Truro BSP

Network Development Report – South West

May 2024

Electricity Distribution

nationalgrid

Contents

Truro BSP

1. Network Overview

Truro Bulk Supply Point (BSP) supplies a mixture of rural and urban sections of 33 kV network, in West Cornwall. It is supplied from the BM-route 132 kV circuit which is fed from Indian Queens Grid Supply Point (GSP), with two 60/90 MVA 132/33 kV grid transformers supplying the group. Truro BSP supplies approximately 20,000 customers.

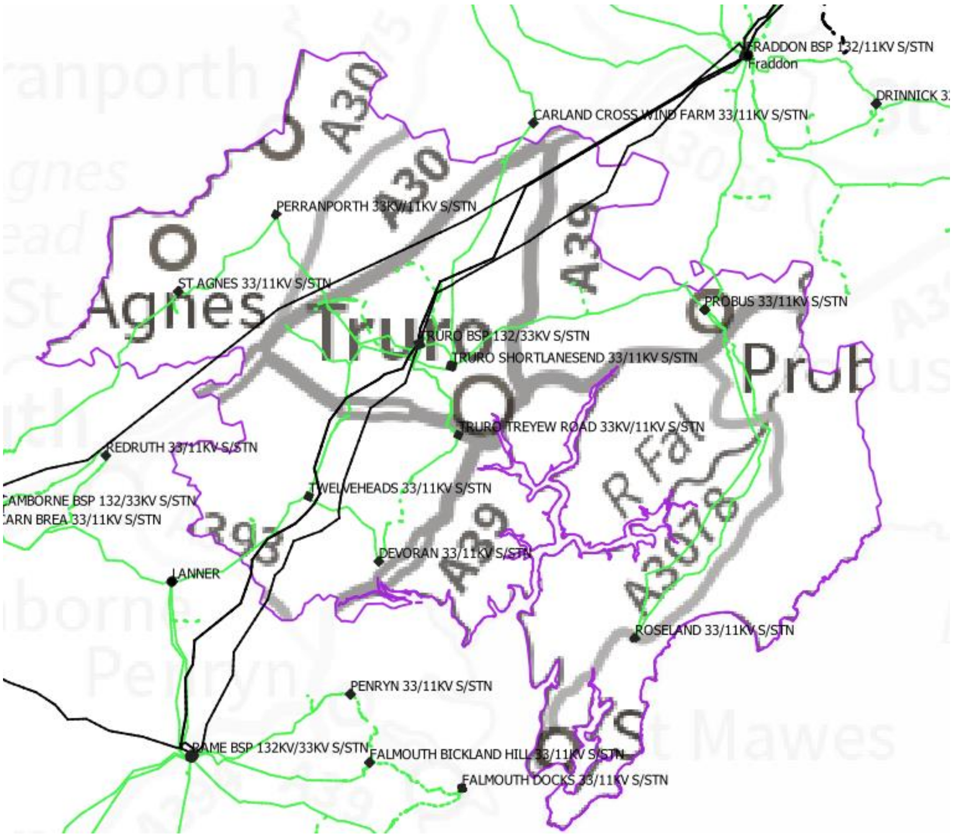

Figure 1.1 Truro BSP geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon associated with the 132/33 kV transformers, 33/11 kV transformers and 33 kV circuits which supply and are supplied by Truro BSP. This uses the methodology outlined in the Network Development Plan Methodology Report with Network Operability Modelling applied as outlined below.

For the purposes of this analysis the NGED Best View Distribution Future Energy Scenario (DFES) has been used to study the years 2022 (baseline), 2028 and 2034, with consideration given to how proposals could change under the other scenarios. The two most onerous half-hours have been studied for each of the five representative days considered: Winter Peak Demand, Intermediate Warm Peak Demand, Intermediate Cool Peak Demand, Summer Peak Demand and Summer Peak Generation.

1.1 Network Topology

The Truro BSP network is arranged as follows:

- A 33 kV ring supplying Twelveheads, Devoran, Truro Treyew Road along with connections to four 33 kV connected generators.
- A 33 kV circuit providing interconnection with Camborne BSP with three tee-offs to 33 kV connected generators and two primary substations - Perranporth with two transformers and St Agnes with one, the circuit is normally run open on circuit breaker 1S0 at St Agnes.
- Two 33 kV circuits providing interconnection to Fraddon Grid Transformer (GT)1 through open points at 1L5 at Truro Shortlanesend and 1L5 at Probus.

1.2 Network Operability Modelling

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

- The 33 kV busbar running arrangement at Truro 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.

2. Summary of Network Constraints

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

- Truro GT Capacity
- Circuit capacity between Truro and Fraddon GT1
- Truro Shortlanesend to Truro BSP circuit and transformer capacity
- Perranporth primary and circuit capacity
- Truro Treyew/Devoran/Twelveheads circuit capacity
- Truro Treyew primary transformer capacity
- St Agnes single transformer primary capacity
- Large generator to Truro Shortlanesend circuit capacity

3. Network Constraint Details and Solution Options

3.1 Truro GT Capacity

Constraint Overview

Generation | Demand

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads seen during outage period.

Table 3.1.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Transformer capacity	Loss of one transformer	-	2030 (2034 w/ cyclic ratings)	2031	2032	2034

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2029 and under falling short it is predicted to arise in 2035.

Solution Options

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

Table 3.1.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	New GT3 at Truro	×	✓	✓	Discounted
2	132/11 kV Transformers at or near Truro	✓	✓	✓	Viable
3	SD8C checks	✓	✓	✓	Viable (until 2034)
4	New BSP 132/33 kV	✓	✓	✓	Viable
Operational Mitigation					
5	Transfer demand to neighbouring BSP potentially Fraddon	×	✓	✓	Discounted
Load Management Schemes					
6	Post-fault transfers	✓	×	✓	Discounted
Flexibility services					
7	Procure flexibility	✓	×	✓	Viable

Solution Development

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

Option 0 – No Intervention

Capacity Released for constraint(s) considered: 0 MVA — **Discounted**

Detailed description: Doing nothing to mitigate the constraint would result in GTs going out of firm.

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

Option 1 – New GT3 at Truro

Capacity Released for constraint(s) considered: 45 MVA — **Discounted**

Detailed description: Due to Truro BSP being in the middle of a Site of Special Scientific Interest it becomes practically not possible to extend the site and create a 132 kV busbar with a new Grid Transformer.

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

Option 2 – 132/11kV Transformers at or near Truro

Capacity Released for constraint(s) considered: 39 MVA — **Viable**

Detailed description: There are a few 132 kV lines running near Truro which makes this solution a real possibility. It is also very close to a load centre and a densely populated area in Cornwall. It would solve the GT capacity and primary capacity issues with one solution.

New limiting factor for constraint(s) considered: Truro GTs and 132/11 kV transformer capacity.

Option 3 – SD8C checks

Capacity released for constraint(s) considered: 24 MVA — Viable (until 2034)

Detailed description: This is necessary to fully use the cyclic ratings. There are some ancillary rating limits, mainly relays, which reduce site to nameplate ratings.

New limiting factor for constraint(s) considered: Cyclic GT ratings.

Option 4 – New BSP 132/33kV

Capacity released for constraint(s) considered: 78 MVA — Viable

Detailed description: A new 132/33 kV BSP would also work. Due to the circuits in the area being mostly part of rings it would not add much 33 kV capacity without major 33 kV works. That is why the preferred option would be the 132/11 kV Transformers.

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

Option 5 – Transfer demand to neighbouring BSP potentially Fraddon

Capacity released for constraint(s) considered: 2 MVA — Discounted

Detailed description: Not a lot of demand will be able to be transferred to Fraddon through the exiting circuits. Some could delay the need for reinforcement by a year or so without building more 33kV circuits in between the BSPs (maybe Newquay to a generator on the way to Truro).

New limiting factor for constraint(s) considered: Existing BSP ratings

Option 6 – Post-fault transfers

Capacity Released for constraint(s) considered: 0 MVA — Discounted

Detailed description: This option would not be suitable due to it being a capacity issue.

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

Option 7 – Procure flexibility

Capacity Released for constraint(s) considered: 0 MVA — Viable

Detailed description: Flexibility should be procured to delay the reinforcement at or around Truro BSP.

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

Solution Recommendation

It is recommended that GTs at Truro are assessed for cyclic rating capability as soon as possible. At or around 2034, 132/11kV will be needed due to large predicted growth happening in the area. Truro is blessed with having several 132kV circuits going through it which makes this solution feasible.

3.2 Circuit capacity between Truro and Fraddon GT1

Constraint Overview

Generation | **Demand**

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads seen during outage period.

Table 3.2.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Interconnection capacity between Truro and Fraddon GT1	Loss of Fraddon GT1 or busbar	-	Baseline	Baseline	Baseline	Baseline

Uncertainty under other Distribution Future Energy Scenarios: As this is a Baseline issue the uncertainty does not exist.

Solution Options

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

Table 3.2.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	New circuit between Newquay and Truro potentially to a 33 kV customer	✓	✓	×	Viable
2	Rearranging circuits at Fraddon GT1 and GT2 by swapping Drinnick and Newquay circuits	✓	✓	✓	Viable
Operational Mitigation					
3	Transfer demand away from the primary substations in the ring	×	×	✓	Discounted
Load Management Schemes					
4	Post-fault transfers	×	×	×	Discounted
Flexibility services					
5	Procure flexibility	✓	×	✓	Viable

Solution Development

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

Option 0 – No Intervention

Capacity Released for constraint(s) considered: 0 MVA

Discounted

Detailed description: Doing nothing to mitigate the constraint would result in Camborne Treswithian continue to overload.

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

Option 1 – New circuit between Newquay and Truro potentially to a 33 kV customer

Viable

Capacity Released for constraint(s) considered: 32 MVA

Detailed description: Building a new circuit between Newquay and Truro would add capability for Newquay to fully run off Truro BSP if needed. It may be a bit too much for the area but it is an option worth considering.

New limiting factor for constraint(s) considered: Backfeed capacity when current transformer retires

Option 2 – Rearranging circuits at Fraddon GT1 and GT2 by swapping Drinnick and Newquay circuits

Viable

Capacity Released for constraint(s) considered: 0 MVA

Detailed description: This option would protect against a busbar outage or fault of Main 1 at Fraddon BSP. It would prevent the normal paralleling of the groups, this is no longer required as the security of supply will meet the design standards. This means Fraddon GT1 and GT2 can behave a bit more independently and do transfer outs as and when needed instead of having it done as part of a first circuit outage.

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

Option 3 – Transfer demand away from the primary substations in the ring

Viable

Capacity released for constraint(s) considered: 0 MVA

Detailed description: The Newquay, Probus, Truro Shortlanesend ring is considerably large which means all primary substations are quite distant from each other making this option not feasible without causing further constraints on the lower voltage network.

New limiting factor for constraint(s) considered: Capacity of existing primary substations.

Option 4 – Post-fault transfers

Discounted

Capacity Released for constraint(s) considered: 0 MVA

Detailed description: Post fault transfers is not the issue here.

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

Option 5 – Procure flexibility

Viable

Capacity Released for constraint(s) considered: 0MVA

Detailed description: Flexibility would help, but would not solve fully the issue unless a very large amount of flexibility happened to exist around Newquay.

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

Solution Recommendation

It is recommended that the circuit off Fraddon GT1 and GT2 are swapped across the busbars, this will protect the circuits for a busbar outage or fault. There is a Green Recovery scheme on the Newquay circuit that will give an opportunity to rearrange the circuits so an auto changeover at Newquay Trencreek gives the interconnection to Truro.

3.3 Truro Shortlanesend to Truro BSP circuit and transformer capacity

Constraint Overview

Generation Demand

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads seen during outage period.

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

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Truro Shortlanesend to Truro BSP circuit capacity	Outage of part of the Devoran ring	Fault of one of the Truro Shortlanesend circuit	2025	2026	2027	2028
Truro Shortlanesend Transformer Capacity	Loss of one transformer	-	2027	2027	2026	2027

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2024 and under falling short it is predicted to arise in 2026.

Solution Options

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

Table 3.3.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Dedicated Transformer feeders to Truro Shortlanesend, Transformer uprating and new primary	✓	✓	✓	Viable
2	Newquay to Truro BSP circuit	×	✓	✓	Discounted
3	132/11 kV Primary with associated 132 kV connection assets	✓	✓	✓	Viable
Operational Mitigation					
4	Transfer demand away from Truro Shortlanesend	✓	×	✓	Discounted
Load Management Schemes					
5	Post-fault transfers	×	×	×	Discounted
Flexibility services					
6	Procure flexibility	✓	×	✓	Viable

Solution Development

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

Option 0 – No Intervention

Capacity Released for constraint(s) considered: 0 MVA — **Discounted**

Detailed description: Doing nothing to mitigate the constraint would result in the circuits from Truro BSP to Truro Shortlanesend being out of firm.

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

Option 1 – Dedicated Transformer feeders to Truro Shortlanesend, Transformer uprating and new primary

Capacity Released for constraint(s) considered: 46 MVA — **Viable**

Detailed description: By putting Truro Shortlanesend on transformer feeders will liberate capacity of the Devoran ring. It is a short distance between Truro Shortlanesend and Truro BSP. If circuits are put in they should be large enough to hold 20/40 MVA transformers.

The transformers should be uprated to 20/40 MVA units at Truro Shortlanesend. Langarth Primary should alleviate the predicted growth in this area too. This new primary should also be on their own transformer feeders so load is moved away from the Twelveheads/Devoran ring.

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

Option 2 – Newquay to Truro BSP circuit

Capacity Released for constraint(s) considered: 23 MVA — **Discounted**

Detailed description: This option would make Fraddon and Truro having to parallel for some different outages. It may not be the cheapest option to solve this constraint and it will not get us the desired outcome.

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

Option 3 – 132/11 kV Primary with associated 132kV connection assets

Capacity Released for constraint(s) considered: 39 MVA Viable

Detailed description: This would be the preferred options if timescales allow it. It would solve the GT capacity and primary capacity issues with one solution and it would allow for Truro to decarbonise more efficiently. There are a few 132 kV lines running near Truro which makes this solution a real possibility.

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

Option 4 – Transfer demand away from Truro Shortlanesend

Capacity released for constraint(s) considered: 0 MVA Discounted

Detailed description: Transferring demand away from Truro Shortlanesend was discounted because all other primary substations are in rings or far away from it.

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

Option 5 – Post-fault transfers

Capacity Released for constraint(s) considered: 0 MVA Discounted

Detailed description: Not applicable as problem is a first circuit outage.

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

Option 6 – Procure flexibility

Capacity Released for constraint(s) considered: 0MVA Viable

Detailed description: Could alleviate the problem.

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

Solution Recommendation

It is recommended that Truro Shortlanesend tries out for flexibility. Once that is exhausted 132/11 kV primary would be the preferred solution. However, dues to potential timescales for reinforcement the 20/40 MVA primary and circuits could be needed before 132/11 kV transformers can be delivered.

3.4 Perranporth primary and circuit capacity

Generation | **Demand**

Constraint Overview

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads seen during outage period.

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

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Primary Transformer Capacity	Loss of one transformer	-	2032	2033	2034	2035
Circuit between Truro BSP and Perranporth primary	Intact	-	2031	2031	2031	2033

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2030 and under falling short it is predicted to arise in 2040.

Solution Options

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

Table 3.4.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	New primary substation	✓	✓	×	Discounted
2	Replace existing primary transformers with 12/24 MVA units and uprate circuits	✓	✓	✓	Viable
Operational Mitigation					
3	Transfer demand away and reinforce the 11 kV	✓	×	✓	Discounted
Load Management Schemes					
4	Post-fault transfers	×	×	×	Discounted
Flexibility services					
5	Procure flexibility	✓	×	✓	Viable

Solution Development

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

Option 0 – No Intervention

Capacity Released for constraint(s) considered: 0 MVA — Discounted

Detailed description: Doing nothing to mitigate the constraint would result in circuits and transformers being out of firm for a variety of conditions described above.

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

Option 1 – New primary substation

Capacity Released for constraint(s) considered: 23 MVA — Discounted

Detailed description: This option would require additional circuits and bays at the BSP. For the next decade it would not be required. St Agnes only has one transformer so if it is needed a second can be put in.

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

Option 2 – Replace existing primary transformers with 12/24 MVA units and uprate circuits

Capacity Released for constraint(s) considered: 9 MVA — Viable

Detailed description: At Perranporth replacing the existing transformers with 12/24 MVA units will add another decade of capacity. The circuits should probably be uprated to 200 mm^2 All Aluminium Alloy Conductor (AAAC) operating at 75°C as this will allow for St Agnes to have the second Primary transformer.

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

Option 3 – Transfer demand away and reinforce the 11 kV

Capacity released for constraint(s) considered: 0 MVA — Discounted

Detailed description: With 11 kV reinforcement some demand could be transferred away. Perranporth is far from any other 33 kV so this option is discounted.

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

Option 4 – Post-fault transfers

Capacity Released for constraint(s) considered: 0 MVA

Discounted

Detailed description: This is a first circuit outage problem, which means post-fault transfers are not an appropriate solution.

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

Option 5 – Procure flexibility

Capacity Released for constraint(s) considered: 0 MVA

Viable

Detailed description: If flexibility could be procured in the area it could delay the need for reinforcement.

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

Solution Recommendation

It is recommended to uprate the transformers at Perranporth to 12/24 MVA units and uprate the circuits to Perranporth to 200 mm^2 AAAC operating at 75°C. Flexibility should be tried before reinforcing.

3.5 Truro Treyew/Devoran/Twelveheads circuit capacity

Constraint Overview

Generation Demand

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads seen during outage period.

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

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Truro BSP to Twelveheads circuit capacity	Loss of Truro 1L5 infeed	-	-	-	-	Baseline
Twelveheads to Devoran circuit capacity	Loss of Truro 1L5 infeed	-	-	-	-	Baseline
Devoran to Truro Treyew circuit capacity	Loss of Truro 1L5 infeed	-	-	-	-	Baseline

Uncertainty under other Distribution Future Energy Scenarios: Mostly a generation issue that happens during Summer Peak generation case study and Baseline.

Solution Options

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

Table 3.5.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	New bay at Truro BSP	✓	✓	×	Viable
2	Move two generators from double banking at 1L5 to 4L5	✓	✓	✓	Viable
Operational Mitigation					
3	Transfer load away from the ring	×	×	×	Discounted
Load Management Schemes					
4	Post-fault transfers	×	×	×	Discounted
Flexibility services					
5	Procure flexibility	×	×	×	Discounted

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full CBA. This CBA will be subsequently carried out by the DNO to determine the optimal reinforcement solution.

Option 0 – No Intervention

Capacity Released for constraint(s) considered: 0 MVA

Discounted

Detailed description: Doing nothing to mitigate the constraint would result in circuit capacity in the Devoran/Twelveheads/Truro Treyew ring being out of firm.

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

Option 1 – New bay at Truro BSP

Capacity Released for constraint(s) considered: 29 MVA

Viable

Detailed description: Building a new bay at Truro BSP would allow for two generators to be put onto a separate circuit which would avoid the potential overloads which a fault could cause.

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

Option 2 – Move two generators from double banking at 1L5 to 4L5

Capacity Released for constraint(s) considered: 29 MVA

Viable

Detailed description: By double banking on the other side of the busbar at Truro would avoid the circuits' potential overload due to a Busbar Fault at Truro.

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

Option 3 – Transfer load away from the ring

Capacity released for constraint(s) considered: 0 MVA

Discounted

Detailed description: Not feasible as these are generator customers.

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

Option 4 – Post-fault transfers

Capacity Released for constraint(s) considered: 0 MVA

Discounted

Detailed description: This option would not be suitable due to it being an n-1 issue.

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

Option 5 – Procure flexibility

Capacity Released for constraint(s) considered: 0 MVA **Discounted**

Detailed description: Flexibility is not currently used to solve generation constraints.

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

Solution Recommendation

It is recommended that the two generators that can be easily moved to the other side of the Truro BSP busbar are moved from 1L5 to 4L5 breaker.

3.6 Truro Treyew primary transformer capacity

Generation Demand

Constraint Overview

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads seen during outage period.

Table 3.6.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Primary Transformer Capacity	Loss of one transformer	-	2035	2040	2035	2040

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2034 and under falling short it is predicted to arise in 2045.

Solution Options

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

Table 3.6.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	New primary substation	✓	✓	×	Discounted
Operational Mitigation					
2	Transfer demand away to the uprated Truro Shortlanesend primary and reinforce the 11 kV	✓	✓	✓	Viable
Load Management Schemes					
3	Post-fault transfers	×	×	×	Discounted
Flexibility services					
4	Procure flexibility	✓	×	✓	Viable

Solution Development

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

Option 0 – No Intervention

Capacity Released for constraint(s) considered: 0 MVA — Discounted

Detailed description: Doing nothing to mitigate the constraint would result in transformers being out of firm for a variety of conditions described above.

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

Option 1 – New primary substation

Capacity Released for constraint(s) considered: 23 MVA — Discounted

Detailed description: This option will not necessarily solve this problem but if Solution 2 is used and Truro Shortlanesend goes out of firm, it may get triggered due to the high predicted growth in the area.

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

Option 2 – Transfer demand away to the uprated Truro Shortlanesend primary and reinforce the 11 kV

Capacity Released for constraint(s) considered: 0 MVA — Viable

Detailed description: This option transfers the problem away to Truro Shortlanesend. It makes sense as it will deload the Devoran/Twelveheads ring and it will put this primary on Transformer feeders. After Truro Shortlanesend being out of firm Option 1 will need to be considered.

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

Option 3 – Post-fault transfers

Capacity Released for constraint(s) considered: 0 MVA — Discounted

Detailed description: This is a first circuit outage problem, which means post-fault transfers are not an appropriate solution.

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

Option 4 – Procure flexibility

Capacity Released for constraint(s) considered: 0 MVA — Viable

Detailed description: If flexibility could be procured in the area it could delay the need for reinforcement.

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

Solution Recommendation

It is recommended to have this area as a flexibility zone in the early 2030s. If site starts getting close to the firm capacity demand should be transferred to the reinforced Truro Shortlanesend. If capacity becomes a problem in both these primary substations a new primary substation should be considered.

3.7 St Agnes single transformer primary capacity

Generation | **Demand**

Constraint Overview

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads seen during outage period.

Table 3.7.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Primary Transformer Capacity	Loss of one transformer	-	2030	2031	2034	2040

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2028 and under falling short it is predicted to arise in 2032.

Solution Options

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

Table 3.7.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Another 7.5/15 MVA transformer	✓	✓	✓	Viable
Operational Mitigation					
2	Transfer demand away to neighbouring primary substations	✓	✓	✓	Viable
Load Management Schemes					
3	Post-fault transfers	×	×	×	Discounted
Flexibility services					
4	Procure flexibility	✓	×	✓	Viable

Solution Development

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

Option 0 – No Intervention

Capacity Released for constraint(s) considered: 0 MVA — **Discounted**

Detailed description: Doing nothing to mitigate the constraint would result in transformers being out of firm for a variety of conditions described above.

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

Option 1 – Another 7.5/15 MVA transformer

Capacity Released for constraint(s) considered: 23 MVA — **Viable**

Detailed description: This option will not necessarily solve this problem but if Solution 2 is used and Truro Shortlanesend goes out of firm, it may get triggered due to the high predicted growth in the area.

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

Option 2 – Transfer demand away to neighbouring primary substations

Capacity Released for constraint(s) considered: 0 MVA — **Viable**

Detailed description: This option transfers the problem away to Truro Shortlanesend. It makes sense as it will deload the Devoran/Twelveheads ring and it will put this primary on Transformer feeders. After Truro Shortlanesend being out of firm Option 1 will need to be considered.

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

Option 3 – Post-fault transfers

Capacity Released for constraint(s) considered: 0 MVA — **Discounted**

Detailed description: This is a first circuit outage problem, which means post-fault transfers are not an appropriate solution.

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

Option 4 – Procure flexibility

Capacity Released for constraint(s) considered: 0 MVA — Viable

Detailed description: If flexibility could be procured in the area it could delay the need for reinforcement.

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

Solution Recommendation

It is recommended to have this area as a flexibility zone in the early 2030s. If site starts getting close to the firm capacity demand should be transferred to the reinforced Truro Shortlanesend. This option may require significant works at 11 kV which will benefit from a CBA with the second transformer or a new primary in the area.

3.8 Large generator to Truro Shortlanesend 1L5 33 kV circuit capacity

Constraint Overview

Generation | Demand

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads seen during outage period.

Table 3.8.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Large generator to Truro Shortlanesend	Intact	-	-	-	-	Baseline

Uncertainty under other Distribution Future Energy Scenarios: Mostly a generation issue that happens during Summer Peak generation case study and Baseline.

Solution Options

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

Table 3.8.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Uprate circuits Truro 1L5 to large generator circuits to 200 mm^2 AAAC	✓	✓	✓	Viable
Operational Mitigation					
	None				
Load Management Schemes					
	None				
Flexibility services					
2	Procure flexibility	✓	×	✓	Discounted

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full cost benefit analysis (CBA). This CBA will be subsequently carried out by the DNO to determine the optimal reinforcement solution.

Option 0 – No Intervention

Capacity Released for constraint(s) considered: 0 MVA **Discounted**

Detailed description: Doing nothing to mitigate the constraint would result in transformers being out of firm for a variety of conditions described above.

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

Option 1 – Uprate circuits Truro 1L5 to large generator circuits to 200 mm^2 AAAC

Capacity Released for constraint(s) considered: 23 MVA **Viable**

Detailed description: Uprating the Truro 1L5 to the large generator circuit is necessary and will help with transferring over Newquay Trencreek once the Green Recovery Scheme gets built. Uprating to 200 mm^2 AAAC 75°C would allow for the generators to not overload the line as combination of LV generation would put it over the edge.

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

Option 2 – Procure flexibility

Capacity Released for constraint(s) considered: 0 MVA **Discounted**

Detailed description: For now flexibility is not considered for generation constraints.

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

Solution Recommendation

It is recommended to uprate the Truro to Shortlanesend to the large generator 33kV circuit with 200 mm^2 75°C AAAC or equivalent. This is on the Truro 1L5 circuit.