Plymouth BSP and Associated 33 kV Network

Network Development Report – South West

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Electricity Distribution

nationalgrid

Contents

Plymouth BSP and Associated 33 kV Network

1. Network Overview

Plymouth Bulk Supply Point (BSP) supplies mainly urban sections of 33 kV network within the City of Plymouth. It is supplied from three 132/33 kV Grid Transformers (GTs) and feeds approximately 59,600 customers.

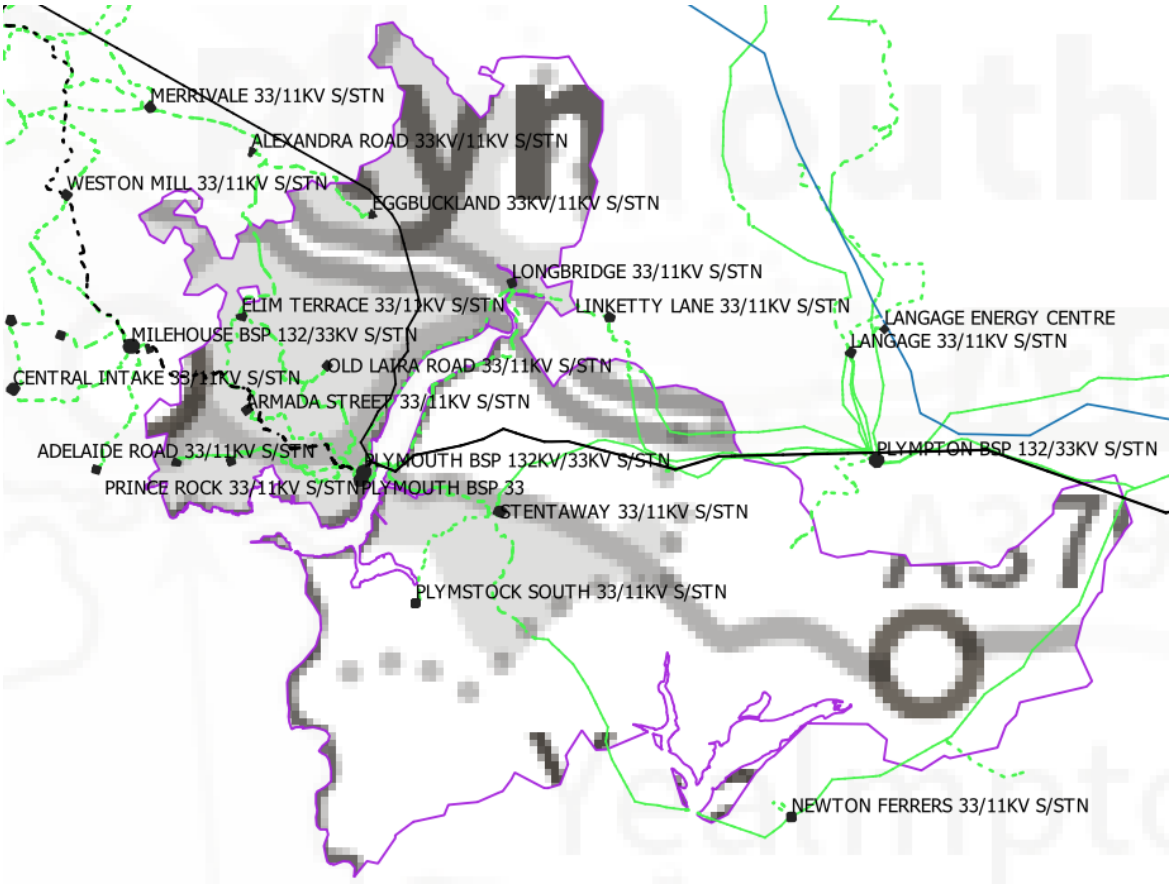

Figure 1.1 Plymouth BSP geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon associated with the 33/11 kV transformers, 33 kV circuits and 132/33 kV transformers which supply Plymouth BSP. This uses the methodology outlined in the Network Development Plan Methodology Report with Network Operability Modelling applied as outlined below.

For the purposes of this analysis the NGED Best View Distribution Future Energy Scenario (DFES) has been used to study the years 2022 (baseline), 2028 and 2034, with consideration given to how proposals could change under the other scenarios. 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 Plymouth BSP network is arranged as follows:

- Armada Street & Prince Rock Primary substations are each fed via two separate transformer feeders both of which are ‘double-banked’ onto two 33 kV circuit breakers at the BSP.
- Adelaide Road & Buckwell Street Primary substations are fed as transformer feeders with one of the feeders to each site ‘double-banked’ onto one 33 kV circuit breaker at the BSP
- Longbridge Primary substation is supplied via two separate transformer feeders with a 33 kV connection to Plympton BSP via a normal open point on isolator 3L3 at Linketty Lane.

- Elim Terrace Primary substation is fed via three 33 kV circuits with Old Laira Road Primary connected as a tee off two of the circuits. Eggbuckland Primary substation is fed via two tee-offs from the Elim Terrace to Alexandra Road circuits. Normal open points exist on the two 33 kV circuit breakers at Alexandra Road which is fed from Ernesettle BSP.
- A 33 kV ring supplying Stentaway and Plymstock South Primary substations. Interconnection to Plympton BSP exists via a normal open point on circuit breaker 3L5 at Stentaway.
- A 33 kV circuit to two 33 kV generator connections.

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 a grid transformer at Plymouth, Eggbuckland Primary is transferred to Ernesettle BSP and Stentaway/Plymstock South Primaries to Plympton BSP

2. Network Constraints and Solution Options

2.1 Summary of Network Constraints

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

- Plymouth BSP 132/33 kV Grid Transformer overloads
- Plymouth-Old Laira Road Tee-Elim Terrace 33 kV circuit overloads
- Stentaway 33/11 kV T2 overloads

3. Network Constraint Details and Solution Options

3.1 Plymouth BSP 132/33 kV GT Overloads

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 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
Plymouth GT1 overload	Plymouth GT2 arranged	Plymouth GT3 or circuit fault		Baseline	2025	
Plymouth GT 2 overload	Plymouth GT1 arranged	Plymouth GT3 or circuit fault None		Baseline	2028	
Plymouth GT3 overload	Plymouth GT2 arranged	Plymouth GT1 fault		Baseline	Baseline	

Uncertainty under other Distribution Future Energy Scenarios: As this constraint occurs under baseline, there is no uncertainty about future forecasts. There is a risk that demand reduces, however this is not forecast under any scenario so mitigation against this constraint is required.

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	Application of an increased rating following checks on ancillaries	✓	✓	✓	**Viable**
2	Install a 4th GT, additional 33 kV switchboard and section of 132 kV busbar	✓	✓	×	**Viable**
Operational Mitigation					
-	*None Identified*	-	-	-	-
Load Management Schemes					
-	*None Identified*	-	-	-	-
Flexibility services					
3	Procure flexibility under Plymouth BSP at 33 kV or below	✓	✓	✓	**Viable**

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full cost benefit analysis (CBA). This CBA will be subsequently carried out by the Distribution Network Operator (DNO) to determine the optimal reinforcement solution, which will then be tested against market provided flexibility by the Distribution System Operator (DSO) as part of the Distribution Network Options Assessment (DNOA) process.

Option 1 – Application of an increased rating following checks on ancillaries

Capacity released for constraint(s) considered: 18 MVA (Winter cyclic) **Viable**

Detailed description: Uprate the existing GTs at Plymouth via use of cyclic ratings in accordance with British Standard 171/IEC60076 and NGED Standard Technique SD8C. This requires a capability assessment of all ancillaries, such as busbars, isolators, Current Transformers (CTs), cables (including cabling within the substation), switchgear, tap changer, transformer bushings, conservator and earthing transformer. In addition, an assessment of the cyclic profile of the load is required to determine if transformer temperature and ageing is within acceptable limits. This should be sufficient to initially resolve the constraint, however once the 78 MVA capacity is exceeded an additional grid transformer may be required.

New limiting factor for constraint(s) considered: 78 MVA (Winter cyclic rating of each GT).

Option 2 – Install a 4th GT at Plymouth BSP

Capacity Released for constraint(s) considered: 78 MVA (winter cyclic) **Viable**

Detailed description: Install a 4th 132/33 kV grid transformer (90 MVA unit) along with an additional 33kV switchboard and section of 132 kV busbar to create 2 BSPs each containing 2 transformers.

New limiting factor for constraint(s) considered: 78 MVA (Winter cyclic ratings of each GT)

Option 3 – Procure flexibility under Plymouth BSP at 33 kV or below

Flexibility service type: Generation turn up/demand turn down **Viable**

Detailed description: Flexibility services could be procured to alleviate projected overloads seen on a Grid Transformer at Plymouth BSP. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

It is recommended to undertake an assessment using NGED Standard Technique SD8C to achieve the full cyclic rating of all Grid Transformers at Plymouth BSP (Option 1).

At present the demand at Stentaway & Plymstock South is transferred to the Plympton BSP 33kV network for arranged outages on a single 33 kV Busbar or grid transformer at Plymouth BSP. This is to prevent overloading the remaining grid transformer for an arranged followed by a fault outage on 2 grid transformers at Plymouth BSP. This will not be possible by 2026 due to increased demand on the Plympton BSP network and a 4th grid transformer at Plymouth BSP will be required to maintain the same level of resilience.

3.2 Plymouth-Old Laira Road-Elim Terrace Overloads

Constraint Overview

Generation | Demand

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads initially 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 year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Plymouth 3L5- Old Laira Road Tee-Elim Terrace 33 kV cct overload	Elim Terrace Main 1 33 kV busbar outage	None	Baseline	Baseline	Baseline	-
Plymouth 16L5 – Old Laira Road Tee – Elim Terrace 33 kV cct overload	Plymouth Main 2 33 kV Busbar outage	None	-	-	-	Baseline

Uncertainty under other Distribution Future Energy Scenarios: As this constraint occurs under baseline, there is no uncertainty about future forecasts. There is a risk that demand reduces, however this is not forecast under any scenario so mitigation against this constraint is required.

Solution Options

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

Table 3.2.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	**Discounted**
Reinforcement					
1	Overlay Plymouth-Old Laira Road Tee-Elim Terrace 33 kV circuit	✓	✓	×	**Viable**
Operational Mitigation					
2	Install an inter-tripping scheme (Eggbuckland transfer)	✓	✓	✓	**Viable**
3	Install an inter-tripping scheme (generation)	✓	✓	✓	**Viable**
Load Management Schemes					
-	*None Identified*	-	-	-	-
Flexibility services					
4	Procure flexibility under Old Laira Road & Elim Terrace at 11 kV or below	✓	✓	✓	**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 1 – Overlay Plymouth 3L5-Old Laira Road Tee- Elim Terrace 33 kV cable circuit

Capacity released for constraint(s) considered: TBC

Viable

Detailed description: Overlay the existing 33 kV cable circuit between Plymouth 3L5 –Old Laira Road Tee and Elim Terrace with larger cable.

New limiting factor for constraint(s) considered: TBC

Option 2 – Install inter-tripping to transfer Eggbuckland for a 33 kV Main 1 Busbar fault at Elim Terrace

Capacity released for constraint(s) considered: N/A

Viable

Detailed description: Install an inter-tripping scheme to transfer Eggbuckland Primary in the event of a 33 kV Busbar fault at Elim Terrace. This will involve opening both 21L5 & 25L5 at Elim Terrace and closing 21L5 & 25L5 at Alexandra Road.

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

Option 3 – Install inter-tripping to trip 33 kV connected generation at Plymouth for a 33 kV Main 2 Busbar fault at Plymouth BSP

Capacity released for constraint(s) considered: N/A

Viable

Detailed description: Install an inter-tripping scheme trip 33 kV connected generation on 18L5 in the event of a 33 kV Main 2 Busbar fault at Plymouth. This will involve opening 18L5 at Plymouth BSP in the event of a 33 kV Main 2 Busbar fault at Plymouth BSP.

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

Option 4 – Procure flexibility under Old Laira Road or Elim Terrace at 11 kV or below

Flexibility service type: Generation turn up or demand turn down

Viable

Detailed description: Flexibility services could be procured to alleviate projected overloads seen on the Plymouth-Old Laira Road/Elim Terrace 33 kV circuits. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

It is recommended to install inter-tripping schemes as described in options 2 & 3 to prevent a circuit overload for specified 33 kV Busbar faults.

3.3 Stentaway T2 overloads

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 intermediate cool/warm peak demand.

Table 3.3.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Stentaway T2 overload	Stentaway Main 1 busbar outage	None	2025	Baseline	Baseline	2028

Uncertainty under other Distribution Future Energy Scenarios: As this constraint occurs under baseline, there is no uncertainty about future forecasts. There is a risk that demand reduces, however this is not forecast under any scenario so mitigation against this constraint is required.

Solution Options

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

Table 3.3.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Install a 2nd 33/11 kV transformer at Plymstock South	✓	✓	✓	Viable
Operational Mitigation					
-	*None Identified*	-	-	-	-
Load Management Schemes					
-	*None Identified*	-	-	-	-
Flexibility services					
2	Procure flexibility under Stentaway and Plymstock South at 11 kV or below	✓	✓	✓	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 1 – Install a 2nd 33/11 kV transformer at Plymstock South

Capacity released for constraint(s) considered: TBC

Viable

New limiting factor for constraint(s) considered: TBC

Detailed description: Install a 2nd 33/11 kV transformer at Plymstock South in order to remove the existing 11 kV parallel and reduce the loading on Stentaway T2 in the event of a 33 kV (Main 1) busbar outage.

Option 2 – Procure flexibility under Stentaway and Plymstock South at 11 kV or below

Flexibility service type: Demand turn down or generation turn up

Viable

Detailed description: Flexibility services could be procured to alleviate projected overloads seen on Stentaway T2. The viability of utilising flexibility will be further investigated as part of the DNOA process.

Solution Recommendation

It is recommended that a 2nd 33/11 kV transformer is installed at Plymstock South to prevent transformer overloads at Stentaway during a 33 kV Main 1 busbar outage.

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