16 West Coast Regional Plan

16.1 Regional overview and transmission system

The West Coast region includes a mix of significant provincial towns (Dobson, Greymouth, Hokitika) and smaller, lower-growth rural localities.

The major industries in the region are minerals, dairying, and tourism. Over the years, the decline of the coal mining industry and closure of the cement plant at Cape Foulwind has resulted in a reduction in forecast demand. Also, an increase in embedded generation in the region has contributed to lower forecast demand. These in turn have impacted on transmission needs within the region.

The existing transmission network for the West Coast region is set out geographically in Figure 16-1 and schematically in Figure 16-2.
Figure 16-1: West Coast region transmission network
16.1.1 Transmission into the region

The West Coast region is connected to the National Grid via two 220/110 kV interconnecting transformers at Kikiwa (one on standby) and two 66 kV circuits from Coleridge. The 220/110 kV interconnection at Kikiwa effectively operates in parallel with the transformer at Stoke (in the Nelson-Marlborough region).

The amount of regional generation is much less than regional demand. Significant imports are required, most of which is supplied from remote generation in the Waitaki Valley, with significant load off-take in the South Canterbury and Canterbury regions.
16.1.2 Transmission within the region

Within the West Coast region, the transmission network comprises 110 kV and 66 kV transmission circuits, with two 110/66 kV interconnecting transformers at Dobson.

Most of the West Coast load is mostly supplied from the northern infeed, with power flowing through the region on the 110 kV circuits from Kikiwa to Dobson via Inangahua and the 110 kV spur from Inangahua to Robertson Street and Westport. Some loads are fed from the south via low capacity 66 kV circuits from Coleridge, which also provide significant voltage support to the region. Reactive support for the region (and grid backbone) is provided by a STATCOM at Kikiwa and capacitor banks at Greymouth and Hokitika.

Most of the assets at Robertson Street, Reefton, Atarau, Greymouth, Kumara and Hokitika are owned by the local lines company (Westpower or Buller Network).

16.2 West Coast demand

After diversity maximum demand for the West Coast region is forecast to grow by an average 2.2 per cent per annum over the next 15 years, from 49 MW in 2017 to 68 MW by 2032. This is higher than the national average of 1.4 per cent per annum.

Table 16-1 sets out forecast peak demand (prudent growth\(^1\)) for each grid exit point for the forecast period.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthur’s Pass</td>
<td>1.00</td>
<td></td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Atarau (1)</td>
<td>0.98</td>
<td></td>
<td>0.6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Castle Hill (2)</td>
<td>1.00</td>
<td></td>
<td>0.8</td>
<td>1.1</td>
<td>5.9</td>
<td>5.9</td>
<td>5.9</td>
<td>5.9</td>
<td>5.9</td>
<td>5.9</td>
<td>5.9</td>
<td>5.9</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>Dobson</td>
<td>0.99</td>
<td></td>
<td>9.2</td>
<td>9.3</td>
<td>9.4</td>
<td>9.5</td>
<td>9.6</td>
<td>9.7</td>
<td>9.8</td>
<td>9.9</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Greymouth</td>
<td>0.99</td>
<td></td>
<td>15</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>17</td>
<td>17</td>
<td>18</td>
<td>18</td>
<td>19</td>
<td>19</td>
<td>19</td>
<td>21</td>
</tr>
<tr>
<td>Hokitika</td>
<td>1.00</td>
<td></td>
<td>17</td>
<td>18</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>20</td>
<td>21</td>
<td>21</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>23</td>
</tr>
<tr>
<td>Kikiwa</td>
<td>1.00</td>
<td></td>
<td>3.5</td>
<td>3.6</td>
<td>3.6</td>
<td>3.7</td>
<td>3.7</td>
<td>3.8</td>
<td>3.8</td>
<td>3.9</td>
<td>3.9</td>
<td>4</td>
<td>4</td>
<td>4.3</td>
</tr>
<tr>
<td>Kumara</td>
<td>1.00</td>
<td></td>
<td>3.3</td>
<td>3.3</td>
<td>3.4</td>
<td>3.4</td>
<td>3.4</td>
<td>3.5</td>
<td>3.5</td>
<td>3.6</td>
<td>3.6</td>
<td>3.7</td>
<td>3.7</td>
<td>3.9</td>
</tr>
<tr>
<td>Murchison</td>
<td>0.98</td>
<td></td>
<td>2.7</td>
<td>2.7</td>
<td>2.8</td>
<td>2.8</td>
<td>2.8</td>
<td>2.8</td>
<td>2.8</td>
<td>2.8</td>
<td>2.8</td>
<td>2.8</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>Orowaiti</td>
<td>1.00</td>
<td></td>
<td>11</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>Otira (3)</td>
<td>0.76</td>
<td></td>
<td>0.6</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>1.5</td>
<td>1.9</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.1</td>
</tr>
<tr>
<td>Reefton</td>
<td>1.00</td>
<td></td>
<td>7.9</td>
<td>8.1</td>
<td>8.3</td>
<td>8.5</td>
<td>8.7</td>
<td>8.8</td>
<td>9</td>
<td>9.2</td>
<td>9.4</td>
<td>9.6</td>
<td>9.6</td>
<td></td>
</tr>
<tr>
<td>Robertson Street</td>
<td>1.00</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Westport</td>
<td>0.97</td>
<td></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

1. Atarau grid exit point decommissioning following closure of Pike River Mine
2. Customer has advised of a 5 MW step load growth in 2018 – Porters Heights Development
3. Customer has advised of a 1.2 MW step load growth in 2022-23 – NZ Rail 1 (0.8 MW) in 2022 and NZ Rail 2 (0.4 MW) in 2023

Our prudent peak forecast has a 10 per cent probability of exceedance forecast for the first seven years of the forecast period. For the rest of the forecast period we assume an expected (or mean) rate of growth. Refer to Chapter 3 for further information on demand forecasting.
16.3 West Coast generation

The West Coast region’s generation capacity is currently 30 MW. Table 16-2 lists the generation forecast for each grid injection point in the West Coast region for the forecast period. This includes all known and committed generation stations including those embedded in local lines company networks (Westpower, Buller Networks, Network Tasman, or Orion).²

Additional generation may be developed during the forecast period but is not sufficiently advanced to be included in our forecasts. (Refer to section 16.5.7 for more information on potential new generation.

Table 16-2: Forecast annual generation capacity (MW) at West Coast grid injection points to 2032 (existing and committed generation)

<table>
<thead>
<tr>
<th>Grid injection point (location/ name if embedded)</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
<th>2032</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dobson (Arnold)</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Hokitika (Amethyst)</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Hokitika (McKays Creek)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Hokitika (Wahapo-Okarito Forks)</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Kumara (Hokitika Diesel)</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Kumara (Kumara and Dillmans)¹</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Robertson Street (Kawatiri Hydro)</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

1. Kumara and Dillmans share the same water resource and are offered into the market as a single 10 MW generator. Kumara does not have significant water storage but is expected to supply an average of 4 MW during summer peaks.

² Only generators with a capacity greater than 1 MW are listed. Generation capacity is rounded to the nearest megawatt.
16.4 Grid enhancement approach

16.4.1 Possible future West Coast transmission configuration

Figure 16-3 shows the possible configuration of West Coast transmission in 2032. New assets, upgraded assets and assets scheduled for replacement within the forecast period (based on potential enhancement approaches set out in the following sections) are shown.

Figure 16-3: Possible West Coast transmission configuration in 2032

16.4.2 Enhancement approach

We ensure secure transmission into and within the West Coast region into the future. Through the E&D process we assess transmission capacity and reactive support requirements in the region over the next 15 years (while remaining cognisant of longer-term development opportunities). In developing Grid Enhancement
Approaches to address identified issues and opportunities we take into account uncertainty in future demand, generation and technological developments.

Transmission issues likely requiring E&D or Customer-funded investments in the West Coast region over the next 10-15 years include:

<table>
<thead>
<tr>
<th>Section number</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.4.2.1</td>
<td>Arthurs Pass supply security</td>
</tr>
<tr>
<td>16.4.2.2</td>
<td>Castle Hill supply capacity and security</td>
</tr>
<tr>
<td>16.4.2.3</td>
<td>Murchison supply security</td>
</tr>
<tr>
<td>16.4.2.4</td>
<td>Hokitika transmission capacity</td>
</tr>
<tr>
<td>16.4.2.5</td>
<td>Westport substation and Orewa–Westport 110 kV lines</td>
</tr>
<tr>
<td>16.4.2.6</td>
<td>West Coast high voltage</td>
</tr>
</tbody>
</table>

16.4.2.1 Arthurs Pass supply security

Arthurs Pass is supplied by a single transformer, resulting in n security.

There is a non-contracted spare transformer on site, allowing possible replacement within 8-14 hours following a unit failure (if the spare unit is available).

Enhancement approach:

- The Arthurs Pass supply transformer is due for risk based condition replacement in 2019 (base capex replacement and refurbishment). Before this time we will discuss, with Orion, whether there is a need to increase supply security.

16.4.2.2 Castle Hill supply capacity and security

Castle Hill is supplied by a single transformer, resulting in n security. The Castle Hill load is expected to exceed the capacity of the supply transformer from 2018.

There is a non-contracted spare transformer on site, allowing possible replacement within 8-14 hours following a unit failure (if the spare unit is available).

Enhancement approach:

- The Castle Hill supply transformer is due for risk based condition replacement in 2019 (base capex replacement and refurbishment). Before this time we will discuss, with Orion, the capacity requirements of the replacement transformer and whether there is a need to increase supply security.

16.4.2.3 Murchison supply security

Murchison is supplied by a single transformer resulting in n security. The Murchison supply transformer is due for risk based condition replacement.

Enhancement approach:

- We are committed to replacing the Murchison supply transformer with a 10 MVA unit which will be commissioned in 2018 (base capex replacement and refurbishment). The customer has not requested a higher level of security for the site so no investments are planned to increase supply security.
16.4.2.4 Hokitika transmission capacity

Hokitika is supplied by two 66 kV circuits, from Kumara and Otira. By the end of the forecast period, an outage of one of these circuits will cause the other to overload.

Enhancement approach:

Options to improve supply security into Hokitika include:

- a special protection scheme that automatically reduces load at Hokitika following a circuit outage. This will cause partial loss of supply
- system reconfiguration that involves decommissioning the Kumara–Otira circuit and bonding the circuits between Kumara and Kawhaka\(^3\) and between Otira and Kawhaka to maintain n-1 security to Hokitika
- reconductoring of the low capacity section of the line from Kawhaka to Hokitika, and thermal upgrading of the other section. This would shift overloading issues to the Dobson–Greymouth circuit which could, in turn, be addressed by constraining on generation at Kumara, thermally upgrading the circuit, or transferring load from Greymouth to Dobson.

16.4.2.5 Westport substation and Orowaiti–Westport 110 kV transmission lines

The Westport substation and associated 110 kV transmission lines (Orowaiti Tee–Westport sections of the Inangahua–Westport–A and Waimangaroa–Westport–B lines) primarily supplied Holcim’s Cape Foulwind cement plant in Westport. Holcim has ceased operations at this site and Buller Electricity has subsequently disconnected its supply at Westport. As a result, our transmission assets into Westport are not currently serving any customers.

Enhancement approach:

- Our investigations have concluded that the preferred option is to retain only the transmission lines into Westport and the Westport substation site. All equipment downstream of the substation 110 kV gantry will be dismantled and removed. We are currently consulting with the Westport community on our preferred option.

Base E&D Capex investments

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Westport Future Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project description</td>
<td>Remove unused assets from the Westport substation</td>
</tr>
<tr>
<td>Project’s state of completion</td>
<td>Proposed</td>
</tr>
<tr>
<td>OAA level completed</td>
<td>2d</td>
</tr>
<tr>
<td>Grid need date</td>
<td>2019</td>
</tr>
<tr>
<td>Indicative cost [$ million]</td>
<td>0.5</td>
</tr>
<tr>
<td>Part of the GEIR?</td>
<td>No</td>
</tr>
</tbody>
</table>

16.4.2.6 West Coast high voltage

Under light load conditions and high generation from the local embedded and grid connected generators, high voltages can occur on the West Coast 110 kV transmission system.

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\(^3\) Kawhaka is a Tee-site on the Aharua–Otira–A line for the line to Kumara, about 18 km from Hokitika.
Currently the issue is managed operationally by switching out of service some of the transmission circuits in the region.

Enhancement approach:

- Investments to resolve the upper South Island high voltage issues will also relieve the high voltage issue in the West Coast (refer to Chapter 6, Grid Backbone, South Island section).
16.5 Asset capability and management

We assess the transmission capacity and reactive support requirements in the region for the next 15 years. When an issue or opportunity exists, we have examined initial options and actions that may be taken to address it. Grid Enhancement Approaches (refer to section 16.4.2) have been developed to address issues or opportunities that require action within the forecast period and where investment is justified.

This section discusses the main inputs to the E&D process. These are:

- transmission capability (taking into account forecast demand and generation and possible technological changes)
- customer requests
- generation proposals and opportunities
- risk-based asset replacements
- significant upcoming work planned over the period
- asset feedback (information on assets or issues submitted through the asset feedback process).

16.5.1 West Coast transmission system significant upcoming work

We integrate our capital project and maintenance works to enable system issues to be resolved, if possible, when assets are replaced or refurbished. Table 16-3 lists the significant upcoming work proposed for the West Coast region for the next 15 years that may significantly impact related system issues or connected parties.

Table 16-3: Proposed significant upcoming work on the West Coast transmission system

<table>
<thead>
<tr>
<th>Description</th>
<th>Tentative year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthur’s Pass supply transformer expected end of life</td>
<td>2019-2021</td>
</tr>
<tr>
<td>Castle Hill’s supply transformer expected end of life</td>
<td>2019-2021</td>
</tr>
<tr>
<td>Greymouth’s capacitor bank replacement</td>
<td>2021-2024</td>
</tr>
<tr>
<td>Kikiwa–T1 refurbishment</td>
<td>2017/2018</td>
</tr>
<tr>
<td>Murchison supply transformer expected end of life</td>
<td>2017-2019</td>
</tr>
</tbody>
</table>

16.5.2 West Coast transmission system asset feedback

The Asset Feedback Register does not include any E&D-related items specific to the West Coast region.

16.5.3 Changes since the 2015 Transmission Planning Report

Table 16-4 lists the specific new issues and those that are no longer relevant within the forecast period (relative to our previous Transmission Planning Report).

---

4 Condition-based replacement of the asset is included in this list.
16 Table 16-4: Changes since the 2015 TPR

<table>
<thead>
<tr>
<th>Issues</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inangahua–Murchison–Kikiwa transmission capacity</td>
<td>Removed. Reduced regional load forecast</td>
</tr>
<tr>
<td>West Coast low voltage</td>
<td>Removed. Reduced regional load forecast</td>
</tr>
<tr>
<td>Castle Hill supply transformer capacity</td>
<td>New Issue. Step growth in demand forecast</td>
</tr>
</tbody>
</table>

16.5.4 West Coast transmission capability

This transmission capability section reports whether the Grid can be reasonably expected to meet (n-1) security requirements over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR).

Table 16-5 summarises transmission capability issues that were identified for the West Coast region during the next 15 years. In each case we have detected a condition that would constrain the network capacity if action were not taken. Each issue is discussed in more detail below.

This transmission capability section reports whether the Grid can be reasonably expected to meet (n-1) security requirements over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR).

Table 16-5: West Coast region transmission issues – regional / site by grid exit point

<table>
<thead>
<tr>
<th>Section number</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regional</td>
<td></td>
</tr>
<tr>
<td>16.5.4.1</td>
<td>Kikiwa interconnecting transformer capacity</td>
</tr>
<tr>
<td>Site by grid exit point</td>
<td></td>
</tr>
<tr>
<td>16.5.4.2</td>
<td>Arthur’s Pass transmission and supply security</td>
</tr>
<tr>
<td>16.5.4.3</td>
<td>Castle Hill transmission and supply security</td>
</tr>
<tr>
<td>16.5.4.4</td>
<td>Hokitika transmission capacity</td>
</tr>
<tr>
<td>16.5.4.5</td>
<td>Kikiwa supply security</td>
</tr>
<tr>
<td>16.5.4.6</td>
<td>Murchison transmission and supply security</td>
</tr>
<tr>
<td>16.5.4.7</td>
<td>Otira supply security</td>
</tr>
</tbody>
</table>

16.5.4.1 Kikiwa interconnecting transformer capacity

Issue

There are two 220/110 kV interconnecting transformers (T1 and T2) at Kikiwa:

- Kikawa–T1 is rated at 50 MVA and normally supplies local 11 kV load only.
- Kikawa–T2 is rated at 150 MVA and normally provides the 220/110 kV interconnection between the West Coast region and the National Grid. It also operates in parallel with the 150 MVA Stoke–T7 interconnecting transformer in the Nelson-Marlborough region due to the 110 kV network connections between them.

The loss of the Stoke interconnecting transformer would result in the Kikiwa interconnecting transformer supplying both the West Coast and Nelson-Marlborough...
loads. This may result in overload of the Kikiwa interconnecting transformer where there is:

- high load in the West Coast and Nelson-Marlborough regions
- low generation in the West Coast and Nelson-Marlborough regions.

**What next?**

We expect this issue to be manageable over the forecast period by constraining on generation at Cobb and/or Kumara. No investments are planned to address this issue but we will continue to monitor the extent of the generation constraints and initiate an investigation to look at investment options as the need arises.

### 16.5.4.2 Arthur’s Pass transmission and supply security

**Issue**

The two circuits supplying Arthur’s Pass only have line circuit breakers and protection at Coleridge and Otira. A fault on any section of the Coleridge–Castle Hill–Arthur’s Pass–Otira circuits will result in a loss of supply to the Arthur’s Pass load.

A single 66/11 kV, 3 MVA transformer supplies load at Arthur’s Pass, resulting in supply security. Load is not forecast to exceed the transformer rating within the forecast period.

**What next?**

The Arthur’s Pass supply transformer is due for risk based condition replacement. However, transformer replacement will not address transmission security. See section 16.4.2.1 for our enhancement approach.

### 16.5.4.3 Castle Hill transmission and supply security

**Issue**

The two circuits supplying Castle Hill only have line circuit breakers and protection at Coleridge and Otira. A fault on any section of the Coleridge–Castle Hill–Arthur’s Pass–Otira circuits will result in a loss of supply to Castle Hill load.

A single 66/11 kV, 3.75 MVA transformer supplies load at Castle Hill, resulting in supply security. This transformer is expected to reach its risk based replacement criteria within the next five years.

Peak load at Castle Hill is forecast to exceed the winter capacity of the transformer by approximately 0.1 MW in 2018, increasing to approximately 5 MW in 2032 (see Table 16-6).

**Table 16-6: Castle Hill supply transformer overload forecast**

<table>
<thead>
<tr>
<th>Circuit/grid exit point</th>
<th>Transformer overload (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Castle Hill</td>
<td>0</td>
</tr>
</tbody>
</table>
What next?

The Castle Hill supply transformer is due for risk based condition replacement. However, transformer replacement will not address transmission security. See section 16.4.2.2 for our enhancement approach.

16.5.4.4 Hokitika transmission capacity

Issue

Two circuits supply the Hokitika grid exit point:

- Hokitika–Kumara rated at 27/32 MVA (summer/winter)
- Hokitika–Otira rated at 27/32 MVA (summer/winter).

By the end of the forecast period, an outage of one circuit will cause the other to exceed its thermal capacity.

What next?

Some initial investigations have been undertaken, and possible options identified for this issue. Refer to section 16.4.2.4 for our enhancement approach.

16.5.4.5 Kikiwa supply security

Issue

The Kikiwa load is normally supplied from the 11 kV tertiary winding of the Kikiwa–T1 interconnecting transformer, with a backup supply from the T2 interconnecting transformer. Transferring the load between T1 and T2 requires a short interruption to the load.

An outage of the 11 kV switchgear or fault limiting reactor results in a total loss of supply, as these assets have only n security.

What next?

The customer (Network Tasman) has not requested a higher level of security for the Kikiwa 11 kV load, so no investments are planned.

16.5.4.6 Murchison transmission and supply security

Issue

The load at Murchison is supplied by:

- two circuits, which do not have line protection at Murchison
- a single 110/11 kV, 5 MVA supply transformer.

A fault on either circuit or the supply transformer will result in a loss of supply to Murchison (n security). Load growth is not forecast to exceed the transformer rating within the forecast period.

What next?

The supply transformer at Murchison is due for risk based condition replacement. However, transformer replacement will not address transmission security. See section 16.4.2.3 for our enhancement approach.
16.5.4.7 Otira supply security

Issue

Otira is supplied by a single 66/11 kV, 2.5 MVA transformer, resulting in n security. Load growth is not forecast to exceed the transformer rating within the forecast period.

What next?

The customer (Westpower) has not requested a higher level of security. Therefore, we have not planned any investments to increase supply security at Otira.

16.5.5 West Coast bus security

This section discusses bus security issues identified for the West Coast region during the next 15 years, arising from the outage of a single bus section rated at 66 kV and above.

Bus outages disconnect more than one power system component (for example, other circuits, transformers, reactive support or generating units). Therefore, bus outages may cause greater issues than a single circuit or transformer outage (although the risk of a bus fault is low, being less common than a circuit or transformer outage).

16.5.5.1 Transmission bus security

Table 16-7 lists bus outages that cause voltage issues or a total loss of supply. Generation is included only if a bus outage disconnects the whole generation station or causes a widespread system impact. Supply bus outages, typically 11 kV and 33 kV, are not listed.

Note that the customers (Buller Networks, Westpower, Network Tasman, and Orion) have not requested a higher security level, and unless otherwise noted we do not propose to increase bus security.

Table 16-7: Transmission bus outages

<table>
<thead>
<tr>
<th>Transmission bus outage</th>
<th>Loss of supply</th>
<th>Generation disconnection</th>
<th>Transmission issue</th>
<th>Further information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthur’s Pass 66 kV</td>
<td>Arthur’s Pass</td>
<td>-</td>
<td>-</td>
<td>16.5.4.2</td>
</tr>
<tr>
<td>Castle Hill 66 kV</td>
<td>Castle Hill</td>
<td>-</td>
<td>-</td>
<td>16.5.4.3</td>
</tr>
<tr>
<td>Coleridge 66 kV</td>
<td>Arthur’s Pass</td>
<td>-</td>
<td>-</td>
<td>note 1</td>
</tr>
<tr>
<td></td>
<td>Castle Hill</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dobson 66 kV</td>
<td>Dobson</td>
<td>-</td>
<td>-</td>
<td>note 2</td>
</tr>
<tr>
<td>Kikiwa 110 kV</td>
<td>West Coast load</td>
<td>-</td>
<td>-</td>
<td>16.5.4.5</td>
</tr>
<tr>
<td>Kikiwa 220 kV</td>
<td>Kikiwa</td>
<td>-</td>
<td>-</td>
<td>16.5.4.5</td>
</tr>
<tr>
<td></td>
<td>West Coast load</td>
<td></td>
<td></td>
<td>16.5.5.2</td>
</tr>
<tr>
<td>Inangahua 110 kV</td>
<td>Robertson Street</td>
<td>West Coast load</td>
<td>-</td>
<td>16.5.5.2</td>
</tr>
<tr>
<td></td>
<td>Westport</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Murchison 110 kV</td>
<td>Murchison</td>
<td>-</td>
<td>-</td>
<td>16.5.4.6</td>
</tr>
<tr>
<td>Otira 66 kV</td>
<td>Arthur’s Pass</td>
<td>-</td>
<td>-</td>
<td>note 1</td>
</tr>
<tr>
<td></td>
<td>Castle Hill</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 16: West Coast Regional Plan

16.5.5.2 West Coast voltage quality and transmission capacity

Issue

The West Coast 110 kV load is mainly supplied from the National Grid via two 110 kV Inangahua–Kikiwa circuits, with lower capacity 66 kV backup circuits from Coleridge. There are single 110 kV bus sections at Kikiwa and at Inangahua, so a bus outage will disconnect both circuits. This will cause:

- low voltage issues at all 110 kV and 66 kV buses
- transmission circuit capacity issues in the West Coast region.

The effect of the low voltages and circuit overloading is difficult to predict. The outcome is heavily influenced by the local generation and load composition at the time of the outage. The low voltages may cause enough motor load to trip so the transmission system stays intact and continues to supply the remaining load. Otherwise, one or more circuits will trip, causing a total loss of supply to some or all of the grid exit points in the region.

In addition, an outage of the Kikiwa 220 kV bus section, which disconnects the Kikiwa–T2 interconnecting transformer, will cause the transmission bus voltages in the region to fall below 0.90 pu (only if it occurs towards the end of the forecast period).

What next?

The customers (Westpower, Buller Networks, Network Tasman, and Orion) have not requested a higher security level. Therefore, we have not planned any investments to increase bus security at Kikiwa and Inangahua.

16.5.6 Other regional items of interest

16.5.6.1 Westport substation

Issue

In mid-2016 Holcim closed its Cape Foulwind cement operation which was supplied from the Westport substation. Buller Electricity served us a disconnection notice and has subsequently disconnected from the substation.

What next?

We are in the process of rationalising our unused assets at Westport. See section 16.4.2.5 for our approach.
16.5.6.2 West Coast high voltage

High voltage will occur on the 110 kV transmission system under light load conditions where there is also high generation from the local embedded and grid connected generators.

In addition, an outage of the Kikiwa–T2 interconnecting transformer, also disconnects the Kikiwa STATCOM (which is connected to the transformer’s tertiary winding) from the network resulting in reduced amount of available reactive power support. This will cause the transmission bus voltages in the region to rise above 1.1 pu.

This issue can be managed operationally at present by switching out selected circuits. If there are increased levels of embedded generation or a further reduction in load, this issue will become more significant and may require more intensive operational control of the generating units’ voltage set-points.

Investments to resolve the upper South Island high voltage (refer to Chapter 6, Grid Backbone, South Island section) will also relieve the high voltage issue in the West Coast.

16.5.7 West Coast generation proposals and opportunities

This section describes relevant regional issues that may affect generation proposals under investigation by developers and in the public domain, or other generation opportunities. We discuss the impact of committed generation projects on the grid backbone separately in Chapter 6.

We have received a number of requests regarding connection of generation to the transmission system in the West Coast region. Some of the larger proposals would require significant transmission upgrades to facilitate the export of generation from the region to the rest of the National Grid.

The maximum generation that can be connected depends on several factors and is usually expressed as a range. Generation developers should consult with us at an early stage of their investigations to discuss connection issues.

16.5.7.1 Maximum regional generation

Our estimates of maximum generation that can be accommodated in the region assume a light load conditions for the South Island and that existing generation in the West Coast region is operating at high levels (Kumara generating 10 MW, Amethyst generating 6 MW, and Kawatiri generating 4 MW).

For generation connected at the Kikiwa 220 kV bus, the maximum generation that can be injected under n-1 is approximately 760 MW. The constraint is the Islington–Kikiwa–2 or 3 circuit when either of the two circuits is out of service.

For a West Coast load of 35 MW, the estimated maximum generation injection at the two key buses is as follows:

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5 Kikiwa T2 contingency
6 The generation injection at a bus applies if the generation is connected directly at the bus, or indirectly at other locations within the region. For example, generation at Dobson or along the Waimangaroa spur connects indirectly to the Inangahua bus and Kikiwa bus. Generation connected to the 110 kV system in the Nelson–Marlborough region (Chapter 15) also injects indirectly to the Kikiwa 110 kV bus.
• At the Kikiwa 110 kV bus, under normal operating conditions, a maximum of 260 MW, to avoid overloading the Kikiwa–T2 interconnecting transformer. The generation injection value decreases to approximately 135 MW for an outage of Kikiwa–T2 to avoid overloading the 110 kV Kikiwa–Stoke circuits.

• At the Inangahua 110 kV bus under normal operating conditions, a maximum of approximately 165 MW, to avoid overloading the 110 kV Inangahua–Murchison–Kikiwa–1 circuit. The generation injection value decreases to approximately 105 MW for an outage of the 110 kV Inangahua–Kikiwa–2 circuit to avoid overloading the Inangahua–Murchison–Kikiwa–1 circuit.

Generation connected to the West Coast 66 kV transmission network may be constrained by several low capacity 66 kV circuits.

16.5.7.2 Generation connected to the Inangahua to Westport spur

Two circuits form the Inangahua to Westport spur, with substations at Waimangaroa, Robertson Street and Westport. The Inangahua–Waimangaroa–1 circuit is rated at 101/111 MVA\(^7\) (summer/winter) and the Inangahua–Waimangaroa–2 circuit is rated at 56/68 MVA (summer/winter).

Depending on the amount of generation connected to the spur, it may be necessary to:

• close the split at the Waimangaroa 110 kV bus
• install a special protection scheme to allow unconstrained pre-contingency generation injection,
• increase the circuit capacity between Waimangaroa, Inangahua, and Kikiwa.

Generation connected to the spur would also form part of the maximum level of generation that can be connected within the region (refer section 16.5.7.1).

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\(^7\) The circuit is presently limited to 76/76 MVA by substation equipment.