P2/7 states that busbars are not considered as circuits, as a result any busbar outage should be considered on their merits. WPD 132 kV network design policy (POL: SD2) considers the impact of arranged busbar outages in demand security assessments, the implementation of which applies to new and significantly modified 132 kV networks. The Barnstaple – East Yelland 132 kV network has not been modified in the last 20 years since the increase in demand above 100 MW. The Network Development Plan analysis allows for identification of network constraints, this is necessary to determine options for network development, which could also help to alleviate constraints on the wider network.

Constrained assets	Barnstaple, East Yelland BSP Group	
Type(s) of constraint	Demand security of supply and thermal overloads	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	ENA Engineering Recommendation P2/7 – load transfer capacity is less than 10 MW (if arranged outages of busbars are considered) Transformer limits 30/60 MVA units	
Outage combination which causes the constraint	Second Circuit outage	Limited by Transfer capacity

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected non-compliance is present in the baseline.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	It is recommended that additional transformer or substation capacity is established to deload the Barnstaple and East Yelland group is deloaded. This can be achieved by establishing a new Bulk Supply Point in the vicinity of Alverdiscott GSP. Consideration should be given to sizing of 33 kV circuits to connect to a new BSP at Alverdiscott, as projected demand growth in the group is expected to substantially increase. This may include reconductoring work of the circuit between Alverdiscott tee and Great Torrington. Alternatively, a 132 kV double busbar arrangement at Alverdiscott GSP would solve the constraint, as this allow a running arrangement where at least one 132 kV circuit is connected for all secured outage conditions. Construction of another 132 kV circuit into Barnstaple could also be an option, but this option also requires replacing of the transformers at Barnstaple/East Yelland with larger units 60/90 MVA units. To solve the issue in the short-term, 132 kV circuit breakers works could be undertaken, to allows for a running arrangement where at least one 132 kV circuit is connected for all secured outage conditions.
Operational mitigation	As the issue is to comply with internal policy attention should be given when taking any outage on Main 2 at Alverdiscott. Any arranged outages can be scheduled to occur after short-term remedial works are completed.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks. In this case it will not solve a security of supply issue.
Flexibility services	Only applicable to reduce transformer overloads at Barnstaple and East Yelland before reinforcement is completed. Flexibility services are not suitable as a solution for second circuit outage security of supply constraints.

K-route and Alverdiscott SGT capacity

Constraint summary

Generation | Demand

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

Constrained assets	132 kV K-route circuits and Alverdiscott SGTs	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation Intermediate Warm Peak Demand Winter Peak Demand	
Limiting factor of constrained assets	20 km section of Overhead line between a 132 kV connected generator and Indian Queens which is ACSR 175 mm² (Lynx) at 75° C, also Alverdiscott SGT capacity.	
Outage combination which causes the constraint	First Circuit Outage	For an outage (arranged or fault) of an SGT at Alverdiscott.
	Second Circuit Outage	For an outage (arranged or fault) of an SGT at Alverdiscott, followed by a subsequent fault of the remaining SGT in service.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Generation Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression			✓	✓
System Transformation			✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Demand Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression			✓	✓
System Transformation			✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Uprate 20 km of 132 kV circuit, currently 175 mm^2 ACSR (Lynx) conductor at 75° C to 300 mm^2 at 75° C. The circuit works this would create some capacity, and it would defer further constraints until additional transmission capacity is established. Pyworthy GSP is a viable option, which would greatly alleviate the generation cases whereas installating additional SGTs at Alverdiscott would be further limited by the 132 kV cables under the River Torridge. If Pyworthy GSP is built consideration must be given to the necessity of reinforcing the K route as that may no longer be required. However, because it can take 10 or more years to build and in all of the scenarios the group goes above 300 MW in 2028 uprating the K route between St Tudy and the 132 kV generation customer along might be the only option. In summary options include: • Reinforce K route and add extra SGT at Alverdiscott with bar at the 400 kV (as there are only two circuits feeding Alverdiscott) and double busbar at 132 kV and potentially 400 kV – this solution may require further reinforcement due to the amount of generation connected South West from Alverdiscott GSP; • Use flexibility until whilst new transmission capacity is established, K-route re-arrangement would have to be made to bring two circuits in at either St Tudy or Pyworthy. This would allow the splitting of Indian Queens from Alverdiscott and run Pyworthy and Alverdiscott interconnected (running pre-emptive splits for any arranged outage on circuits and busbars on the 132 kV); • A mix of both reinforcing the K route between St Tudy and the 132 kV generator and building a GSP at Pyworthy; • Pyworthy GTs would need remedial works to achieve full cyclic capabilities as they are currently limited. • If Pyworthy GSP is built contractual arrangements with generators may need to be reviewed to not overload any of the SGTs in the area. This is due to the amount of generation that even with two extra SGTs if left unconstrained would still overload. Any of the above suggestions would require further design collaboration between WPD and National Grid.
Operational mitigation	A split of the K-route circuit for an arranged outage of the Alverdiscott SGTs will reduce overloads. However, this solution is only viable until the group demand of Alverdiscott exceeds 300 MW.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout any SGT outage.

Indian Queens SGT Capacity

Constraint summary

Generation | Demand

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

Constrained assets	Indian Queens SGTs	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation Intermediate Warm Peak Demand Winter Peak Demand	
Limiting factor of constrained assets	SGT capacity at Indian Queens	
Outage combination which causes the constraint	First Circuit Outage	For a busbar Fault or fault which results in the loss of one of the three SGTs at Indian Queens GSP.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Split Indian Queens at the 132 kV bar and run with a split on the 132 kV double busbar, with 2 SGTs feeding each section. A revision of the fault level at Indian Queens may allow the running of four SGTs solid. Alternative options include an auto-changeover scheme installed on SGT4, allowing it to be automatically switched in following a fault
Operational mitigation	As it is a first circuit outage there is no immediate operational mitigation possible. Short term ratings of SGTs may be available for short duration overloads, this requires further assessment.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout any SGT outage.

A-route Capacity

Constraint summary

Generation | Demand

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

Constrained assets	132 kV A-route capacity	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Intermediate Warm Peak Demand Winter Peak Demand Summer Peak Generation Summer Peak Demand	
Limiting factor of constrained assets	132 kV circuit capacity	
Outage combination which causes the constraint	First Circuit Outage	Circuit fault between Fraddon BSP and Hayle BSP
	Second Circuit Outage	Arranged busbar outage at Indian Queens Main 2, followed by a combination of circuit faults

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Demand Driven Constraints

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	From 2025 the following reinforcements alleviate the projected overloads: - Reprofile Fraddon to Camborne with 175 mm² Lynx conductor at 75° C. - Reconductor Fraddon to Indian Queens 305 with Twin 175 mm² Lynx conductor at 50° C and 400 mm² Zebra conductor at 50° C.
Operational mitigation	Reducing outages at Indian Queens to the summer period could defer the reinforcement requirement until 2028. After that there is no possible outage period that will not risk overloads on the A-route.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout any arranged outage.

B-route Capacity

Constraint summary

Generation | Demand

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

Constrained assets	B-route 132 kV circuit	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Intermediate Warm Peak Demand Winter Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	132 kV circuit capacity	
Outage combination which causes the constraint	First Circuit Outage	For an outage (arranged or fault) of one of the St Austell infeed circuits

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Generation Driven Constraints

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Demand Driven Constraints

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	From 2028 the Indian Queens to the St Austell/St Germans Tee will overload in all scenarios, this means that this circuit will be the first to need reinforcement. Potential solutions include reconductoring this portion of the line with twin 175 mm² Lynx conductor at 50° C. The section between the St Germans/St Austell tee and St Austell only overloads for a generation constraint, this is because of the large amount of small scale PV and 33 kV installed generators. Both sections of line between St Austell and Indian Queens will overload on generation from 2025 for three of the scenarios and overload in 2028 for all scenarios. However, because the load share at St Germans is uneven, construction of a new 132 kV line between Landulph GSP to St Germans BSP should be considered as an alternative to the above reinforcement. This can allow the 33 kV loose couple between Indian Queens and Landulph to be broken, solving the near term overloads on GT2 at St Germans and circuit between Indian Queens and St Austell/St Germans tee.
Operational mitigation	This is a generation and demand problem, hence there is no possible outage window from 2028 onwards.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout any circuit outage.

BM-route Capacity

Constraint summary

Generation | Demand

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

Constrained assets	BM-route 132 kV circuit	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Intermediate Warm Peak Demand Winter Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	132 kV circuit capacity	
Outage combination which causes the constraint	Second Circuit Outage	Indian Queens Main 2 outage followed by a combination of circuit faults

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Generation Driven Constraints

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Demand Driven Constraints

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Cable between Camborne and Rame will decrease overload but further works will be required. From 2025 onwards: - Reconductor Pencoose to Rame on the 750 m stretch of Overhead Wood pole section. From 2028 onwards: - Fraddon to Indian Queens 105 (all scenarios) - reconductor with Twin 300 mm² Upas 50° C. - Fraddon to Rame 303 (only in Leading the Way, Consumer Transformation and Best View)– reprofile one section to 300 mm² Upas 75° C and reconductor the rest with 300 mm² Upas 75° C
Operational mitigation	Reducing outages to Summer at Indian Queens could take it to 2025. After that there is no possible outage period that will not risk the integrity of the BM route.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout any SGT outage.

CC-route Capacity

Constraint summary

Generation Demand

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

Constrained assets	CC-route 132 kV circuit	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Intermediate Warm Peak Demand Winter Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	132 kV circuit capacity	
Outage combination which causes the constraint	Second Circuit Outage	Arranged outage of an A-route circuit followed by a combination of circuit faults

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Installation of a cable between Camborne and Rame is planned and will decrease the overload. In later years, the reconductoring of the CC-route is required, potentially using AAAC 300 mm² at 50° C for the wood pole section and reprofile the PL16 with ACSR 175 mm² for 75° C operation. In addition, reconductor the section of 132 kV circuit between Rame 103 and Rame Tee between Fraddon and Hayle with 300 mm² at 50° C.
Operational mitigation	Not applicable.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout any arranged outage.

J-route Capacity

Constraint summary

Generation Demand

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

Constrained assets	J-route 132 kV circuit	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation	
Limiting factor of constrained assets	132 kV circuit capacity	
Outage combination which causes the constraint	First Circuit Outage	Alverdiscott Main 2 busbar fault
	Second Circuit Outage	Arranged outage which results in the loss of direct infeed to the J-route outage followed by a combination of circuit faults.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				✓
Leading the Way			✓	✓
WPD Best View				✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	It is recommended to reprofile the J route for 75° C operation.
Operational mitigation	Not applicable as it is caused by a First Circuit Outage.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout any arranged outage.

GT Capacity at Hayle BSP

Constraint summary

Generation | Demand

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

Constrained assets	Hayle 132/33 kV Grid Transformers	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	30/60 MVA transformer rating	
Outage combination which causes the constraint	First Circuit Outage	For an outage (arranged or fault) of one transformer at Hayle.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Demand and Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	It is recommended to replace GTs with 60/90 MVA units. Another solution would be to create a 132 kV circuit to Penzance with associated transformers. As Penzance is a very isolated area with demand centre away from main electricity infrastructure a higher voltage for example 66 kV could also increase capacity.
Operational mitigation	Not applicable
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout any GT outage.

GT Capacity at Truro BSP

Constraint summary

Generation Demand

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

Constrained assets	Truro 132/33 kV GT capacity	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	30/60 MVA and 40/60 MVA transformer rating	
Outage combination which causes the constraint	Second Circuit Outage	For an arranged busbar outage at Fraddon on the GT1 side, where most of the connected demand is supplied from Truro. This is followed by a fault on either transformer or circuit into Truro BSP.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Generation Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Replace GT1 and GT2 with 60/90 MVA units. Alternatively, install a 33 kV double busbar arrangement at Fraddon BSP, which will increase capacity at Fraddon BSP.
Operational mitigation	Truro GT overloads can be alleviate by disconnecting demand connected to Fraddon GT1.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout any GT outage.

GT Capacity at Fraddon BSP

Constraint summary

Generation Demand

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

Constrained assets	Fraddon 132/33 kV GT1 and GT2 capacity	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	30/60 MVA transformer rating	
Outage combination which causes the constraint	First Circuit Outage	For an outage (arranged or fault) of one transformer at Fraddon.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Replace GTs with 60/90 MVA units. Installation of a 33 kV double busbar will also alleviate GT overloads at Truro BSP.
Operational mitigation	Not applicable
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout any GT outage.

GT Capacity at St Austell BSP

Constraint summary

Generation | Demand

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

Constrained assets	St Austell 132/33 kV transformer capacity	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	60/90 MVA and 45/90 MVA transformer rating including ancillary limitations	
Outage combination which causes the constraint	First Circuit Outage	For an outage (arranged or fault) of one transformer at St Austell.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the Baseline.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation	✓	✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Remedial works are needed to allow both transformers to achieve their full cyclic ratings. This would be uprating Air Break Isolators, CTs and circuit breakers. Reverse power flow ratings should also be assessed. The worst overloads happen during Summer for a generation case.
Operational mitigation	Reduce outages on the St Austell Transformers to the summer period, including constraints of any generation customers to alleviate generation driven overloads.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for outages of any GT at St Austell BSP.

GT Capacity at Pyworthy BSP

Constraint summary

Generation | Demand

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

Constrained assets	Pyworthy 132/33 kV transformer capacity	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	60/90 MVA transformer rating including ancillary limitations	
Outage combination which causes the constraint	Second Circuit Outage	For a loss of two Transformers in the North Tawton and Pyworthy group.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				✓
System Transformation				✓
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032. Any final solution will be subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Remedial works to allow Pyworthy Transformers to achieve their full cyclic rating.
Operational mitigation	Not applicable.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for outages of any GT in the Pyworthy and North Tawton group.

Barnstaple BSP

Network Overview

Barnstaple Bulk Supply Point supplies a mixture of rural and urban sections of 33 kV network, in North Devon. It is supplied from two 132 kV circuits which are fed from Alverdiscott GSP, with two 30/60 MVA grid transformers supplying the group. The 33 kV network supplies the following Primary substations:

- Rock Park and Roundswell Primaries are each supplied via two transformer feeders.
- A 33 kV ring supplying South Molton & Heddon Cross, along with connections to two 33 kV connected generators and a 33 kV demand customer with 33 kV interconnection to Taunton BSP via a normal open points at South Molton.
- Lynton and Bratton Flemming are fed via a single 33 kV circuit with interconnection to the East Yelland network via normal open points at Lynton and Barnstaple Quay
- A 33 kV circuit supplying Great Torrington, Middle Barlington & Tinkers Cross along with three 33 kV generator connections. Interconnection with East Yelland BSP exists via a normal open point at Great Torrington and Exeter City BSP at Lapford.

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.

- Curtailment of 33 kV connected generators within the group are modelled are a variety of arranged outages, as outlined in customer connection agreements
- For an arranged outage on Lynton 33 kV main busbar 2, the substation demand is transferred to the East Yelland network
- For an arranged outage on Great Torrington 33 kV main busbar 2, the substation demand is transferred to the East Yelland network

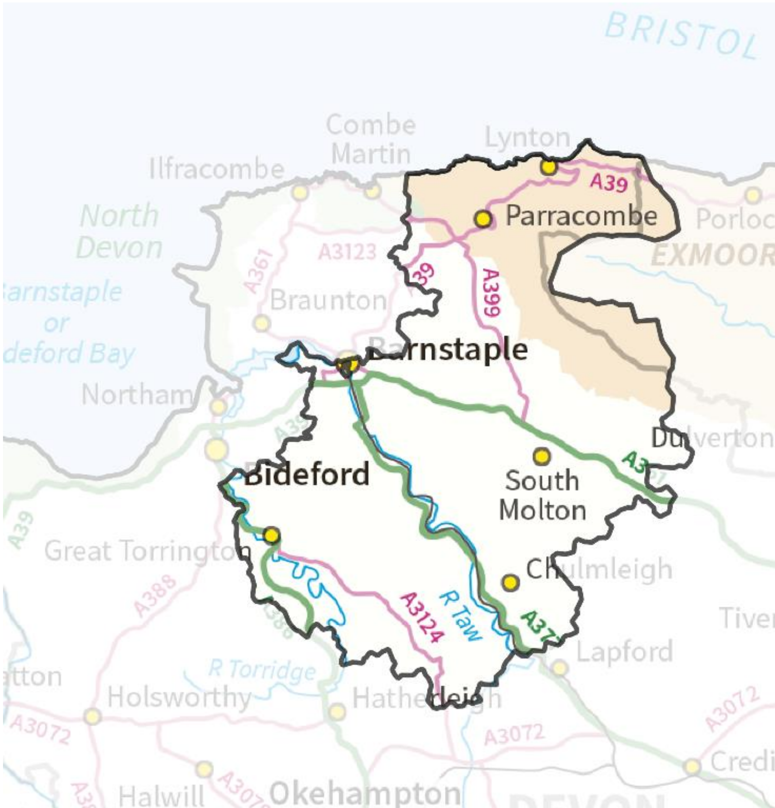

Figure 12: Barnstaple BSP geographic network coverage

A schematic diagram of the Barnstaple BSP group is included in the Appendix of this report

Future Network Constraints

Barnstaple Grid Transformer Capacity

Constraint summary

Generation | **Demand**

Constrained assets	132/33 kV Grid Transformers at Barnstaple	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	30/60 MVA Grid Transformers, demand limited by ancillary rating of 60 MVA.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the Grid Transformers which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Replacement of the grid transformers with larger 60/90 MVA units (including removal of any ancillary rating limitations) will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. An alternative solution is to permanently transfer load away from Barnstaple BSP by establishing a new Bulk Supply Point at Alverdiscott, which would also alleviate projected overloads on this group.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services via a ‘Secure’ product could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period throughout multiple seasons.

Roundswell Transformer Capacity

Constraint summary

Generation | Demand

Constrained assets	33/11 kV Primary Transformers at Roundswell	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	7.5/15 MVA Primary Transformers, demand limited by ancillary rating of 14 MVA (winter), 12.6 MVA (summer cyclic) & 11.2 MVA (summer emergency). 6.08 MVA Reverse power flow rating	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

Generation Driven Constraints

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression				
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Demand Driven Constraints

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Replacement of the grid transformers with larger 12/24 MVA units (including removal of any ancillary rating limitations) will alleviate any of the projected overloads in the 0-10 year period for the projected load growth.
Operational mitigation	As constraint occurs during first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional connections (demand or generation) into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services via a 'Secure' product could be procured to alleviate projected transformer overloads in peak demand conditions. Similarly, generation turn down and/or demand turn up services could be procured to alleviate projected transformer overloads in peak generation conditions. Dispatch of services would be required for an extended period throughout multiple seasons.

South Molton Transformer Capacity

Constraint summary

Generation | **Demand**

Constrained assets	33/11 kV Primary Transformers at South Molton	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	7.5/15 MVA Primary Transformers, demand limited by ancillary rating of 14 MVA (winter)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Replacement of the grid transformers with larger 12/24 MVA units (including removal of any ancillary rating limitations) will alleviate any of the projected overloads in the 0-10 year period for the projected load growth.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services via a 'Secure' product could be procured to alleviate projected transformer overloads. Dispatch of services would be required for an extended period throughout the winter seasons.

Barnstaple, Heddon Cross, South Molton 33 kV circuit Capacity

Constraint summary

Generation Demand

Constrained assets	33 kV circuits between Barnstaple & South Molton	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 Cu)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The generation driven overloads are first identified in the baseline year, and is affected by the large amount of small scale embedded generation installed in the area.

Demand driven overloads are first identified in 2028.

Generation Driven Constraints

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Demand Driven Constraints

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	For the demand driven constraints reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth.
Operational mitigation	It is possible to constrain the export of some of the 33 kV connected generation for outages on either 33 kV circuit between Barnstaple and South Molton.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Both generation turn up/down and demand turn up/down services could be procured to alleviate projected circuit overloads for demand and generation driven constraints. Dispatch of services would be required for an extended period of time throughout multiple seasons.

Middle Barlington Regulator Capacity

Constraint summary

Generation Demand

Constrained assets	33 kV Voltage Regulator at Middle Barlington	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Intermediate Warm Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	11.4 MVA Voltage Regulator rating	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Replacement of the voltage regulator with a larger unit (including removal of any ancillary rating limitations) will alleviate any of the projected overloads in the 0-10 year period for the projected load growth.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Both generation turn up/down and demand turn up/down services could be procured to alleviate projected circuit overloads for demand and generation driven constraints. Dispatch of services would be required for an extended period of time throughout multiple seasons.

Barnstaple to Roundswell 33 kV circuit Capacity

Constraint summary

Generation | **Demand**

Constrained assets	33 kV circuits between Barnstaple and Roundswell	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	Circuits limited by 668 m of existing 33 kV overhead conductor (100 mm^2 ACSR), also a 320 A protection limit.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

Scenario	**Study year**			
	Baseline	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor along with the removal of the 320 Amp protection limit will alleviate any of the projected overloads in the 0-10 year period for the projected load growth.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the winter period.

Tinkers Cross Transformer Capacity

Constraint summary

Generation Demand

Constrained assets	33/11 kV Primary transformer at Tinkers Cross	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation	
Limiting factor of constrained assets	5/6.25 MVA Primary Transformer, demand limited by ancillary rating of 6.25 MVA (winter)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers or circuits which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way				
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Replacement of the grid transformers with larger 7.5/15 or 12/24 MVA units (including removal of any ancillary rating limitations) will alleviate any of the projected overloads in the 0-10 year period for the projected load growth.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

East Yelland BSP

Network Overview

East Yelland Bulk Supply Point supplies a mixture of rural and urban sections of 33 kV network in North Devon. It is supplied from two 132 kV circuits which are fed from Alverdiscott Grid Supply Point (GSP), with two 30/60 MVA 132/33 kV grid transformers supplying the group. The 33 kV network supplies the following Primary substations:

- Northam Primary is supplied via a single transformer feeders.
- A 33 kV ring supplying Park Lane, Bideford Main, along with connections to three 33 kV connected generators and with 33 kV interconnection to Pyworthy BSP with normal open point at Clovelly and with Barnstaple BSP with a normal open point at Great Torrington.
- 33 kV circuits feeding Fremington, Barnstaple Quay, Braunton, Ilfracombe and Georgeham with interconnection to Barnstaple BSP via Lynton.

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.

- Arranged outages of the 33 kV transformer at Northam result in the transfer of the demand at Northam to Park Lane.
- For arranged outages of isolator 1L3 at Braunton, 1S0 at Braunton is closed.

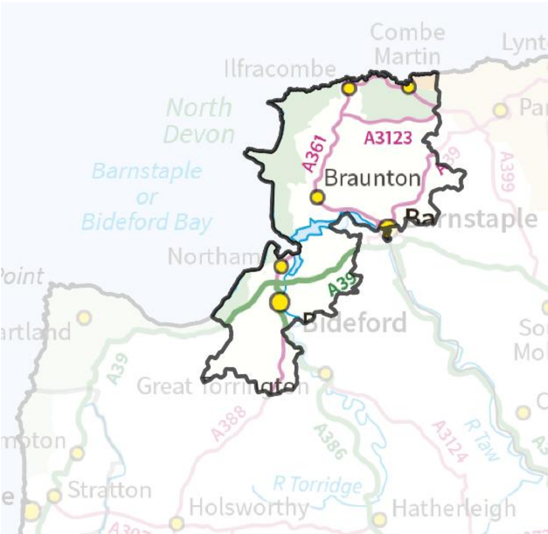

Figure 13: East Yelland Geographic network coverage

A schematic diagram of the East Yelland BSP group is included in the Appendix of this report.

Future network constraints

East Yelland Grid Transformer Capacity

Constraint summary

Generation Demand

Constrained assets	132/33 kV grid transformers at East Yelland	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	30/60 MVA Grid Transformers, demand limited by ancillary rating of 60.13 MVA rating	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers or circuits which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Replacement of the grid transformers with larger 60/90 MVA units (including removal of any ancillary rating limitations) will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. Alternatively demand may be transferred to a new BSP at Alverdiscott.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period across multiple seasons.

Park Lane Transformer Capacity

Constraint summary

Generation | **Demand**

Constrained assets	33/11 kV Primary Transformers at Park Lane	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	7.5/15 MVA Primary transformers, demand limited by ancillary rating of 14 MVA (winter), 12.6 MVA (summer cyclic) & 11.2 MVA (summer emergency)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers or circuits which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Replacement of the grid transformers with larger 12/24 MVA units (including removal of any ancillary rating limitations) will alleviate any of the projected overloads in the 0-10 year period for the projected load growth.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period across multiple seasons.

East Yelland, Bideford Main and Park Lane 33 kV circuit Capacity

Constraint summary

Generation | **Demand**

Constrained assets	33 kV circuit between East Yelland 2L5 & Bideford Main 2L5	
Type(s) of constraint	Thermal overload of 33 kV circuit	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 Cu)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. Alternatively the re-configuration of the 33 kV network if Alverdiscott BSP is established may reduce the amount of circuit reconductoring.
Operational mitigation	As constraint occurs during first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period across multiple seasons.

Constraint summary

Generation | **Demand**

Constrained assets	33 kV circuit between East Yelland 3L5 & Park Lane 2L3	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 and 100 mm^2 Cu)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way		✓	✓	✓
WPD Best View				

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor (6.4 km) will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. Alternatively the re-configuration of the 33 kV network if Alverdiscott BSP is established may reduce the amount of circuit reconductoring.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the winter period.

East Yelland, Braunton and Ilfracombe 33 kV circuit Capacity

Constraint summary

Generation Demand

Constrained assets	33 kV circuit between East Yelland 8L5 & Pen Hill Tee	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 Cu)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth.
Operational mitigation	As constraint occurs during first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period across multiple seasons.

Constraint summary

Generation | **Demand**

Constrained assets	33 kV circuit between East Yelland 6L5 & Braunton	
Type(s) of constraint	Thermal overload of 33 kV circuit	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.15 in^2 Cu) & 400 A circuit breaker & isolator	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation			✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Constraint summary

Generation | Demand

Constrained assets	33 kV circuit between East Yelland & Ilfracombe teed Luscott Barton	
Type(s) of constraint	Thermal overload of 33 kV circuit	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.1 in^2 Cu)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation			✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

St Tudy BSP

Network Overview

St Tudy Bulk Supply Point supplies a sparse area of 33 kV network, mostly in Cornwall. It is supplied from the K-route 132 kV circuit between Indian Queens and Alverdiscott GSPs, with two 30/60 MVA 132/33 kV grid transformers supplying the group. The 33 kV network supplies the following Primary substations:

- St Tudy Primary supplied via two transformer feeders.
- A 33 kV ring supplying Polzeath and Wadebridge Primaries, along with connections to three 33 kV connected generators and normally open 33 kV interconnection with Fraddon BSP via Padstow.
- A 33 kV ring supplying Callywith and Bodmin Primaries, along with connections to three 33 kV connected generators and normally open 33 kV interconnection with Fraddon BSP via Treningle switching station.
- A 33 kV ring supplying Davidstow, Delabole and Laneast Primaries, along with connections to a 33 kV connected generators and large demand customer, with normally open 33 kV interconnection with Pyworthy/North Tawton BSP group via Launceston.

In addition the 33 kV connected generation, there is currently a large amount of LV and 11 kV connected generation present in this group, with over 5.5 MW of domestic rooftop solar generation connected in the baseline year of study.

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 an arranged outage of either grid transformer at St Tudy, the normal open point at Treningle switching station is moved from isolator 4L3 to circuit breaker 2L5, which is available for operation with tele control. This allows for quicker restoration of customers in the event of a fault where the network needs to be reconfigured.
- Directional overcurrent schemes are modelled on 33/11 kV transformer T2 at Wadebridge substation and on both 132/33 kV grid transformers at St Tudy BSP.
- The 33 kV busbar running arrangement at St Tudy is altered for a variety of circuit and busbar outages to maintain network integrity.
- Arranged outages of the 33 kV busbar at Davidstow result in the transfer of Laneast and a 33 kV wind farm onto the neighbouring Pyworthy/North Tawton BSP group.
- For arranged outages of the 1S0 circuit breakers at Callywith and Delabole Primary substations, one of the Primary transformers is run with the 11 kV circuit breaker open (i.e. on 'hot standby'). This is to reduce the risk of through-flow for credible next faults on the network, where the 11 kV network at the Primary becomes a link to the wider 33 kV network and could overload transformers.
- Curtailment of 33 kV connected generators within the group are modelled are a variety of arranged outages, as outlined in customer connection agreements.

Any modelling of schemes on the upstream 132 kV networks are reported as part of the Alverdiscott/Indian Queens Network Development Report.

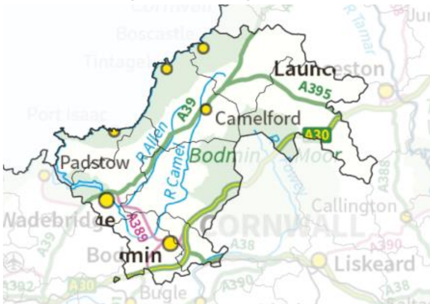

Figure 14: St Tudy BSP geographic network coverage

A schematic diagram of the St Tudy BSP group is included in the Appendix of this report.

Future network constraints

St Tudy Grid Transformer capacity

Constraint summary

Generation Demand

Constrained assets	132/33 kV Grid Transformers at St Tudy BSP	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation Winter Peak Demand	
Limiting factor of constrained assets	30/60 MVA Grid Transformers, demand limited by ancillary rating limitation of 69 MVA. Generation limited by reverse power flow rating of 60 MVA.	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers, the remaining transformer in service overloads.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Generation Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Demand Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Replacement of the grid transformers with larger 60/90 MVA units (including removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032. Note as group demand does not exceed 100 MW, there is requirement to secure demand for a second circuit outage of loss of 132 kV infeed into the group.
Operational mitigation	As constraint occurs for a first circuit fault outage, limiting outage windows is not suitable mitigation. Permanent load transfers is not possible due to unavailability of capacity in neighbouring BSPs in future study years.
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period of time throughout the summer period for generation constraints, and during winter peak demand periods for demand constraints.

Polzeath/Wadebridge ring 33 kV circuit capacity

Constraint summary

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

Constrained assets	33 kV circuits between St Tudy - Wadebridge and St Tudy - Polzeath	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation	
Limiting factor of constrained assets	Circuits limited by existing 33 kV overhead conductor (0.1 in² HDC).	
Outage combination which causes the constraint	Intact	Due to coincident output of large amount of small scale embedded generation.
	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year, and is affected by the large amount of small scale embedded generation installed in the area.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during intact network running and first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Camborne BSP

Network Overview

Camborne Bulk Supply Point supplies a mixture of rural and urban sections of 33 kV network in West Cornwall. It is supplied from the A-route 132 kV circuit which is fed from Indian Queens GSP, with two 60/90 MVA 132/33 kV grid transformers supplying the group. The 33 kV network supplies the following Primary substations:

- Carn Brea Primary is supplied via two transformer feeders.
- A 33 kV ring supplying Camborne Holmans, Camborne Treswithian, along with connections to two 33 kV connected generators and with 33 kV interconnection to Hayle BSP with normal open points on 11L5 & 12L5 at Hayle Switching Station.
- Redruth Primary is fed on its own via a 33 kV ring
- A 33 kV circuit providing interconnection with Truro BSP with a tee-off to a 33 kV connected generator with the circuit being normally run open on circuit breaker 1S0 at St Agnes.

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.

- The 33 kV busbar running arrangement at Camborne is altered for a variety of circuit and busbar outages to maintain network integrity.
- Curtailment of 33 kV connected generators within the group are modelled are a variety of arranged outages, as outlined in customer connection agreements.

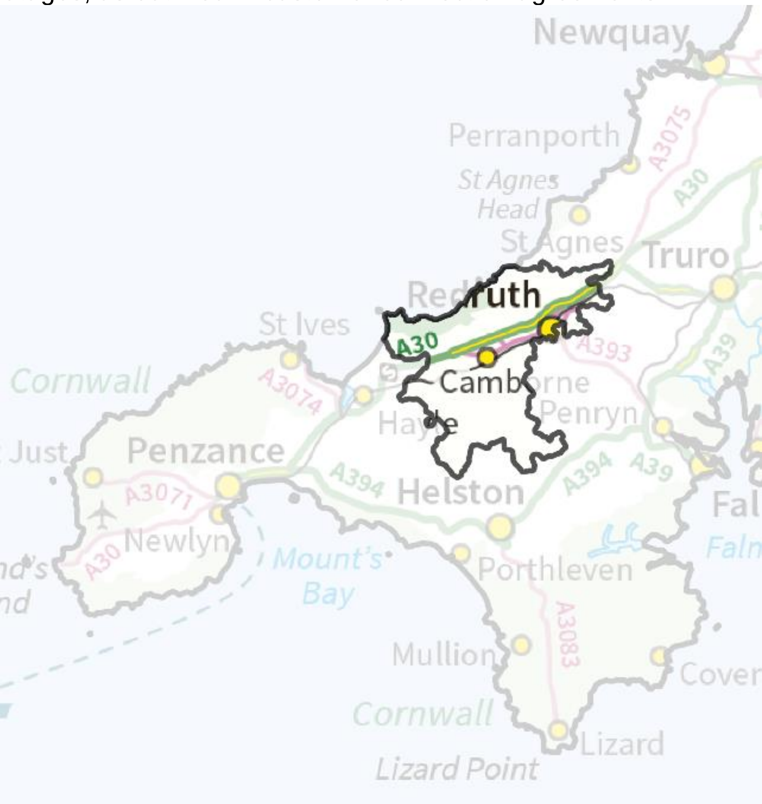

Figure 15: Camborne BSP geographic network coverage

A schematic diagram of the Camborne BSP group is included in the Appendix of this report.

Future network constraints

Camborne Grid Transformer Capacity

Constraint summary

Generation Demand

Constrained assets	132/33 kV Grid Transformers at Camborne	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation	
Limiting factor of constrained assets	30/60 MVA Grid Transformers, reverse power flow rating of 33.84 MVA	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the transformers or circuits which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are affected by the large amount of small scale embedded generation installed in the area.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Enhancement of the reverse power flow rating by replacing ancillaries will alleviate the projected overloads in all scenarios out to 2032. This will include installation of a Load Blinder relay.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services via the 'Secure' product could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Camborne to Camborne Holmans/Treswithen 33 kV circuit capacity

Constraint summary

Generation | **Demand**

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

Constrained assets	33 kV circuit between Camborne 1L5 to Camborne Holmans and Camborne 3L5 to Churchtown Tee	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Circuits limited by circuit breaker CT rating of 440 A, underground cable ratings of 466 A and 476 A, also overhead line rating of 479 A	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Uprating of the 440A CT rating will resolve the overload until 2028 when reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor along with underground cable overlays with 185 mm^2 EPR is required to alleviate al projected overloads in the 0-10 year period.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional demand connections into this group could be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down via the ‘Dynamic’ product. Dispatch of services may be required for an extended period of time given the constraint is present under a First Circuit Outage and across multiple seasons.

Camborne Treswithian Primary Transformer capacity

Constraint summary

Generation Demand

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

Constrained assets	33/11 kV Primary Transformer at Camborne Treswithien	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	5 MVA Primary Transformers, demand limited by ancillary rating limitation of 5 MVA.	
Outage combination which causes the constraint	Intact	Due to coincident output of large amount of embedded generation.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Application of an enhanced transformer rating or replacement of the transformer with larger 15 MVA unit (including removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032.
Operational mitigation	As constraint occurs during intact conditions, operational mitigation is not possible
Load Management Schemes	Any additional connections (demand or generation) into this group could be included in an ANM scheme, which can be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down via the 'Secure' product. Dispatch of services may be required for an extended period of time given the constraint is present under a First Circuit Outage and across multiple seasons.

Rame BSP

Network Overview

Rame Bulk Supply Point supplies a mixture of rural and urban sections of 33 kV network in West Cornwall. It is supplied from three 132 kV circuits which are fed from Indian Queens GSP, with two 30/60 MVA and one 22.5/45 MVA 132/33 kV grid transformers supplying the group. The 33 kV network supplies the following Primary substations:

- A 33 kV ring supplying Penryn, Falmouth Bickland Hill & Falmouth Docks Primaries, along with connections to three 33 kV connected generators.
- A 33 kV ring supplying Constantine, St Keverne, Mullion, Helston and Wheal Reeth Primaries and with a 33 kV interconnection to Hayle BSP via a normal open point at Wheal Reeth.
- A 33 kV ring supplying Lanner along with connections to two 33 kV connected generators and with 33 kV interconnection to Camborne BSP via a normal open point at Camborne.

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.

- The 33 kV busbar running arrangement at Rame is altered for a variety of circuit and busbar outages to maintain network integrity.
- Curtailment of 33 kV connected generators within the group are modelled are a variety of arranged outages, as outlined in customer connection agreements.

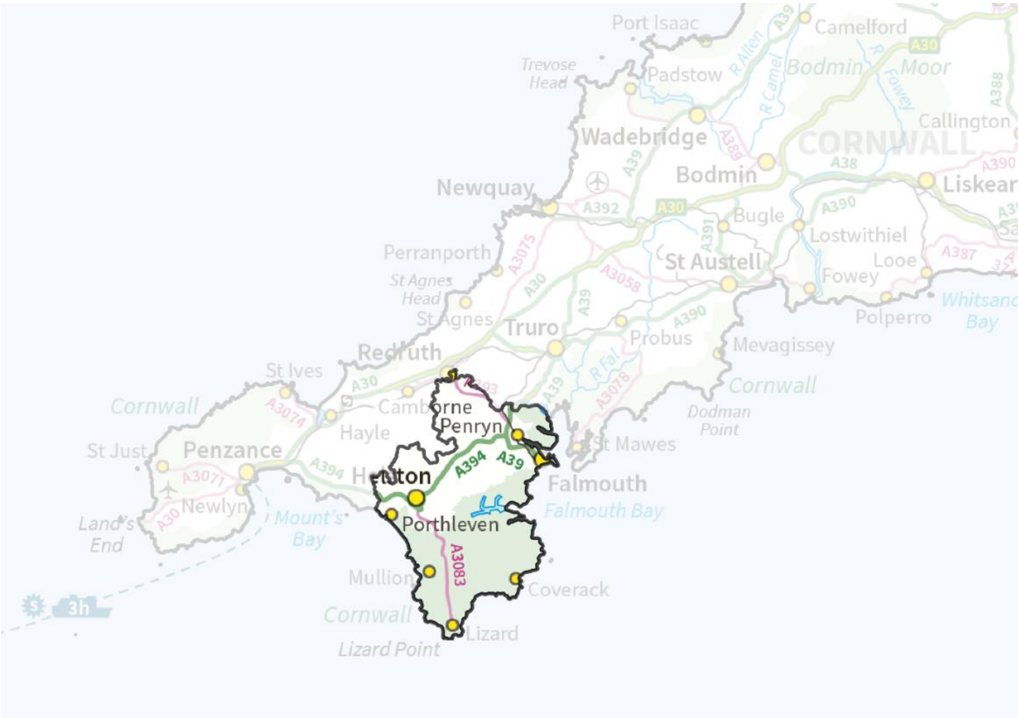

Figure 16: Rame BSP geographic network coverage

A schematic diagram of the Rame BSP group is included in the Appendix of this report.

Future network constraints

Rame Grid Transformer Capacity

Constraint summary

Generation Demand

Constrained assets	132/33 kV Grid Transformers at Rame BSP	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	GT3 rated at 22.5/45 MVA GT1 rated at 30/60 MVA	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2025.

Rame GT3 Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Rame GT1 Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way				
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Replacement of grid transformers with a larger 60/90 MVA units (including removal of any ancillary rating limitations) will alleviate the projected overloads in all scenarios out to 2032. Note as group demand does not exceed 100 MW, there is no requirement to secure demand for a second circuit outage of loss of 132 kV infeed into the group.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period across multiple seasons.

Rame to Roskrow Barton Tee/Penryn 33 kV circuit capacity

Constraint summary

Generation | **Demand**

Constrained assets	33 kV circuit between Rame 9L5 and Roskrow Barton Tee	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Circuits limited by a short section of 0.1 in^2 Cu overhead line and 440 A CTs	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline year, and is affected by the large amount of small scale embedded generation installed in the area.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period across multiple seasons.

Helston to St Keverne 33 kV circuit capacity

Constraint summary

Generation | Demand

Constrained assets	33 kV circuit between Helston 4L5 and St Keverne 1L5	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Generation	
Limiting factor of constrained assets	Circuits limited by a section of 0.1 mm^2 Cu overhead line	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the baseline.

Generation Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Demand Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions in the baseline year, operational mitigation is not possible.
Load Management Schemes	Any additional connections (demand or generation) into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected circuit overloads for demand constraints. Dispatch of services would be required for an extended period across multiple seasons. Similarly, generation turn down and/or demand turn up services could be procured to alleviate projected circuit overloads for generation constraints. Dispatch of services would be required for an extended period of time throughout the summer period.

Rame - Little Treavese Circuit Capacity

Constraint summary

Generation Demand

Constrained assets	33 kV circuit between Rame 11L5 & Little Treavese	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Summer Peak Generation	
Limiting factor of constrained assets	Circuits limited by a section of 0.15 in^2 Cu overhead line	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028, and is affected by the large amount of small scale embedded generation installed in the area.

Generation Driven Constraints

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm² Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional generation connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Rame to Falmouth Bickland Hill 33 kV Circuit Capacity

Constraint summary

Generation | **Demand**

Constrained assets	33 kV circuit between Rame 1L5 and Falmouth Bickland Hill	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	Circuits limited by 100 mm^2 Cu overhead line	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	**Summary**
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the winter period.

Rame to Helston 33 kV Circuit Capacity

Constraint summary

Generation | **Demand**

Constrained assets	33 kV circuit between Rame 8L5 and Helston 1L5	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Circuits limited by 0.15 in^2 Cu overhead line	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period across multiple seasons.

Constraint summary

Generation | **Demand**

Constrained assets	33 kV circuit between Rame 4L5 and Helston 3L5	
Type(s) of constraint	Thermal overload of 33 kV circuits	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Circuits limited by 7.8 km of 0.1 in^2 Cu overhead line, 530 m of Underground cable & 440 A CT	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028.

Demand Driven Constraints

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Reconductoring relevant sections of 33 kV overhead line with 150 mm^2 Cu conductor will alleviate any of the projected overloads in the 0-10 year period for the projected load growth. This will also include removal of ancillary rating limitations on current transformers and existing protection systems.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn down or demand turn up services could be procured to alleviate projected circuit overloads. Dispatch of services would be required for an extended period of time throughout the summer period.

Helston Transformer Capacity

Constraint summary

Generation | **Demand**

Constrained assets	33/11 kV Primary Transformers at Helston	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Transformers rated at 12/24 MVA (18 MVA summer)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining transformer in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in the 2028.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Installation of a third 33/11 kV transformer.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period across multiple seasons.

Falmouth Bickland Hill Transformer Capacity

Constraint summary

Generation | **Demand**

Constrained assets	33/11 kV Primary Transformers at Falmouth Bickland Hill	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Transformers rated at 12/24 MVA (18 MVA summer)	
Outage combination which causes the constraint	First Circuit Outage	For the arranged or fault outage of one of the circuits which feeds into this group, the remaining circuit in service could overload.

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios. The projected overloads are first identified in 2028, and is affected by the large amount of small scale embedded generation installed in the area.

Demand Driven Constraints

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

All of the solutions identified below could alleviate the projected constraints in all scenarios out to 2032 subject to cost benefit analysis.

Solution option	Summary
Reinforcement	Installation of a third 33/11 kV transformer.
Operational mitigation	As constraint occurs during first circuit fault outage conditions, operational mitigation is not possible.
Load Management Schemes	Any additional connections into this group may be included in an ANM scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down services could be procured to alleviate projected overloads. Dispatch of services would be required for an extended period across multiple seasons.

Appendix: Network Schematics

This appendix includes network schematic diagrams for each of the areas included in the Network Development Reports.

Feeder Road

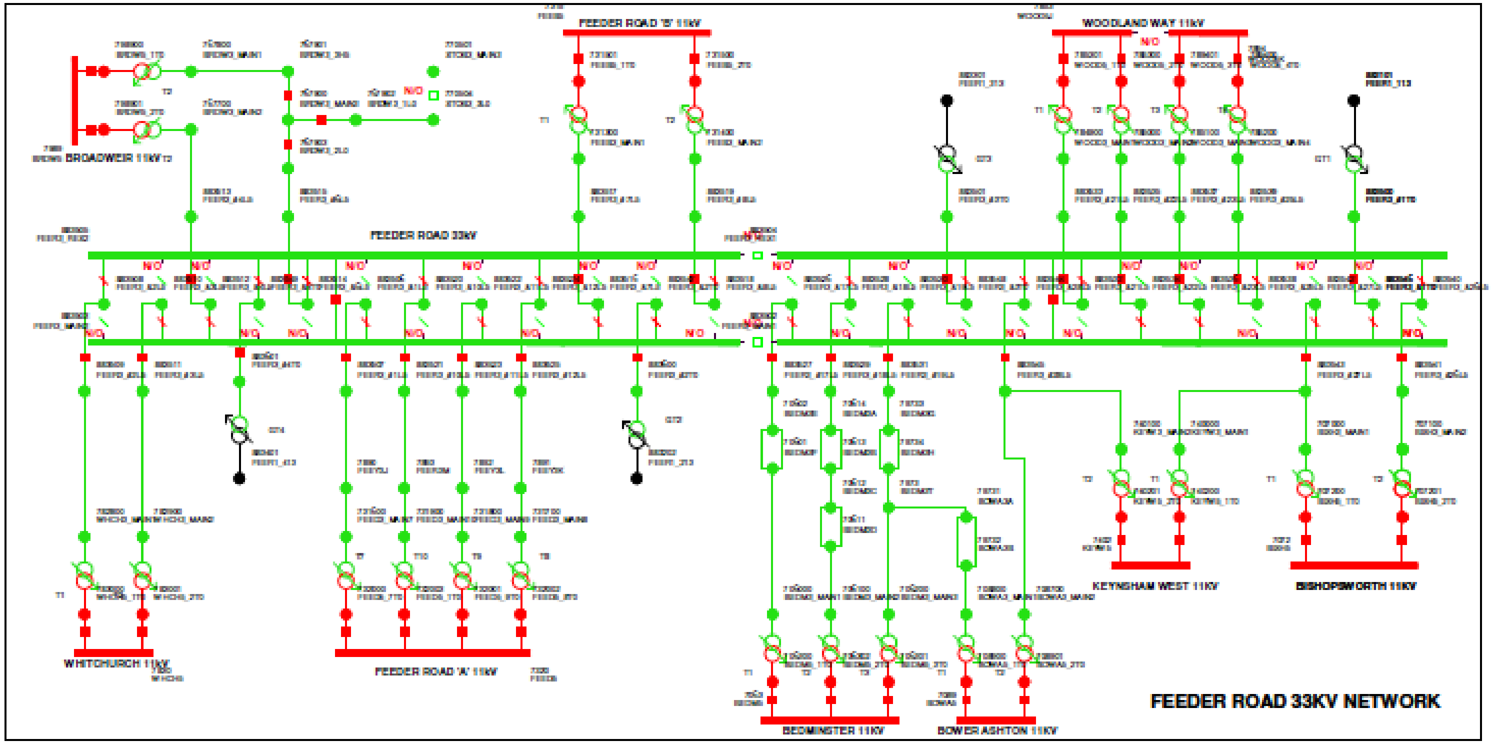

Figure 17: Network schematic diagram for Feeder Road Bulk Supply Point and 33 kV network, as published in the Long Term Development Statement (November 2021)

Radstock

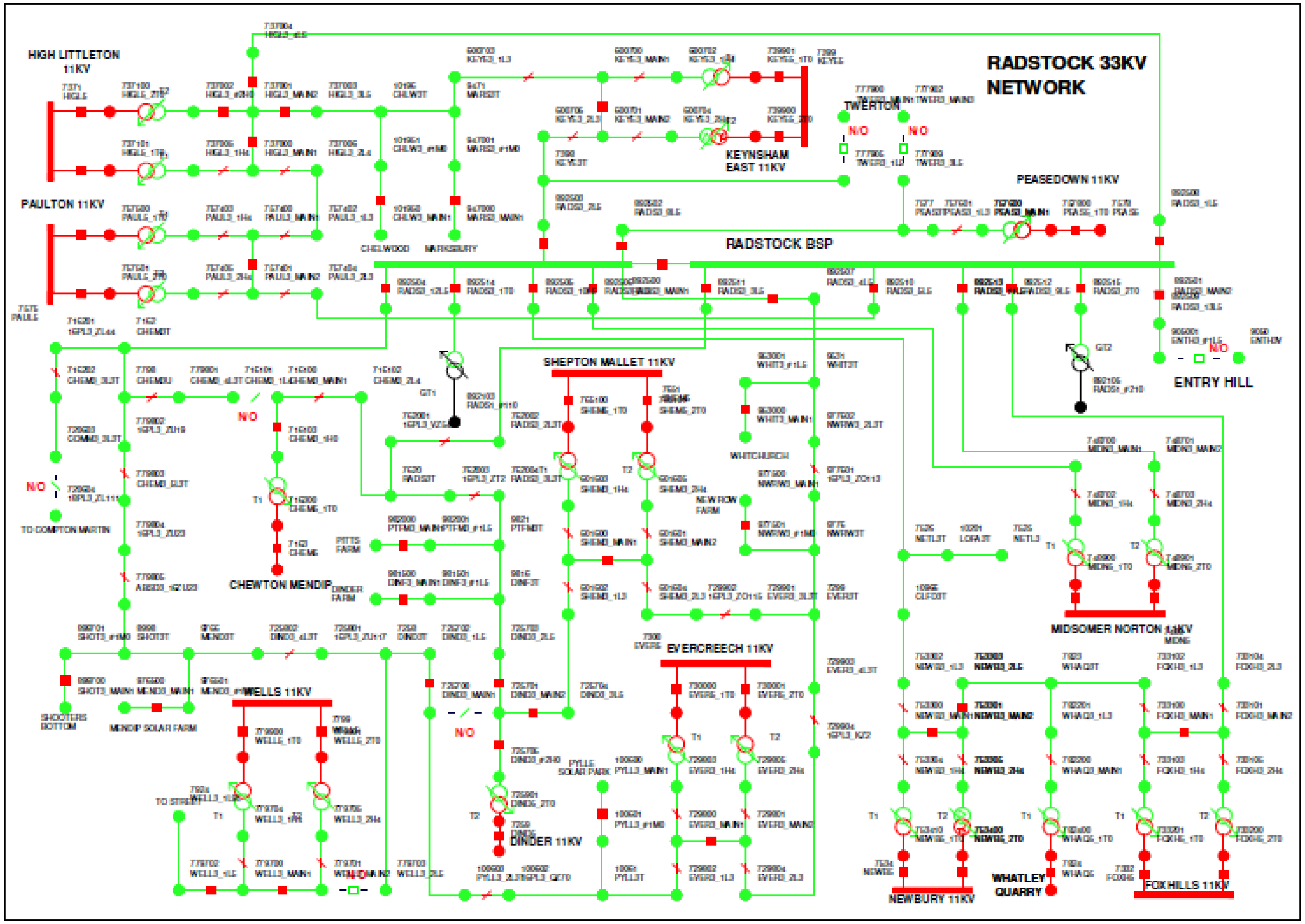

Figure 18: Network schematic diagram for Radstock Bulk Supply Point and 33 kV network, as published in the Long Term Development Statement (November 2021)

Churchill

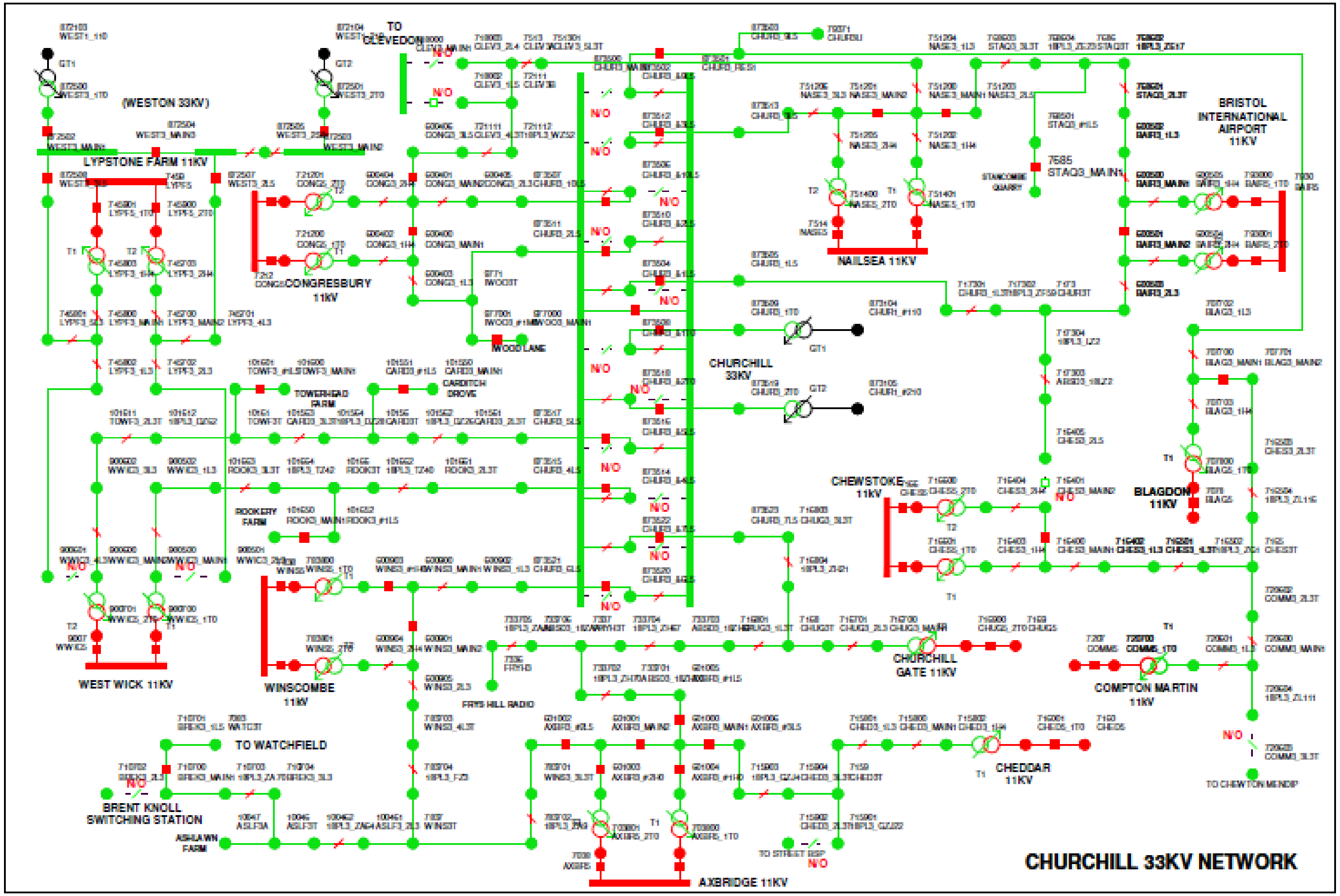

Figure 19: Network schematic diagram for Churchill Bulk Supply Point and 33 kV network, as published in the Long Term Development Statement (November 2021)

Abham Exeter Landulph 132 kV

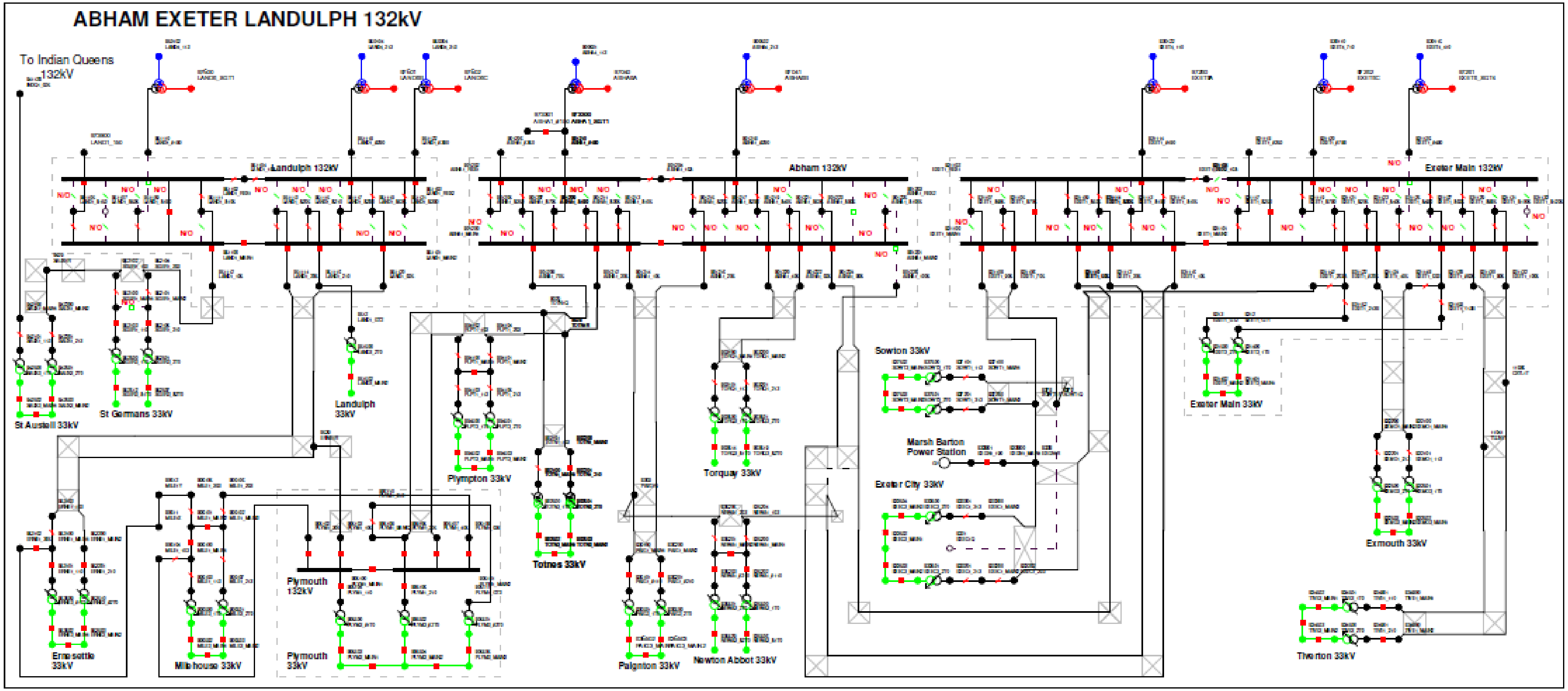

Figure 20: Network schematic diagram for Abham/Exeter/Landulph Grid Supply Points and 132 kV network, as published in the Long Term Development Statement (November 2021)

Exeter City

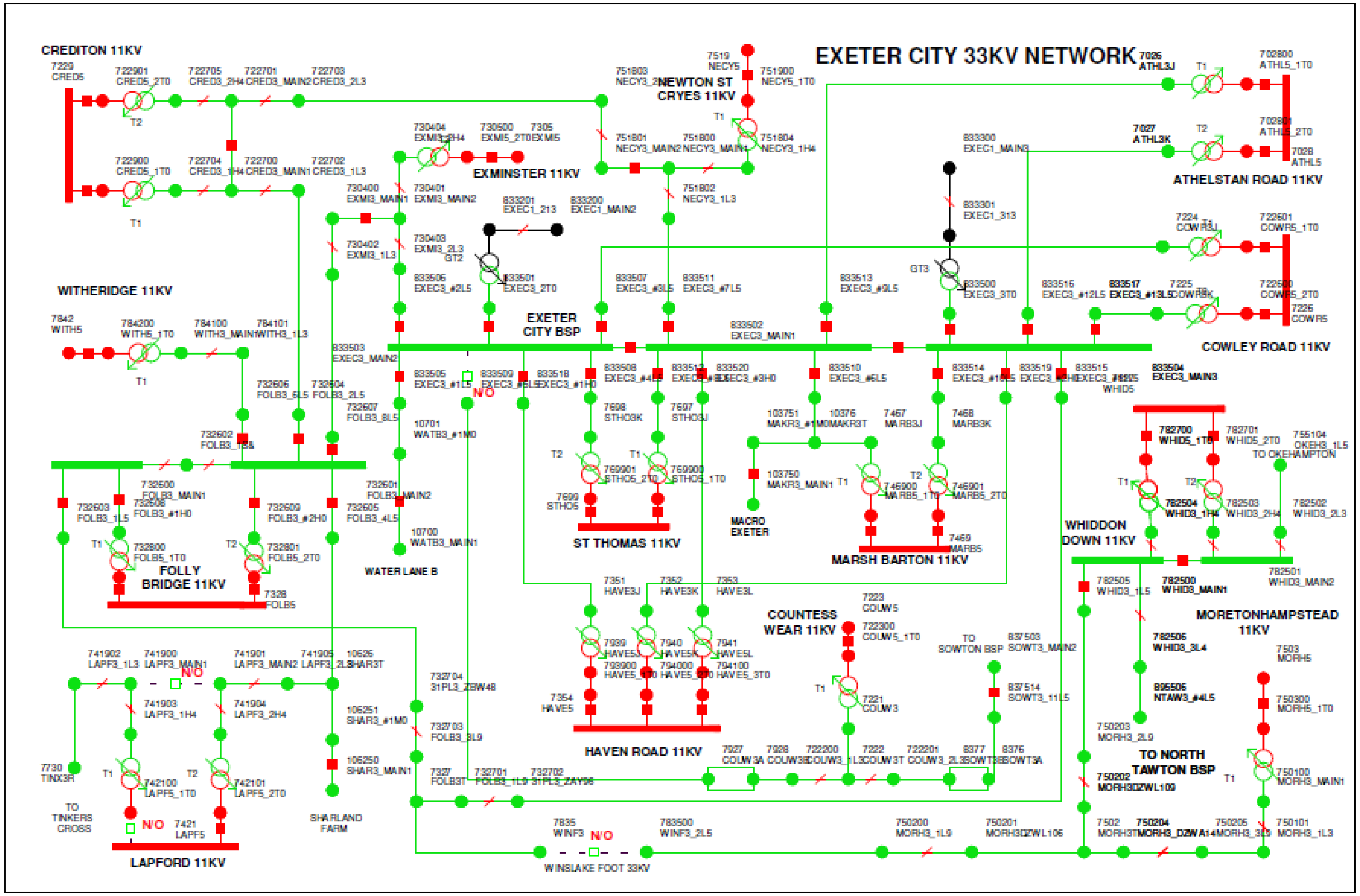

Figure 21: Network schematic diagram for Exeter City Bulk Supply Point and 33 kV network, as published in the Long Term Development Statement (November 2021)

Paignton

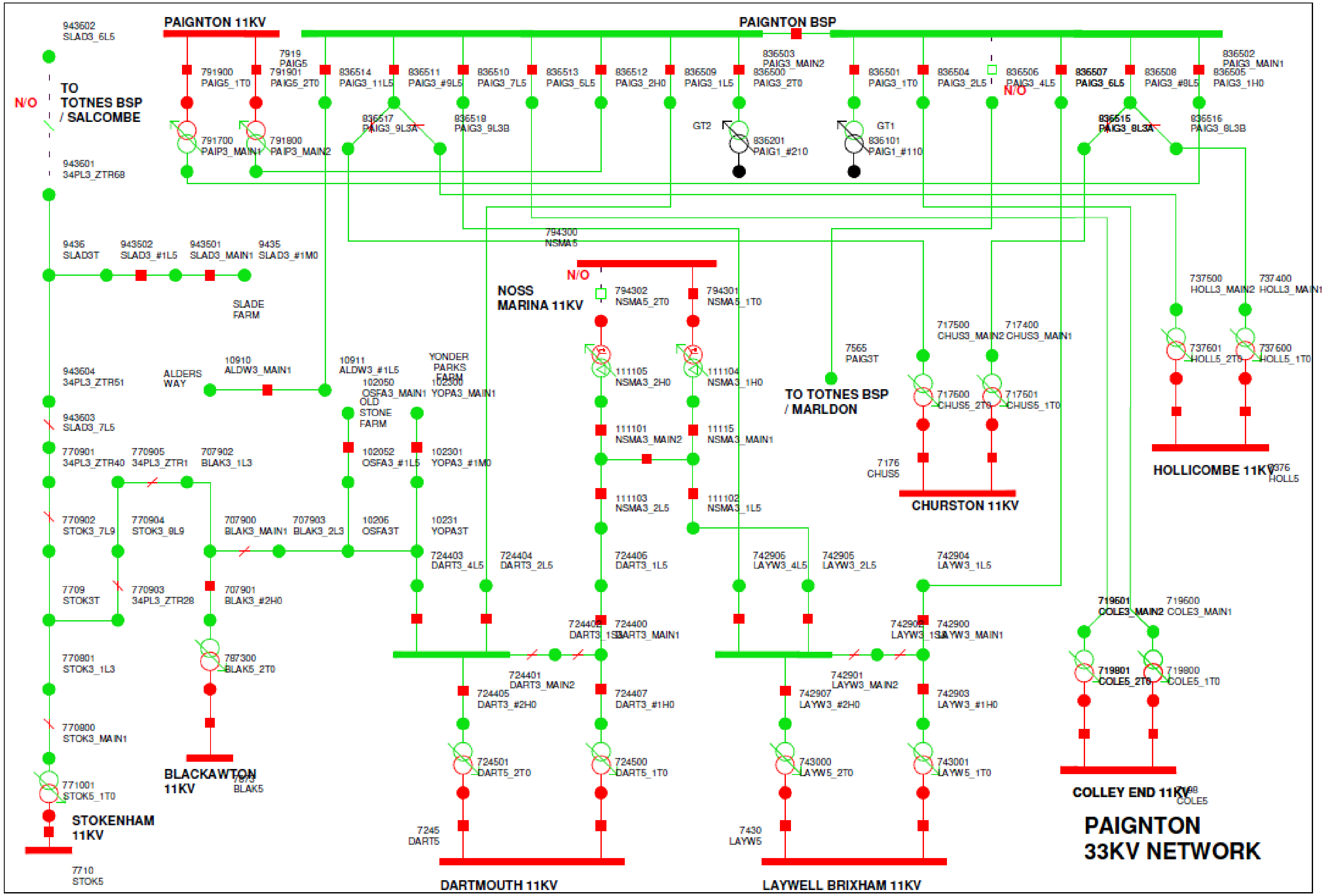

Figure 22: Network schematic diagram for Paignton Bulk Supply Point and 33 kV network, as published in the Long Term Development Statement (November 2021)

Plympton

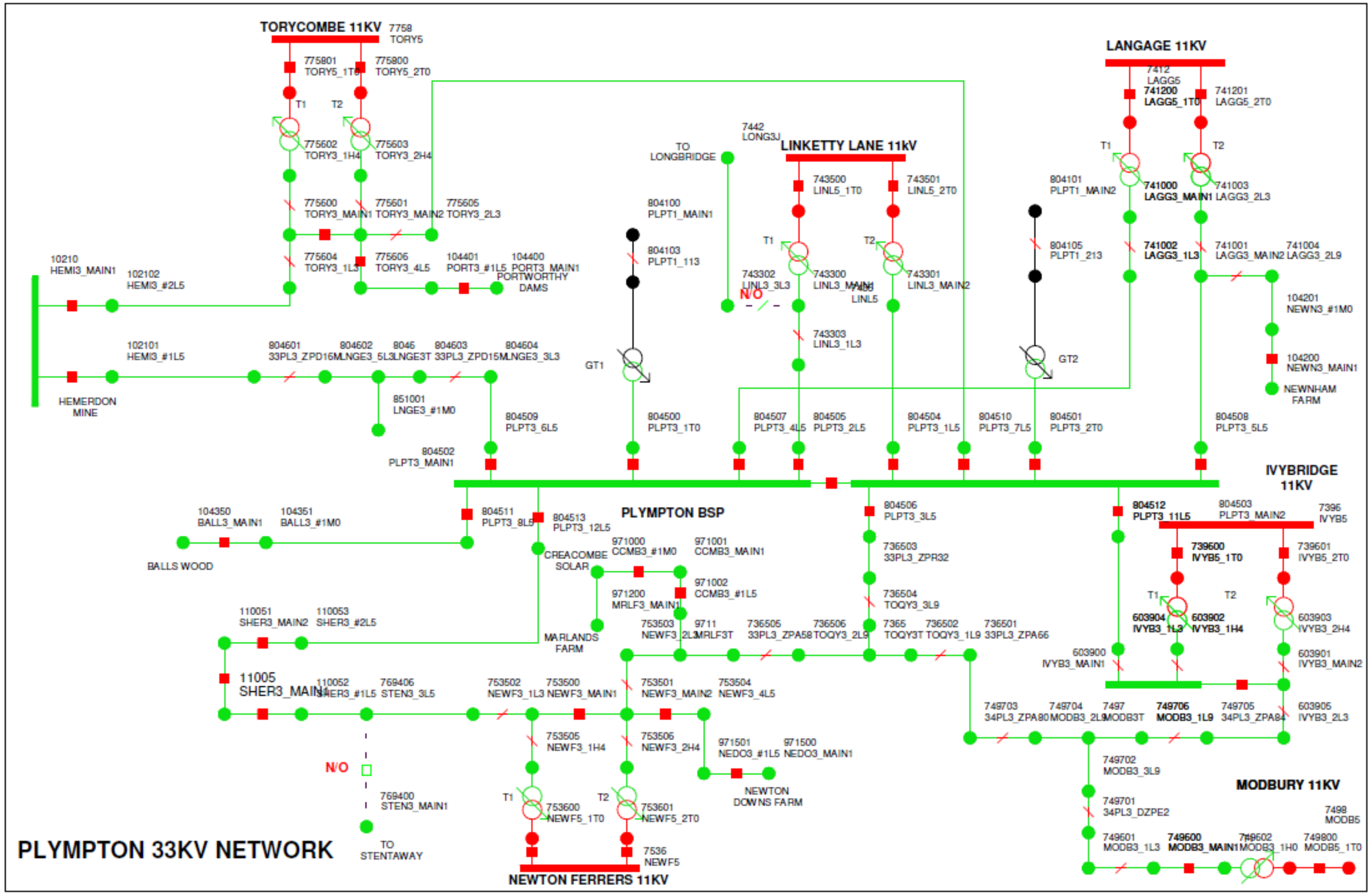

Figure 23: Network schematic diagram for Plympton Bulk Supply Point and 33 kV network, as published in the Long Term Development Statement (November 2021)

Landulph St Germans

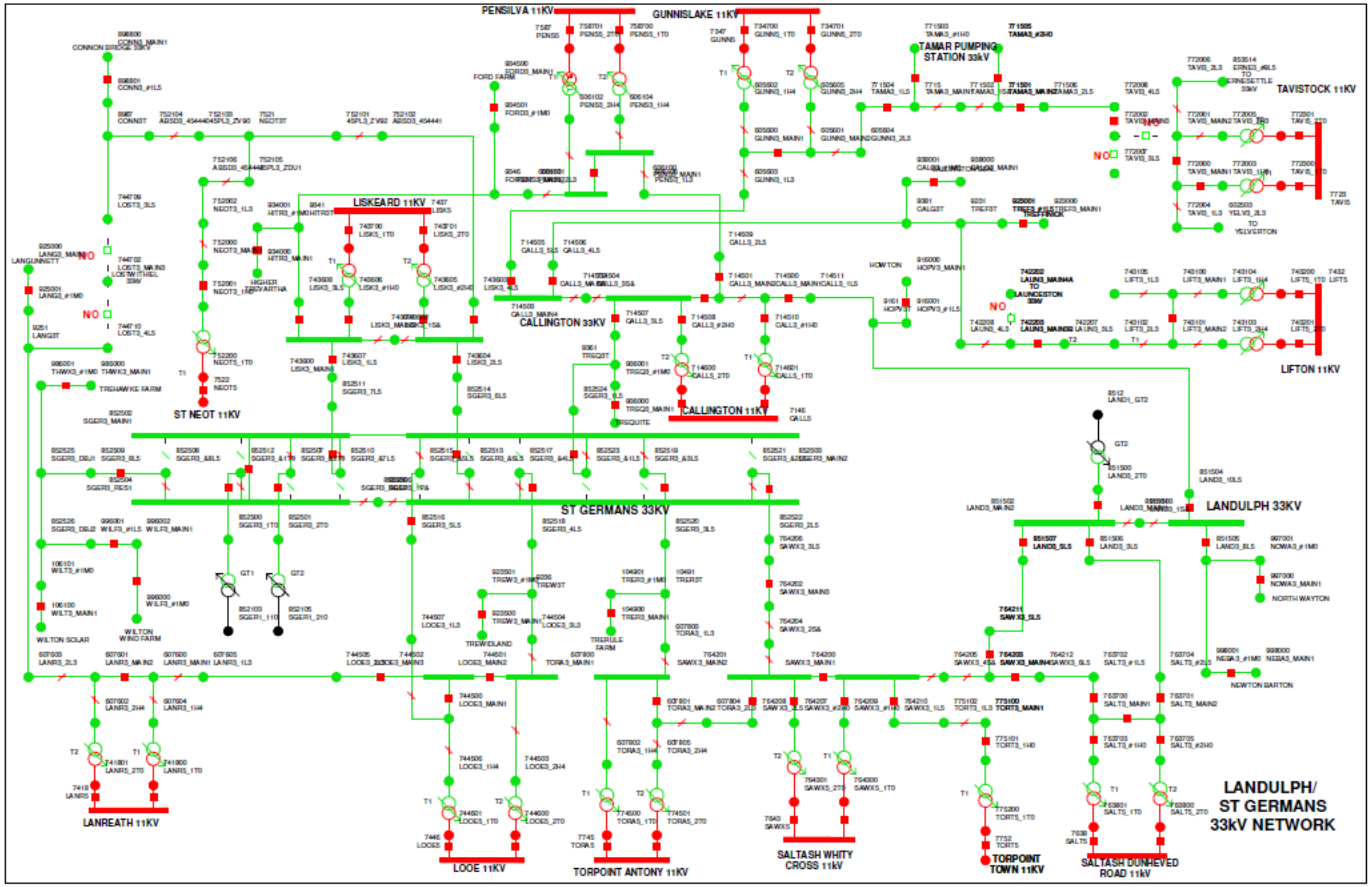

Figure 24: Network schematic diagram for Landulph and St Germans Bulk Supply Point and 33 kV network, as published in the Long Term Development Statement (November 2021)

Alverdiscott/Indian Queens 132 kV

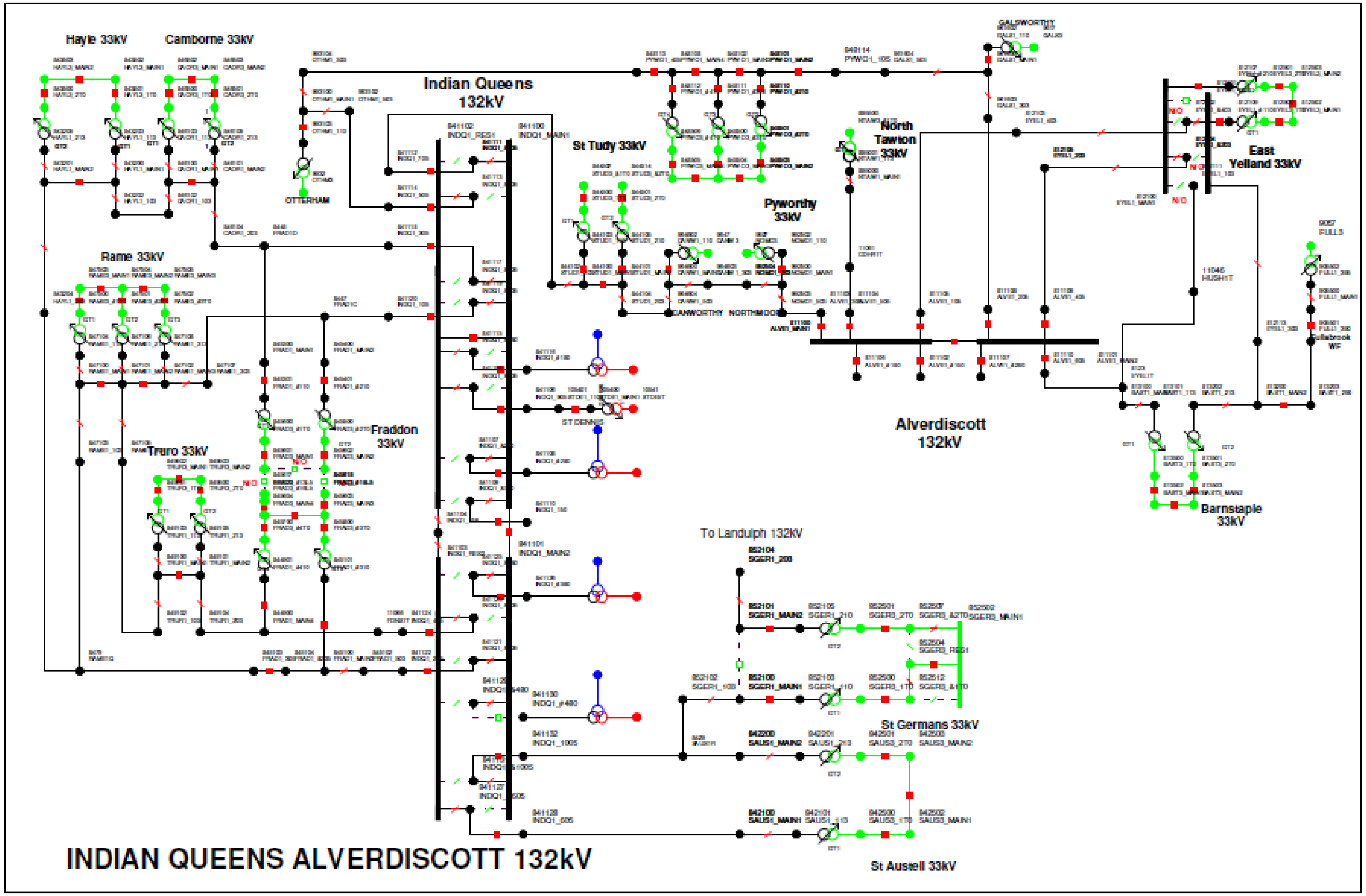

Figure 25: Network schematic diagram for Alverdiscott/Indian Queens Grid Supply Points and 132 kV network, as published in the Long Term Development Statement (November 2021)

Barnstaple

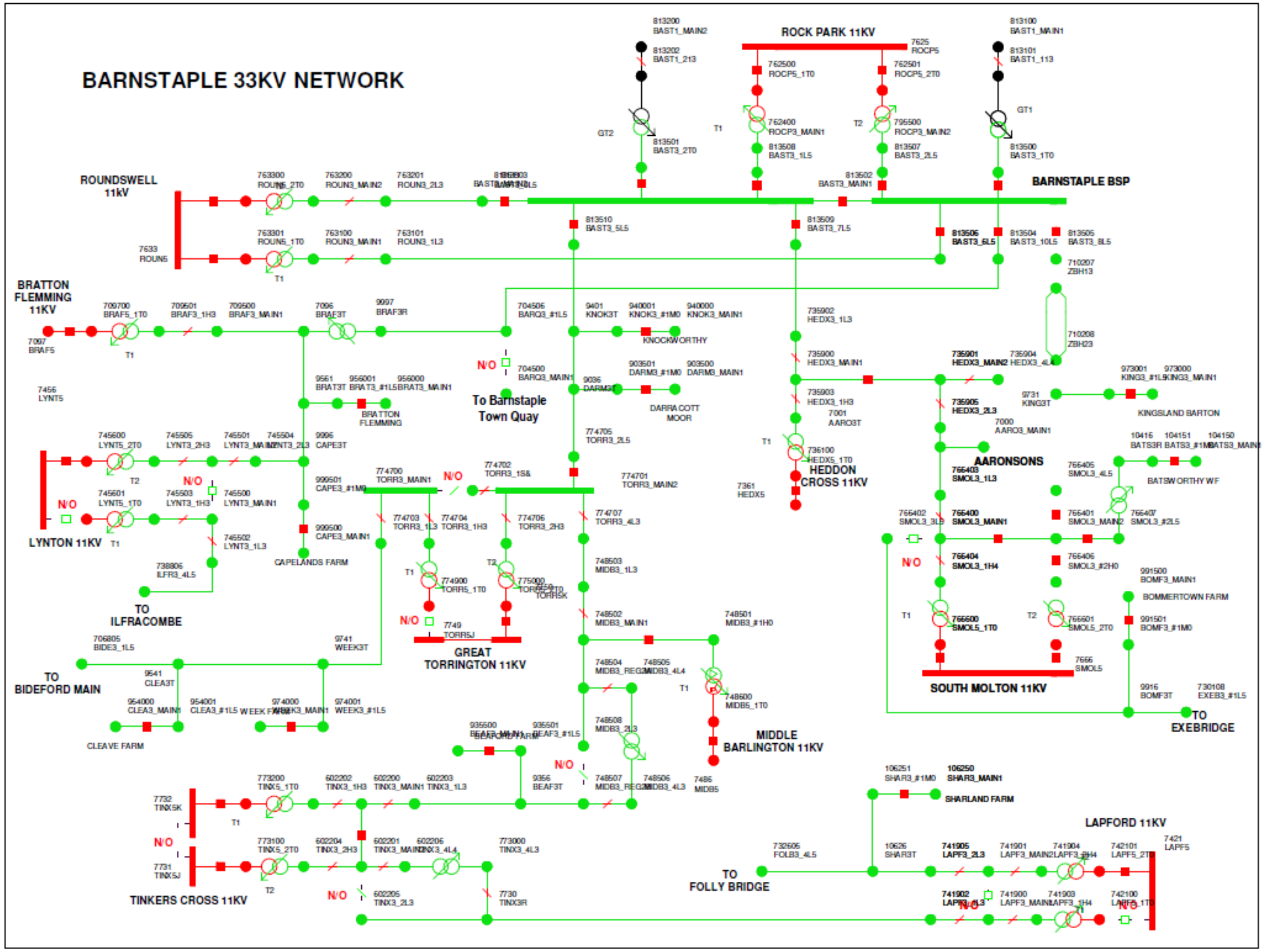

Figure 26: Network schematic diagram for Barnstaple Bulk Supply Point and 33 kV network, as published in the Long Term Development Statement (November 2021)

East Yelland

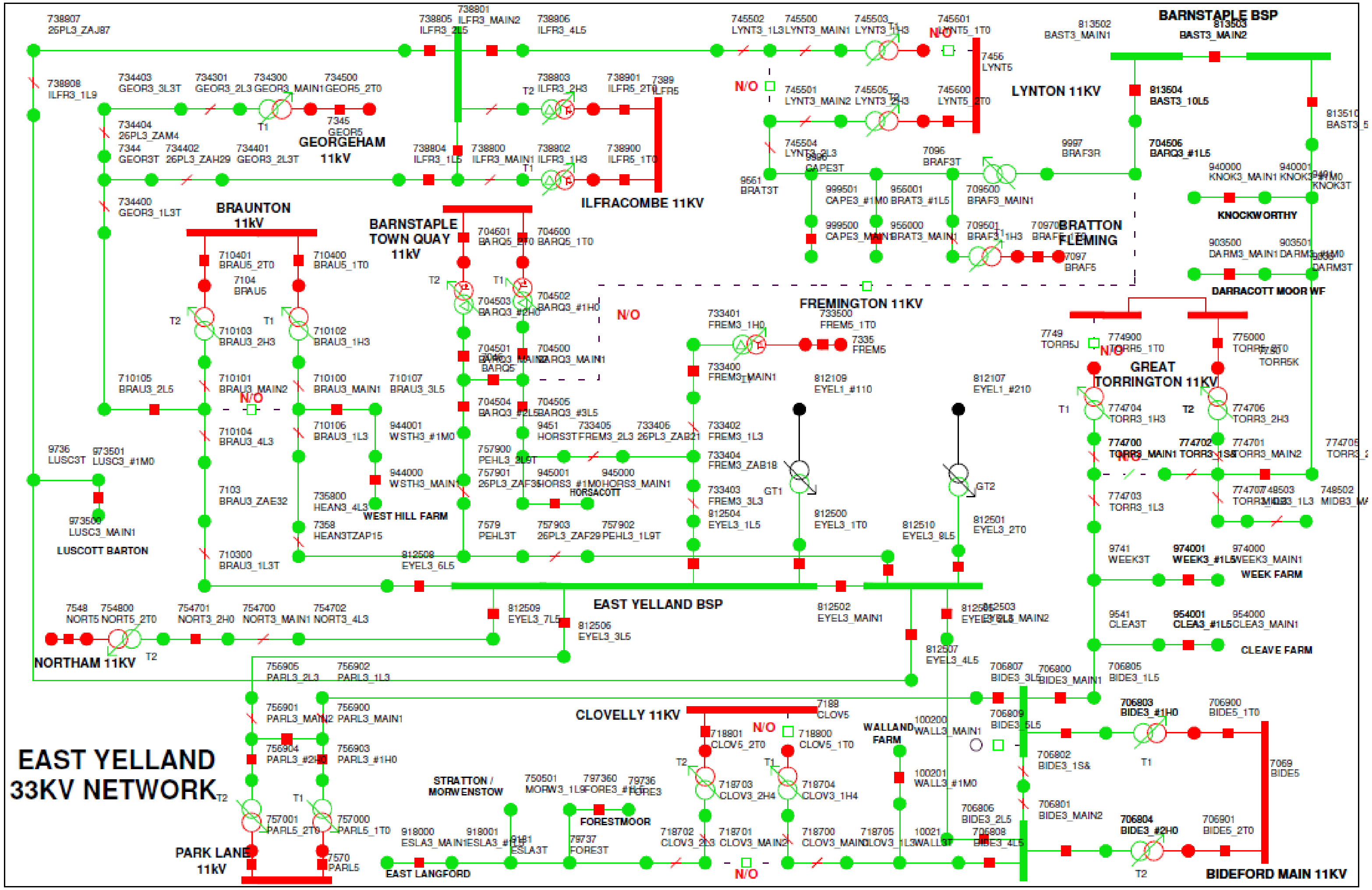

Figure 27: Network schematic diagram for East Yelland Bulk Supply Point and 33 kV network, as published in the Long Term Development Statement (November 2021)

St Tudy

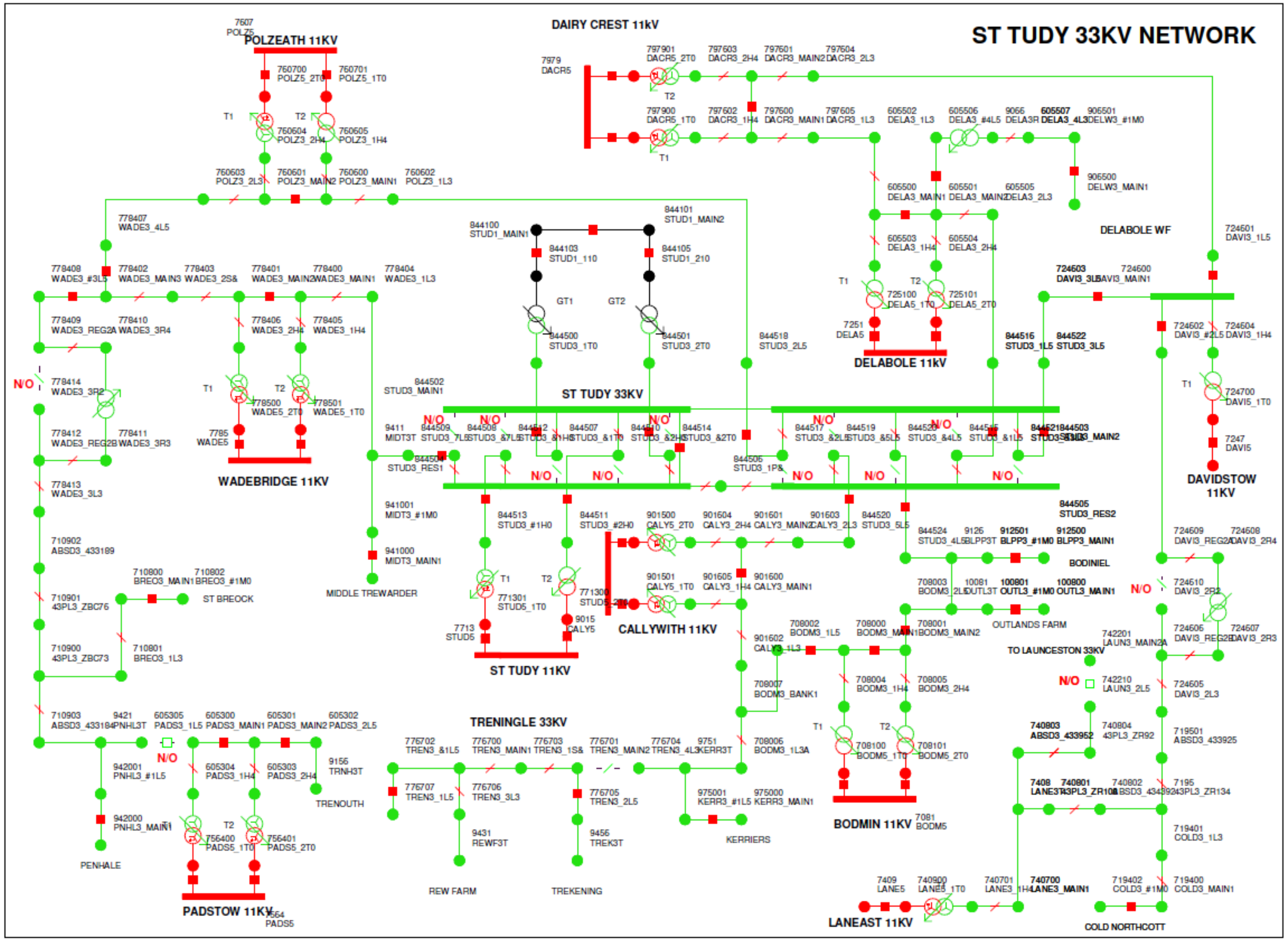

Figure 28: Network schematic diagram for St Tudy Bulk Supply Point and 33 kV network, as published in the Long Term Development Statement (November 2021)

Camborne

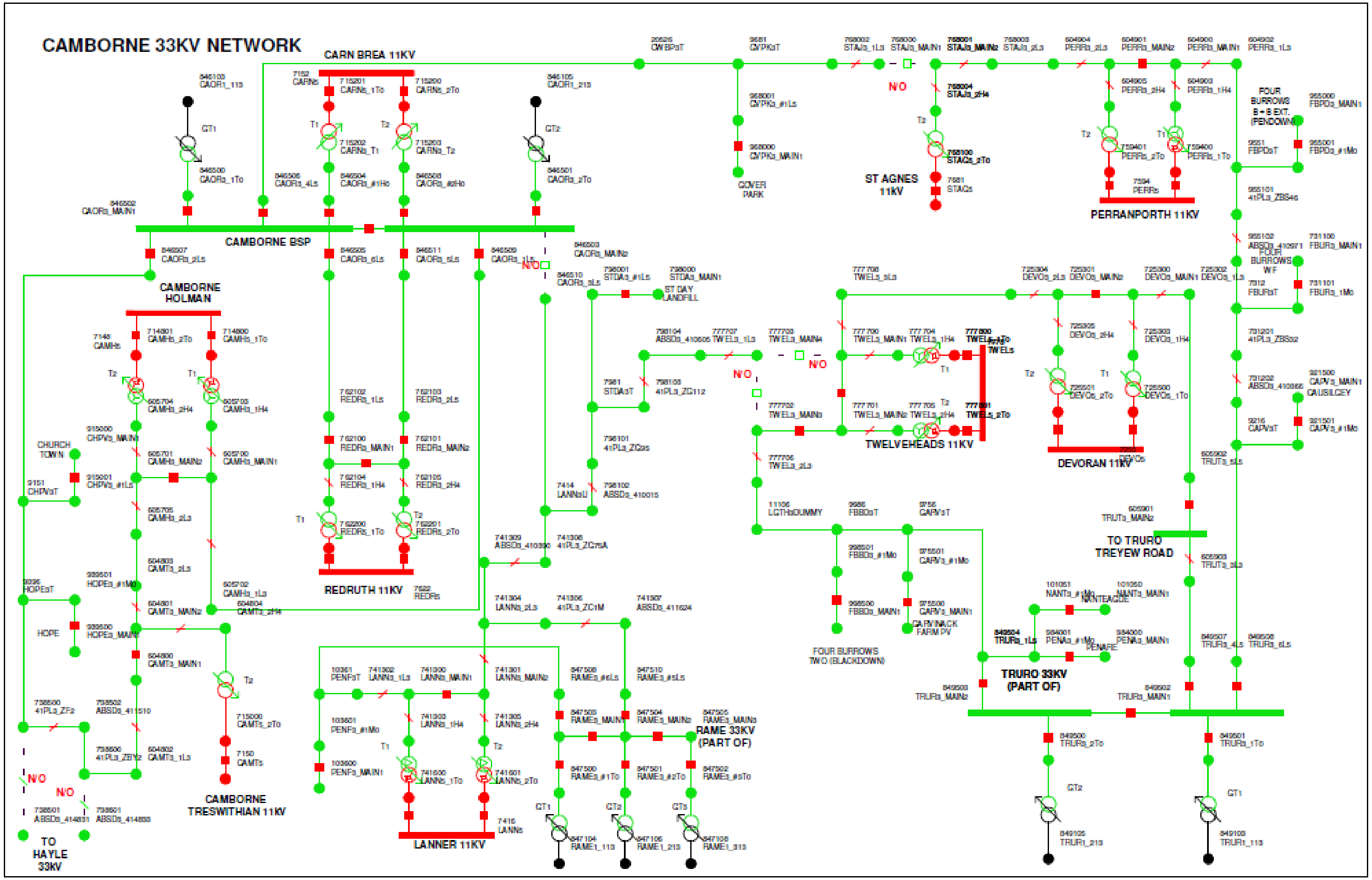

Figure 29: Network schematic diagram for Camborne Bulk Supply Point and 33 kV network, as published in the Long Term Development Statement (November 2021)

Rame

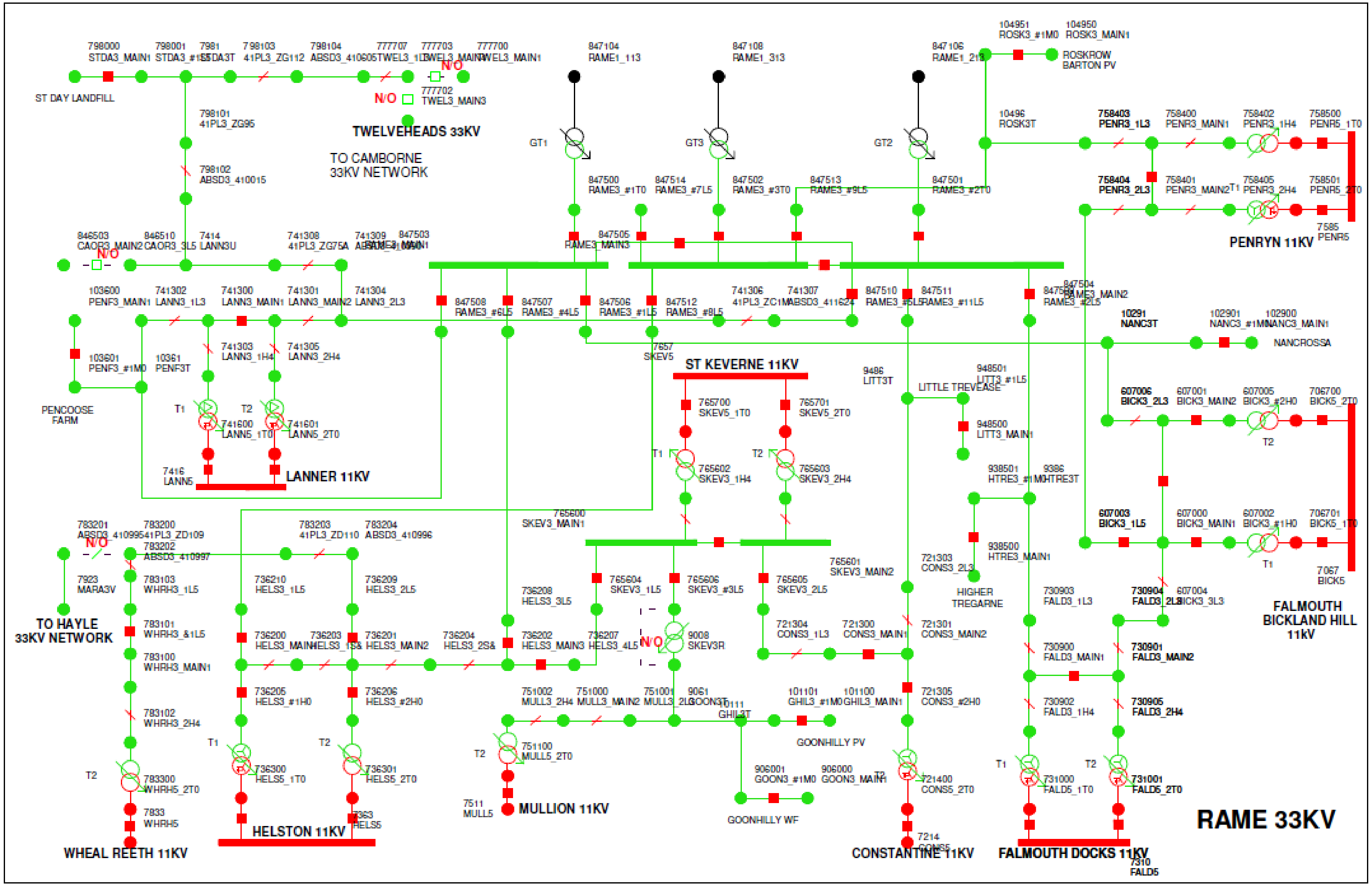

Figure 30: Network schematic diagram for Rame Bulk Supply Point and 33 kV network, as published in the Long Term Development Statement (November 2021)