Indian Queens and Alverdiscott GSP group

Network Development Report – South West

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Electricity Distribution

nationalgrid

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Indian Queens and Alverdiscott GSP group

1. Network Overview

Indian Queens and Alverdiscott Grid Supply Point (GSP) group supplies a sparse area of 132 kV network, mostly in Cornwall and North Devon. It is supplied from six 400/132 kV (Super Grid Transformers) SGTs (two at Alverdiscott and four at Indian Queens), the two GSPs are interconnected at 132 kV via the double circuit K-route. Indian Queens GSP together with Alverdiscott GSP supplies approximately 400,000 customers.

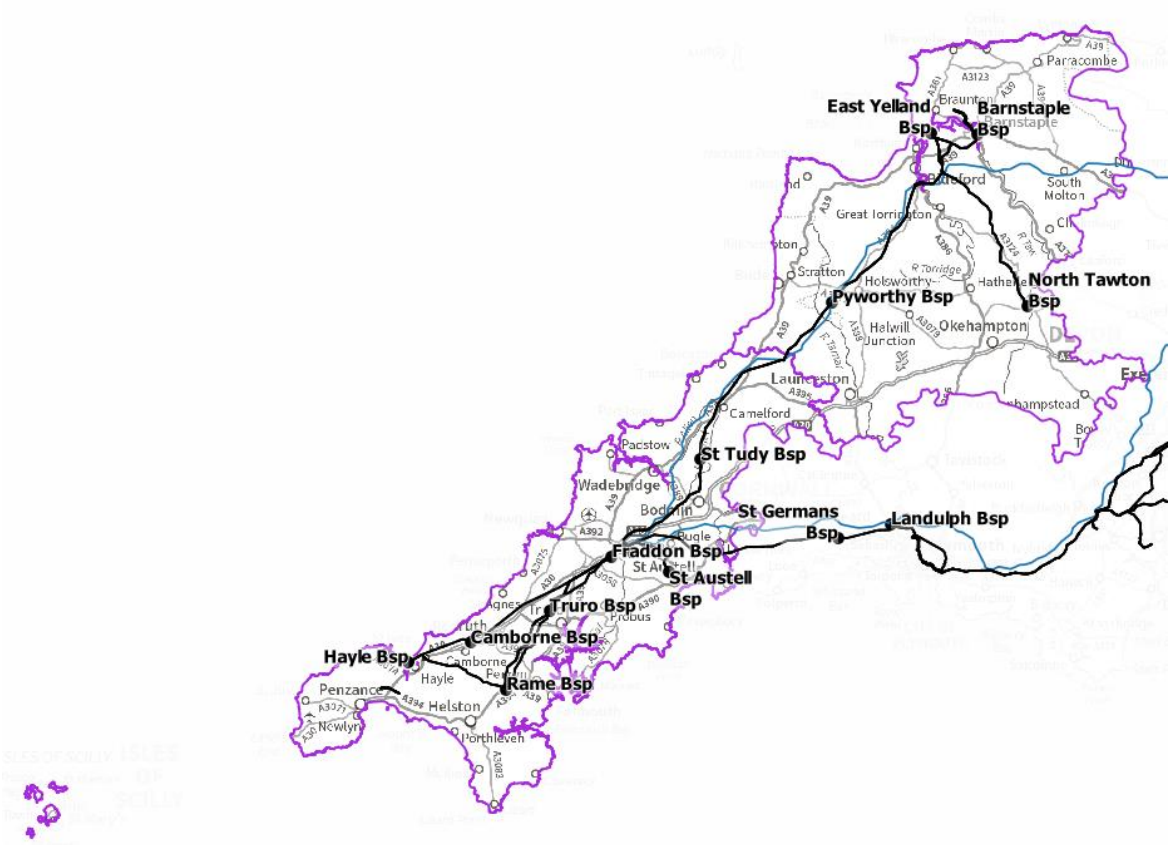

Figure 1.1 Indian Queens and Alverdiscott GSP geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon associated with the SGTs and 132kV circuits which supply and are supplied by Indian Queens and Alverdiscott GSPs. 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 Indian Queens and Alverdiscott GSPs network is arranged as follows:

- East Yelland and Barnstaple Bulk Supply Points (BSPs) group fed from three circuits off Alverdiscott via the K-route northern section and subsequent J-route.
- The K-route interconnecting section between the GSPs has Pyworthy BSP, St Tudy BSP and a number of 132 kV generators connected on to it.

- West Cornwall group is fed from four circuits from the Indian Queens double busbar and supplies several BSPs: Camborne BSP, Hayle BSP, Rame BSP, Truro BSP, Fraddon BSP.
- St Austell BSP is fed from two circuits off Indian Queens.
- St Germans BSP is fed from a circuit teed-off from the circuit towards St Austell and it is loosely coupled at 33 kV with Landulph GSP.

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.

- For an arranged outage of any SGT at Indian Queens SGT4 on hot standby closes in.
- K-route pre-emptive split for an arranged outage of any SGT at Alverdiscott (this only works when the group is below 300 MW – not class E).
- Pre-emptive split of Pyworthy-North Tawton 33 kV interconnection to avoid overloading assets at North Tawton BSP when Pyworthy 132 kV is left at single-circuit risk.
- Arranged outage of 120 at Camborne open Camborne 1T0 and open Hayle 103 to anticipate a fault on the A route into Camborne.
- East Yelland busbars coupling for outage of one of the incoming circuits.
- Curtailment of 132 kV connected generators within the group are modelled are a variety of arranged outages, as outlined in customer connection agreements.

2. Summary of Network Constraints

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

- Alverdiscott Super Grid Transformers capacity, western K route and security of supply issues
- Barnstaple and East Yelland 132 kV circuit capacity and security of supply
- Indian Queens SGT capacity
- West of Cornwall circuit capacity
- AY circuit capacity

3. Network Constraint Details and Solution Options

3.1 Alverdiscott Super Grid Transformers capacity, western K route and security of supply issues

Generation | Demand

Constraint Overview

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

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

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Alverdiscott Super Grid Transformer capacity	Loss of one transformer	None	2028	2028	2034	-
Alverdiscott Super Grid Transformer capacity	Arranged outage of 705 bay at Indian Queens	Loss of and SGT at Alverdiscott	2031	2031	2034	2028 (generation)
Alverdiscott Super Grid Transformer capacity	Arranged outage of 132 kV section breaker 120 at Alverdiscott	Followed by a fault of Barntaple GT2 fault	2034	2034	-	-
Alverdiscott Indian Queens K route capacity (Indian Queens to Pyworthy section)	Loss of on SGT at Alverdiscott	Followed by the loss of another SGT at Alverdiscott	2027	2028	2029	-
Alverdiscott Indian Queens K route capacity (Alverdiscott to Pyworhty section)	Loss of Pyworthy Main 4 busbar	None	-	-	-	2028 (generation)

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2027 and under falling short is it predicted to arise in 2029.

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	New Super Grid capacity	✓	✓	✓	**Viable**
2	Reinforcing 132 kV to neighbouring GSPs	×	×	✓	**Viable**
3	Split K route	✓	✓	✓	**Viable**
4	New circuits from Indian Queens to St Tudy	✓	✓	×	**Discounted**
5	Install double busbar 132 kV at Alverdiscott and use it as remote Indian Queens busbar	×	✓	✓	**Viable**
Operational Mitigation					
6	Transfer demand to neighbouring GSPs	×	×	×	**Discounted**
Load Management Schemes					
7	ANM	×	✓	×	**Viable**
Flexibility services					
8	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.

A number of the options discussed below involve works on the transmission network and will therefore require a modification application and discussions with National Grid Electricity Transmission (NGET) and National Grid ESO to ensure the optimal solution for the whole system (considering both the distribution and transmission systems) is taken forward.

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 Alverdiscott GSP.

Current Alverdiscott and Indian Queens group has about 600 MW of demand putting it in Class E

For groups above 300 MW which Alverdiscott alone is projected to be around 2032/2034 the supply class in P2 is increased to class E which expects all demand to be restored immediately.

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

Option 1 – New Super Grid capacity

Capacity Released for constraint(s) considered: 240 MVA

Viable

Detailed description: A new SGT at Alverdiscott or a new GSP at Pyworthy will be needed to keep compliance at Alverdiscott. The solution is dependent on discussions with NGET where a third SGT would be dependent on transmission building a 400 kV busbar at Alverdiscott.

A new GSP at Pyworthy will give more confidence on the distribution side and could take Pyworthy and St Tudy BSPs off Alverdiscott.

Splitting Alverdiscott from Indian Queens will make it clearer where capacity is needed from transmission which should reflect in future compliance reports.

New limiting factor for constraint(s) considered: New SGT or GSP.

Option 2 – Reinforcing 132 kV to neighbouring GSPs

Capacity released for constraint(s) considered: 60 MVA

Viable

Detailed description: By reinforcing the 132 kV between Indian Queens and Alveridscott which would be about 38.5 km of larger conductors on the dual circuit tower line reconductoring the existing 175 mm² Lynx 75° C Aluminium Conductor Steel Reinforced (ACSR) and 22 km of 300 mm² Upas 75° C All Aluminium Alloy Conductor (AAAC) to 500 mm² Rubus 75° C AAAC AL5, it would enable transferring Pyworthy away from Alverdiscott into Indian Queens. Reinforcing the 132kV would link well with the K line split to stop overloads on these circuits and clearly split up the groups to make them smaller.

This would mean that from Pyworthy to Alverdiscott less reinforcement will be needed as that would be used as the backfeed for an n-2 scenario or even for n-1 to take some load off Pyworthy and dropping some demand for the n-2. This reinforcement, if the above is not chosen, would consist in about 16 km of 175 mm² Lynx 75° C ACSR which would need to be replaced with 300 mm² Upas 75° C AAAC.

This reinforcement could be complemented with moving some demand to Landulph GSP away from Indian Queens by building another 132 kV circuit to St Germans BSP from Landulph GSP. Option 2 would accelerate the need for a new GSP in or around Truro or Rame within the next 10 years and use up the SGT capacity at Landulph where we have more confidence of transmission capacity being deliverable at the moment of writing this document.

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

Option 3 – Split K route

Capacity Released for constraint(s) considered: 0 MVA

Viable

Detailed description: This option would allow splitting at Pyworhty or St Tudy depending on what other solutions are chosen. The two different options are as follows:

1. Splitting and twin-teeing the K route at St Tudy would require less 132 kV reinforcement but would require more transmission infeed with either a GSP at Pyworhty or a third SGT at Alverdiscott GSP.
2. Splitting and twin-teeing the K route at Pyworthy would require the most 132 kV reinforcement including the reconductoring of about 40 km of circuit and potentially an extra 132 kV circuit between Pyworthy and some of the generation single customers to balance generation between Alverdiscott and Indian Queens depending how the network evolves in the coming years. This option assumes the 132 kV circuit between Alverdiscott and North Tawton is built, which stops the loose coupling between two GSPs.

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

Option 4 – New circuits from Indian Queens to St Tudy

Capacity Released for constraint(s) considered: 114 MVA

Discounted

Detailed description: New circuits between Indian Queens and St Tudy would benefit K route loading. These could be two trident lines with 200 mm² Poplar 75° C AAAC conductor.

However, this option would not resolve any generation issues in the area.

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

Option 5 – Install double busbar 132 kV at Alverdiscott and use the reserve bar as remote Indian Queens GSP area busbar, splitting the groups

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

Detailed description: This option would allow splitting the K route section between Alverdiscott and Indian Queens. This option would need an extra 132 kV circuit to take some generation off the K route, towards Alverdiscott. It was suggested as it would make it easier to protect the circuits and alleviate Alverdiscott site.

The priority of reinforcement of either Alverdiscott or Indian Queens GSPs need to be agreed between distribution and transmission. This option forces the network to be reinforced at Indian Queens and assumes the build of North Tawton second GT.

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

Option 6 – Transfer demand to neighbouring GSPs

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

Detailed description: Not possible with current network without reinforcement.

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

Option 7 – ANM

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

Detailed description: Any new generators connecting to current network would have to be on ANM, this would minimise the generation increase of small scale generation.

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

Option 8 – Procure flexibility

Estimated Flexibility Required (MVA): 4 MVA+ — Viable

Detailed description: Flexibility services could be procured to alleviate projected overloads. This could defer reinforcement but due to the large quantity of flexibility required this may not be a viable solution. However, for generation constraints it would not be possible to procure flexibility.

Solution Recommendation

It is recommended to procure flexibility across Alverdiscott GSP to defer the reinforcement requirements whilst demand issues dominate and season specific, subject to a cost benefit analysis confirmation through the DNOA process.

To facilitate longer term growth it is likely that the K route split would happen at Pyworthy with a K route split and 132 kV circuit reinforcement in line with Option 3. By doing these works the reinforcement would be deferred at Alverdicott GSP which is currently uncertain on the transmission side and give more delivery certainty on NGED's side. This proposed split will exacerbate the loading issues at Indian Queens GSP (see section 3.3) which will be required in any case.

If it is difficult to protect these circuits with the proposed twin tee topology then Option 5 can be used making a 132 kV ring via out of Indian Queens GSP via a busbar section at Alverdiscott GSP, this option may be challenging to achieve due to space constraint at Alverdiscott GSP site.

Applying for a connection application in or around Truro/Rame would make it clear where capacity is needed and would improve capacity in the West Cornwall area and resolve many 132 kV constraints in the K route and West Cornwall.

The above solutions will not be enough for the level of growth predicted to 2050 where a new GSP at Pyworhty combined with extra SGT capacity at Alverdiscott will be needed.

3.2 Barnstaple and East Yelland 132 kV circuit capacity and security of supply

Generation | Demand

Constraint Overview

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

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

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
J route overload due to new BSP at or around north of East Yelland connecting near Barnstaple	Loss of one side of the J route	None	2028	2029	2030	2034 (generation)

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2027 and under falling short is it predicted to arise in 2029.

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 132 kV circuits	✓	×	✓	Viable
2	Install dual circuit tower line between J route tee and Alverdiscott and reinforce the remaining section towards Barnstaple	✓	✓	✓	Viable
Operational Mitigation					
3	Transfer demand to other BSPs	×	×	×	Discounted
Load Management Schemes					
4	ANM	×	✓	×	Viable
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 East Yelland and Barnstaple BSPs.

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

Option 1 – Reinforce existing 132 kV circuits

Capacity Released for constraint(s) considered: 90 MVA

Viable

Detailed description: Currently Alverdiscott GSP 132 kV Main 2 busar arranged outages take out two of the three circuits into the Barnstaple/East Yelland area. To improve the outage it could be possible to build a bridging circuit to the other side of the busbar at Alverdiscott GSP for one of the lost circuits. As a consequence of this change this option would require 16 km of circuit to be reinforced and would limit a BSP from being built North of Alverdiscott.

It would require the circuits to East Yelland and Barnstaple to be reinforced. However if a new BSP is built past Barnstaple this option would not work as it would exacerbate security of supply issues due to limited backfeed options in the area.

However, if a new dual circuit tower line circuit is chosen to be built between Barnstaple and Alverdiscott the existing J route would need to be reinforced to 300 mm² Upas 75° C AAAC AL5 due to having Barnstaple and the new BSP off it.

New limiting factor for constraint(s) considered: Reinforced circuits and security of supply class D n-2.

Option 2 – Install dual circuit tower line between J route tee and Alverdiscott and reinforce the remaining section towards Barnstaple

Capacity released for constraint(s) considered: 160 MVA

Viable

Detailed description: The reason for suggesting this option is mainly due to the need for more GT capacity in the area and it being needed north of the river Taw. There is an existing 132 kV customer in that area which would reduce the circuit costs.

This would mean splitting Barnstaple from East Yelland and building a dual circuit tower line from the J-Route tee to Alverdiscott GSP as larger conductor would be needed to support two large demand sites Barnstaple BSP and Fullabrook BSP. The recommended size for the new circuits would be 300 mm² Upas 75° C AAAC AL5 and reconductor the existing J route from East Yelland Tee to Barnstaple BSP.

A 132 kV busbar at or around Barnstaple will be needed to feed the new Fullabrook BSP. Due to the high interconnectivity of Barnstaple, East Yelland and potentially the new BSP it would make it more resilient for outages.

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

Option 3 – Transfer demand to other BSPs

Capacity Released for constraint(s) considered: 0 MVA

Discounted

Detailed description: This option has been discounted due to the geographical isolation of both Barnstaple and East Yelland and reduced interconnection.

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

Option 5 – ANM

Capacity Released for constraint(s) considered: 0 MVA

Viable

Detailed description: ANM could help this area before reinforcement is done and when the network gets overcommitted on generation which is likely. Reinforcement would still need to happen as the more pressing issue is related to demand.

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

Option 6 – Procure flexibility

Estimated Flexibility Required (MVA): 1 MVA+

Viable

Detailed description: Flexibility services could be procured at or around Barnstaple and East Yelland.

Solution Recommendation

It may be possible to procure flexibility at Barnstaple or East Yelland BSP to defer the reinforcement requirements, subject to a cost benefit analysis confirmation through the DNOA process.

However, longer term a dual circuit tower line between Alverdiscott GSP and the J Route tee towards Barnstaple and reinforcing the remaining circuit to Barnstaple will be needed to facilitate the proposed Fullabrook BSP. There may be space constraints at Alverdiscott GSP in terms of 132 kV bays which will need addressing with conversations with the Transmission Operator. This option would ensure there is enough capacity in the group to get the network into 2050.

3.3 Indian Queens SGT 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
Indian Queens SGT capacity	Arranged outage of 120 breaker at Indian Queens GSP	Loss of Indian Queens 205 circuit	2028	2029	2030	2028 (generation)
Indian Queens SGT capacity	Fault of Main 2 at Indian Queens GSP	None	2028	2029	2030	2028 (generation)

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2027 and under falling short is it predicted to arise in 2029.

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	New GSPs	✓	✓	✓	Viable
2	Reinforce 132 kV circuit to transfer demand to Landulph GSP	×	✓	×	Viable
Operational Mitigation					
3	Transfer demand to other GSPs	×	×	×	Discounted
Load Management Schemes					
4	ANM	×	✓	×	Viable
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.

A number of the options discussed below involve works on the transmission network and will therefore require a modification application and discussions with NGET and National Grid ESO to ensure the optimal solution for the whole system (considering both the distribution and transmission systems) is taken forward.

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 Indian Queens GSP substations.

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

Option 1 – New GSPs

Capacity Released for constraint(s) considered: 240 (maybe 480) MVA

Viable

Detailed description: A new GSP will be needed in the area in or around Truro at first and a new GSP at Rame. This is if the discussions and CBAs between transmission and distribution agree with this solution.

To build these two new GSPs, long 400 kV circuits would be required. Indian Queens to Truro being about 17 km and Truro to Rame an additional 17 km.

For the next 10 years only one new GSP would be needed with the location to be discussed with transmission. But up to the 2050s the next GSP will be needed or two extra SGTs at the new GSP.

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

Option 2 – Reinforce 132 kV circuit to transfer demand to Landulph GSP

Capacity released for constraint(s) considered: 20 MVA

Viable

Detailed description: Adding an extra circuit between Landulph GSP and St Germans BSP will deload Indian Queens slightly deferring the need of a new GSP back by two years. This circuit may require changing some of the single circuit tower lines with double circuit towers and add an extra circuit of at least 175 mm^2 AAAC conductor operating at 75° C, and reprofile the current circuit to 65° C.

This would be a temporary solution that will also simplify and help with the St Germans GT constraint now and in the future when GTs get replaced as it would evenly load them.

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

Option 3 – Transfer demand to other GSPs

Capacity Released for constraint(s) considered: 0 MVA

Discounted

Detailed description: Not possible without reinforcement.

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

Option 4 – ANM

Capacity Released for constraint(s) considered: 0 MVA

Viable

Detailed description: ANM could help this area before reinforcement is done and when the network gets overcommitted on generation which is likely. Reinforcement would still need to happen alongside it.

The option of reducing outage window was not considered due to the issues being both generation and demand which limits the ability for reducing outage windows.

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

Option 5 – Procure flexibility

Estimated Flexibility Required (MVA): 20 MVA+

Viable

Detailed description: Flexibility services could be procured at or around Indian Queens and Alverdiscott GSPs.

Solution Recommendation

It may be possible to procure flexibility at Indian Queens and Alverdiscott GSPs to defer the reinforcement requirements, subject to a cost benefit analysis confirmation through the DNOA process.

However, longer term a new circuit between Landulph GSP and St Germans BSP will deload Indian Queens. Deferring reinforcement by about two years.

A new GSP at or around Truro will be needed in the next ten years. This will help with SGT capacity at Indian Queens and with the 132 kV circuit in the West of Cornwall capacity.

3.4 West of Cornwall 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 3.4.1 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
A route capacity between Fraddon Tee and Camborne and Fraddon Tee and Indian Queens 305	Arranged outage of 120 breaker at Indian Queens GSP	Loss of Indian Queens 205 circuit	Baseline	Baseline	Baseline	2026
Circuit capacity between Fraddon Main 2 and Indain Queens 105	Arranged of Indian Queens 205 leg	Fault of Indian Queens 405 circuit	2028	2028	2028	2030
CC route capacity between Hayle 203 and Rame 105	Fault of Main 2 at Indian Queens GSP	None	Baseline	Baseline	Baseline	Baseline
L route circuit capacity between Fraddon Main 2 and Rame 303	Arranged of Indian Queens 205 leg	Fault of Indian Queens 405 circuit	2028	2028	2028	2030
AU route capacity Indian Queens 205 or 405 to Fraddon	Loss of one A route circuit	Loss of the other A route circuit	2034	2034	2034	2034
BM route capacity between Truro and Rame	Loss of one A route circuit	Loss of the other A route circuit	2034	2034	2034	2034
Hayle to Camborne circuit capacity	Loss of one infeed into Camborne	Loss of another infeed into Camborne	2034	2034	2034	2034
Hayle 103 CC circuit capacity	Loss of one infeed into Camborne	Loss of another infeed into Camborne	2034	2034	2034	2034

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 3.4.2 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	New GSPs	✓	✓	×	**Viable**
2	Replace A route towers with double circuit and add an extra 132 kV circuit	✓	✓	✓	**Viable**
3	Camborne to Rame cable (currently being built) and uprate CC route	✓	✓	×	**Viable**
4	L route reinforcement	✓	✓	✓	**Viable**
5	New double 132 kV circuit to Fraddon BSP	✓	✓	✓	**Viable**
6	Reprofile BM route	✓	✓	✓	**Viable**
Operational Mitigation					
	None				
Load Management Schemes					
7	ANM	×	✓	×	**Viable**
Flexibility services					
8	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 Indian Queens GSP due the West of Cornwall group being over 300 MW of demand and into Class E, which means for an n-2 no demand can be dropped.

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

Option 1 – New GSPs

Capacity Released for constraint(s) considered: 240 (maybe 480) MVA

Viable

Detailed description: A new GSP will be needed in the area in or around Truro at first and a new GSP at Rame. This is if the discussions and CBAs between transmission and distribution agree with this solution.

To build these two new GSPs long 400 kV circuits would be required. Indian Queens to Truro being about 17 km and Truro to Rame another 17 km.

For the next 10 years only one new GSP would be needed with the location to be discussed with transmission. But up to the 2050s the next GSP will be needed or two extra SGTs at the new GSP.

Circuit reinforcement will still need to be done even if this goes ahead as delivery of such a scheme will be very lengthy. There is a danger of leaving some interconnecting circuits with too much capacity once the GSP or GSPs are built.

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

Option 2 – Replace A route towers with double circuit and add an extra 132kV circuit

Capacity released for constraint(s) considered: 20 MVA

Viable

Detailed description: This option would require a new circuit from the A route Fraddon tee. It would be recommended to reconductor the existing circuit between Fraddon tee and Camborne to 300 mm² Upas 75° C AAAC and the new circuit to match that too. However, the circuits between Fraddon Tee and Indian Queens should be upped to 500 mm² Rubus 75° C AAAC which would then support Fraddon and Camborne. This option would also solve the CC-route constraint and the Hayle to Camborne circuit overloads in the future.

In the future a third busbar section may be needed at Camborne to continue the Hayle Rame ring connecting to a future Truro GSP or Rame GSP.

This matches the proposal of having Camborne, Fraddon and St Austell fed from Indian Queens and the remaining BSPs from the other GSP or GSPs.

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

Option 3 – Camborne to Rame cable (currently being built) and uprate CC route

Capacity Released for constraint(s) considered: 100 MVA

Viable

Detailed description: A Camborne to Rame cable is being built with enough capacity to add Penzance BSP off it. This will also solve some constraints on the cc route as the n-1 position will become the n-2 position.

There is also a 500 m section of 132 kV Trident line from circuit breaker 105 to the teeto the Fraddon circuit that may need to be undergrounded and at least 800 mm² XLPE Cu cable put in, in case Rame becomes a GSP or a tower line with 500 mm² Rubus 75°C AAAC AL5.

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

Option 4 – L route reinforcement

Capacity Released for constraint(s) considered: 150 MVA

Viable

Detailed description: L route will need to be reinforced with larger conductor which means it will need to become a tower line circuit. Ideally it will need to be 500 mm² Rubus 75° C AAAC AL5 to support a new BSP in the Truro area. This line is about 32 km denoting the amount of works needed in the area.

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

Option 5 – New double 132 kV circuit to Fraddon BSP

Capacity Released for constraint(s) considered: 114 MVA

Viable

Detailed description: New circuit from Indian Queens to Fraddon will be needed to deload AU route as they are already of a very large size. This option may not be needed if Truro or Rame GSP is built before the constraint is predicted to appear (around 2034).

Small double circuit tower line could be used which will need to support at least 200 mm² Poplar 75° C AAAC AL5. This circuit will have a length of approximately 4 km.

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

Option 6 – Reprofile BM route

Capacity Released for constraint(s) considered: 45 MVA

Viable

Detailed description: BM route will need to be reprofiled to be able to operate at 75° C this is about 16 km of line. It will get the network past 2034.

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

Option 7 – ANM

Capacity Released for constraint(s) considered: 0 MVA

Viable

Detailed description: ANM could help this area before reinforcement is done and when the network gets overcommitted on generation which is likely. Reinforcement would still need to happen alongside it.

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

Option 8 – Procure flexibility

Estimated Flexibility Required (MVA): 20 MVA+

Viable

Detailed description: Flexibility services could be procured at or around Indian Queens GSP.

Solution Recommendation

It may be possible to procure flexibility at Indian Queens and Alverdiscott GSPs to defer the reinforcement requirements, subject to a cost benefit analysis confirmation through the DNOA process. Once it becomes a generation issue it will need to be reinforced.

However, longer term it is recommended to continue conversations with the Transmission Operator to establish at least one GSP west of Indian Queens with suggested locations to be around Truro or Rame BSPs.

As the above will be a lengthy process some reinforcement of the 132 kV will be needed. Mainly converting the A route to a dual circuit which will future proof putting Camborne onto Indian Queens. Uprate a small section of CC route to the Truro and Fraddon tee.

The rest of the above reinforcement option 4, 5 and 6 will be needed in due course and needs to be worked through to see if a GSP will be built before the need for the circuit reinforcement.

3.5 AY 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 3.5.1 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
AY route circuit capacity (Indian Queens to St Austell)	Loss of St Austell GT1 to Indian Queens 605 circuit	Loss of St Germans GT2	2028	2029	2030	2028 (generation)

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 3.5.2 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	Reinforce AY route	✓	✓	✓	Viable
2	Reinforce 132 kV circuit to transfer demand to Landulph GSP	✓	✓	✓	Viable
Operational Mitigation					
	None				
Load Management Schemes					
3	ANM	×	✓	×	Viable
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 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 Austell BSP.

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

Option 1 – Reinforce AY route

Capacity Released for constraint(s) considered: 70 MVA

Viable

Detailed description: Option 2 and option 1 will be mutually exclusive in a ten year timeframe. This option consists in reconductoring 2 km section between St Austell and Indian Queens with 300 mm^2 Upas AAAC AL5.

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

Option 2 – Reinforce 132 kV circuit to transfer demand to Landulph GSP

Capacity released for constraint(s) considered: 114 MVA

Viable

Detailed description: Adding an extra circuit between Landulph GSP and St Germans BSP will deload Indian Queens slightly deferring the need of a new GSP back by two years. This circuit may require changing some of the single circuit tower lines with double circuit towers and add an extra circuit of at least 200 mm^2 Poplar AAAC AL5 conductor operating at 75° C, and reprofile the current circuit to 65° C, the length of the new circuit would be about 10 km.

This would be a temporary solution that will also simplify and help with the St Germans GT constraint now and in the future when GTs get replaced as it would evenly load them.

This option would solve the loading issues on the AY route for the next ten years.

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

Option 3 – ANM

Capacity Released for constraint(s) considered: 0 MVA

Viable

Detailed description: ANM could help this area before reinforcement is done and when the network gets overcommitted on generation which is likely. Reinforcement would still need to happen alongside it.

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

Option 4 – Procure flexibility

Estimated Flexibility Required (MVA): 5 MVA+

Viable

Detailed description: Flexibility services could be procured at or around Indian Queens GSP.

Solution Recommendation

It may be possible to procure flexibility at St Austell BSP and St Germans BSP to defer the reinforcement requirements, subject to a cost benefit analysis confirmation through the DNOA process. Once it becomes a generation issue it will need to get reinforced.

However, longer term it is recommended to build a new circuit between Landulph GSP and St Germans BSP taking it off Indian Queens GSP completely which will help with the AY route circuit capacity and Indian Queens GSP loading issues.

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