Seabank and Sandford 132 kV

Network Development Report – South West

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Electricity Distribution

nationalgrid

Contents

Seabank and Sandford 132 kV

1. Network Overview

Seabank and Sandford Grid Supply Points (GSPs) supply a mixture of rural and urban demand over a very large area as shown by the map below. Each GSP runs as an independent group, separated from each other, but there is the ability to run them in parallel via the 132 kV network which runs between them. Seabank and Sandford GSPs together supply approximately 204,000 customers.

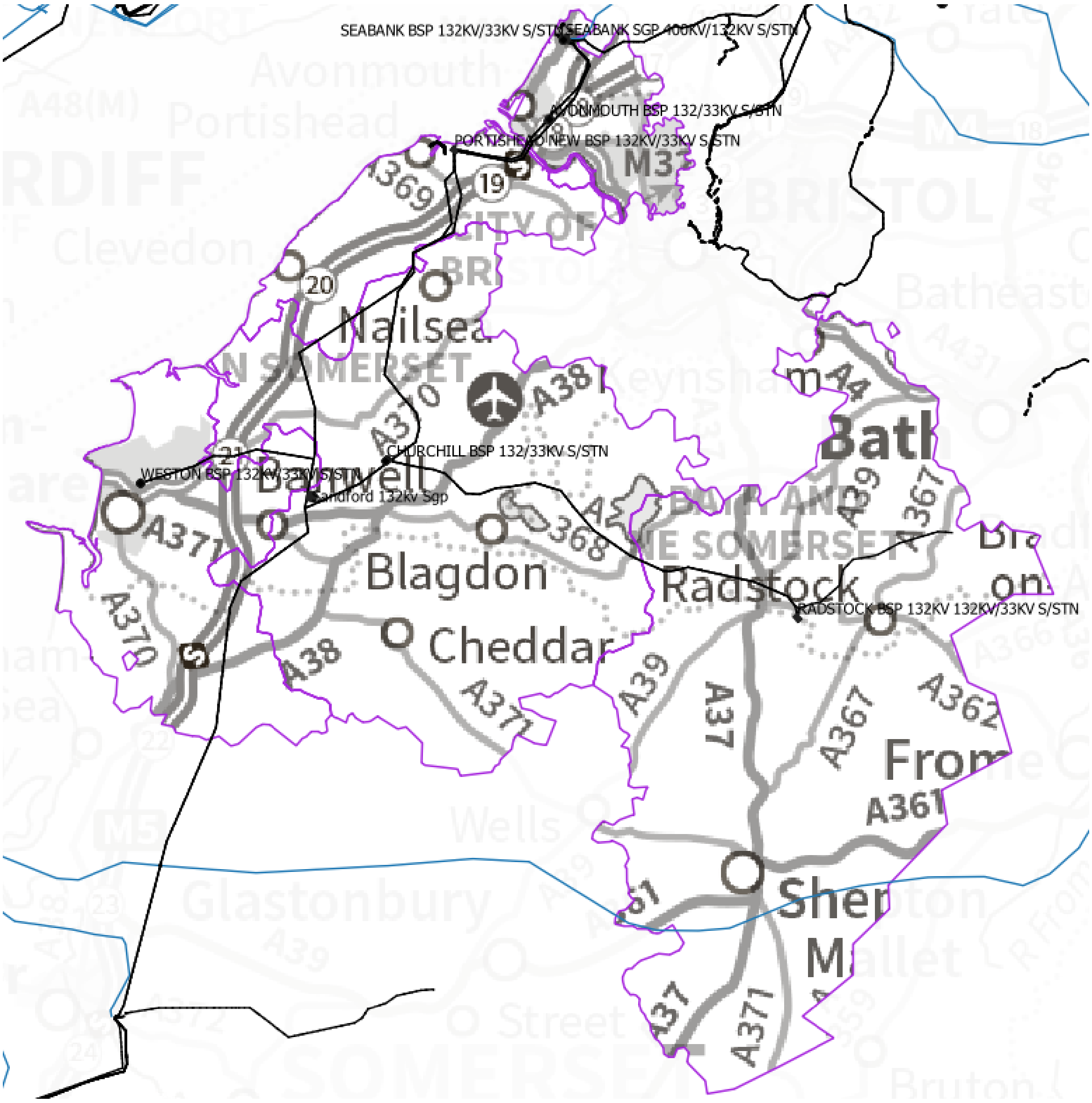

Figure 1.1 Seabank and Sandford GSPs geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon associated with the 132 kV circuits which are supplied by Seabank and Sandford 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 Seabank and Sandford 132 kV network is arranged as follows:

- Seabank GSP and Sandford GSPs run split from each other via two open 132 kV circuit breakers at Churchill BSP which can be used to parallel the two GSPs when required.
- Seabank GSP is supplied by two 400/132 kV Super Grid Transformers (GTs).
- Sandford GSP is supplied by two 400/132 kV Super Grid Transformers.
- Under normal running Sanford GSP supplies Weston BSP and Churchill BSP via dual 132 kV circuits to each Bulk Supply Point (BSP). Weston BSP has no interconnection options whereas normally open circuit breakers at Churchill BSP separate the Sandford 132 kV network from the Seabank 132 kV network.
- Under normal running Seabank GSP supplies Avonmouth BSP via dual 132 kV circuits. These circuits have no 132 kV interconnection to the rest of the group.
- Under normal running dual 132 kV circuits from Seabank GSP supply Portishead BSP. The same circuits continue to Churchill BSP and further onto Radstock BSP. Normal open points at Churchill BSP stop it being supplied by Seabank BSP under normal running.
- Only one side of the dual circuit from Seabank GSP to Churchill/Radstock BSPs is connected into Churchill BSP via two tee offs on the same circuit. The other side of the circuit continues from Portishead BSP straight to Radstock BSP, passing by Churchill BSP but with no tee off. This circuit only connects to Churchill via a very long loop via the 132 kV section breaker at Radstock BSP.

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.

- During an N-2 where both SGTs are off supply at Sandford GSP, it is assumed the 132 kV circuit breakers at Churchill BSP are closed in order to pick up Sandford GSP demand from Seabank GSP.
- During an N-2 where both SGTs are off supply at Seabank GSP, it is assumed the 132 kV circuit breakers at Churchill BSP are closed in order to pick up Seabank GSP demand from Sandford GSP.
- The Seabank 132 kV double busbar is re-configured for various busbar outages.

2. Summary of Network Constraints

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

- Radstock to Portishead 132 kV circuit overloads
- Lost load at Portishead and Radstock BSPs (Engineering Recommendation P2 compliant but potential to improve Security of Supply)
- Seabank to Churchill 132 kV circuit overload for double SGT outage at Sandford GSP
- Sandford to Churchill 132 kV circuit overloads for double SGT outage at Seabank GSP
- Seabank Super Grid Transformers (SGTs) Overloads

3. Network Constraint Details and Solution Options

3.1 Radstock to Portishead 132 kV circuit overloads

Constraint Overview

Generation | **Demand**

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

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

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Radstock 203 to Portishead 103 132 kV Circuit overload	Arranged outage of Seabank 205 to Portishead 403/associated isolator arranged outage	Portishead GT1 fault	2032	2032	2034	>2034
Radstock 103 to Portishead 203 132 kV Circuit overload	Arranged outage of Seabank 805 to Portishead 303/associated isolator arranged outage	Portishead GT2 fault	2032	2032	2034	>2034

Uncertainty under other Distribution Future Energy Scenarios: Under leading the way this is predicted to occur in 2028, under falling short it is predicted to occur in 2036.

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 132 kV section breaker at Portishead	×	×	×	Discounted
2	Reinforce 132 kV circuits	✓	×	×	Discounted
Operational Mitigation					
3	Change running arrangement during arranged outage	✓	✓	✓	Viable
Load Management Schemes					
-	*None Identified*	-	-	-	-
Flexibility services					
4	Procure flexibility	×	×	×	Discounted

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.

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. Therefore, not intervening would cause problems with system integrity (overloads) and would not be a technically viable solution.

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

Option 1 – Install 132 kV section breaker at Portishead

Capacity Released for constraint(s) considered:

Discounted

0 MVA (new configuration only)

Detailed description: Installing a 132 kV section breaker between the Main 1 and Main 2 bars at Portishead would prevent power flow all the way around the loop via Radstock BSP and therefore mitigate the overload for this condition. However, the section breaker introduces a new constraint for a 132 kV busbar outage/fault at Seabank GSP as there is a through flow back to the bar which supplies Avonmouth BSP causing a 132 kV circuit overload between Seabank GSP and Portishead BSP. Therefore, this is not a viable option.

New limiting factor for constraint(s) considered: Seabank GSP Busbar fault causing overload.

Option 2 – Reinforce 132 kV circuits

Capacity Released for constraint(s) considered:

Discounted

25 MVA (limited by zebra conductor profiled to 75° C)

Detailed description: This would involve reinforcing the circuits the whole length between Radstock and Portishead. This is a significant length of 132 kV circuit and the benefit for the significant cost is limited. Therefore, this option is discounted.

New limiting factor for constraint(s) considered: New 132 kV circuit rating.

Option 3 – Change running arrangement during arranged outage

Capacity Released for constraint(s) considered:

Viable

0 MVA (running arrangement change only)

Detailed description: This would involve preventing a flow all the way around the ring during this arranged outage, for example by opening the 132 kV section breaker and incoming transformer breaker of the relevant transformer at Radstock BSP to prevent flow around the ring but keep all of Radstock on supply.

New limiting factor for constraint(s) considered: New running arrangement loading.

Option 4 – Procure flexibility

Estimated Flexibility Required (MVA): 10 MVA+

Discounted

Detailed description: Due to the complex nature of this constraint flexibility would not be a viable option.

Solution Recommendation

Option 3 – it is recommended to assess running arrangement changes to prevent this overload by implementing a split at Radstock BSP during the arranged outage.

3.2 Lost load at Portishead and Radstock BSPs

Constraint Overview

Generation | Demand

The table below outlines the nature of the network constraints identified in the network analysis, with the worst lost load 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	Group load			
			Baseline	2025	2028	2034
Lost load at Portishead and Radstock BSPs	Portishead Busbar Arranged Outage	Fault of Seabank to Portishead 132kV circuit	122MW	131MW	149MW	225MW
Lost load at Portishead and Radstock BSPs	Portishead 203 or 103 Isolator Arranged Outage	Fault of Seabank to Portishead 132kV circuit	122MW	131MW	149MW	225MW

Uncertainty under other Distribution Future Energy Scenarios: As this constraint occurs under baseline, there is no uncertainty about future forecasts.

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	Install 132 kV line breakers at Portishead and move one side of double tee between Portishead and Churchill to the other side of the dual circuit	✓	✓	✓	Viable
Operational Mitigation					
2	Restore demand via Avonmouth or other BSPs via 33 kV	✓	✓	✓	Viable
Load Management Schemes					
-	*None Identified*	-	-	-	-
Flexibility services					
3	Procure flexibility	×	×	×	Discounted

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full CBA. This CBA will be subsequently carried out by the DNO to determine the optimal reinforcement solution.

Option 0 – No Intervention

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

Detailed description: Doing nothing to restore the lost load would result in unacceptable disconnection of demand under Engineering Recommendation P2, therefore this is not an option. P2 compliance can be achieved with existing 33 kV restoration options at present (Option 2).

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

Option 1 – Install 132 kV line breakers at Portishead and move one side of double tee between Portishead and Churchill to the other side of the dual circuit

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

90 MVA at Radstock can be restored via Sandford GSP

Detailed description: This would involve installing 132 kV line circuit breakers at Portishead BSP on the Churchill/Radstock side with isolators on either side. This would mean for an arranged isolator outage one side of the circuit can remain online.

In addition, it would be beneficial to move one of the two tee offs currently on the same side of the Portishead to Radstock 132 kV circuit, to the other side of the dual circuit by installing a new tee off. This is because for certain outages the circuit with both tee offs to Churchill BSP would be disconnected meaning there would be no ability to pick up Radstock, only Portishead. Being able to pick up Radstock for these outages would reduce the number of N-2 combinations where Radstock would be off supply meaning it would provide significant benefit to security of supply, particularly given the large amount of demand centred at Radstock BSP.

New limiting factor for constraint(s) considered: Lost load at Portishead

Option 2 – Restore demand via Avonmouth or other BSPs via 33 kV

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

0 MVA (only demand transfers)

Detailed description: This would involve assessing the transfer capacity off Radstock BSP and Portishead BSP to restore as much demand as possible via the 33 kV network for this N-2 event. Under baseline the group demand is approximately 122MW. This means there is a requirement to restore 22MW within 3 hours. There is a 33 kV circuit rated to 54 MVA from Avonmouth BSP to Portishead BSP meaning this can be used to pick up a lot of the group, as well as potential transfer options from Radstock. This does pose a risk of overloading the transformers at the BSPs where demand is transferred for a subsequent fault, however, this would be N-3 which is a very rare occurrence and protection should operate to prevent damage in this eventuality.

Therefore, this is a viable option until demand exceeds the transfer capacity.

New limiting factor for constraint(s) considered: 33kV transfer capacity

Option 3 – Procure flexibility

Estimated Flexibility Required (MVA): 22 MVA+ **Discounted**

Detailed description: Due to the large amount of demand required to be restored flexibility is not a viable option.

Solution Recommendation

It is recommend to do a cost benefit analysis of Option 1 (132 kV solution) and Option 2 (33 kV transfer solution). Option 2 is technically sufficient until demand exceeds transfer capacity, however Option 1 allows a significant amount more demand to be kept online as either one or both of Radstock and Portishead can remain online for N-2 events where both are currently disconnected. Option 1 also increases the configurability of the 132 kV network.

3.3 132kV circuit overloads for double SGT outage at Seabank or Sandford GSP

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
Seabank to Churchill 132kV circuit overload (SEAB1_205 - POIS1_403 and POIS1_203 - W69_1W sections)	Sandford SGT arranged outage	Sandford SGT fault	2032	2032	2032	>2034
Churchill to Portishead 132kV circuit overload (POIS1_203 - W69_1W section)	Seabank SGT arranged outage	Seabank SGT fault	2034	2034	2032	>2034
Sandford to Churchill 132kV circuit overloads (Sandford 105 and 205 circuits)	Seabank SGT arranged outage	Seabank SGT fault	2032	2032	2032	2034

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, the constraint is predicted to arise in 2029 and under Falling Short it is predicted to arise in 2036.

Solution Options

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

Table 3.3.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Reinforce 132kV circuits	✓	✓	✓	Viable
Operational Mitigation					
2	Reduce demand during N-2 within allowance of Engineering Recommendation P2	✓	✓	✓	Viable
Load Management Schemes					
-	*None Identified*	-	-	-	-
Flexibility services					
3	Procure flexibility	×	×	×	Discounted

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full CBA. This CBA will be subsequently carried out by the DNO to determine the optimal reinforcement solution.

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. Therefore, not intervening would cause problems with system integrity (overloads) and would not be a technically viable solution.

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

Option 1 – Reinforce 132 kV circuits

Capacity Released for constraint(s) considered: — Viable

25 MVA (limited by zebra conductor profiled to 75°C)

Detailed description: Re-profiling or reconductoring the 132 kV circuits would remove the overloads and allow all demand to remain connected during N-2. This would come at significant cost given the length of the 132 kV circuits. However, it would allow more demand to stay online for this N-2 condition without an overload. Therefore, a cost benefit analysis should be carried out to determine if this is a viable option, taking account of the benefit provided by more secure supplies.

New limiting factor for constraint(s) considered: New 132 kV circuit rating

Option 2 – Reduce demand during N-2 within allowance of Engineering Recommendation P2

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

Detailed description: To prevent overloads in 2032 under Best View, for a double SGT outage at Seabank GSP where it is fed from Sandford GSP, Radstock BSP and Portishead BSP can remain connected with Avonmouth BSP disconnected with possible transfers to outside of the group to restore as much as possible. As group demand is around 250 MW, there is a requirement to restore 83.3 MW within 3 hours which is achieved by restoring Radstock and Portishead (approx 130 MW).

Similarly, to prevent overloads for a double SGT outage at Sandford GSP where is fed from Seabank BSP, Churchill BSP can remain connected with Weston BSP disconnected with possible transfers to outside the group to restore as much as possible. As group demand is around 172 MW in 2034, there is a requirement to restore 57.3 MW within 3 hours which is achieve by restoring Churchill BSP (85 MW in 2034).

This presents a very low cost option given the rarity of double SGT outages, however reinforcement of the 132 kV circuits would secure the demand further.

New limiting factor for constraint(s) considered: Ability to reduce demand

Option 3 – Procure flexibility

Estimated Flexibility Required (MVA): 20MVA+ — Discounted

Detailed description: Due to the very large amount of flexibility required as well as having to maintain the contracts for an indefinite period this is not a cost effective option.

Solution Recommendation

It is recommended to carry out a cost benefit analysis of Option 1 and Option 2 whilst considering the wider benefits than cost to a more secure supply afforded by Option 2. In addition, demand growth should be monitored to determine if the need is materialising as predicted around 2032.

3.4 Seabank Super Grid Transformers (SGTs) Overloads

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
Seabank SGT Overload	Seabank SGT fault/outage	None	2028	2028	2034	2034

Uncertainty under other Distribution Future Energy Scenarios: This may occur sooner under Leading the Way scenario and later is Falling Short scenario. It is also particularly dependent on battery demand. Therefore, the timing should be assessed on a frequent basis.

Solution Recommendation

It is recommended to coordinate with National Grid ESO, who are responsible for assessing and mitigating SGT loading, to refine study results and determine the best solution option. Modelling further diversity and different battery behaviour may solve or defer this constraint.

However, additional SGT capacity at Seabank GSP or in the vicinity is likely to be needed in the near future. In particular, if it is considered to move Seabank BSP onto Seabank GSP instead of Iron Acton GSP where it is currently fed from.

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