Fraddon BSP

Network Development Report – South West

May 2024

Electricity Distribution

nationalgrid

Contents

Fraddon BSP

1. Network Overview

Fraddon Bulk Supply Point (BSP) supplies a partly urban and rural area of 33 kV network, with the bulk of the demand centred in Newquay town, as well as Probus village. It is supplied from four 132/33 kV (Grid Transformers) GTs at Fraddon BSP, fed via 132 kV circuits from Indian Queens Grid Supply Point (GSP). Fraddon BSP supplies approximately 50,000 customers.

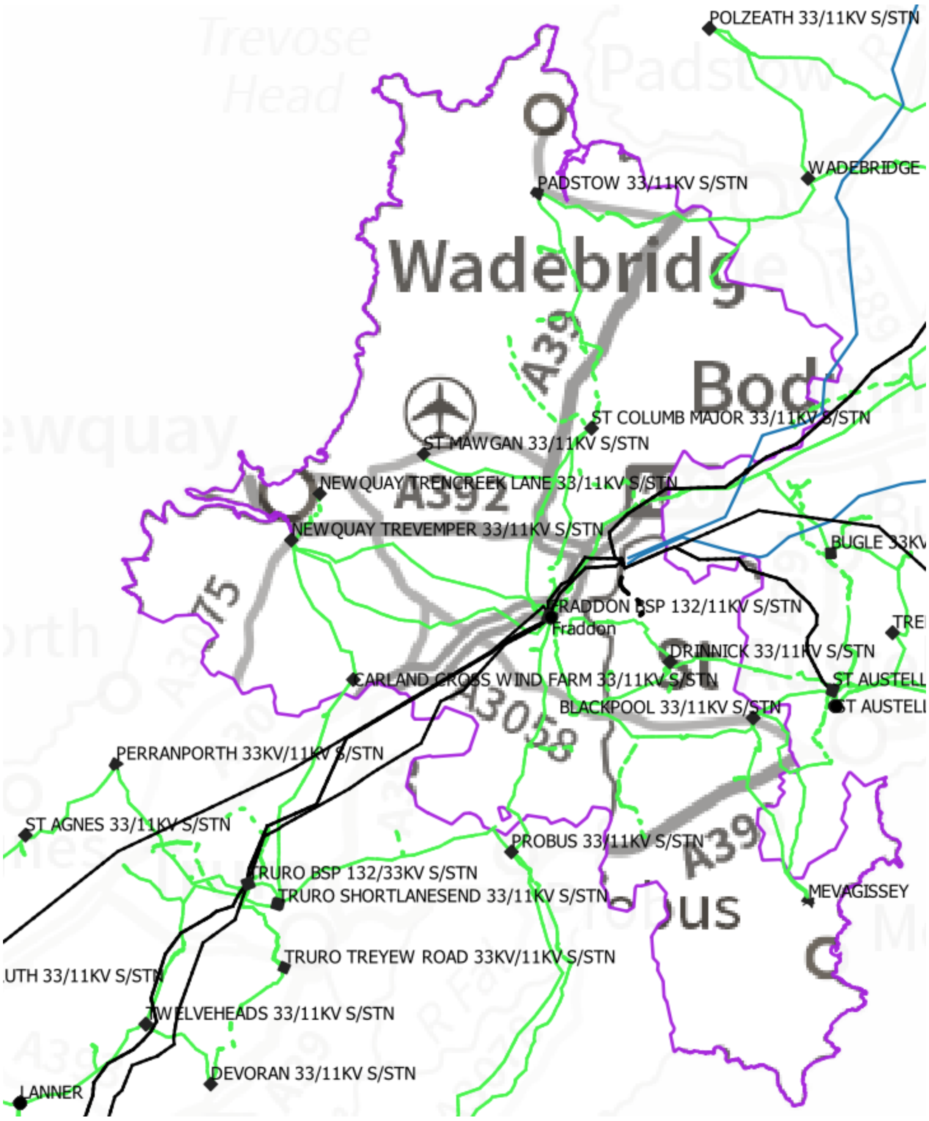

Figure 1.1 Fraddon BSP geographic network coverage

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

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

1.1 Network Topology

The Fraddon BSP network is arranged as follows:

- GT1, GT2 currently run in parallel. GT3 and GT4 also run in parallel.

On the GT1, GT2 side the network is arranged as follows:

- Newquay ring with two primaries Newquay Trevemper with two 33/11 kV transformers and a single transformer primary at Newquay Trencreek. There are currently two generators on s radial feed from Newquay towards Truro.
- There is a radial feed towards Probus Single Transformer Primary which then has an open point which interconnects with Truro. On the radial circuit from Fraddon to Probus there are two 33 kV generators. Roseland is fed from Probus bar through two 33 kV circuits.
- There are two circuits off to Treningle switching station with three generators attached to it. Vistoria primary is looped in from Fraddon 3L5 running to Bugle. From Treningle there are interconnections towards St Tudy and St Germans BSPs.
- Drinnick is on transformer feeders from Fraddon BSP. It has three 33/11 kV transformers and one generator on the connecting circuits. From the middle busbar there is interconnection to St Austell and a generator connection.
- On the GT1 and GT2 busbars there is interconnection to the GT3 and GT4 Fraddon site.
- On the GT2 busbar there is a circuit interconnecting Fraddon GT2 and St Austell.

On the GT3, GT4 side the network is arranged as follows:

- Fraddon primary is on transformer feeders from the BSP.
- A ring towards St Columb Major with St Mawgan single transformer primary teed off one of the connecting circuits.
- Off St Columb Major Primary busbar there is a generator connected and from the other circuit goes to Padstow primary which if lost would swap over to St Tudy. This same circuit has three generators connected to it.

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 Fraddon 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.
- Transfer of Padstow to St Tudy BSP for loss of feeding circuit.
- Transfer of Probus and Roseland to Truro BSP for loss of feeding circuit.

2. Summary of Network Constraints

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

- Fraddon GT1 and GT2 capacity
- Newquay Trevemper to Fraddon circuit capacity
- St Mawgan Single Transformer Primary backfeed capacity
- Newquay Trevemper and Newquay Trencreek primary capacities
- Probus STP capacity
- Roseland primary capacity
- Drinnick circuit capacity (after Fraddon 33kV re-arrangement)

3. Network Constraint Details and Solution Options

3.1 Fraddon GT1 and GT2 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 at winter peak demand.

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

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Transformer capacity demand	Loss of one GT	None	Baseline (2031 with cyclic ratings)	Baseline	Baseline	Baseline
Transformer capacity generation	Loss of one GT	None	Baseline (2029 with cyclic ratings)	Baseline	Baseline	Baseline

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

Solution Options

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

Table 3.1.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Uprate GT1 and GT2 at Fraddon	✓	✓	✓	Viable
2	Transformer checks and enable of cyclic rating	✓	✓	✓	Viable
3	Reinforce 33 kV circuits to transfer generation to other BSPs	✓	✓	✓	Viable
4	Install auto changeover to parallel GT3 and GT4 with the remaining GT1 or GT2	✓	✓	✓	Viable
Operational Mitigation					
5	Transfer demand/generation to other BSPs	✓	×	✓	Viable
Load Management Schemes					
6	Post-fault transfers	×	×	×	Discounted
Flexibility services					
7	Procure flexibility at Fraddon GT1 and GT2	✓	✓	✓	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 the BSP being out of firm for both demand and generation.

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

Option 1 – Uprate GT1 and GT2 at Fraddon

Capacity Released for constraint(s) considered: 36 MVA — Viable

Detailed description: By uprating the two GTs to 60/90 MVA units would increase group capacity substantially, this would allow demand growth in the area to continue. With the current running arrangement generation takes the GTs over firm. If both SD8C checks and running arrangement change are made the generation and demand issues get pushed to 2030.

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

Option 2 – Transformer checks and enable of cyclic rating

Capacity released for constraint(s) considered: 18 MVA — Viable

Detailed description: By going through SD8C checks the Transformers will be able to use their full cyclic rating and defer the need for reinforcement.

New limiting factor for constraint(s) considered: Cyclic Ratings of GTs

Option 3 – Reinforce 33 kV circuits to transfer generation to other BSPs

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

Detailed description: Reinforcing of 33 kV circuits towards Truro would have to happen in the baseline anyway. Potentially option 5 needs to be done alongside option 3 as the generator is best suited to Truro BSP even after the ongoing reinforcement at Newquay Trencreek finishes. At the time of publishing this could already be completed.

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

Option 4 – Install auto changeover to parallel GT3 and GT4 with the remaining GT1 or GT2

Capacity Released for constraint(s) considered: 90 MVA — Viable

Detailed description: By installing an auto changeover that parallels GT3/GT4 with GT1 or GT2 for an outage of the other would defer the need for reinforcement further.

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

Option 5 – Transfer demand/generation to other BSPs

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

Detailed description: Transferring a large generator will make GTs at Fraddon within cyclic ratings. However, SD8C checks and 33 kV reinforcement would also need to go ahead. This would make Fraddon limited by demand instead of generation.

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

Option 6 – Post-fault transfers

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

Detailed description: Post fault transfers cannot be utilised as the overload is beyond post-fault ratings meaning there is no window to reduce the load on the GTs.

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

Option 7 – Procure flexibility at Fraddon BSP

Estimated Flexibility Required (MVA): 0 MVA — Discounted

Detailed description: As it is a demand and mainly generation constraint, flexibility is not appropriate yet. However, if the generation issue gets fixed it is possible that flexibility could be used to fix demand issues at certain times of the year.

Solution Recommendation

It is recommended to assess the feasibility of transferring generation from Fraddon to Truro. 33 kV reinforcement between Truro Shortlanesend and the large 33 kV generator on that circuit will be needed in baseline.

SD8C checks will need to be commissioned for Fraddon GT1 and GT2 to allow the use of cyclic ratings.

If all the above is done the need to use an auto changeover or replace GT1 and GT2 at Fraddon will only appear in the early 2030s.

3.2 Newquay Trevemper to Fraddon 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 at winter peak demand.

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

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Newquay Trevemper 3L3 to Fraddon 1L5 circuit capacity	Fraddon Main 2 busbar fault	None	2031	2031	2032	2032
Newquay Trevemper 2L5 to Fraddon 8L5 circuit capacity	Fraddon Main 1 busbar fault	None	2031	2031	2032	2032

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2029 and under falling short is it 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 3.2.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Reinforce existing 33 kV circuits	✓	×	✓	Viable
2	Install additional 33 kV circuits	✓	✓	×	Discounted
Operational Mitigation					
4	Transfer demand to other Primaries	✓	×	✓	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 overloads for the conditions described above. This would lead to an inability to meet the Security of Supply requirements of Engineering Recommendation P2 for Newquay Trevemper.

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

Option 1 – Reinforce existing 33 kV circuits

Capacity Released for constraint(s) considered: 14 MVA — Viable

Detailed description: The dates above are assuming the current geographic distribution which would put a lot of growth to Newquay Trencreek and Newquay Trevemper. If the reinforcement at St Mawgan goes ahead it may mean the dates for this circuit reinforcement get pushed back but it will still be needed as when Newquay Trencreek gets transferred over to Fraddon due to autochangeover the circuits will need to be able to support the full load.

This would require about 11km of All Aluminium Alloy Conductor (AAAC) 200 mm^2 Poplar would be enough to get us through the long term this conductor is equivalent to 150 mm^2 Hard Drawn Copper (HDC).

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

Option 2 – Install additional 33 kV circuits

Capacity released for constraint(s) considered: 17 MVA — Viable

Detailed description: If there is a need for additional circuit this should probably be done on the GT3 and GT4 side of Fraddon towards St Mawgan as part of a wider area scheme.

This would include 11 kV reinforcement and a new 33/11 kV transformer but most of this reinforcement trigger would be due to St Mawgan backfeed capacity.

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

Option 3 – Transfer demand to other Primaries

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

Detailed description: High load growth will mean transferring demand to primaries that get reinforced in the area. As per option 1 and 2, but it is not possible to do without some reinforcement.

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: Post fault transfers cannot be done as this constraint exceeds post fault ratings.

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

Option 5 – Procure flexibility

Estimated Flexibility Required (MVA): 0 MVA — Viable

Detailed description: Flexibility at Newquay Trencreek and Newquay Trevemper would help push back the reinforcement need of this area of network.

Solution Recommendation

It is recommended to procure flexibility for the area of Newquay Trencreek and Newquay Trevemper. Reinforcement would entail circuit reconductoring with 200 mm^2 AAAC Poplar conductor.

Primary capacity will become an issue in the area which means linking it with the Single Transformer Primary St Mawgan constraint. This recommendation includes circuit reinforcement between St Columb Major and Fraddon. It also means an extra circuit between St Mawgan and Fraddon if load growth follows the highest growth pathway.

3.3 St Mawgan Single Transformer Primary backfeed capacity and 33 kV St Columb to Fraddon 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 at winter peak demand.

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

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
St Mawgan STP backfeed capacity (demand only)	Loss of 33/11 kV Transformer	None	2029	2029	2029	2029
Proposed between St Columb and Fraddon through St Mawgan 33 kV circuit overload (demand and generation)	Busbar fault at St Mawgan (new arrangement)	None	2029	2029	2029	2029

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2026 and under falling short is it 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 3.3.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Reinforce existing 33 kV circuits and new 33/11 kV Transformer	✓	×	✓	Viable
2	Install additional 33 kV circuits and new 33/11 kV Transformer	✓	✓	×	Discounted
3	Reinforce 11 kV circuits to transfer demand to other Primaries	✓	×	✓	Viable
Operational Mitigation					
4	Transfer demand to other Primaries	✓	×	✓	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 overloads for the conditions described above. This would lead to an inability to meet the Security of Supply requirements of Engineering Recommendation P2 for St Mawgan 11 kV backfeeds.

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

Option 1 – Reinforce existing 33 kV circuits and new 33/11 kV Transformer

Capacity Released for constraint(s) considered: 17 MVA **Viable**

Detailed description: The natural reinforcement solution for St Mawgan is to add the second 33/11 kV transformer. This would allow for demand to be restored for a loss of the current transformer enabling P2 security of supply standard to be met.

This would mean St Columbs 1L3 to Fraddon 10L5 circuit would need to have their isolators uprated as this circuit would need to support St Mawgan, St Columbs and Padstow in the event of a fault. This would mean uprating 7 km section to 200 mm^2 AAAC AL5 conductor.

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

Option 2 – Install additional 33 kV circuits and new 33/11 kV Transformer

Capacity released for constraint(s) considered: 17 MVA **Viable**

Detailed description: Similar to option 1 but with new circuits from Fraddon. Currently it is not necessary. However, depending on how much demand gets transferred from Newquay to St Mawgan a circuit from Fraddon to St Mawgan will need to be considered, which would be about 11 km of large 200 mm^2 AAAC AL5 conductor. That is the reason why it was put as viable.

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

Option 3 – Reinforce 11 kV circuits to transfer demand to other Primaries

Capacity Released for constraint(s) considered: 5 MVA **Viable**

Detailed description: By reinforcing 11 kV transfer the need for the second transformer is put back by some years in the area. Newquay Trencreek EHV side is being reinforced as part of Green Recovery which could be the back-up for St Mawgan with some more 11 kV being built in the area.

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

Option 4 – Transfer demand to other Primaries

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

Detailed description: As there is large growth in Newquay it is not advisable to transfer demand away from St Mawgan.

However, if the second transformer is built the running arrangement of the new St Mawgan primary would potentially need to be split at 11 kV to let some demand drop for the busbar fault which could be restored with a SQC scheme.

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: Post fault transfers cannot be done without 11 kV reinforcement.

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

Option 6 – Procure flexibility

Estimated Flexibility Required (MVA): 0 MVA **Discounted**

Detailed description: As this constraint is a backfeed capacity issue flexibility would not solve the issue.

Solution Recommendation

It is recommended to build the second primary transformer at St Mawgan and a ring into St Columb Major/Fraddon. For the running arrangement in the future an 11 kV split at St Mawgan should be considered due to a fault of its busbar overloading the Fraddon to St Columb via St Mawgan circuits, if not the isolators on the circuit between St Columb Major 1L3 and Fraddon 10L5 will need to be replaced.

11 kV reinforcement could also be considered to increase the backfeed capacity. This would potentially be towards Newquay.

The new 33 kV circuit between Fraddon and St Mawgan has some merit depending how much load gets transferred between Newquay and St Mawgan. As according to DFES projections Newquay will reach up to 60 MVA by 2050, which means quite a lot of load needing to be transferred across to St Mawgan. This will come with 11 kV reinforcement.

3.4 Newquay Trevemper and Newquay Trencreek primary capacities

Constraint Overview

Generation | Demand

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

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

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Newquay Trencreek to Fraddon circuit	Fraddon Main 2 busbar fault	None	2032	2033	2033	2034
Actual transformer capacity	Fraddon Main 1 busbar fault	None	2035	2035	2040	2040

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2031 and under falling short is it 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 Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Replace one primary transformers with 20/40 MVA units and dedicated circuits	✓	×	×	Discounted
2	New 12/24 MVA primary potentially to the GT3 and GT4 side to the East of the town	✓	✓	×	Viable
3	St Mawgan STP reinforcement, 11 kV reinforcement and new 33 kV circuit	✓	✓	✓	Viable
Operational Mitigation					
4	Transfer demand to other Primaries	✓	×	✓	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 overloads for the conditions described above. This would lead to an inability to meet the Security of Supply requirements of Engineering Recommendation P2 for Newquay Trevemper and Newquay Trencreek.

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

Option 1 – Replace both primary transformers with 20/40 MVA units and dedicated circuits

Capacity Released for constraint(s) considered: 38 MVA — **Discounted**

Detailed description: Newquay Trevemper is be the prime candidate to have the transformers upgraded to 20/40 MVA units and new circuits run into it. The problem here is having this primary connecting to GT1 and GT2 side exacerbating the GT overloads and circuit capacity constraints. This will then mean new dedicated 33 kV. The old reinforced circuits would connect to Trevemper and new dedicated smaller circuits to Trencreek (ratings similar to the existing circuits).

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

Option 2 – New 12/24 MVA primary potentially to the GT3 and GT4 side to the East of the town

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

Detailed description: This option could align with the capacity constraint at St Mawgan, as both primary substations supply the same geographic area. The decision on putting it towards the GT3 and GT4 side comes from balancing the loads of Fraddon busbar.

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

Option 3 – St Mawgan STP reinforcement, 11 kV reinforcement and new 33 kV circuit

Capacity Released for constraint(s) considered: 17 MVA — **Viable**

Detailed description: St Mawgan is the next logical step for the area. An in depth study of the 11 kV in the area will be needed to understand feasibility of reinforcing 11 kV towards St Mawgan from Newquay. It would also help load up on GT3 and GT4 side of Fraddon which would help the wider area.

The new 33 kV circuit would potential be needed later on from Fraddon GT3/GT4 to St Mawgan, this would enable the full usage of the capacity at St Mawgan and let it accept load from Newquay.

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

Option 4 – Post-fault transfers

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

Detailed description: Post fault transfers cannot be done as this constraint exceeds post fault ratings.

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

Option 5 – Procure flexibility

Estimated Flexibility Required (MVA): 0 MVA — **Viable**

Detailed description: Flexibility at Newquay Trencreek and Newquay Trevemper would help push back the reinforcement need of this area of network.

Solution Recommendation

It is recommended to procure flexibility for the area of Newquay Trencreek and Newquay Trevemper. The recommended solution would be to focus on reinforcing St Mawgan to allow load to be shifted there. This may require another 33 kV circuit to allow St Colum Major and Padstow to grow.

Primary capacity will become an issue in the area which means linking it with the Single Transformer Primary St Mawgan constraint. It will include extensive 11 kV reconfiguration and reinforcement that will need to be explored. It also means an extra circuit between St Mawgan and Fraddon if load growth follows the highest growth pathway.

3.5 Probus Single Transformer Primary 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 at winter peak demand.

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

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Primary Transformer Capacity	INTACT	None	2031	2033	2033	2034

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2031 and under falling short is it 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 3.5.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Two new 12/24 MVA 33/11 kV transformer	✓	✓	✓	Viable
2	Uprate 11 kV backfeeds	×	×	✓	Discounted
Operational Mitigation					
3	Transfer demand to other Primaries	✓	×	✓	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 overloads for the conditions described above. This would lead to an inability to meet the Security of Supply requirements of Engineering Recommendation P2 for Probus Single Transformer Primary.

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

Option 1 – Two new 12/24 MVA 33/11 kV transformer

Capacity Released for constraint(s) considered: 16 MVA **Viable**

Detailed description: The reason for going for 12/24 MVA units is the load predicted which goes above 14 MVA in the 2040s. This is due to high predicted growth of EV Chargers in this area.

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

Option 2 – Uprate 11 kV backfeeds

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

Detailed description: There has been a review of the backfeeds into Probus and the Secondary System Planning team calculated its backfeed capacity to be 6.9 MVA. This is above the Transformer capacity which means it is no longer the limiting factor as assessed in 2019 and can be removed from the flexibility list until a couple of years it is needed.

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

Option 3 – Transfer demand to other Primaries

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

Detailed description: Due to the geographical location Probus does not lead itself to transfer demand away.

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: Post fault transfers cannot be done as this constraint exceeds post fault ratings.

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

Option 5 – Procure flexibility

Estimated Flexibility Required (MVA): 0 MVA **Viable**

Detailed description: Flexibility at Probus would help push back the reinforcement need of this area of network.

Solution Recommendation

It is recommended that flexibility is procured at Probus. It should push back the need of reinforcement to a certain extent. Then two new 12/24 MVA transformer will be needed which then will solve the constraints for the area.

3.6 Roseland primary 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 at winter peak demand.

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

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Primary Transformer Capacity	INTACT	None	Baseline	Baseline	2031	2034

Uncertainty under other Distribution Future Energy Scenarios: Under all scenarios, this constraint is predicted to arise this year and under falling short is it predicted to arise in 2025.

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 Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Two new 7.5/15 MVA 33/11 kV transformer	✓	✓	✓	Viable
2	Add fans if possible	✓	×	✓	Viable
3	Reinforce ancillaries as per SD8C recommendations	✓	×	✓	Viable
Operational Mitigation					
4	Transfer demand to other Primaries	✓	×	✓	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 overloads for the conditions described above. This would lead to an inability to meet the Security of Supply requirements of Engineering Recommendation P2 for Roseland primary substation.

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

Option 1 – Two new 7.5/15 MVA 33/11 kV transformer

Capacity Released for constraint(s) considered: 9 MVA

Viable

Detailed description: 7.5/15 MVA units according to projections will be sufficient to last into the 2040s.This option should come after seeing if we can make the Winding temperature show up in control (option 3).

As the transformers are 60 and 66 years old, there may be an opportunity to align upgrade works with asset replacement.

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

Option 2 – Add fans if possible

Capacity released for constraint(s) considered: 3.3 MVA Viable

Detailed description: By adding fans the transformer will be able to be pushed above its nameplate rating, obviously this would need to be done alongside Option 3 to fully utilise the cyclic capabilities of the transformers. If both options are done Option 1 only needs to be done in 2040.

However, if it needs asset replacement soon this option becomes discontinued and Option 1 will need to be chosen.

New limiting factor for constraint(s) considered: Transformer cyclic ratings

Option 3 – Reinforce ancillaries as per SD8C recommendations

Capacity released for constraint(s) considered: 2.5 MVA Viable

Detailed description: Roseland has had SD8C checks done, but they have failed. The reason for failure was that the winding temperature shown in control was different from the one measured on site. Depending on feasibility if this can be achieved it can defer Option 1 to 2035. Combined with Option 2 if feasible it could push back needing new transformers to 2040.

However, if it needs asset replacement soon this option becomes discontinued and Option1 will need to be chosen.

New limiting factor for constraint(s) considered: Transformer cyclic ratings

Option 4 – Transfer demand to other Primaries

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

Detailed description: Due to the geographical location of Roseland, it does not lead itself to transfer demand away.

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: Post fault transfers cannot be done as this constraint exceeds post fault ratings.

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

Option 6 – Procure flexibility

Estimated Flexibility Required (MVA): 0 MVA Viable

Detailed description: Flexibility at Roseland would help push back the reinforcement need of this area of network.

Solution Recommendation

It is recommended that flexibility is procured at Roseland.

Roseland primary should be in a priority list for asset replacement as the transformers are 60 and 66 years old. If all ancilliary restrictions identified in the SD8C checks are addressed it may mean that the constraint can be successfully deferred by ten years, as most of the year the transformers will operate within their nampelate rating this may be a credible solution.

Option 1 to replace the current 5 MVA ONAN with 7.5/15 MVA units on asset replacement soon.

3.7 Drinnick circuit capacity (after Fraddon 33 kV re-arrangement)

Constraint Overview

Generation Demand

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

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

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Drinnick to Fraddon both circuits capacity	Fault of Fraddon Main 2	None	N/A	N/A	N/A	2032 (after Fraddon 33 kV re-arrangement)

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2030 and under falling short is it predicted to arise in 2034.

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 Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Reinforce existing 33 kV circuits	✓	✓	×	Viable
2	Install additional 33 kV circuits	✓	✓	×	Viable
3	Add intertrip to St Austell so it parallels the 33 kV for the conditions above	✓	×	✓	Viable
Operational Mitigation					
4	Transfer generation to other BSPs and autochangeover	✓	✓	✓	Viable
5	Loose Couple Drinnick between St Austell and Fraddon	✓	✓	✓	Viable
Load Management Schemes					
6	Post-fault transfers	×	×	×	Discounted
Flexibility services					
7	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, 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 overloads for the conditions described above. This would lead to overloads on the Drinnick to Fraddon circuits. This only occurs after Fraddon is re-arranged on the 33 kV (putting Drinnick circuits across the two busbars).

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

Option 1 – Reinforce existing 33 kV circuits

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

Detailed description: By reinforcing both of the circuits to 200 mm^2 AAAC Poplar conductor it would solve this issue. These would be 6 km section between Fraddon and Drinnick.

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

Option 2 – Install additional 33 kV circuits

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

Detailed description: If more 33 kV circuits were built towards Drinnick a thought should be given to pontentially loose couple T2 and T3 across the BSPs moving one generator to St Austell fixing the generation issue in these circuits and alleviating generation issues at Fraddon BSP (Option 5).

With the extra circuit it would allow for the n-1 position to be the n-2 which would solve all the generation issues.

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

Option 3 – Add intertrip to St Austell so it parallels the 33 kV for the conditions above

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

Detailed description: Adding an intertrip to the generators at St Austell would ensure that they would be curtailed for the same conditions that currently exist due to the running arrangement.

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

Option 4 – Transfer generation to other BSPs and autochangeover

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

Detailed description: Transferring generation to St Austell could work by opening the 33 kV section breakers at Drinnick. Then an 11 kV autochangeover would need to be in place between T2 and T3. There could also be a parallel on the 33 kV but that may not be desirable due to added complexity of operating the network.

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

Option 5 – Loose Couple Drinnick between St Austell and Fraddon

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

Detailed description: Loose coupling Drinnick across the BSPs may not be the most desirable options but it would solve the problems with the current assets. It would need a SQC scheme between T1 and the remaining transformers to meet demand security of supply.

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

Option 6 – Post-fault transfers

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

Detailed description: Post fault transfers do not apply as issue beyond fault ratings.

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

Option 7 – Procure flexibility

Estimated Flexibility Required (MVA): 0 MVA **Discounted**

Detailed description: As this is a generation constraint, flexibility cannot be procured.

Solution Recommendation

It is recommended to loose couple Drinnick T2 and T3 across St Austell and Fraddon. This would solve the generation issues for when Fraddon gets a 33 kV re-arrangement. It is also recommended to consider an autochangeover for T2 and T3 to decrease the generation constraints in the area.

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