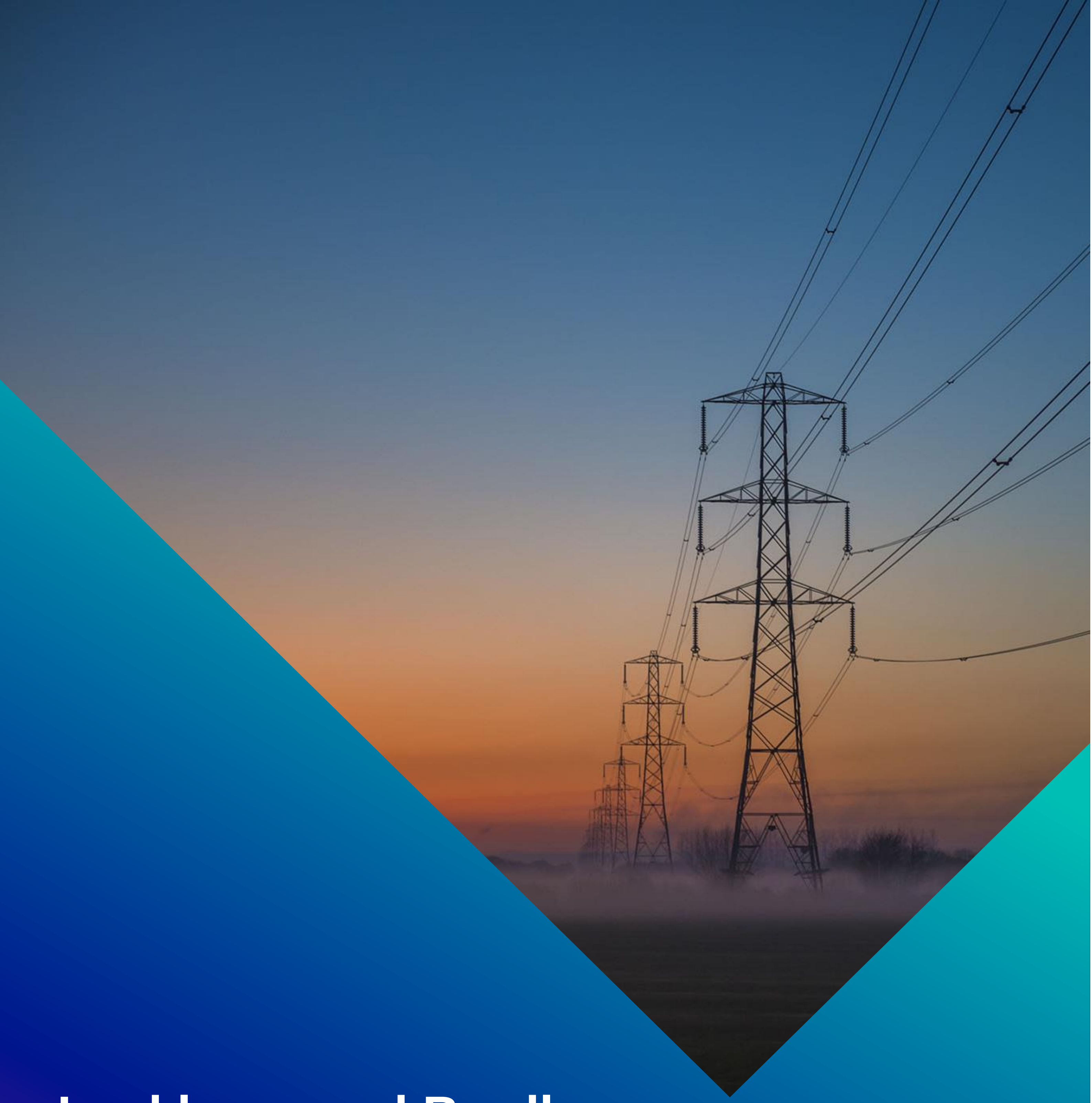

Lockleaze and Bradley Stoke BSPs

Network Development Report – South West

May 2024

Electricity Distribution

nationalgrid

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Lockleaze and Bradley Stoke BSPs

1. Network Overview

Lockleaze and Bradley Stoke Bulk Supply Points (BSP) supply a mostly urban area of 33 kV network, with the bulk of the demand centred in the North of Bristol and South Gloucestershire. It is supplied from four 132/33 kV Grid Transformers (GTs) at Lockleaze with a double busbar arrangement and two 132/33 kV GTs at Bradley Stoke. Lockleaze and Bradley Stoke BSP together supply approximately 99,000 customers.

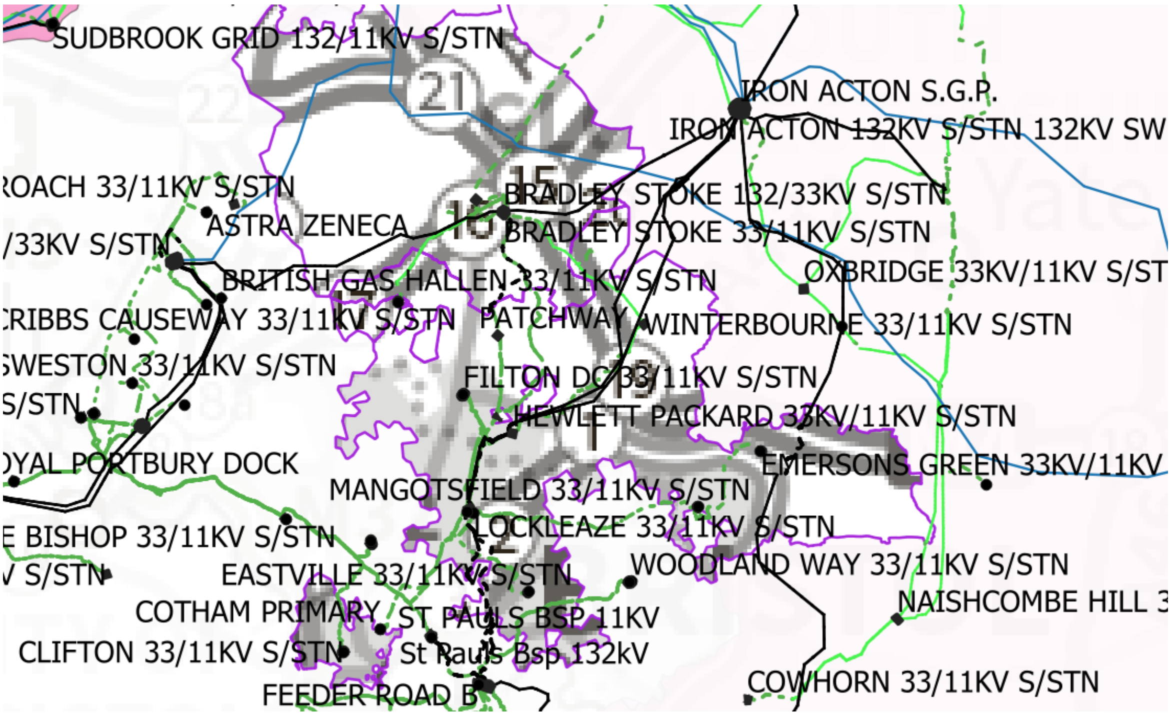

Figure 1.1 Lockleaze and Bradley Stoke BSPs geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon associated with the 33/11 kV transformers and 33 kV circuits which supply and are supplied by Lockleaze and Bradley Stoke Bulk Supply Points (BSPs). 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. The two most onerous half-hours have been studied for each of the five representative days considered: Winter Peak Demand, Intermediate Warm Peak Demand, Intermediate Cool Peak Demand, Summer Peak Demand and Summer Peak Generation.

1.1 Network Topology

The Lockleaze and Bradley Stoke BSPs network is arranged as follows:

At Bradley Stoke:

- Bradley Stoke and Almondsbury Primaries are double banked on the same Circuit Breakers from different GT busbars at Bradley Stoke BSP.
- Cribbs Causeway Primary currently has clean feeds from Bradley Stoke BSP from each GT busbar.
- Almondsbury Primary is loosely coupled on the 11kV between Bradley Stoke and Lockleaze BSPs.
- IDNO primary may connect soon to Bradley Stoke with current view of having it double banked from Cribbs Causeway transformers.

At Lockleaze BSP:

- Lockleaze Primary is connected to the GT3 busbar with two circuits.
- Clifton Primary has three circuits all connected to GT1 busbar.
- Cotham Primary is connected by two circuits to GT1 and GT4 busbars.
- Filton Primary has a normal open point in the 11kV busbar with four transformers all connected to GT4 busbar.
- Eastville Primary is connected to GT4 busbar with two ciruits.
- Emersons Green and Mangotsfield Primaries are connected to Staple Hill Swtiching Station which in turn connects to Lockleaze BSP by two circuits to the GT2 busbar.
- Patchway Primary is connected to GT2 and GT3 busbars with the GT2 leg being double banked to Hewlett Packard Primary.
- Winterborne Primary is connected to GT3 busbar with one leg being double banked with Hewlett Packard Primary.
- Hewlett Packard Primary, has three feeds with two being double banked with other primaries and one clean feed to GT2 busbar.

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.

- Double busbar scheme at Lockleze that keeps the split of one of the busbars at Lockleaze and the one coupled to Bradley Stoke.
- There are some conditions where the loose couple at Abbeywood is broken to avoid overloading of the interconnectors.
- Modelled solid intertrips between Lockleaze and some of its primaries also included the Staple Hill Switching Station intertrips.

2. Summary of Network Constraints

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

- Clifton Transformers capacity
- Mangotsfield and Winterbourne transformer overloads (uprate via application of cyclic rating)
- Hewlett Packard Circuits overload

3. Network Constraint Details and Solution Options

3.1 Clifton Transformers Capacity

Constraint Overview

Generation | **Demand**

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads seen during outage period.

Table 3.1.1 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
Transformer capacity	Loss of one transformer	Loss of another transformer	2033	2034	2040	2045

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2033 and under falling short it is predicted to arise in 2040.

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 Area Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Reinforce existing 33 kV circuits and Transformers	✓	×	✓	Viable
2	New primary	✓	✓	✓	Viable
3	Install additional 33 kV circuit, Transformer and rebuild 11 kV busbar with 8 section of busbar	✓	×	✓	Viable
4	Reinforce 11 kV circuits to transfer demand to other Primaries	✓	×	×	Discounted
Operational Mitigation					
5	Transfer demand to other Primaries	✓	×	✓	Discounted
Load Management Schemes					
6	Post-fault transfers	×	×	×	Discounted
Flexibility services					
7	Procure flexibility at Clifton Primary	✓	×	✓	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 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. The capacity of the site was calculated to be around 34.5 MVA as that is the maximum capacity of three sections of 11 kV busbar and three primary transformers.

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

Option 1 – Reinforce existing 33 kV circuits

Capacity Released for constraint(s) considered: 32.5 MVA

Viable

Detailed description: Replace the Transformers with larger 20/40 MVA units, change switchgear/busbar to larger size potentially 2000 A breakers and need about 7 km of circuits of 300 mm^2 of XLPE Copper (Cu).

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

Option 2 – New primary

Capacity Released for constraint(s) considered: 23 MVA **Viable**

Detailed description: Build a new primary to support Clifton and Cotham primaries. The installation of another primary substation to the north of the River Avon in Bristol should provide ample capacity for future load growth out to 2050. This could be delayed with potential reinforcement being done earlier than this constraint.

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

Option 3 – Install additional 33 kV circuit, Transformer and rebuild 11 kV busbar with 8 sections of busbar

Capacity released for constraint(s) considered: 34.5 MVA **Viable**

Detailed description: To unlock the full capacity of three transformers an additional transformer and cable will be needed alongside a rebuild of the 11 kV to eight busbar sections. This allows for full flexibility of splitting load as and how it is needed. One disadvantage of creating a three transformer primary is that it presents additional network operability issues (such as needing to split the 11 kV network for an arranged outage on any transformer/circuit).

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

Option 4 – Reinforce 11 kV circuits to transfer demand to other Primaries

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

Up to 20 MVA (dependent on decisions made for other constraints)

Detailed description: Cotham primary is a single customer primary but the closest to Clifton it also has some spare capacity that could help with some de-loading. The potential new 132/11/11 kV at Feeder Road could help shift some load to the East of Bristol.

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

Option 5 – Transfer demand to other Primaries

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

Up to 5 MVA (dependent on 11 kV circuit capacity)

Detailed description: Transferring approximately 5 MVA demand to Cotham from Clifton would alleviate constraints in the short term. However, further reinforcement will be required for longer term growth around the area.

New limiting factor for constraint(s) considered: 11kV circuit capacity.

Option 6 – Post-fault transfers

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

Detailed description: Post fault transfers cannot be utilised as the overload is beyond post-fault ratings meaning there is no window to reduce the load on the 33 kV circuits through load management.

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

Option 7 – Procure flexibility

Estimated Flexibility Required (MVA): 4 MVA+ by 2035 **Viable**

Detailed description: Flexibility services could be procured to alleviate projected overloads. This could defer reinforcement if enough can be procured around Clifton.

Solution Recommendation

It is recommended to assess the feasibility of transferring demand from Clifton primary to Cotham primary via the existing 11 kV circuits. If the 11 kV circuits do not offer sufficient capacity then flexibility could be procured at Clifton to defer the reinforcement requirements, subject to a cost benefit analysis confirmation through the DNOA process. The outage season for this primary should be reduced until there is no outage window which would happen in the Summer of 2045.

To facilitate longer term growth it is likely that a new primary to support both Cotham and Clifton primaries could be built but consideration for transferring demand to the East of the city should be given as a method to maximise the available capacity between primary substations in Bristol'.

3.2 Mangotsfield and Winterbourne transformer overloads (uprate via application of cyclic rating)

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 year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Transformer overload	Loss of one transformer	None	2029	2030	2030	2030

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

Solution Recommendation

For Mangotsfield and Winterbourne primaries there are no constraints other than not having passed the SD8C internal policy checks yet. This will require a capability assessment of all ancilliaries, such as busbars, isolators, Current Transformers (CTs), cables (including cabling within the substation), switchgear, tap changer, transformer bushings, conservator and earthing transformer. These should be carried out to unlock the full cyclic rating which will allow the transformer to be pushed past its nameplate rating.

3.3 Hewlett Packard Circuits overload

Constraint Overview

Generation Demand

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads seen during outage period.

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
33 kV Circuit Capacity Rolls Royce Tee to Lockleaze 18L5	Busbar Fault Lockleaze Main 1	None	2028	2029	2030	2032
33 kV Circuit Capacity Hewlett Packard 2L3 to Lockleaze 22L5	Busbar Fault Lockleaze Main 1	None	2030	2031	2032	2035

Uncertainty under other Distribution Future Energy Scenarios: Under Leading the Way Scenario, this constraint is predicted to arise in 2027 and under falling short it is predicted to arise in 2030.

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	Add two bays at Lockleaze BSP and two 33 kV circuits	✓	✓	×	Viable
2	New primary	✓	✓	×	Discounted
3	Reinforce 11 kV circuits to transfer demand to other Primaries	✓	×	×	Viable
Operational Mitigation					
4	Transfer demand to other Primaries	✓	×	✓	Discounted
Load Management Schemes					
5	Post-fault transfers	×	×	×	Discounted
Flexibility services					
6	Procure flexibility	✓	×	✓	Viable

Solution Development

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

Option 0 – No Intervention

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

Detailed description: Doing nothing to mitigate the constraint would result in overloads for the conditions described above.

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

Option 1 – Add two bays at Lockleaze BSP and two 33 kV circuits

Capacity Released for constraint(s) considered: 20 MVA — Viable

Detailed description: This option suggests laying two 2.5 km 33kV 185 mm^2 Cu cables to Hewlett Packard to unbank the 33kV circuits this will allow to use more capacity of Hewlett Packard and the neighbouring primaries. Due to Lockleaze being split on the couplers for a busbar fault it loses two of the four infeeds into Winterbourne/Hewlett Packard which overloads two of the circuits.

New limiting factor for constraint(s) considered: Primary capacities

Option 2 – New primary

Capacity Released for constraint(s) considered: 23 MVA — Discounted

Detailed description: At this stage there is still a lot of capacity at these three primaries. A new primary in the area will not be needed at this stage or even for the foreseeable future.

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

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

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

Detailed description: As this is a gradual increase in demand some new connection could connect to neighbouring primaries instead which would enable Hewlett Packard reinforcement to be deferred.

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

Option 4 – Transfer demand to other Primaries

Capacity Released for constraint(s) considered: Discounted

0 MVA

Detailed description: Similar to the above but with no reinforcement. This option would potentially lead to similar constraints.

New limiting factor for constraint(s) considered: Local primary capacities.

Option 5 – Post-fault transfers

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

Detailed description: Not applicable in this area.

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

Option 6 – Procure flexibility

Capacity Released for constraint(s) considered: 5 MVA Viable

Detailed description: Flexibility would need to be procured across Patchway, Winterbourne and Hewlett Packard would help alleviate the constraint.

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

Solution Recommendation

It is recommended to add two additional bays at Lockleaze to add two new 33 kV cables to the nearest point where it splits away from Hewlett Packard. This would provide capacity at Hewlett Packard to use a bit more of the transformers, but due to the restrictive number of bus section the primary will not be able to be pushed to its capacity limit.

Flexibility may be able to delay this constraint if enough is procured, Patchway, Winterbourne and Hewlett Packard are the Electricity Supply Areas that feed into the circuits affected.

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