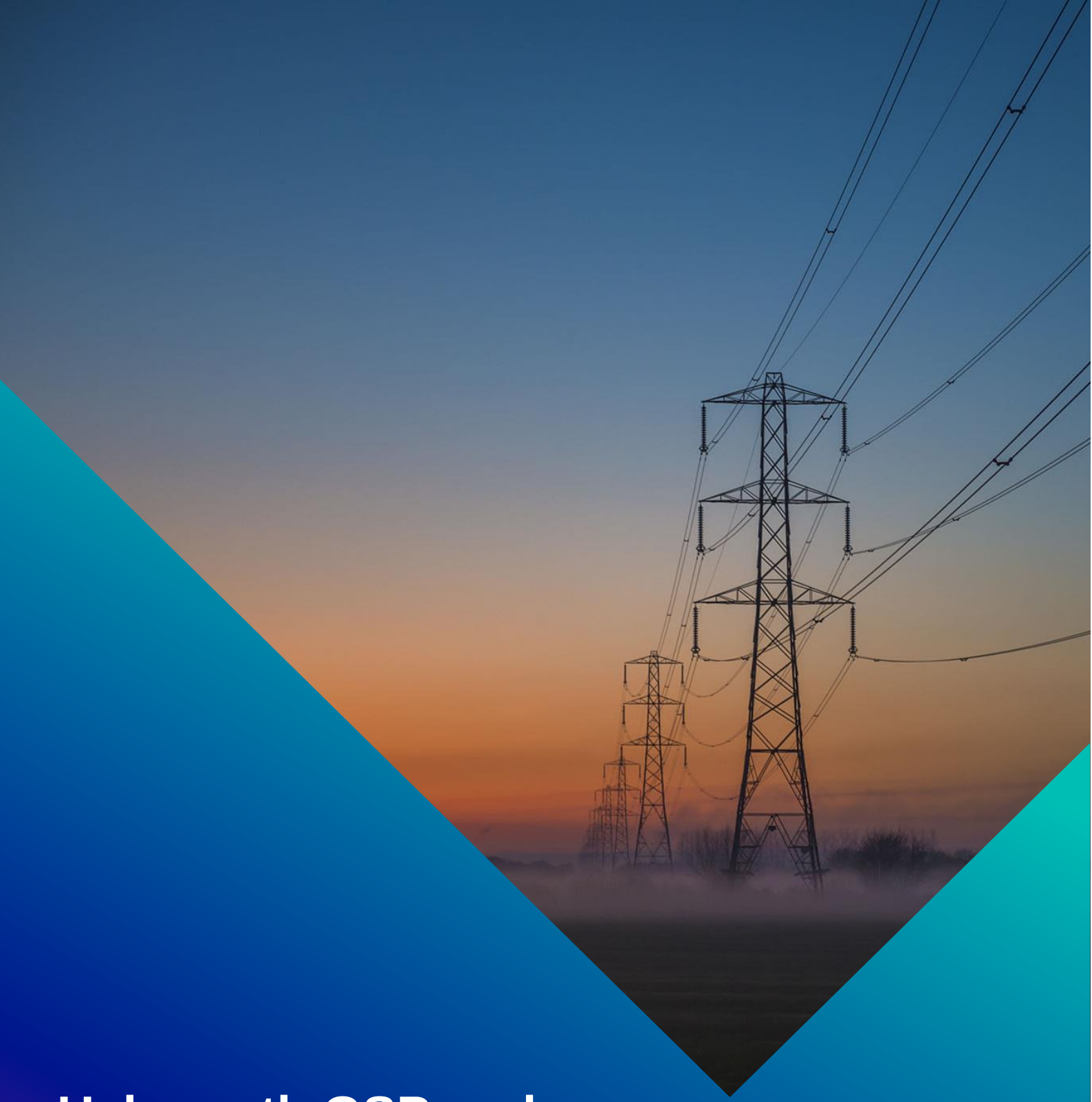

Uskmouth GSP and Associated 132 kV Network

Network Development Report – South Wales

May 2024

Electricity Distribution

nationalgrid

Contents

Uskmouth GSP and Associated 132 kV Network 2

1. Network Overview 2
1.1 Network Topology 3
1.2 Network Operability Modelling 3

2. Summary of Network Constraints 4

3. Network Constraint Details and Solution Options 5
3.1 Uskmouth GSP fourth Supergrid Transformer 5
3.2 Sudbrook BSP Grid Transformer replacement 8
3.3 Newport area new primary substation 10
3.4 Llantarnam BSP new local primary 12

Uskmouth GSP and Associated 132 kV Network

1. Network Overview

Uskmouth Grid Supply Point (GSP) supplies a mixed area of 132 kV network in the South Eastern corner of Wales, bordering England, with an urban demand centre around Newport city and a large and more rural area with sparse industrialised pockets into the valleys to the north.

Supplied from three 400/132 kV SGTs at Uskmouth GSP, the 132 kV and below networks supply approximately 100’000 customers.

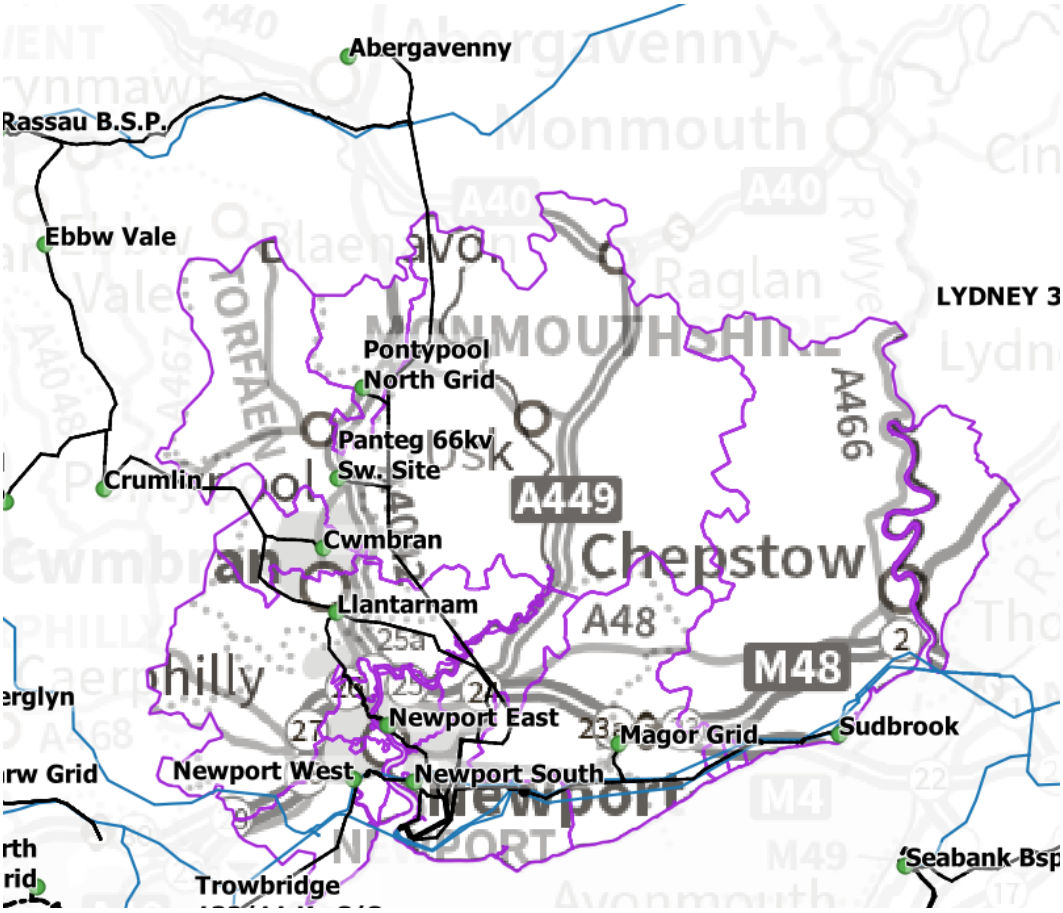

Figure 1 - Uskmouth GSP geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon associated with the SGT transformers, 132 kV circuits and Bulk Supply Point 132 kV transformers which are supplied by Uskmouth GSP. 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 Uskmouth GSP network is arranged as follows:

- Uskmouth GSP is supplied from an on-site 275 kV two section double busbar owned by NGET, which is supplied by 275 kV circuits from South Wales and the West of England.
- Three Supergrid Transformers supply a 132 kV two section double busbar.
- The 132 kV bar is normally run solid. A legacy of high fault level due to a former power station at the site has left a series reactor bridging the bar sections which was previously used to connect a split busbar arrangement. This is normally run in-service although it provides little utility in the current arrangement except under specific outage conditions.
- Five double circuit tower lines radiate into the Uskmouth GSP area, supplying a total of nine Bulk Supply Points.
- One of these tower lines (R-Route) crosses into the Cardiff/Aberthaw GSP group and two (L-Route and J-Route) cross into the Rassau GSP group.

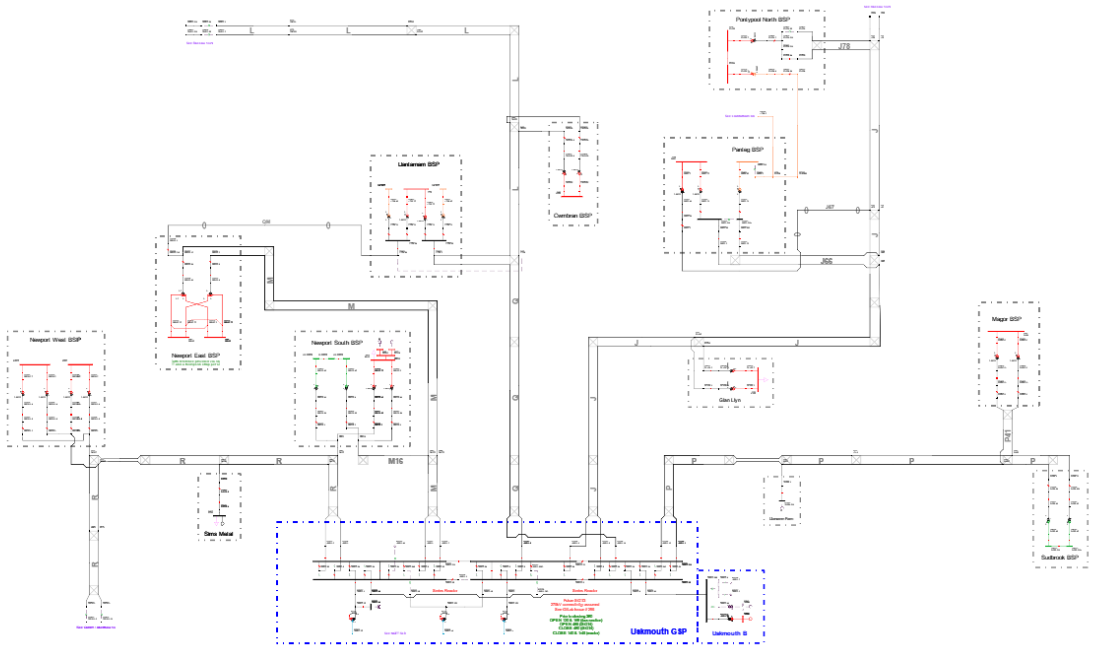

Figure 2 - Uskmouth GSP Single Line Diagram

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 interconnection between the adjacent circuits on many of the tower lines, through the respective BSPs Grid Transformers and their lower voltage bars which are normally run solid, there is a risk that power could flow into a circuit from the adjacent circuit on the tower if the source circuit breaker at the GSP had opened. To control this risk, many of the circuits on this network are equipped with intertripping protection which ensures that all ends of a circuit are cleared for faults detected by the source breakers at the GSP. These schemes are reasonably complex as depending on the state of the network at the instant of the fault occurs a different selection of breakers are required to operate.
- Some 132 kV arranged outages in the adjacent Rassau GSP group require the transfer of BSPs into Uskmouth GSP, to avoid potential overloads for the faults that may follow. Crumlin BSP is commonly transferred, Ebbw Vale BSP and Panteg BSP are less commonly transferred.

2. Summary of Network Constraints

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

- Uskmouth GSP fourth Supergrid Transformer
- Sudbrook BSP Grid Transformer replacement
- Newport area new primary substation
- Llantarnam BSP new local primary

3. Network Constraint Details and Solution Options

3.1 Uskmouth GSP fourth Supergrid Transformer

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. The constraint is managed in the winter period by avoiding the arranged outage during this time.

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
Uskmouth SGT overload	Arranged outage of a SGT	A fault of a second SGT	Baseline	2025	2025	2028

Uncertainty under other Distribution Future Energy Scenarios: Due to the relatively short duration until this constraint, there is little divergence of timing in its emergence between scenarios. Higher loading scenarios might bring it forwards to 2024 which would be managed with a reduction of the available N-1 outage window.

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 a fourth SGT	✓	✓	✓	Viable
2	Construct a new GSP	✓	✓	×	Discounted
Operational Mitigation					
3	Transfer demand at 132 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 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.

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 Uskmouth GSP

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

Option 1 – Install a fourth SGT

Capacity Released for constraint(s) considered: 180 MVA ⬆ **Viable**

Detailed description: At this time SGT4A is connected to both 132 kV bar sections such that it can be connected to either as required. This will be split and a new SGT will supply one of these two incoming breakers. The expected new running arrangement is for the two 132 kV bar sections to be run normally split with two SGTs on each; the series reactor being used to bridge the sections and improve load balance during faults. Under SGT outage conditions it is expected that the bar will be made solid.

This reinforcement scheme is associated with a large contracted Connection Offer however the constraint will happen without them in a similar timeframe. If the new connection were not to proceed then the constraint may be more manageable with flexibility services and supervision of available outage window for the arranged outage. A strategic assessment of the combined area might be required if this approach is considered as the adjacent GSPs also have large and complex connection led reinforcement schemes and it may not be possible to schedule conflicting outage window requirements.

New limiting factor for constraint(s) considered: Raising to four SGTs, there will now be two SGTs remaining during an N-2 outage for potentially 480 MVA of capacity.

Option 2 - Construct a new GSP

Capacity released for constraint(s) considered: 240 MVA ⬇ **Discounted**

Detailed description: Instead of reinforcing the existing Uskmouth GSP a separate GSP could be constructed and the load divided between these sites. A typical minimum build GSP would include two new SGTs supplying a new 132 kV bar. This option would require significantly more assets to be deployed for only a marginal improvement in released capacity so has been discounted.

New limiting factor for constraint(s) considered: Capacity of the two new SGTs.

Option 3 – Transfer demand at 132 kV

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

Detailed description: During N-1 conditions at Uskmouth GSP it would be possible to transfer BSPs out of the group to adjacent groups on the interconnecting circuits. Unfortunately the adjacent groups have 132 kV circuit constraints (Cardiff/Aberthaw GSP) or SGT constraints (Rassau GSP) caused by large new connections which prevent effective load transfers away from Uskmouth. If these connections were to not proceed then this option may increase in viability in the future.

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: By utilising the short term ratings of the SGTs at Uskmouth it would be possible to consider holding an overload on the remaining SGT for a sufficient duration, the issue remains where to transfer it too with the adjacent groups also being constrained. Depending on the timing and quantity of growth this option may be useful for periods in the future.

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

Option 5 – Procure flexibility across the group

Estimated Flexibility Required (MVA): 140 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 flexibility of the 132 kV network in transferring large tranches of load and the possibility that the timing in the deployment of large new connections might vary in both this and adjacent groups, it should be investigated what quantity of Flexibility Services might be available to call on.

Solution Recommendation

It is recommended to proceed with the contracted position of installing an additional SGT at Uskmouth GSP. It may be beneficial to test the market for flexibility procurement potential as the site will exceed its capacity without their connection and a delay on their part might delay the deployment of the reinforcement.

3.2 Sudbrook BSP Grid 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 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
A Sudbrook BSP GT overload	Fault or outage of the other GT	None	2034	N/A	N/A	N/A

Uncertainty under other Distribution Future Energy Scenarios: Under Consumer Transformation and Leading the Way the constraint is forecast by 2032, under Falling Short and System Transformation 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 existing Grid Transformers	✓	✓	✓	**Viable**
2	Build new 33 kV circuits to transfer demand	✓	✓	×	**Discounted**
Operational Mitigation					
3	11 kV demand transfers to adjacent BSPs	✓	×	✓	**Viable**
Load Management Schemes					
4	Post-fault transfers	×	×	×	**Discounted**
Flexibility services					
5	Procure flexibility for Sudbrook 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 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 Sudbrook BSP.

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

Option 1 – Replace existing Grid Transformers

Capacity Released for constraint(s) considered: 13 MVA initially

Viable

Detailed description: The existing Grid Transformers are 22.5/45 MVA rated, they could be replaced with a pair of 45/90 MVA units. The site would then be limited by the 33 kV bar.

New limiting factor for constraint(s) considered: 1250 A rated 33 kV bar for a new limit of 71.4 MVA. Subsequently replacing the 33 kV bar would permit an additional 42.9 MVA of new capacity to be released in the future.

Option 2 – Build new 33 kV circuits to transfer demand

Capacity released for constraint(s) considered: 23 MVA

Discounted

Detailed description: Unfortunately there are no suitable networks in the vicinity as Sudbrook BSP is relatively isolated at 33 kV. The cost of this scheme would far outweigh Option 1 and would not enable additional capacity to be released in the future.

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

Option 3 – 11 kV demand transfers to adjacent BSPs

Capacity Released for constraint(s) considered: 0 MVA

Viable

Detailed description: Whilst Sudbrook BSP is relatively isolated from other networks due to the River Severn and the River Wye with some distance to alternative 33 kV sources; the nearby Magor 132/11 kV BSP could be used to take load off of Caldicott primary and de-load Sudbrook BSP. There are inadequate load transfers available to adjacent networks to provide an effective long term solution. Small transfers might be useful to defer the works by several years to assist scheduling.

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 5 – Procure flexibility for Sudbrook BSP

Estimated Flexibility Required (MVA): 6 MVA+ by 2034

Viable

Detailed description: Flexibility services could be procured at Sudbrook BSP, they may be able to provide a deferral or a full solution at this site.

Solution Recommendation

It may be possible to procure flexibility at Sudbrook BSP or transfer a tranche of load to defer the reinforcement requirements substantially, subject to a cost benefit analysis confirmation through the DNOA process.

However, longer term the Grid Transformers should be replaced, with the 33 kV bar replacement following in due course.

3.3 Newport area new primary substation

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
A Newport East BSP GT overload	Fault or outage of the other GT	None	2034	2034	N/A	N/A

Uncertainty under other Distribution Future Energy Scenarios: Under Consumer Transformation the constraint is forecast by 2031, under Leading the Way 2030 and under Falling Short and System Transformation 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 3.3.2 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	Expand existing Newport East site	✓	×	×	Discounted
2	Build a new primary and transfer load	✓	✓	✓	Viable
Operational Mitigation					
3	11 kV demand transfers to adjacent primaries	✓	×	✓	Viable
Load Management Schemes					
4	Post-fault transfers	×	×	×	Discounted
Flexibility services					
5	Procure flexibility for Newport East	✓	✓	✓	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 Newport East BSP.

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

Option 1 – Expand existing Newport East site

Capacity Released for constraint(s) considered: 30 MVA

Discounted

Detailed description: Expanding the existing site with an additional set of 132/11 kV transformers might be possible, but it will be exceedingly challenging as the site is constrained between a school and a bus depot. New land would be required and if that is not forthcoming this solution may not be possible. This solution also does not provide any wider benefits, the adjacent 132 kV substations are also quite highly loaded and a new site closer to those issues would be more useful.

New limiting factor for constraint(s) considered: 30 MVA rated new Grid Transformer

Option 2 – Build a new primary and transfer load

Capacity released for constraint(s) considered: 23 MVA

Viable

Detailed description: Newport City is predominantly supplied by three 132/11 kV BSPs, Newport East, Newport West and Newport South. East and West are both 132/11 kV sites, without 33 kV bars and both are highly loaded. Newport East is projected to be constrained first but the other sites are also highly loaded. It is suggested that a new primary substation in-between all three sites could be constructed so that all three may be de-loaded. Newport South has a 33 kV bar, it is recommended that the new primary is supplied from there and sufficient load is transferred to solve the constraints of all three sites.

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

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

Capacity Released for constraint(s) considered: 0 MVA

Viable

Detailed description: Whilst there may be adequate load transfers available at this time, all three substations in the group are reasonably highly loaded and transferring load between them is not an effective long term solution. Depending on the distribution of demand at the time the scheme is initiated it may be useful to temporarily transfer load to defer the works for a respectable period.

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, additionally short term ratings would need to be determined for the overloaded assets and this may not provide a great deal of scope for this option.

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

Option 5 – Procure flexibility for Newport East BSP

Estimated Flexibility Required (MVA): 3 MVA+ by 2034

Viable

Detailed description: Flexibility services could be procured at Newport East to allow flexibility with the scheduling of these complex works.

Solution Recommendation

It is recommended to eventually pursue a new substation somewhere in central Newport. Flexibility and managing the overall distribution of 11 kV load between the group of substations covered by this constraint would be of worthy use for deferring the work however large new connections may easily accelerate the requirement for this reinforcement.

3.4 Llantarnam BSP new local 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 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
Llantarnam BSP 132/11 kV Tx overload	Fault or outage of the other GT	None	2034	N/A	N/A	N/A

Uncertainty under other Distribution Future Energy Scenarios: Under Consumer Transformation the constraint is forecast by 2030, under Leading the Way 2029 and under Falling Short and System Transformation 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 3.4.2 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	Build an on-site primary and transfer load	✓	✓	✓	Viable
Operational Mitigation					
2	11 kV demand transfers to adjacent primaries	✓	×	✓	Viable
Load Management Schemes					
3	Post-fault transfers	×	×	×	Discounted
Flexibility services					
4	Procure flexibility for Newport East	✓	✓	✓	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 Llantarnam BSP 11 kV bar.

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

Option 1 – Build an on-site primary and transfer load

Capacity Released for constraint(s) considered: 23 MVA

Viable

Detailed description: Llantarnam BSP 66 kV is now a relatively lightly loaded bar due to an industrial legacy. There should be space to expand the 66 kV bar to accommodate additional bays to supply a pair of 66/11 kV Transformers for a new 11 kV bar. Load can be transferred simply from the existing 11 kV bar which is on site.

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

Option 2 – 11 kV demand transfers to adjacent primaries

Capacity released for constraint(s) considered: 0 MVA

Viable

Detailed description: For the small scope of overloads seen by 2034 it is likely that a solution without building a new primary could be found at 11 kV for that timeframe. But if a higher growth scenario occurs or large new connections are forthcoming then this option may become insufficient.

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: A short term rating for the site could be developed however the minor overloads within the scope of this assessment period should be feasibly resolvable without creating operational risks.

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

Option 4 – Procure flexibility for Newport East BSP

Estimated Flexibility Required (MVA): 1 MVA+ by 2034

Viable

Detailed description: Flexibility services could be procured at Llantarnam primary to reduce or remove the constraint.

Solution Recommendation

It is recommended that in the first instance the 11 kV demand is managed between the existing sites. If large new connections progress or the growth is stronger than the new primary scheme should be developed. Flexibility may be useful for deferrals or for convenient scheduling of the works.

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