Thermal Fuel Scenarios

September 2019

Keeping the energy flowing
IMPORTANT

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1 THERMAL WHAT-IF SCENARIOS

In March 2019 we produced our first set of thermal fuel scenarios to provide insights into what impact fuel availability would have on security of supply. This month we have updated these scenarios. A new scenario has been added that investigates the known and expected thermal fuel limitations that may occur during early 2020. This represents a conservative outlook of what may occur during the HVDC, Pohokura and other outages. The other two scenarios are similar to what we published in March 2019, and are more generic scenarios. The first of these models the impact of a gas supply limitation or generation plant failure. The second generic scenario models a gas pipeline disruption, like that experienced in 2011 when the Maui pipeline was out of service while repairs were made.

The scenarios from March 2019 were carried out under the previous version of the SoSFIP where the calculated risk curves were called Hydro Risk Curves (HRCs), and Watch and Alert status were based on the 1% and 4% risk curves. The SoSFIP was updated on 1 August 2019, and the risk curves are now called Electricity Risk Curves (ERCs). Under this updated policy, Watch and Alert Status are calculated on a “time to Official Conservation Campaign” basis, and the Status ERCs are based on these calculated status rather than based on the 1% and 4% risk curves. The scenarios in this document are presented against the new Status ERCs. For a direct comparison to the March 2019 scenarios, each of the new scenarios are presented against the 1% and 4% ERCs in Appendix 3.

1.1 BASE CASE

The most recently published ERCs and Simulated Storage Trajectories (SSTs) were published on 1 August 2019. These charts have been included below as a base-case for comparison. In this chart Security of Supply status is shown by the Watch, Alert and Emergency curves. The SSTs are the cluster of 87 sequences that start from 1 August 2019. In last month’s ERC and SST update, no sequences crossed any of the status curves, indicating there is currently no foreseeable risk of an emergency situation occurring.
A set of ERCs and SSTs have been produced for each of the thermal constraint scenarios and are specifically for the purpose of analysing potential future scenarios. It is important to note the SSTs are a complex model that includes a mix of objective and subjective inputs and assumptions, including market behaviour. Certain assumptions around generator behaviours can have major impacts on the results in the SSTs, and therefore while the charts included here may represent one possible outcome of constraints in the gas market, there are many different possible outcomes depending on these assumed behaviours and specific situations modelled.

The South Island ERCs and SSTs for the base-case, as well as the three thermal scenarios, can be seen in the Appendix.

1.2 EARLY 2020 THERMAL CONSTRAINTS

There are a number of planned gas supply outages occurring early in 2020, such as the Pohokura gas field outage in March 2020. The first scenario includes possible restrictions to thermal generation due to these outages, and aligns with the reduced gas scenario used in the latest NZGB Report. This scenario is a conservative approach to modelling the gas supply outages as we currently observe them.

In the chart above, the ERCs are elevated in the first months of 2020 in response to the thermal outages and limitations at this time, and no sequences fall below the Watch status curve. Restricted generation means the Emergency Status Curve increases by approximately 500GWh – i.e. the risk of shortage rises when potential generation is reduced. The chart below shows the change to the Emergency curve when the thermal constraints have been modelled.
1.3 GAS SUPPLY SHORTAGE SCENARIO

In this scenario, one CCGT is indefinitely de-rated to 50% capacity from 1 May 2020 to represent a decrease in available gas supply for electricity generation or reduction in plant availability. This scenario could arise from a range of situations including upstream gas supply outages and limitations, or unplanned plant outages.

In the chart above, only one sequence crosses the Watch status curve (although only very briefly). This gas constraint effects both the ERCs and the SSTs. Restricted generation means the Emergency Status Curve increases by approximately 300GWh. The chart below shows the change to the Emergency curve when the thermal constraints have been modelled.
The gas constraint also impacts the SSTs in that the sequences fall to lower storage levels more rapidly as more water is used to meet demand due to reduced thermal generation.

### 1.4 GAS PIPELINE DISRUPTION SCENARIO

This scenario reflects a major infrastructure failure – the complete loss of gas transmission to major North Island electricity generators for an extended period (from 1 May 2020 to 31 July 2020). This scenario is reflected in the model by reducing Huntly gas-fired generation to zero for 3 months. This is an extreme, but plausible, scenario (in 2011 an unplanned outage on the Maui pipeline lasted five days) and is designed to test the edge of the envelope in terms of plausible futures.

In the chart above, three sequences cross the Watch status curve. Similar to the gas constraint scenario, both the ERCs and SSTs are impacted by the loss of gas transmission in the North Island. In this scenario, the Emergency Status Curve rises by up to 800GWh. The chart below shows the change to the Emergency curve when the additional thermal constraints have been modelled.
The increase to the ERCs is more pronounced in this scenario due to the scale of lost generation caused by the disrupted fuel supply. The SSTs also fall at a faster rate, again due to increased hydro generation to cover the loss of thermal generation.

1.5 WHAT DOES THIS ALL MEAN?

These scenarios show how a failure of a significant component of the New Zealand energy system can have a major impact on security of supply. Small changes to the electricity system that occur over a long period of time, such as gradually increasing demand, allow for a market response to keep supply and demand in balance, for example, by building new generation. But in sudden events such as the failure of major equipment, there is little time for the market to respond. Additionally, security of supply is a balance between avoiding emergency situations without over investing in costly generation.

- Unlike the thermal scenarios carried out in March 2019, no sequences cross the Emergency status curve in either thermal fuel scenario. This is largely due to the time of year that the sequences start and the addition of contingent storage to available storage.

- In these new scenarios, we are at a time of year when risk is lowest and there is significant time for generators to adjust their behaviour to manage their resources and avoid the heightened risk situation. In the March 2019 scenarios, the additional thermal outages immediately effected the risk curves, and generators had limited time to adapt their behaviour to avoid dropping below the elevated risk curves.

- Since the March 2019 thermal fuel scenarios, contingent storage has been included in the ERCs, which has shifted the shape of the curves to be lower in the later months of the year and increased available storage by between 245 and 465 GWh (depending on time of year). This has significantly reduced the chance of a storage sequence crossing the risk curves in the later months of the year.
2 APPENDIX: SOUTH ISLAND CHARTS

2.1 MOST RECENTLY PUBLISHED SOUTH ISLAND ERCs AND SSTs

SI Available Storage and Status Curves

Nominal SI Full
Historical 1% Risk
Historical 4% Risk
Mean
90th Percentile
10th Percentile
Watch
Alert
Emergency
Available Storage

Updated: 1 August 2019
Actual storage courtesy of NZX Hydro
(Lakes Tekapo, Pukaki, Hawea, Te Anau & Manapouri)
2.2 **SOUTH ISLAND ERCs AND SSTs FOR EARLY 2020 THERMAL CONSTRAINTS SCENARIO**

SI Available Storage and Status Curves - Thermal Constrained

Updated: 23 August 2019

(Areas Tekapo, Pukaki, Hawea, Te Anau & Manapouri)

For Illustrative Purposes Only

2.3 **SOUTH ISLAND ERCs AND SSTs FOR GAS SUPPLY SHORTAGE SCENARIO**

SI Available Storage and Status Curves - Gas Supply Shortage Scenario

Updated: 23 August 2019

(Lakes Tekapo, Pukaki, Hawea, Te Anau & Manapouri)

For Illustrative Purposes Only
2.4 SOUTH ISLAND ERCs AND SSTs FOR GAS PIPELINE DISRUPTION SCENARIO

SI Available Storage and Status Curves - Gas Pipeline Scenario

For Illustrative Purposes Only
3 Appendix: Percentage Risk Charts

3.1 Most Recently Published ERCs and SSTs – Percentage Risk

NZ Available Storage and Status Curves

SI Available Storage and Status Curves

Updated: 1 August 2019

Actual storage courtesy of NZX Hydro

(Lakes Taupo, Tekapo, Pukaki, Hawea, Te Anau & Manapouri)
3.2 Early 2020 Thermal Constraints – Percentage Risk

NZ Available Storage and Status Curves - Thermal Constrained

Updated: 23 August 2019

SI Available Storage and Status Curves - Thermal Constrained

Updated: 23 August 2019

Actual storage courtesy of NZX Hydro

For Illustrative Purposes Only
3.3 ERCs AND SSTs FOR GAS SUPPLY SHORTAGE SCENARIO – PERCENTAGE RISK

NZ Available Storage and Status Curves - Gas Supply Shortage Scenario

SI Available Storage and Status Curves - Gas Supply Shortage Scenario
3.4 ERCs and SSTs for Gas Pipeline Disruption Scenario – Percentage Risk

NZ Available Storage and Status Curves - Gas Pipeline Scenario

SI Available Storage and Status Curves - Gas Pipeline Scenario

For Illustrative Purposes Only

Nominal NZ Full – 1% Risk – 4% Risk – 10% Risk – Mean – 10th Percentile – 90th Percentile – Available Storage

Nominal SI Full – 1% Risk – 4% Risk – 10% Risk – Mean – 10th Percentile – 90th Percentile – Available Storage

Actual storage courtesy of NZX Hydro

(Lakes Taupo, Tekapo, Pukaki, Hawea, Te Anau & Manapouri)

Updated: 23 August 2019

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