West Wales 33 kV Network
(Carmarthen BSP, Ammanford BSP, Rhos BSP, Llanarth BSP and Lampeter BSP)

Network Development Report – South Wales

May 2024

Electricity Distribution

nationalgrid

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West Wales 33 kV Network (covering Carmarthen BSP, Ammanford BSP, Rhos BSP, Llanarth BSP and Lampeter BSP)

1. Network Overview

To the west of the South Wales licence area is a very large geographic area covered by an interconnected 33 kV group referred to as the West Wales Network. This group encompasses most of the area which is supplied by NGED north and west of Swansea city, excluding the environs of Milford Haven and Pembroke Dock. Supplied by two pairs of 132 kV circuits out of Swansea North GSP, these five BSPs have an extended interconnected 33 kV network between them.

Supplied from a total of seven Grid Transformers (GTs) distributed between the five Bulk Supply Points (BSPs), the 33 kV and below networks supply approximately 89,500 customers.

Figure 1.1 – West Wales – Carmarthen, Ammanford, Rhos, Llanarth and Lampeter BSPs geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon associated with the 33 kV circuits and primary substation transformers which are supplied by the West Wales Network. 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 West Wales Network is arranged as follows:

- Ammanford BSP is supplied by two 132 kV circuits on the PP/C Routes from Swansea North GSP, feeding a pair of 60 MVA GTs. Ammanford has four Primary substations connected to it directly but also provides a single 33 kV circuit into the larger interconnected part of the 33 kV network.
- Carmarthen BSP is supplied by two 132 kV circuits on the B/C/V Routes from Swansea North GSP, supplying a 132 kV bar. Two GTs feed into the interconnected 33 kV network from here and two 132 kV circuits continue onwards to Rhos BSP on the H Route.
- Rhos BSP also has a 132 kV bar, supplying a single GT feeding into the interconnected network and two single 132 kV circuits which continue further.
- Each of these two 132 kV circuits provides supplies an additional GT at Llanarth BSP and Lampeter BSP respectively before crossing into SP Manweb's distribution area where they take supplies for their substations at Rhydlydan and Aberystwyth.
- The interconnected 33 kV network between these five BSPs supplies nineteen Primary Substations, these are mostly small and supplying largely rural areas.
- Generation connections have been made at all voltage levels of this network, including several large scale wind farms at 132 kV.
- For a more detailed depiction of this network's topology, please consult the Long Term Development Statement for the relevant diagrams

Several reinforcement schemes beyond the current topology are already in development and are expected to be constructed in the near future. Whilst each of these schemes has been justified for localised network constraints, some also contribute towards the long term strategy to split this interconnected group into smaller BSP groups.

- Rhos BSP second Grid Transformer.
    - The N-2 loss of both Carmarthen GTs or alternatively a combination of Rhos 33 kV Main 1 plus one of the remaining two 33 kV infeeds to Rhos 33 kV lead to overloads elsewhere on remaining assets.
    - The proposed works include a new 132 kV circuit breaker bay on Rhos 132 kV Main 2, the re-use of a 45 MVA GT coming out of another site and the extension of the 33 kV bar to connect the new GT to Rhos 33 kV Main 2.
    - The scheme is anticipated to be completed by 2025.
    - This scheme contributes to the long term strategy by permitting Rhos BSP to not require support from adjacent groups in the future.
- Second 33 kV circuit to Aberaeron Primary
    - Load growth at Aberaeron has meant that supplying the substation's demand during an outage of the single 33 kV circuit has become increasingly difficult.
    - It is proposed to construct a second 33 kV circuit from Llanfihangel Ystrad Primary to Aberaeron, a second 33/11 kV transformer at Aberaeron and associated reconfiguration of the 33 and 11 kV bars.
    - The scheme is expected to be complete by 2027

    - This scheme contributes towards the long term strategy by creating a 33 kV ring out of Llanarth BSP and potentially permitting the sites between Llanarth and Lampeter BSPs to be operated securely out of only Llanarth BSP. Alternatively the additional route will allow for greater interconnection between Llanarth and Lampeter should they stay together.

- Second 33 kV circuit to Llanfyrnach Primary
    - Load growth at Llanfyrnach has meant that supplying the substation's demand during an outage of the single 33 kV circuit has become increasingly difficult.
    - It is proposed to construct a second 33 kV circuit from St Clears Primary to Llanfyrnach, a second 33/11 kV transformer at Llanfyrnach and associated reconfiguration of the 33 and 11 kV bars.
    - The scheme is expected to be complete by 2027
    - Whilst this scheme won't assist the long term strategy it will help within a future Carmarthen BSP group as it permits Llanfyrnach to be fed from an alternative short route from Carmarthen rather than the current arrangement where it might be fed the long way around via Whitland Primary
- New Primary substation at Carmarthen West
    - Demand connection at Trevaughan Primary are prospectively causing the Primary to be out of firm capacity. A new substation site is proposed close to the BSP and closer to many of the new developments to supply the various new demands.
    - The Carmarthen West 33/11 kV primary substation shall be fed by two dedicated 33 kV outdoor circuit breaker bays at Carmarthen BSP which will be cable connected to two 12/24 MVA transformers that will feed an extensible 9-panel 11 kV switchboard. This primary substation will permit 23 MVA of capacity which will be used to de-load nearby primary substations such as Trevaughan and St Clears and ensure adequate demand headroom is available throughout ED2 period and beyond.
    - The scheme is expected to be complete by 2026
    - This scheme also does not contribute greatly towards the long term strategy in the group however it might be a useful location of transfer capacity to de-load adjacent sites, such as Cwmffrwd Primary.

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.

- Due to the complexity of this interconnected 33 kV group, it is quite common that additional switching actions are required during arranged outage conditions to ensure network integrity and demand security for the faults that may potentially follow. It is difficult to describe these actions with rigorous definitions as they are often dependant on the prevailing load of the network due to seasonal variations in the apparent demands and generation expectations.
- This uncertainty in operations makes it difficult to study this network using the typical assessment methodology. Normally results which are demonstrating potential non-compliances could be resolved with deterministic operational schemes however in this network there are legitimate potential issues without a specifically defined resolution; which in the real world would be resolved operationally by one means or another. These potential non-compliance issues might be overshadowing some legitimate issues. More comprehensive studies are required for this complex network in order to further improve the understanding of its behaviour under prospective future loading scenarios. Further collaboration with other stakeholders in the business will be required to appreciate how they might operate the network if it was to develop in the various scenario directions.
- Whilst any required additional operational actions would be reviewed on a per-outage basis, the following schemes could be anticipated under most conditions:
    - The 33 kV bypass isolator 2L3B at Blaenporth Primary is normally closed if the 33 kV ring out of Rhos BSP via Bridell/Cardigan is broken for outages of the Blaenporth 33 kV bar.
    - The Troste to Ammanford interconnectors via Tumble Primary may be switched in for outages of Ammanford GTs to support that site.

2. Summary of Network Constraints

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

- 33 kV reinforcement of the Bridell/Cardigan/Blaenporth area
- Bridell Primary transformer replacement
- 33 kV reinforcement of the Llandovery area
- 33 kV reinforcement to Tregaron Primary

3. Network Constraint Details and Solution Options

3.1 33 kV reinforcement of the Bridell/Cardigan/Blaenporth area

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 intermediate cool 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
33 kV circuit between Rhos BSP and Bridell Primary	Llanarth BSP to Blaenport Primary 33 kV circuit	Rhos BSP to Blaenport Primary 33 kV circuit	2032	2032	2033	2034
Rhos BSP to Blaenport Primary 33 kV circuit	33 kV circuit between Rhos BSP and Bridell Primary	Llanarth BSP to Blaenport Primary 33 kV circuit	2028	2027	2027	2030
Llanarth BSP to Blaenport Primary 33 kV circuit	Rhos BSP to Blaenport Primary 33 kV circuit	33 kV circuit between Rhos BSP and Bridell Primary	2029	2028	2028	2031

Uncertainty under other Distribution Future Energy Scenarios: Under the Leading the Way scenario the thermal constraints are forecast by 2025, under Consumer Transformation by 2026, under System Transformation by 2027 and under Falling Short by 2028.

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	Install capacitors and re-profile lines	✓	✓	✓	Viable
2	Reinforce the existing 33 kV circuits	✓	✓	✓	Viable
3	Construct a fourth 33 kV circuit	✓	✓	✓	Viable
Operational Mitigation					
4	Transfer demand at 11 kV	×	×	×	Discounted
Load Management Schemes					
5	Post-fault transfers	×	×	×	Discounted
Flexibility services					
6	Procure flexibility across the group	✓	×	✓	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 DNO to determine the optimal reinforcement solution, which will then be tested against market provided flexibility by the 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 the conditions described above. This would lead to an inability to meet the Security of Supply requirements of Engineering Recommendation P2 for the West Wales Network

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

Option 1 – Install capacitors and re-profile lines

Capacity Released for constraint(s) considered: Approximately 2-6 MVA **Viable**

Detailed description: The existing circuits are constructed of 100 mm^2 AAAC AL3 "Oak" conductor, a typical medium conductor. Due to the high forecast loadings and long distances involved with this area the voltage performance of the network is eventually unsatisfactory with thermal issues following shortly thereafter. It is plausible that the thermal rating of the line could be improved by re-surveying the clearances and increasing the maximum operating temperature of the line. It is likely that the voltage performance will become an issue before the thermal limit is reached but this can be improved with the use of reactive compensation. This reactive compensation would still be useful even if the lines were eventually replaced so it is a worthwhile investment. The three potentially constraining circuits into this network area would all need re-profiling under this scenario, at various times based on their current thermal rating and the particular requirements under the relevant worst case outages.

New limiting factor for constraint(s) considered: Assuming the voltage issues are resolved with reactive compensation, the best possible rating out of the 100 mm^2 Oak, at 75^{0}C, is 23.3 MVA winter cyclic

Option 2 - Reinforce the existing 33 kV circuits

Capacity released for constraint(s) considered: 14.9 MVA **Viable**

Detailed description: If, or when, the re-profiling is inadequate the conductor could be replaced on the existing route to further improve both the thermal rating and the voltage performance through reduced circuit impedance. A typical conductor choice might be 175 mm^2 AAAC AL3 "Elm", however if any of the structure heights would require a greater than 10% increase then new consents would be needed so a compromise size might be necessary.

New limiting factor for constraint(s) considered: 175 mm^2 AAAC AL3 "Elm" at 75^{0}C, is 34.0 MVA winter cyclic rated

Option 3 - Construct a fourth 33 kV circuit

Capacity released for constraint(s) considered: 34.0 MVA **Viable**

Detailed description: An alternative to Option 2 would be to construct an entirely new route into the area. This will probably take more time and cost due to the consenting and additional substation works however if any of the existing routes prove impracticable then this option may be necessary.

If future developments of the 132 kV network would permit Llanarth BSP to have a second 132 kV infeed then a 33 kV circuit between Llanarth BSP and Blaenporth Primary might be recommendable in order to remove Blaenporth Primary from the constrained area for most conditions. If this is not the case then a rearrangement of Rhos 33 kV bar might be pursued instead. A third bar section could be created there from which a new circuit into the area of constraint could be taken, the ideal destination being a tee off of the 33 kV circuit between Bridell and Cardigan.

New limiting factor for constraint(s) considered: The best possible rating out of the existing 100 mm^2 Oak circuits, now at 75^{0}C, is 23.3 MVA winter cyclic, but at least one less Primary substation would need be fed from this.

Option 4 – Transfer demand at 11 kV

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

Detailed description: This network area does not have adequate 11 kV transfers available, the adjacent networks are quite distant.

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: As with Option 4, there are inadequate available transfers to provide a long term solution

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

Option 6 – Procure flexibility across the group

Estimated Flexibility Required (MVA): 8 MVA by 2034 (Best View) — Viable

Detailed description: Flexibility services could be procured to alleviate projected overloads in the short term. This could defer reinforcement but due to the large quantity of flexibility required in the long term this may not be a viable permanent solution. Given the complexity of the probable solutions in this network, the available flexibility should be tested for use in scheduling and constraint deferral.

Solution Recommendation

It is recommended to proceed with Option 2 when required and if Option 1 is insufficient, installing any necessary reactive compensation and performing the required survey work to understand what might be possible with the existing linear assets. From there a more complete plan for re-conductoring or new routes can be developed.

Following this and if Option 2 is not practical or further reinforcement is required Option 3 may be pursued.

3.2 Bridell Primary transformer replacement

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 intermediate cool 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
Bridell Primary transformer thermal capacity	The opposite Bridell Primary transformer	n/a	2029	2028	2028	2030

Uncertainty under other Distribution Future Energy Scenarios: Under the Leading the Way scenario the thermal constraints are forecast by 2029, under Consumer Transformation by 2032, under System Transformation by 2032 and under Falling Short it is beyond the period of assessment.

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	Replace the transformers	✓	✓	✓	Viable
2	Build a new primary substation	✓	✓	✓	Viable
Operational Mitigation					
3	Transfer demand at 11 kV	×	×	×	Discounted
Load Management Schemes					
4	Post-fault transfers	×	×	×	Discounted
Flexibility services					
5	Procure flexibility across the group	✓	×	✓	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 Bridell Primary

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

Option 1 – Replace the transformers

Capacity Released for constraint(s) considered: 15.3 MVA Viable

Detailed description: The existing units could be replaced, other works will be required to reach the full rating of the new units which may include civil works, replacement switchgear and renewed ancillaries.

New limiting factor for constraint(s) considered: 11.5/23 MVA rated units would be a typical choice to provide some additional capacity for future development.

Option 2 - Build a new primary substation

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

Detailed description: Considering that the above constraints discussed in section 3.1 may result in new or improved 33 kV circuits into this network area, it is plausible that a newly developed site might provide a better strategic outcome. The distribution of existing and future 11 kV demand would need to be assessed but if there was a location closer to Rhos BSP with sufficient load density then a new primary substation might solve both of these constraints with a single scheme by creating load transfer opportunities that don't currently exist.

New limiting factor for constraint(s) considered: 11.5/23 MVA rated units would be a typical choice to provide some additional capacity for future development.

Option 3 – Transfer demand at 11 kV

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

Detailed description: This network area does not have adequate 11 kV transfers available and the adjacent networks are quite distant.

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: As with Option 3, there are inadequate available transfers to provide a long term solution

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

Option 6 – Procure flexibility across the group

Estimated Flexibility Required (MVA): 4.5 MVA by 2034 (Best View) Viable

Detailed description: Flexibility services could be procured to alleviate projected overloads and could defer reinforcement. Given the complexity due to constraints in the wider area and the desire for a single solution, some degree of Flexibility could be practical.

Solution Recommendation

It is recommended to replace the Bridell Primary transformers when they become overloaded. Consideration should be made when the linear assets are being assessed to whether a new site might be useful instead.

3.3 33 kV reinforcement of the Llandovery area

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
Lampeter BSP to Pont Ar Anell Primary 33 kV circuit	Ammanford BSP to Llandeilo Primary 33 kV circuit	Cwnffrwd Primary to Towy Intake 33 kV circuit	2029	2029	2029	2034
Cwnffrwd Primary to Towy Intake 33 kV circuit	Lampeter BSP to Pont Ar Anell Primary 33 kV circuit	Ammanford BSP to Llandeilo Primary 33 kV circuit	2030	2029	2029	2034
Ammanford BSP to Llandeilo Primary 33 kV circuit	Cwnffrwd Primary to Towy Intake 33 kV circuit	Lampeter BSP to Pont Ar Anell Primary 33 kV circuit	2028	2031	2031	2033

Uncertainty under other Distribution Future Energy Scenarios: Under the Leading the Way scenario the thermal constraints are forecast by 2025, under Consumer Transformation by 2025, under System Transformation by 2026 and under Falling Short by 2026.

Solution Options

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

Table 3.3.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Install capacitors and re-profile lines	✓	✓	✓	Viable
2	Reinforce the existing 33 kV circuits	✓	✓	✓	Viable
3	Construct a fourth 33 kV circuit	✓	✓	✓	Viable
Operational Mitigation					
4	Transfer demand at 11 kV	×	×	×	Discounted
Load Management Schemes					
5	Post-fault transfers	×	×	×	Discounted
Flexibility services					
6	Procure flexibility across the group	✓	×	✓	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 the West Wales Network

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

Option 1 – Install capacitors and re-profile lines

Capacity Released for constraint(s) considered: Approximately 1-4 MVA **Viable**

Detailed description: The existing circuits are generally constructed of 0.1 sq.in HDC conductor, which gives relatively poor voltage performance compared to heavier conductors due to its higher resistance per unit length. Eventually the voltage performance of the network degrades sufficiently that the tap changers at the Primary Substations can no longer maintain regulation at the 11 kV bars. There is also a 33 kV demand customer embedded in this network to be considered.

Reactive compensation could be effective in the short to medium term to improve the voltage profile in the most extreme cases however the thermal rating of the lines is also approaching capacity. It may be possible to improve the thermal rating of the lines through increasing their running temperatures by surveying the line clearances to a higher level.

Considering future scenario demands it may be beneficial to have access to a capacitor bank to provide reactive compensation even if the more severe reinforcement below is subsequently undertaken.

New limiting factor for constraint(s) considered: 0.1 sq.in HDC conductor has a winter cyclic rating of 21.4 MVA at 75^{0}C

Option 2 - Reinforce the existing 33 kV circuits

Capacity released for constraint(s) considered: 9.3 MVA **Viable**

Detailed description: If, or when, the re-profiling is inadequate the conductor could be replaced on the existing route to further improve both the thermal rating and the voltage performance through reduced circuit impedance. Given an expectation of lighter construction of the existing route due to the smaller cross-sectional area a medium conductor might be possible without requiring the complete rebuild of the line and the revised consents that would entail.

New limiting factor for constraint(s) considered: Potentially a reconductoring with 150 mm^2 AAAC AL3 “Ash” at 75^{0}C, for a 30.7 MVA winter cyclic rating

Option 3 - Construct a fourth 33 kV circuit

Capacity released for constraint(s) considered: 34.0 MVA **Viable**

Detailed description: An alternative to Option 2 would be to construct an entirely new route into the area. This will probably take more time and cost due to the consenting and additional substation works however if any of the existing routes prove unworkable then this option may be necessary.

If future developments of the 132 kV network would permit Lampeter BSP to have a second 132 kV infeed then a 33 kV circuit between Lampeter BSP and Llandeilo Primary might be recommendable in order to remove create a 33 kV ring out of Lampeter and allow this network area to be split in line with the long term strategy. If this is not the case then a second circuit out of Ammanford BSP might be a better scheme to create a 33 kV ring out of that site.

New limiting factor for constraint(s) considered: 0.1 sq.in HDC conductor has a winter cyclic rating of 21.4 MVA at 75^{0}C, this would now only need to supply around half of the existing area of constraint.

Option 4 – Transfer demand at 11 kV

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

Detailed description: This network area does not have adequate 11 kV transfers available, the adjacent networks are quite distant.

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: As with Option 4, there are inadequate available transfers to provide a long term solution

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

Option 6 – Procure flexibility across the group

Estimated Flexibility Required (MVA): 4.8 MVA by 2034 (Best View) **Viable**

Detailed description: Flexibility services could be procured to alleviate projected overloads in the short term. This could defer reinforcement but due to the large quantity of flexibility required in the long term this may not be a viable permanent solution. Given the complexity of the probable solutions in this network, the available flexibility should be tested for use in scheduling and constraint deferral.

Solution Recommendation

It is recommended to proceed with Option 2 when required, installing any necessary reactive compensation to resolve the more imminent voltage problems and initiating the required survey work to understand what might be possible with the existing linear assets. From there a more complete plan for re-conductoring or new routes can be developed.

3.4 33 kV reinforcement to Tregaron Primary

Constraint Overview

Generation | Demand

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads seen for summer generation conditions.

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
Tregaron 33 kV circuit	None	None	n/a	n/a	n/a	2031

Uncertainty under other Distribution Future Energy Scenarios: Under the Leading the Way scenario the thermal constraints are forecast by 2032, under Consumer Transformation by 2033 and under System Transformation and Falling Behind it is beyond the scope of this assessment.

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	Negotiate power factors with incoming customers and re-profile the 33 kV line	✓	✓	✓	Viable
Operational Mitigation					
2	11 kV demand transfers to adjacent primaries	×	×	×	Discounted
Flexibility services					
3	Procure flexibility at Tregaron Primary	×	×	×	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.

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

Option 1 –Power factor review of area generation and re-profile the 33 kV line

Capacity Released for constraint(s) considered: 4.1 MVA **Viable**

Detailed description: This constraint is primarily a voltage rise constraint, it is important that the incoming generation customers generate with a leading power factor to avoid exacerbating it. Eventually it is also a thermal constraint. As only a small capacity uplift would be required to meet the requirement a reprofiling assessment could increase capacity sufficiently to avoid replacing the conductor.

New limiting factor for constraint(s) considered: The best possible rating for the existing conductor at 75^0C is 23.3 MVA

Option 2 – 11 kV demand transfers to adjacent primaries

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

Detailed description: Tregaron Primary is very remote from the rest of the network, transfers will be quite difficult.

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

Option 3 – Procure flexibility at Tregaron Primary

Estimated Flexibility Required (MVA): N/A **Viable**

Detailed description: We do not currently procure generation turn down flexibility services due to limitations in internal tooling. However we are looking to build out this capability, which should be available before intervention is needed. Separate flexibility procurements could be made for each site.

Solution Recommendation

It is recommended that Option 1 is pursued and the generation applications at Tregaron are managed to avoid creating a voltage rise issue. When necessary, consideration of reprofiling the line should be made.

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