Rame BSP

Network Development Report – South West

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Electricity Distribution

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Rame BSP

1. Network Overview

Rame Bulk Supply Point (BSP) 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 (Grid Supply Point) GSP, with two 30/60 MVA and one 22.5/45 MVA 132/33 kV grid transformers supplying the group. Rame BSP supplies approximately 43,000 customers.

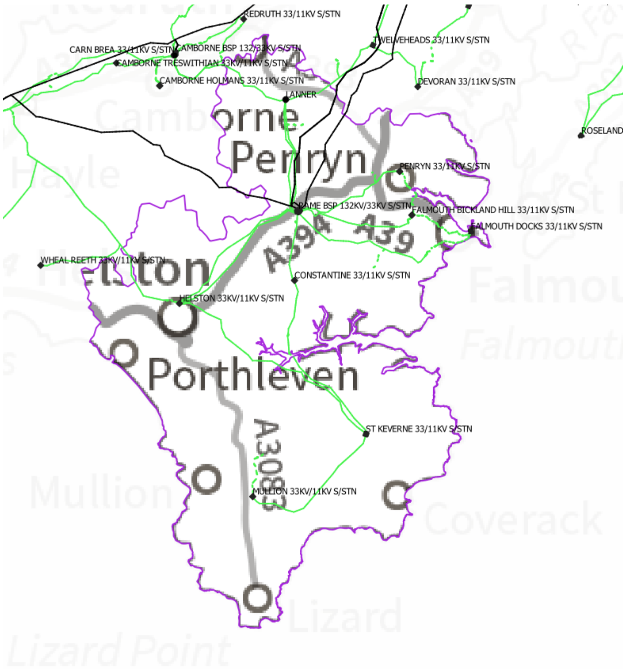

Figure 1.1 Rame BSP geographic network coverage

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 Rame 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 Rame BSP network is arranged as follows:

- 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.

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 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.

2. Summary of Network Constraints

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

- Rame Grid Transformer (GT) Capacity
- Penryn/Falmouth Docks/Falmouth Bickland Hill circuit ring Capacity
- Falmouth Bickland Hill Transformer Capacity
- St Keverne/Mullion/Constantine/Helston ring Capacity
- Helston Transformer Capacity
- Mullion Single Transformer Backfeed Capacity
- Constantine Single Transformer Backfeed Capacity
- Lanner transformer Capacity

3. Network Constraint Details and Solution Options

3.1 Rame 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
GT3 capacity	Loss of one transformer	-	2028	2028	2029	2029
GT1 capacity	Loss of one transformer	Loss of another transformer	2032	2032	2032	2032
GT2 capacity	Loss of one transformer	Loss of another transformer	2032	2032	2032	2032

Uncertainty under other Distribution Future Energy Scenarios: Leading the Way would bring the GT3 constraint forward to 2027 and Falling Short would drag it back to 2033. GT2 and GT3 would have an interval of 2031 in Leading the Way and 2040 in Falling Short.

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	Replace GT3 unit with 60/90 MVA transformer	✓	✓	✓	Viable
2	New GT and 33kV busbar	✓	✓	×	Discounted
3	Replace GT3 and GT2 or GT1 with 60/90 MVA	✓	✓	✓	Viable
Operational Mitigation					
4	Transfer primaries away from the BSP	✓	×	✓	Discounted
Load Management Schemes					
5	Post-fault transfers	✓	×	✓	Viable
Flexibility services					
6	Procure flexibility at Rame BSP	✓	×	✓	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 overloads for GT1 at Rame and in the future for the other two GTs. Currently the capacity is 105 MVA, but due to the flows the smaller GT gets out of firm capacity around 2028.

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

Option 1 – Replace GT3 unit with 60/90 MVA transformer

Capacity Released for constraint(s) considered: 15 MVA **Viable**

Detailed description: Replacing the 22.5/45 MVA transformer with a 60/90 MVA unit would stop it overloading for the loss of GT1 or GT2 this would increase the capacity by 15 MVA to 120 MVA (this is all pre SD8C checks and ancillary rating removal). It would also be the precursor to uprating one of the other two GTs to 60/90 MVA transformers which would increase the site capacity to 170 MVA once ancillary ratings are removed.

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

Option 2 – New GT and 33kV busbar

Capacity Released for constraint(s) considered: 60 MVA **Discounted**

Detailed description: A new GT would allow for a more even split of loading across the GTs and potentially running two and two split similar to Fraddon. With the current level of predicted growth it may be a bit too large for the needs of the area.

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

Option 3 – Replace GT3 and GT2 or GT1 with 60/90 MVA

Capacity released for constraint(s) considered: 75 MVA **Viable**

Detailed description: Only Hayle and a bit of Marazion primaries could be transferred onto other BSPs. However, we would be shifting load into areas with their own problems exacerbating their problems. With 33 kV reinforcement and reactive compensation it would be possible, but not recommended.

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

Option 4 – Transfer primaries away from the BSP

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

Detailed description: Transferring primaries out of the BSP could work on a temporary basis as it Rame would be the least problematic BSP in the area in terms of how easy it is for it to grow when and if necessary.

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

Option 5 – Post-fault transfers

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

Detailed description: This option will be used as part of the above reinforcement as it will be necessary to keep Customer Interruptions (CIs) and Customer Minutes Lost (CMLs) low.

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

Option 6 – Procure flexibility at Rame BSP

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

Detailed description: Flexibility will be a viable option for the area and it could delay the need to reinforce if enough is procured.

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

Solution Recommendation

It is recommended to carry out SD8C checks to uprate transformers to fully use cyclic ratings, replace the breaker with 1760 A with 2000 A breaker. The Rame GTs constraint will be a stepped reinforcement. First the 22.5/45 MVA GT will need to be uprated to 60/90 MVA. As there are no requirements for an n-2 restoration this arrangement with one 60/90 MVA transformer and two 30/60 MVA will last until 2032 where another GT will need to be uprated to 60/90 MVA. If all ancillary ratings are removed this last date could get pushed back to 2034.

3.2 Penryn/Falmouth Docks/Falmouth Bickland Hill circuit ring 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 3.2.1 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**
Penryn and Falmouth ring circuit capacity – Roskrow to Rame 9L5 and Falmouth Docks to Rame circuit	Loss of Main 1 busbar	Loss of another leg of the circuit	Baseline	Baseline	Baseline	Baseline
Penryn and Falmouth ring circuit capacity – Noncrossa to Rame 1L5 and Noncrossa to Falmouth Bickland Hill	Loss of Main 2 Rame busbar	Fault of Hayle 5L5 to Penzance 7L5	Baseline	Baseline	Baseline	Baseline
Penryn to Falmouth Bickland Hill	Loss of Main 2 Rame busbar	Fault of GT2 transformer taking out 132 kV busbar allowing 33 kV imbalance	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 33 kV circuit to separate Falmouth Bickland Hill from the loop	✓	✓	✓	Viable
2	Reconductor circuits into the ring with larger conductor	✓	✓	✓	Viable
Operational Mitigation					
3	Leave circuits at next fault risk so they are not overloaded	×	×	✓	Viable
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 the Falmouth Penryn ring circuits being out of firm capacity.

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

Option 1 – New 33 kV circuit to separate Falmouth Bickland Hill from the loop

Capacity Released for constraint(s) considered: 12 MVA

Viable

Detailed description: This option offers to add a new 33 kV circuit to take the highest loaded primary of the ring. This would allow for Penryn or Falmouth Docks to replace the smaller transformers with 12/24 MVA units (this would probably need some 11 kV reinforcement). Option 1 and 2 can work in tandem or done in order dependent where loads appears first on the ground. This is probably the most expensive option so probably is easier to reconductor first and build the new circuit to solve the next problem.

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

Option 2 – Reconductor circuits into the ring with larger conductor

Capacity Released for constraint(s) considered: 23 MVA

Viable

Detailed description: This option allows for the circuits to be reconductored with 200 mm^2 All Aluminium Alloy Conductor (AAAC) Poplar conductor which would increase the rating of the circuit and increase the capacity of the ring substantially. This includes the review of the protection settings and protection equipment on both ends of the circuits in the ring for it to not be the limiting factor.

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

Option 3 – Leave circuits at next fault risk so they are not overloaded

Capacity released for constraint(s) considered: 0 MVA

Viable

Detailed description: This option will work as a temporary solution before reinforcement is delivered. It would mean splitting the Falmouth ring for any arranged outage of an infeed to the group. This cannot be done for an arranged outage of Rame Main 1 due to both remaining circuits not being adequately rated.

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

Option 4 – Post-fault transfers

Capacity Released for constraint(s) considered: 0 MVA

Discounted

Detailed description: Post fault transfers could happen at 11 kV. However, these primaries feed an area close to the sea with the only 11 kV backfeed coming from other constrained areas or primaries fed from Truro.

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

Option 5 – Procure flexibility

Capacity Released for constraint(s) considered: 0MVA

Viable

Detailed description: Could be feasible and delay reinforcement.

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

Solution Recommendation

Ratings are currently being reviewed by Engineering and Design if ancillary ratings can be raised. This would potentially mean pushing some reinforcement dates back by a year or two. The recommended route would be to reconductor the parts of the circuits that are 100 mm^2 to 200 mm^2 AAAC (when reconductoring it would be great if circuit could be surveyed to get the maximum temperature it can operate to, ideally we would want the ability to run it to 75° C). The reconductoring will need to be done alongside the operational solution to split the ring for arranged outages. Once that gets out of firm build the new 33 kV circuit to separate Falmouth Bickland Hill from the Falmouth Penryn ring.

3.3 Falmouth Bickland Hill 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
Transformer overload	Loss of one transformer	None	2031	2032	2028	2031

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2027 and under falling short it is predicted to arise in 2033.

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	New 12/24 MVA primary	✓	✓	×	Discounted
2	Single Transformer Primary where load is larger (could be part of the new 33 kV circuit into the ring)	✓	✓	✓	Viable
3	Reinforce 11 kV network and replace Falmouth Docs and Penryn units with 12/24 MVA transformers	✓	✓	✓	Viable
Operational Mitigation					
4	Transfer demand to other sites	✓	×	✓	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 transformers at Falmouth Bickland Hill being out of firm capacity.

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

Option 1 – New 12/24 MVA primary

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

Detailed description: This is the most expensive option and it would be a bit too much for the area at this time. It has been discounted due to the cost but if necessary the second primary transformer could be built at the single transformer primary in around 2045.

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

Option 2 – Single Transformer Primary where load is larger (could be part of the new 33 kV circuit into the ring)

Capacity Released for constraint(s) considered: 10 MVA **Viable**

Detailed description: This option adds just enough primary transformer capacity for the area as it has a lot of 11 kV interconnection. Location will have to be discussed with the Secondary System Planning Team to understand where the load is most likely to appear. First Option 3 should be exhausted before attempting this one. As part of the new circuit when it is needed a thought of the route should be given to allow for the connection of a Single Transformer Primary with space for a second Transformer.

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

Option 3 – Reinforce 11 kV network and replace Falmouth Docs and Penryn units with 12/24 MVA transformers

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

Detailed description: This is the preferred option at this stage as it would require the least amount of new circuits and would allow for more interconnectivity in the 11 kV. Reconductoring of the circuits will need to match the capacity of these primaries.

New limiting factor for constraint(s) considered: Capacity of new primaries

Option 4 – Transfer demand to other sites

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

Detailed description: Possible to transfer some demand out but 11 kV reinforcement will be needed as described in Option 3.

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

Option 5 – Post-fault transfers

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

Detailed description: Not applicable in this area.

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

Option 6 – Procure flexibility

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

Detailed description: Flexibility would need to be procured around Falmouth Bickland Hill primary.

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

Solution Recommendation

It is recommended that Falmouth Bickland Hill primary is put forward as a flexibility area. When that is exhausted reinforcement will be needed and the suggestion here is to replace the transformers at Falmouth Docks with larger units first and reinforce 11 kV do the same at Penryn. When capacity is exhausted at both sites think about building new Single Transformer Primary with space for the second Primary Transformer if needed.

3.4 St Keverne/Mullion/Constantine/Helston ring 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 3.4.1 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
Rame 8L5 to Helston 1L5	Fault of Rame Main 1	-	2030	2031	2032	2033
Rame 4L5 to Helston 3L5	Arranged of Rame Main 3 busbar	Fault of the other circuit into the group	2029	2030	2031	2032
Rame 11L5 to Constantine and St Keverne	Arranged of Rame Main 2 busbar	Fault of the other circuit into the group	2029	2030	2031	2029

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 2034.

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	Extra 33 kV circuit to split off Helston from the rest of the ring	✓	✓	✓	Viable
2	Reconductor existing circuits with 200 mm^2 AAAC	✓	✓	✓	Viable
Operational Mitigation					
3	Transfer primaries away from the BSP	✓	×	✓	Viable
4	Split 33 kV network for arranged network	✓	×	✓	Viable
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 circuits being out of firm for a variety of conditions described above

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

Option 1 – Extra 33 kV circuit to split off Helston from the rest of the ring

Capacity Released for constraint(s) considered: 11.5 MVA — Viable

Detailed description: Adding a new 13km 200 mm^2 AAAC circuit will solve some of the constraints, make it easier to operate and will allow for a connection of another single transformer primary. If this solution is chosen it would be wise to have as large conductor into the group as the other circuits will be reconductored eventually.

New limiting factor for constraint(s) considered: Circuit capacity into the ring

Option 2 – Reconductor existing circuits with 200 mm^2 AAAC

Capacity Released for constraint(s) considered: 30 MVA — Viable

Detailed description: Reconductoring the existing 13 km circuits with 200 mm^2 AAAC is the option that will be more sensible to do in the short term. The circuits needing reinforcement will mainly be the two into Helston and one into St Keverne. The other circuit into St Keverne from Helston may need reconductoring and it would get joined to Option 1 when it gets built.

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

Option 3 – Transfer primaries away from the BSP

Capacity released for constraint(s) considered: 7 MVA — Viable

Detailed description: This option is temporarily not viable. However, if Penzance BSP gets built Wheal Reeth could be transferred into the Hayle network adding some more capacity into the Helston circuits and the new Single Transformer Primary that could be built due to projected demands at Helston.

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 reconductor sections of the 33 kV network in the Helston/St Keverne/Mullion/Constantine ring. Once that is exhausted Option 1 of a new circuit will be necessary and will give the opportunity of splitting Helston from the ring. Flexibility should be procured in the area to see if it is feasible.

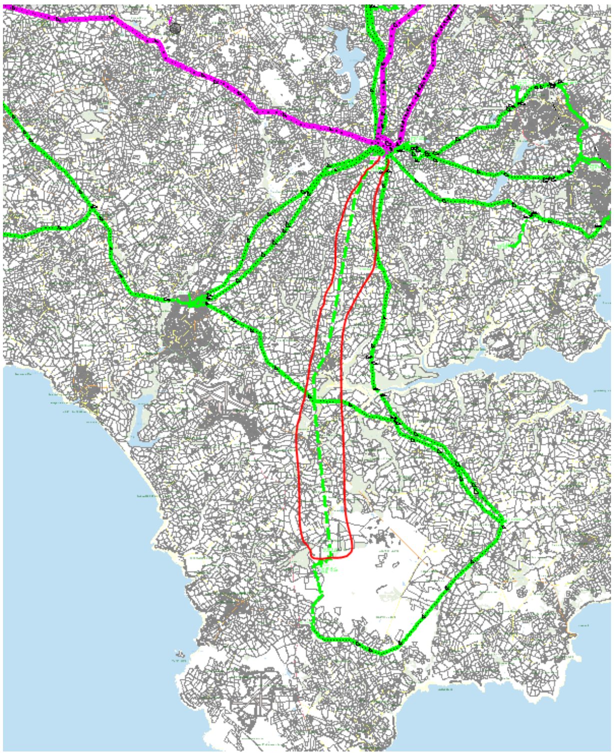

Figure 2 - Proposed new circuit in the Helston/St Keverne/Mullion ring where in the intersection have a Single Transformer Primary to alleviate Helston

3.5 Helston 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 3.5.1 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
Transformer overload	Loss of one transformer	None	2032	2033	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 3.5.2 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 12/24 MVA primary	✓	✓	×	Viable
2	Single Transformer Primary at the intersection of the potential new circuit and existing St Keverne and Helston 33 kV circuit	✓	✓	✓	Viable
Operational Mitigation					
3	Transfer demand to other sites	✓	×	✓	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 the transformers at Helston being out of firm capacity.

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

Option 1 – New 12/24 MVA primary

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

Detailed description: This is the most expensive option and it would be a bit too much for the area at this time. It has been discounted in the short term due to the cost but if necessary the second primary transformer could be built at the single transformer primary in the 2040s.

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

Option 2 – Single Transformer Primary at the intersection of the potential new circuit and existing St Keverne and Helston 33 kV circuit

Capacity Released for constraint(s) considered: 10 MVA — Viable

Detailed description: This option adds just enough primary transformer capacity for the area as it has a lot of 11 kV interconnection. As part of the new circuit when it is needed a thought of the route should be given to allow for the connection of a Single Transformer Primary with space for a second Transformer. This second one could be connected as load can justify in time.

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

Option 3 – Transfer demand to other sites

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

Detailed description: All other primaries are quite far from Helston which means extensive 11 kV reinforcement needed and potential not great voltage at the ends of these circuits.

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

Option 4 – Post-fault transfers

Capacity Released for constraint(s) considered: 0MVA

Discounted

Detailed description: Not applicable in this area.

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

Option 5 – Procure flexibility

Capacity Released for constraint(s) considered: 0 MVA

Viable

Detailed description: Flexibility would need to be procured around Helston primary.

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

Solution Recommendation

It is recommended that Helston primary is put forward as a flexibility area. When that is exhausted reinforcement will be needed and the suggestion here is to add a new 12/24 MVA transformer in the intersection of the new 33 kV circuit between Rame and Mullion passing through the St Keverne to Helston circuit. This is the precursor for another 12/24 MVA transformer so in this case both could be put in at the same time as load growth in the latter years justify it.

3.6 Mullion Single Transformer Backfeed 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 3.6.1 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
Mullion Backfeed capacity and geographic location (4.02 MVA)	Fault or arranged outage of the primary transformer	None	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 3.6.2 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	Extra 33 kV circuit to split off Helston from the rest of the ring same as Constraint 3.4 plus the matched primary transformer 7.5/15 MVA	✓	✓	✓	Viable
2	33 kV circuit from St Keverne plus the matched primary transformer 7.5/15 MVA	✓	×	✓	Discounted
3	33 kV circuit from Helston plus the matched primary transformer 7.5/15 MVA	✓	✓	✓	Viable
Operational Mitigation					
4	Transfer demand to other sites	×	×	×	Discounted
Load Management Schemes					
5	Post-fault transfers	×	×	×	Discounted
Flexibility services					
6	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 a potential loss of load which may not be recovered which may mean a P2 Security of Supply breach.

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

Option 1 – Extra 33 kV circuit to split off Helston from the rest of the ring same as Constraint 3.4 plus the matched primary transformer 7.5/15 MVA

Capacity Released for constraint(s) considered: 10 MVA Viable

Detailed description: This solution would increase capacity and would prevent a P2 non-compliance in an area with limited 11 kV network due to it being in a peninsula. Joining with other constraints could mean building a circuit from Rame to Mullion where the attributable part for this specific reinforcement would be the 5 km circuit between the 33 kV generator and the intersection of the new circuit and existing between St Keverne and Helston.

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

Option 2 – 33 kV circuit from St Keverne plus the matched primary transformer 7.5/15 MVA

Capacity Released for constraint(s) considered: 8 MVA Discounted

Detailed description: This circuit length is similar to Option 1 and it is not adding any geographical diversity to our 33 kV circuits. The main reason for discounting is that there is more of a danger of having low volts due to the increased length of the ring.

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

Option 3 – 33 kV circuit from Helston plus the matched primary transformer 7.5/15 MVA

Capacity released for constraint(s) considered: 10 MVA — Viable

Detailed description: Similar to Option 1 but the circuit would come all the way from Helston which would be further distance to go to, it would mean the reinforcement of the circuits between Helston and Rame would be desirable.

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

Option 4 – Transfer demand to other sites

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

Detailed description: Due to geographical reasons it is not possible.

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.

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

Option 6 – Procure flexibility

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

Detailed description: This is possible in the area if there is enough flexibility procured, but previous round showed there were not and reinforcement will be needed.

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

Solution Recommendation

Due to previous round of flexibility not procuring enough for this particular area, reinforcement is needed. Option 1 of having the circuit from Rame to Mullion with the intersection in the middle is the strategic option that solves the circuit issue in the ring and the backfeed capacity at Mullion. Additional 7.5/15 MVA transformer will give further support at primary level and allow for demand restoration following an outage enabling NGED to meet the Security of Supply design standard.

3.7 Constantine Single Transformer backfeed 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 3.7.1 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
Constantine Backfeed capacity and geographic location (5.56 MVA)	Fault or arranged outage of the primary transformer	None	2033	2033	2033	2033

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2032 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 3.7.2 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	New primary transformer and 1S0 breaker looped into the exiting Rame to St Keverne circuit	✓	×	✓	Viable
2	11 kV reinforcement to increase backfeed capacity	✓	×	✓	Viable
Operational Mitigation					
3	Transfer demand to other sites	✓	×	✓	Viable
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 a potential loss of load which may not be recovered which may mean a P2 Security of Supply breach.

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

Option 1 – New primary transformer and 1S0 breaker looped into the exiting Rame to St Keverne circuit

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

Detailed description: This option would allow for the restoration of demand after n-1 through the primary network.

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

Option 2 – 11 kV reinforcement to increase backfeed capacity

Capacity Released for constraint(s) considered: 6 MVA Viable

Detailed description: Reinforcing the 11 kV network to allow for 11 MVA in total of backfeed will allow for this site to reach 2040 with demand. If we are looking as far as 2050 Option 1 may need to go ahead.

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

Option 3 – Transfer demand to other sites

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

Detailed description: Demand could be transferred on the 11 kV but this would probably require some level of 11 kV reinforcement which means probably carrying out Option 2 in the process.

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: Not applicable.

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

Option 5 – Procure flexibility

Capacity Released for constraint(s) considered: 0 MVA

Viable

Detailed description: Flexibility could alleviate the constraint by ensuring behaviour is kept under the limits for backfeed.

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

Solution Recommendation

It is recommended that flexibility is procured when necessary. For the reinforcement which at the moment will be around 2033 the first thing to do will be to reinforce 11 kV circuits with the addition of a primary transformer coming in later years.

3.8 Lanner 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 3.8.1 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
Transformer capacity	Fault or arranged outage of one transformer	None	2033	2033	2032	2033

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2031 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 3.8.2 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	Replace primary Transformers with 12/24 MVA units	✓	✓	✓	Viable
Operational Mitigation					
2	Transfer demand to other sites	✓	×	✓	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.

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

Option 1 – Replace primary Transformers with 12/24 MVA units

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

Detailed description: This option should be considered as it expands the capacity in the area quite substantially. If this is done circuits may need to be reconductored as they will be the next limiting factor.

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

Option 2 – Transfer demand to other sites

Capacity Released for constraint(s) considered: 6 MVA **Viable**

Detailed description: Reinforcing the 11 kV network to allow some demand to be transferred to other primaries. As Lanner is in the centre of Cornwall and in between BSPs it is not the easiest to transfer demand out of in terms of distance. On the other hand it is in the middle of BSPs so has more choice of transferring out demand to multiple neighbouring primaries

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

Option 3 – Post-fault transfers

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

Detailed description: Demand could be transferred on the 11 kV but this would probably require some level of 11 kV reinforcement which means probably carrying out Option 2 in the process.

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

Option 4 – Procure flexibility

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

Detailed description: Flexibility could alleviate the constraint by ensuring behaviour is kept under the limits of the transformer.

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

Solution Recommendation

It is recommended that flexibility is procured when necessary. For the reinforcement which at the moment will be around 2033 the first thing to do will be to reinforce 11 kV circuits with the addition of a primary transformer coming in later years.

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