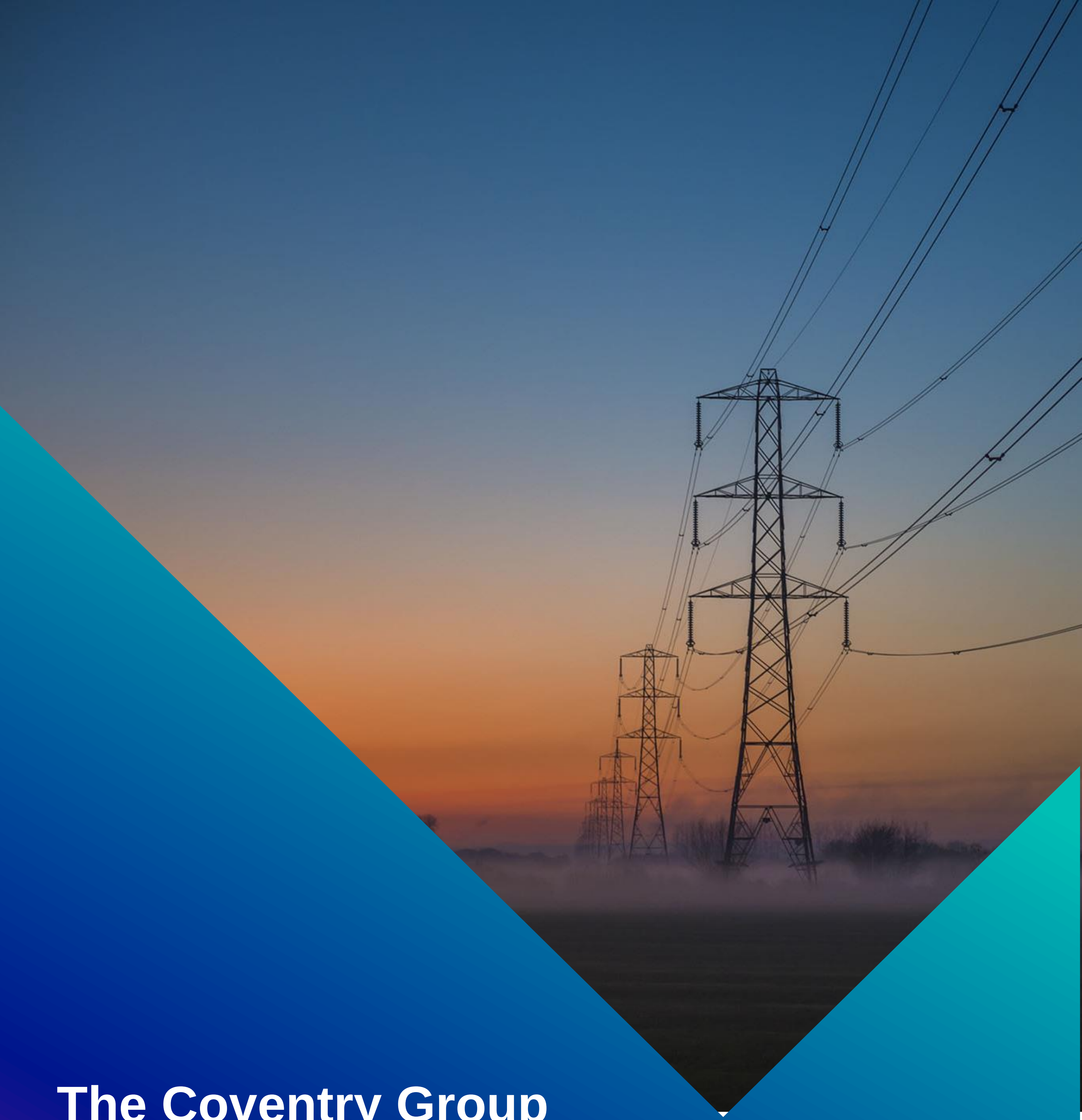

# The Coventry Group

Network Development Report – East Midlands

**May 2024**

Electricity Distribution

nationalgrid

# Contents

# The Coventry Group 33 kV

## 1. Network Overview

Coventry North 132/33 kV and Coventry South 132/11 kV BSPs are fed from Coventry GSP in National Grid Electricity Distribution's (NGED's) East Midlands licence area. Coventry North is supplied directly from Coventry GSP via dedicated 132 kV dual circuits. Coventry South 132/11 kV shares a dual 132 kV circuit with Whitley 132/33 kV BSP.

Coventry Central 132/33 kV, Coventry West 132/33 kV and Coventry South 132/33 kV Bulk Supply Points (BSPs) are all fed from Berkswell Grid Supply Point (GSP) in National Grid Electricity Distribution's (NGED's) East Midlands licence area. Coventry Central 132/33 kV is supplied directly from Berkswell GSP via dual 132 kV circuits, whereas Coventry South 132/33 kV shares a dual circuit 132 kV circuit with Coventry West 132/33 kV.

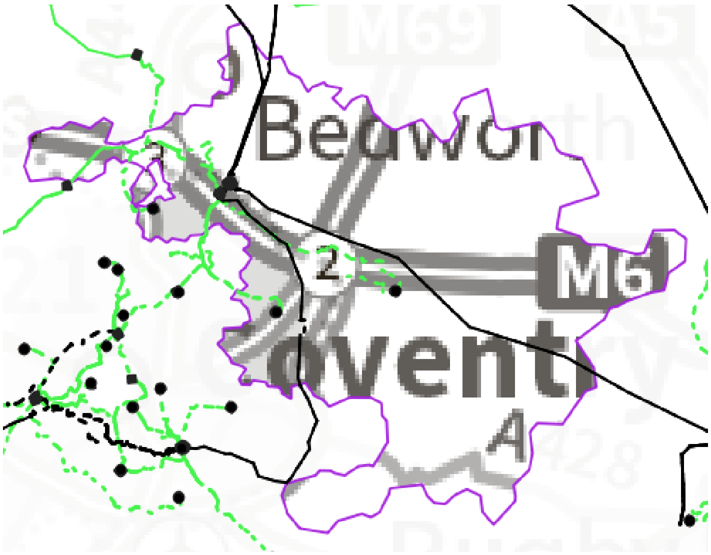


*Figure 1.1 Coventry North geographic network coverage*

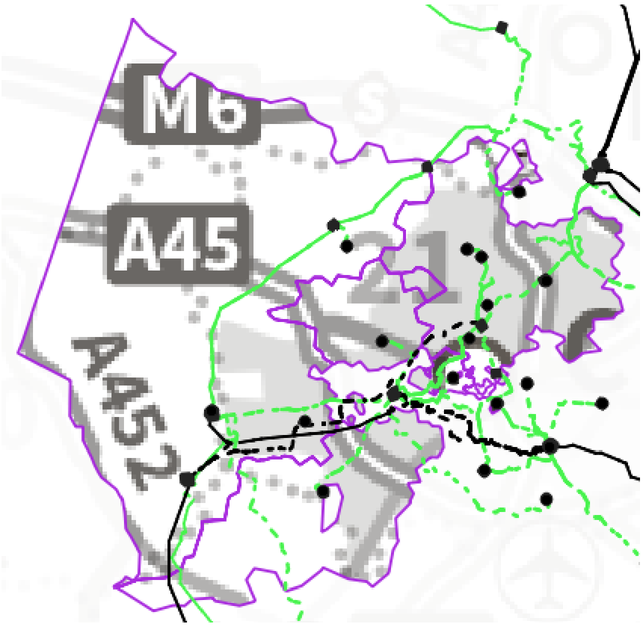


*Figure 1.2 Coventry West, Coventry Central and Coventry South 33 kV geographic network coverage*

This report discusses all existing and future network constraints over a 0-10 year horizon identified on the 33 kV network supplied from Coventry Central, North, West and South 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. 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

Coventry North BSP is a two 90/117 MVA, 132/33 kV Grid Transformer (GT) substation. The 33 kV busbar comprises three sections and is rated at 2000 A. Coventry North BSP supplies six primary substations: Ansty, Coventry Arena, Coventry Colliery, Coventry North, Newdigate T2, and Walsgrave. Coventry North primary is located at the same site as the BSP and comprises two 33/11 kV transformers.

Ansty primary is supplied from Coventry North BSP via two dedicated 33 kV circuits and 33/11 kV transformers. Newdigate T2 is supplied from Coventry North BSP via a 33 kV circuit and associated 33/11 kV transformer, whereas T1 is supplied from Nuneaton BSP. The 11 kV bus section circuit breaker at Newdigate primary is normally run closed.

Coventry Arena and Coventry Colliery primaries share two 33 kV circuits from Coventry North BSP. Walsgrave is a three 33/11 kV primary fed from Coventry North BSP via three 33 kV circuits, each connected to a separate 33 kV busbar at the BSP.

Coventry North BSP is interconnected at 33 kV with Nuneaton BSP, through Newdigate primary, with Coventry Central BSP through Walsgrave primary, and with Coventry West BSP through Coventry Colliery primary.

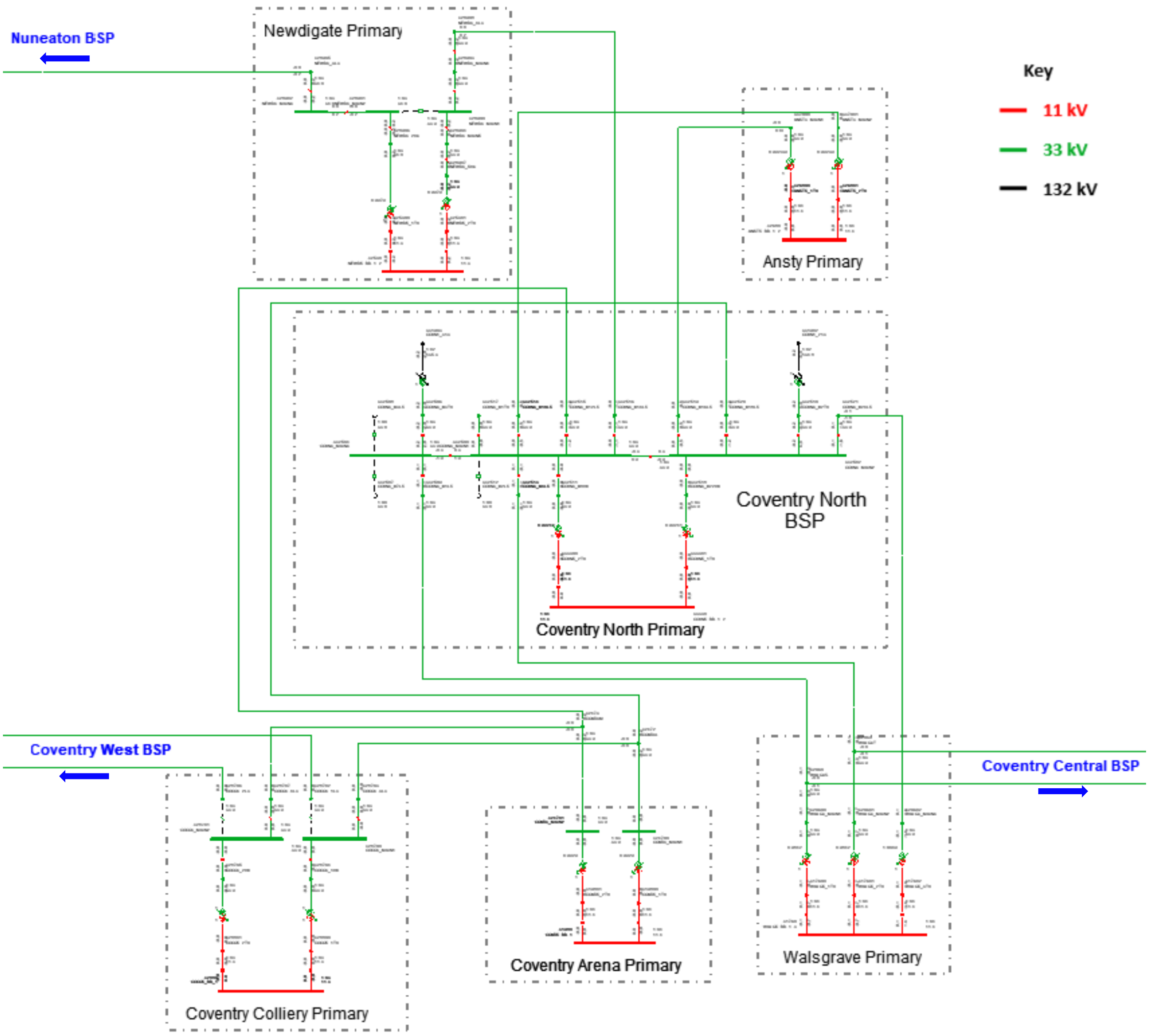


*Figure 1.1.1 Coventry North 33 kV network single line diagram*

Coventry West BSP is a two 90/114 MVA, 132/33 kV GT substation. The 33 kV busbar comprises two sections. Coventry West BSP supplies three primary substations: Hawksmill Lane, Browns Lane, Kenilworth, and Torrington Avenue. All of the primaries fed from Coventry West BSP have two 33/11 kV transformers (apart from Hawksmill Lane which has two 33/6.6 kV transformers).

Coventry West BSP is interconnected at 33 kV with Warwick BSP, through Kenilworth primary and a 33 kV circuit, with Coventry North BSP through Coventry Colliery primary, and with Coventry South BSP via Torrington Avenue primary.

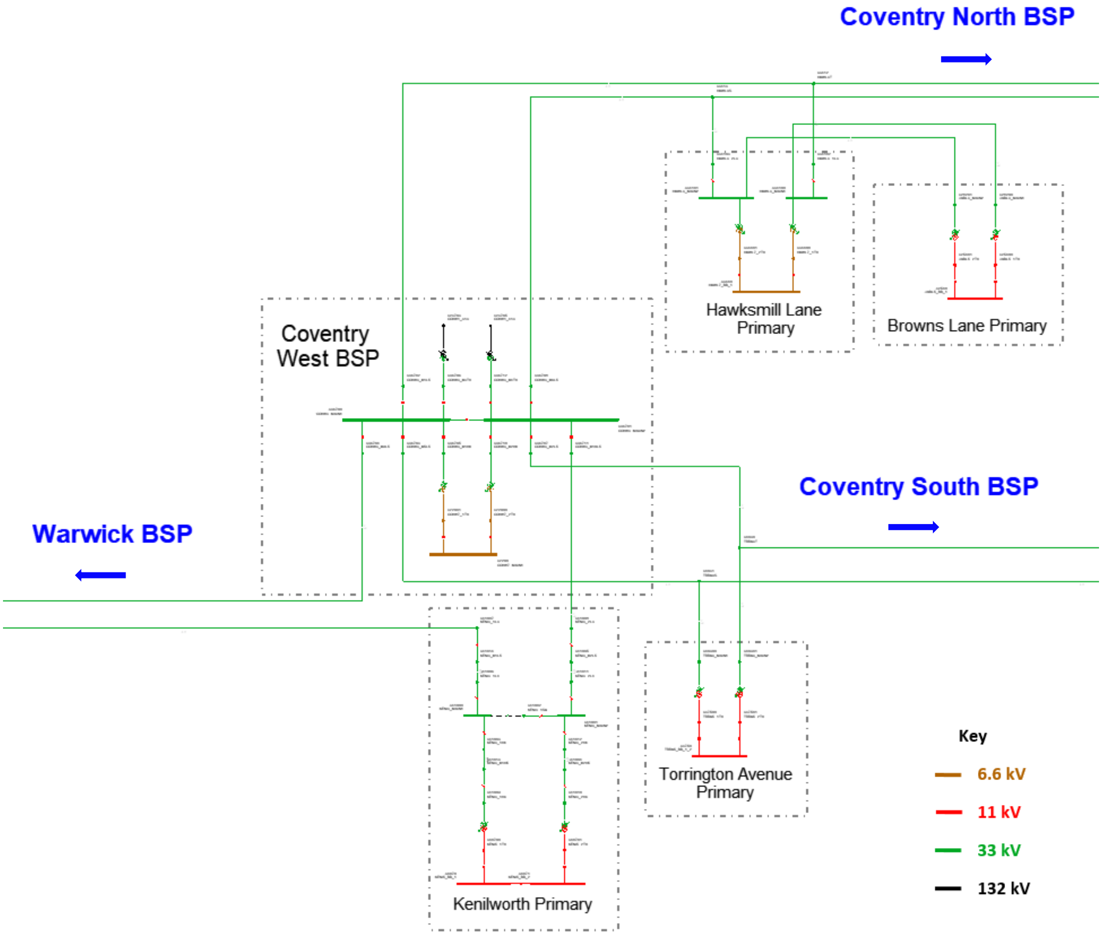


*Figure 1.1.2 Coventry West 33 kV network single line diagram*

Coventry Central BSP is a two 90/114 MVA, 132/33 kV GT substation. The 33 kV busbar comprises two sections. Coventry Central BSP supplies six primary substations: Courthouse Green, Courtaulds, Cox Street, Dunlop, Holbrook Lane, and Sandy Lane. All of the primaries fed from Coventry Central BSP have two 33/6.6 kV transformers, apart from Courthouse Green, which has one 33/6.6 kV transformer and two 33/11 kV transformers.

Coventry Central BSP is interconnected at 33 kV with Coventry North BSP, through Courthouse Green primary and with Coventry South BSP, through Sandy Lane primary and a 33 kV circuit.

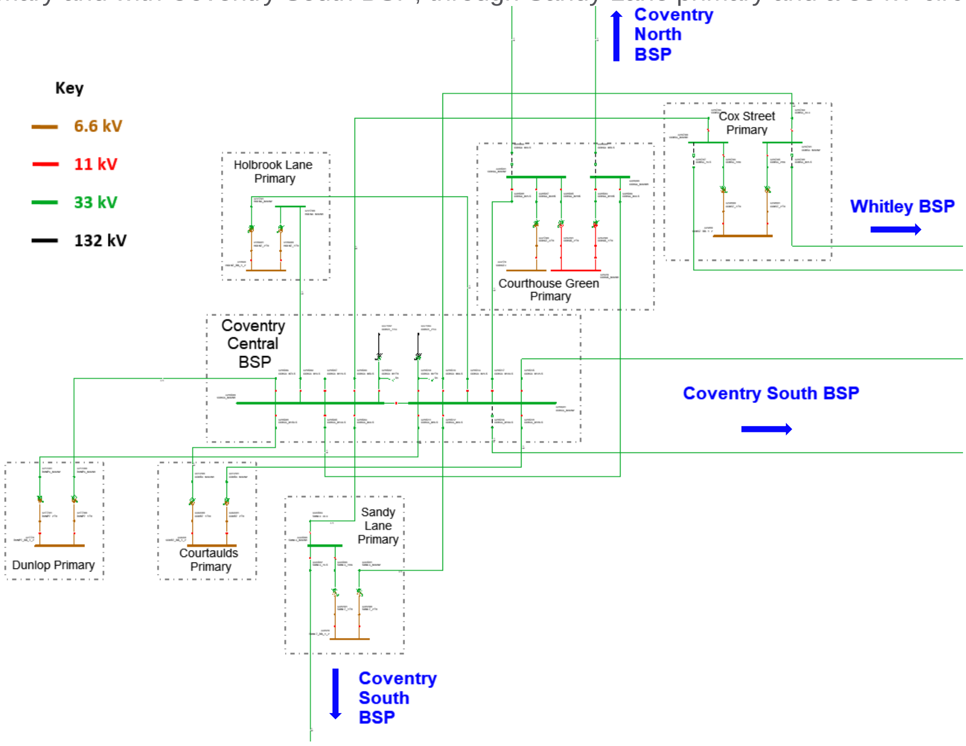


*Figure 1.1.3 Coventry Central 33 kV network single line diagram*

Coventry South BSP is a two 90/114 MVA, 132/33 kV GT substation. The 33 kV busbar comprises two sections. Coventry South BSP supplies five primary substations: Dillotford Avenue, Holyhead Road, Spon Street and two dedicated customer sites. All of the primaries fed from Coventry South BSP have two 33/11 kV transformers, apart from Spon Street, which has two 33/6.6 kV transformers.

Coventry South BSP is interconnected with Coventry Central BSP, through Sandy Lane primary and a 33 kV circuit, and Coventry West BSP via Torrington Avenue primary.

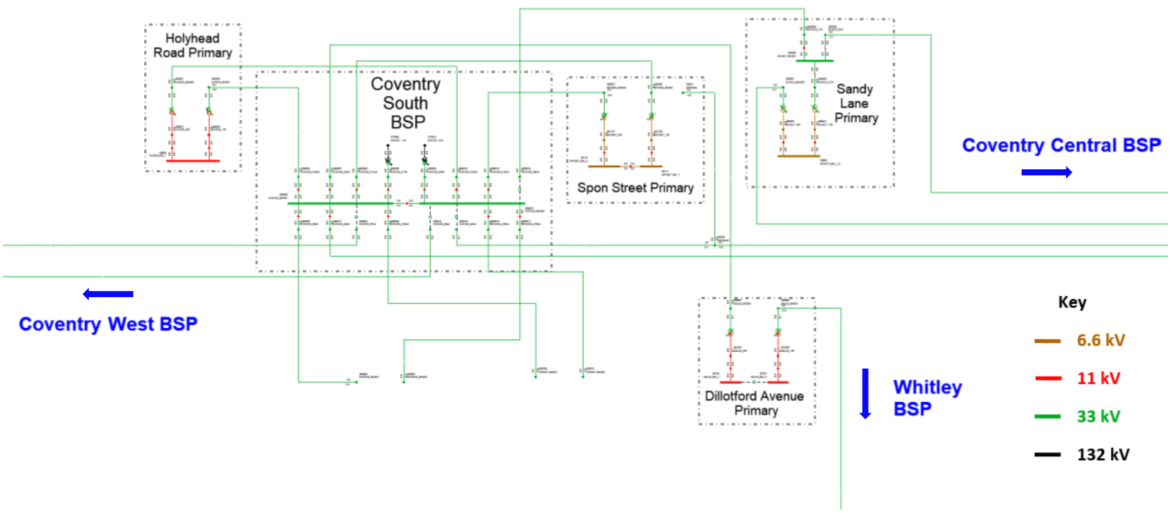


*Figure 1.1.4 Coventry South 33 kV network single line diagram*

## 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.

- For arranged outages on any GT at Coventry North, West, Central and South BSPs, or their associated 132 kV infeeds, the lower voltage side circuit breaker is opened to prevent back-energisation.
- For arranged outages on any GT at Coventry North, or their associated 132 kV infeeds, the 11 kV bus section circuit breaker at Newdigate primary is opened to prevent loose couples.
- For arranged outages on the 33 kV bus section circuit breaker at Coventry North, West, Central and South BSPs, the downstream network is split, where applicable, at 11 kV or 6.6 kV to prevent loose couples.
- For an arranged outage on an infeed to, or a transformer at any of the primaries, the lower voltage side circuit breaker is opened to prevent back-energisation.
- For arranged outages on one of the transformers at Walsgrave primary, the site is split at 11 kV to prevent overloading under the next credible fault.
- For an outage on the infeed to, or the transformer at Princethorpe primary, the demand at Princethorpe is transferred to Southam primary on the 11 kV network.
- For any arranged outage affecting infeed in to any GT at Warwick BSP or Coventry West BSP, the loose couple at Kenilworth primary is split by opening the 11 kV bus section circuit breaker.

# 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:

- Both transformers at Newdigate primary overload by 2034, following a planned or unplanned outage on the other transformer or its associated 33 kV infeed.
- Both transformers at Torrington Avenue primary overload by 2034, following a planned or unplanned outage on the other transformer or its associated 33 kV infeed.
- Both transformers and 33 kV circuits to at Holbrook Lane primary overload by 2034, following a planned or unplanned outage on the other transformer or its associated 33 kV infeed.
- Constraints are observed on the primary transformers and circuits at Kenilworth primary; these are considered in the Warwick & Harbury 33 kV report.

## 2.2 Newdigate primary transformer overloads

### Constraint Overview

Generation Demand

The table below outlines the nature of the network constraints identified in the network analysis.

*Table 2.2.1 constraint(s) and conditions under which constraint(s) occur*

| 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 |
| Newdigate primary transformer overloads | Arranged or fault outage on the other infeed or transformer | None | 2034 | 2034 | 2034 | 2034 |

**Uncertainty under other Distribution Future Energy Scenarios:** The constraint is present under Leading the Way, Consumer Transformation and Best View by 2034. By 2050, all scenarios forecast an overload on the existing transformers.

### Solution Options

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

*Table 2.2.2 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 both transformers with 12/24 MVA units | × | × | ✓ | Discounted |
| 2 | Replace both transformers with 20/40 MVA units | ✓ | × | ✓ | Viable |
| 3 | Install a third transformer on site | ✓ | × | × | Viable |
| **Operational Mitigation** | | | | | |
| 4 | Transfer demand to other primaries | ✓ | × | ✓ | Viable |
| **Flexibility services** | | | | | |
| 5 | Procure flexibility under Newdigate 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 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 1 – Replace both transformers with 12/24 MVA units

Discounted

**Capacity released for constraint(s) considered:** 1.2 MVA

**New limiting factor for constraint(s) considered:** the new transformers

**Detailed description:** Uprating both primary transformers at Newdigate to 12/24 MVA units will only marginally increase capacity across all seasons from the current 15/21.8 MVA. The replacement of the transformers at Newdigate would confer an asset condition benefit, as the existing units are over 60 years old. The 11 kV switchboard is rated at 1250 A and would therefore not require replacement if 12/24 MVA units were installed. The new capacity would shortly be exceeded, which means this is not a suitable long term solution. For this reason, this option has been discounted.

## Option 2 – Replace both transformers with 20/40 MVA units

**Capacity released for constraint(s) considered:** 4.4 MVA — Viable

**New limiting factor for constraint(s) considered:** 33 kV circuits supplying Newdigate primary

**Detailed description:** Uprating both primary transformers at Newdigate to 20/40 MVA units will increase capacity on the transformers more than in option 1; however, the 11 kV switchboard will also require reinforcement to align with the new transformer ratings. The primary substation's winter firm capacity will still also be limited by the 33 kV circuits. Additional capacity can be released later on by undertaking 33 kV circuit works only as required. As with option 1 the replacement of the transformers at Newdigate would also confer an asset condition benefit (the existing units are over 60 years old).

## Option 3 – Install a third transformer on site

**Capacity released for constraint(s) considered:** Depending on 11 kV arrangement — Viable

**New limiting factor for constraint(s) considered:** 33 kV circuits supplying Newdigate primary

**Detailed description:** Installing a third 33/11 kV transformer at Newdigate could increase capacity; however, it will require additional works such as a third section of 11 kV switchboard and transferring of 11 kV feeders.

There are only two 33 kV circuits feeding Newdigate, therefore the options would be to either install additional 33 kV equipment and re-configure the network arrangement, or to install a third circuit from either Coventry North BSP, which is approximately 6 km away, or Nuneaton BSP, which is approximately 8 km away. At the BSP, the third circuit would need to be supplied from the side of the switchboard that doesn't already supply the site, to avoid the risks associated with a busbar outage.

## Option 4 – Transfer demand to other primaries

**Capacity released for constraint(s) considered:** Depending on transfers — Viable

**New limiting factor for constraint(s) considered:** As before

**Detailed description:** Transferring demand out of Newdigate primary to adjacent primary substations through the 11 kV network will be assessed as part of a full 11 kV study. However, this may not be a viable long term solution for constraint management.

## Option 5 – Procure flexibility under Newdigate primary

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

**Detailed description:** Flexibility services could be procured to alleviate the projected overloads on the 33/11 kV transformers at Newdigate primary. The viability of utilising flexibility will be further investigated as part of the DNOA process.

## Solution Recommendation

Installing 20/40 MVA transformers on site and replacing the 11 kV switchboard is the optimal long term solution that reduces future expenditure at Newdigate primary. Should the demand at Newdigate increase beyond the 33 kV circuit capacity at a later stage, reinforcement options for the 33 kV circuits will be assessed.

## 2.3 Torrington Avenue primary transformer overloads

### Constraint Overview

Generation | **Demand**

The table below outlines the nature of the network constraints identified in the network analysis.

*Table 2.3.1 constraint(s) and conditions under which constraint(s) occur*

| 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 |
| Torrington Avenue primary transformer overloads | Arranged or fault outage on the other infeed or transformer | None | 2034 | 2034 | - | - |

**Uncertainty under other Distribution Future Energy Scenarios:** The constraint is present under Leading the Way, Consumer Transformation and Best View by 2034. Under the lower growth scenarios, the constraint appears shortly after 2034. By 2050, all scenarios forecast an overload on the existing transformers, across all seasons.

### Solution Options

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

*Table 2.3.2 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 | Replace both transformers with 12/24 MVA units | ✓ | × | ✓ | Viable |
| 2 | Replace both transformers with 20/40 MVA units | ✓ | × | ✓ | Viable |
| **Operational Mitigation** | | | | | |
| 3 | Transfer demand to other primaries | ✓ | × | ✓ | Viable |
| **Flexibility services** | | | | | |
| 4 | Procure flexibility under Torrington Avenue 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 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 1 – Replace both transformers with 12/24 MVA units**

Discounted

**Capacity released for constraint(s) considered:** 9 MVA

**New limiting factor for constraint(s) considered:** the new transformers

**Detailed description:** Uprating both primary transformers at Torrington Avenue to 12/24 MVA units will increase capacity across all seasons from the current 15 MVA. As the existing transformers are around 60 years old, their replacement may also be triggered based on their condition. It is anticipated that the new capacity released at Torrington Avenue primary by installing 12/24 MVA transformers will be exceeded between 2034 and 2050, which will require further upgrading the transformers, alongside 11 kV switchboard and 33 kV circuit reinforcement.

## Option 2 – Replace both transformers with 20/40 MVA units

**Capacity released for constraint(s) considered:** 11.6 MVA **Viable**

**New limiting factor for constraint(s) considered:** 33 kV circuits to Torrington Avenue primary

**Detailed description:** Uprating both primary transformers at Torrington Avenue to 20/40 MVA units will increase capacity on the transformers more than in option 1; however, the 11 kV switchboard will also require reinforcement to align with the new transformer ratings. The primary substation's winter firm capacity will still be limited by the 33 kV circuits. Additional capacity can be release later on by undertaking 33 kV circuit works only, which would involve around 10 km of uprating, due to Torrington Avenue having two circuits to Coventry West and another two to Coventry South (each approximately 2.5 km). The circuits to only one BSP could be uprated, but this would reduce network operability.

## Option 3 – Transfer demand to other primaries

**Capacity released for constraint(s) considered:** Depending on transfers **Viable**

**New limiting factor for constraint(s) considered:** As before

**Detailed description:** Transferring demand out of Torrington Avenue primary to adjacent primary substations through the 11 kV network will be assessed as part of a full 11 kV study. However, this may not be a viable long term solution for constraint management.

## Option 4 – Procure flexibility under Torrington Avenue primary

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

**Detailed description:** Flexibility services could be procured to alleviate the projected overloads on the 33/11 kV transformers at Torrington Avenue primary. The viability of utilising flexibility will be further investigated as part of the DNOA process.

## Solution Recommendation

Installing 20/40 MVA transformers on site would be the optimal long term solution that reduces future expenditure at Torrington Avenue primary. However, significant 33 kV circuit works will be required in order to release this capacity upstream.

# 2.4 Holbrook Lane primary transformer and 33 kV circuit overloads

## Constraint Overview

Generation Demand

The table below outlines the nature of the network constraints identified in the network analysis.

*Table 2.4.1 constraint(s) and conditions under which constraint(s) occur*

| 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 |
| Holbrook Lane primary transformer overloads | Arranged or fault outage on the other infeed or transformer | None | 2034 | 2034 | 2034 | 2034 |
| Coventry Central – Holbrook Lane 33 kV circuit overloads | Arranged or fault outage on the other infeed | None | 2034 | 2034 | 2034 | 2034 |

**Uncertainty under other Distribution Future Energy Scenarios:** The constraint is present under Leading the Way, Consumer Transformation and Best View by 2034. By 2050, all scenarios forecast an overload on the existing transformers and circuits.

## Solution Options

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

*Table 2.4.2 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 | Replace both transformers with 20/40 MVA units | ✓ | × | ✓ | **Discounted** |
| 2 | Install a third transformer and circuit to Holbrook Lane primary | × | × | × | **Discounted** |
| **Operational Mitigation** | | | | | |
| 2 | Transfer demand to other primaries | ✓ | × | ✓ | **Viable** |
| **Flexibility services** | | | | | |
| 5 | Procure flexibility under Holbrook Lane 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 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 1 – Replace both transformers with 20/40 MVA units

**Discounted**

**Capacity released for constraint(s) considered:** 9 MVA

**New limiting factor for constraint(s) considered:** The new transformers or 6.6 kV switchboard

**Detailed description:** Uprating both transformers at Holbrook Lane primary to 20/40 MVA would resolve the projected transformer constraint at the site. The primary is currently a 33/6.6 kV site, and would need converting to a 33/11 kV site in order to utilise the capacity of the 20/40 MVA transformers. This is because the highest rated switchgear used as standard on the network (2000 A) only provides 23 MVA of capacity when run at 6.6 kV.

There are a number of 33/6.6 kV primaries within the Coventry group which are interconnected at 6.6 kV. If the Holbrook Lane 6.6 kV network were converted to 11 kV, this would either further island the remaining primaries or require a large number of 11/6.6 kV transformers to be installed. As the majority of the 33/6.6 kV primary substations do not require transformers to be uprated to 20/40 MVA sites before 2050, this solution is not recommended at this time. The implications of converting 6.6 kV network to 11 kV are discussed in more detail in the NDP Introduction and Methodology.

### Option 2 – Install a third transformer and circuit to Holbrook Lane primary

Discounted

**Capacity released for constraint(s) considered:** Minimal

**New limiting factor for constraint(s) considered:** Transformer ratings for a busbar fault

**Detailed description:** Installing a third transformer and 33 kV circuit to Holbrook Lane primary would not free up significant capacity at the site. This is due to the fact that there are only two 33 kV busbars at Coventry Central BSP, so two of the primary transformers would need to be supplied from a single busbar and would consequently both be lost for a fault on that busbar.

### Option 3 – Transfer demand to other primaries

Viable

**Capacity released for constraint(s) considered:** Dependent on transfers

**New limiting factor for constraint(s) considered:** As before

**Detailed description:** Transferring demand out of Holbrook Lane primary to adjacent primary substations through the 6.6 kV network will be assessed as part of a full 6.6 kV study. In the 2034 studies there is ample capacity at neighbouring primaries, which may require 6.6 kV circuit works to facilitate but would ensure existing assets are well utilised.

### Option 4 – Procure flexibility under Holbrook Lane primary

Viable

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

**Detailed description:** Flexibility services could be procured to alleviate the projected overloads on the 33/6.6 kV transformers and 33 kV circuits at Holbrook Lane primary. As the constraint occurs under a first circuit fault, flexibility services may be required for extended periods of time. The viability of utilising flexibility will be further investigated as part of the DNOA process.

## Solution Recommendation

In the short term, it is recommended that load transfers are investigated using the existing 6.6 kV network. This may defer the need for reinforcement at Holbrook Lane on the primary transformers and circuits, however in the longer term (post 2034) reinforcement of these assets will be likely. Any reinforcement solution should be considered alongside a review of all 6.6 kV networks, as strategically upgrading the 6.6 kV network to 11 kV could provide wider benefits to the secondary networks.

The demand at Holbrook Lane and the surrounding primaries will be monitored and reassessed as part of future NDP and DNOA reports to identify the optimal long term reinforcement strategy for the area.

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