Contingent Project
Sheffield to Burnie 220 kV Augmentation

TasNetworks Project Needs Analysis

Regulatory Control Period: 1 July 2019 to 30 June 2024

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Responsibilities

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1 Introduction

1.1 Purpose of this document

In January 2018, TasNetworks submitted our combined Revenue Proposal for transmission and distribution for the regulatory period commencing on 1 July 2019 and ending on 30 June 2024. On 27 September 2018, the Australian Energy Regulator (AER) released its draft decision. This document responds to the AER's draft decision in relation to one of TasNetworks' contingent projects, that is, the North West 220 kV Network Development referred to as the Sheffield to Burnie 220 kV augmentation.

1.2 Overview of the AER's Decision

Contingent projects are significant network augmentation projects that are reasonably required to be undertaken in order to achieve the capital expenditure objectives as defined in the Rules. However, unlike other proposed capital expenditure projects, the need for the project within the regulatory control period and the associated costs are relatively uncertain.

The AER rejected our contingent projects on the basis that we had not demonstrated that the contingent project triggers are:

- reasonably specific and capable of objective verification
- probable to occur during the regulatory control period[1].

To address the AER's draft decision TasNetworks has prepared this project needs analysis report, providing further discussion on the need for reinforcing the Sheffield to Burnie 220 kV corridor to facilitate significant generation developments in the North West or to facilitate a connection of a second Bass Strait interconnector into the Burnie area.

The inclusion of the Sheffield to Burnie 220 kV augmentation as a contingent project in our revised Regulatory Proposal ensures that provisions are made to allow this significant infrastructure project to proceed if it is demonstrated to deliver a net economic benefit.

This reports is provided as a supporting document to this revised Regulatory Proposal. The Project Needs Analysis sets out the following information:

- background on the existing network capacity and configuration;
- the issues or 'identified need' that would arise if particular 'triggers' eventuate;
- high level options for addressing the identified need;
- preliminary analysis of the net benefits that would arise from the proposed contingent project; and
- specific trigger events that are consistent with the analysis presented.

[1] AER, draft decision, TasNetworks Transmission Determination 2019 to 2024, Attachment 5, Capital Expenditure, page 50.

2 Background

The existing Sheffield to Burnie 220 kV transmission corridor includes a 46 km single circuit transmission line (TL504), built in 1957. It uses GOAT conductor at strung 49°C design temperature, providing a rating of 229 MA/138 MA (Winter/Summer).

We have received a number of connection applications from potential new generators in North West Tasmania – currently totalling 565 MW of new wind generation. There are significant further proposals that have submitted connection enquiries.

In order to accommodate a significant amount of new generation in North West Tasmania, the augmentation of the existing Sheffield to Burnie220 kV transmission corridor with a new double circuit 220 kV transmission line is likely to be required. The augmentation of this transmission corridor will avoid the need to constrain generation in order to maintain the power system security in a secure operating state. The estimated cost of this project is $80 million.

In addition, a second Bass Strait interconnector that connects into the network in North West Tasmania would also require the upgrade of the existing Sheffield–Burnie single circuit 220 kV transmission line with a new double circuit 220 kV transmission line. This augmentation would be required in order to address the thermal limitations caused by the additional energy transferred across the second Bass Strait interconnector (for both import and export scenarios), and is independent of the development of new generation.

This augmentation has been identified as a possible solution to address limitations caused by either high wind generation in North West Tasmania or high power flow between Victoria and Tasmania through a second Bass Strait interconnector, in the Australian Energy Market Operators (**AEMO**'s) 2018 Integrated System Plan (**ISP**).[2]

[2] http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Integrated-System-Plan

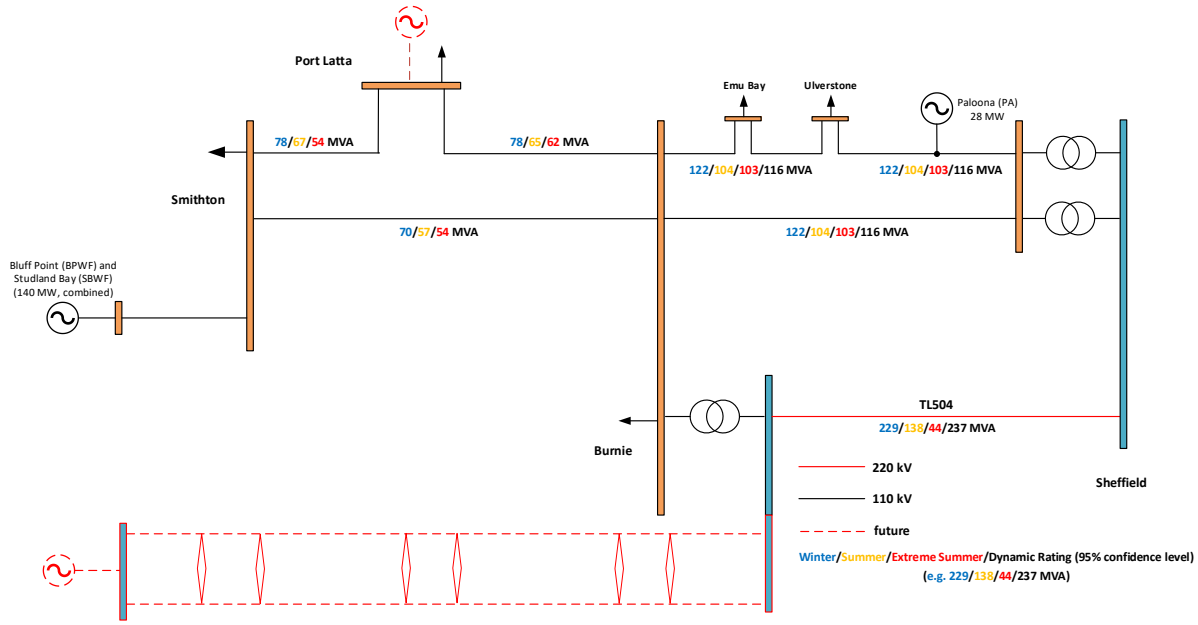
3 Need analysis – new generation in North West Tasmania

3.1 Overview

3.1.1 Transmission arrangements in North West Tasmania

Figure 1 presents the transmission arrangements in North West Tasmania, of which the TL504 is the only 220 kV circuit in the existing network. Also shown are the two existing wind farms, Bluff Point and Studland Bay, with a combined capacity of 140 MW. There are a number of other wind farms, totalling 565 MW, that have submitted connection applications. These wind farms are detailed in Table 1.

Figure 1: Transmission arrangements in North West Tasmania



TasNetworks applies dynamic ratings in operating its transmission network, which are generally well above its static ratings for the majority of time. Presented in Figure 1 are static ratings in Winter, Summer and Extreme Summer, as well as the dynamic ratings[3] for the circuits between Sheffield and Burnie substations. The dynamic ratings for the circuits west to Burnie are currently unavailable due to a lack of local weather stations.

3.1.2 Proposed new generation developments

There is 565 MW of new generation currently under connection applications in North West Tasmania, all proposing to connect within the 2019–24 regulatory control period. These are presented in Table 1. There is significantly more proposed generation that have submitted connection enquiries, but not yet submitted a connection application.

[3] Dynamic ratings presented here are the data corresponding to 95% confidence level, which means that there is 95% of time that the dynamic ratings of the circuits would be above the given values.

Table 1: Connection applications

Generation Development	Capacity (MW)	Timing
Connection application to 110 kV network west of Burnie	65	2019
Connection application to 220 kV network west of Burnie	500	2023
Connection enquiries west of Burnie	+900	+2024

3.2 The issue

Dynamic analysis carried out using generic wind farm models, suggests that the voltage in North West Tasmania could collapse for the loss of the single Sheffield–Burnie 220 kV transmission circuit once the new generation connecting at 220 kV at Burnie Substation exceeds 135 MW. The technical envelop for this operational limit is presented in the following equation:

$$NW220WF_{MW} \leq 193 + 6.72 \times 10^{-6} \times (NetNW110WF_{MW})^3 - 1.61 \times 10^{-3} \times (NetNW110WF_{MW})^2 - 0.242 \times NetNW110WF_{MW} \quad (1)$$

Where:

$NW220WF_{MW}$: the total MW output from wind farms connecting to 220 kV at or west of Burnie Substation; and

$NetNW110WF_{MW}$: the total MW output from wind farms connecting to 110 kV west of Burnie Substation minus the total demand of Burnie, Port Latta and Smithton substations.

When this equation[4] binds, wind generation in North West Tasmania will be constrained. In this analysis, it is assumed constrained generation will result in spill.

3.3 Options to address the issue

To maintain the power system security requirements as stipulated in the Rules with increasing generation in North West Tasmania, as presented in Section 3.2, credible options identified are:

- Option 0: Maintain power system security by invoking constraint equation; and
- Option 1: Construct a new double circuit Sheffield–Burnie 220 kV transmission line.

Option 0 will avoid the cost of undertaking the augmentation, but customers may suffer economic loss from not having access to this new generation.

[4] This equation has been developed for this analysis. It is not required until the amount of new wind generation in North West Tasmania exceeds a certain threshold, it is however not an existing equation.

Option 1 would avoid the need to introduce a new constraint equation (Option 0), and therefore would allow additional generation to be dispatched in North West Tasmania. Where the market benefits from this additional generation exceeds the costs of the augmentation, the option will deliver an overall positive net market benefit.

Option 1 is feasible after extension of the existing easements. Detailed options analysis will be carried out once the project reaches the Regulatory Investment Test for Transmission (**RIT-T**) stage (and therefore prior to any contingent project application by TasNetworks, based on the proposed contingent project triggers in Section 5.3).

3.3.1 Cost estimate

The cost estimate to construct a new double circuit Sheffield–Burnie 220 kV transmission line is $80 million. This includes construction of the transmission line alongside the existing line, the required substation work at both Sheffield and Burnie substations, and all other associated activities.

Table 2 presents the cost breakdown of the project.

Table 2: Cost breakdown of the project[5]

Item description	Base estimate ($m)
Double circuit 220 kV transmission line within Electricity Transmission Corridor	63
Sheffield and Burnie Substation	17
Total	**80**

3.4 Benefits of the augmentation

Preliminary analysis has been undertaken to identify the magnitude of the key market benefits associated with an augmentation to construct a new double circuit Sheffield–Burnie 220 kV transmission line (Option 1) against invoking the constraint equation to maintain power system security (Option 0).

This analysis has been used to identify the amount of new generation capacity (MW) that connects at or west of Burnie Substation in North West Tasmania beyond which the benefits of relieving the constraint equation are expected to be greater than the costs of the augmentation.

3.4.1 Benefits quantified

Two key market benefits are quantified in this analysis:

- Avoided wind spill in North West Tasmania, which results in avoided dispatch costs; and
- Reduction in transmission network loss in Tasmania.

[5] Base Level 1 estimate only

3.4.2 Assumptions made

To quantify the market benefit, the following assumptions were adopted in the analysis:

- Actual operational scenarios for the Tasmanian transmission system from July 2011 to June 2015 and July 2016 to June 2018[6] (half hourly) were used to model the existing network for both the spill and loss assessments;
- The historic output of Bluff Point and Studland Bay wind farms (only established transmission scale wind generation in the greater North West areas) were applied uniformly to all the new wind farms in North West Tasmania;
- The new wind farm output is exported to Victoria via Basslink up to the short-term export limit of 630 MW, then displaces hydro generation in the remainder of the network (i.e. excluding North West Tasmania and the West Coast of Tasmania[7]);
- In the spill assessments, generation exceeding the limit as determined by Equation (1) was considered spilled;
- The annual market benefit was derived by multiplying the annual energy curtailed with the annual volume weighted average spot price in Victoria[8] during 2017–18, which was $99/MWh, where the market is assumed to be fully competitive, and where the spot price has been used to represent the underlying cost of generation; and
- A reduction in transmission network losses was calculated by comparing losses from the historic operation against what they would have been with the new transmission line in service.

3.4.3 Market benefit assessment

The annual market benefit realised by implementing a new double circuit Sheffield–Burnie 220 kV transmission line is presented in Figure 2. The total benefit is the contribution from avoided spill and reduced losses. The benefit increases with increasing amounts of new generation in North West Tasmania. The point at which the proposed transmission line is expected to become economic is when the annual market benefit exceeds the annualised cost of the augmentation. As shown in Figure 2, approximately 277 MW of new generation would need to connect (or committed to connect) to or west of Burnie Substation for the project to become economical.

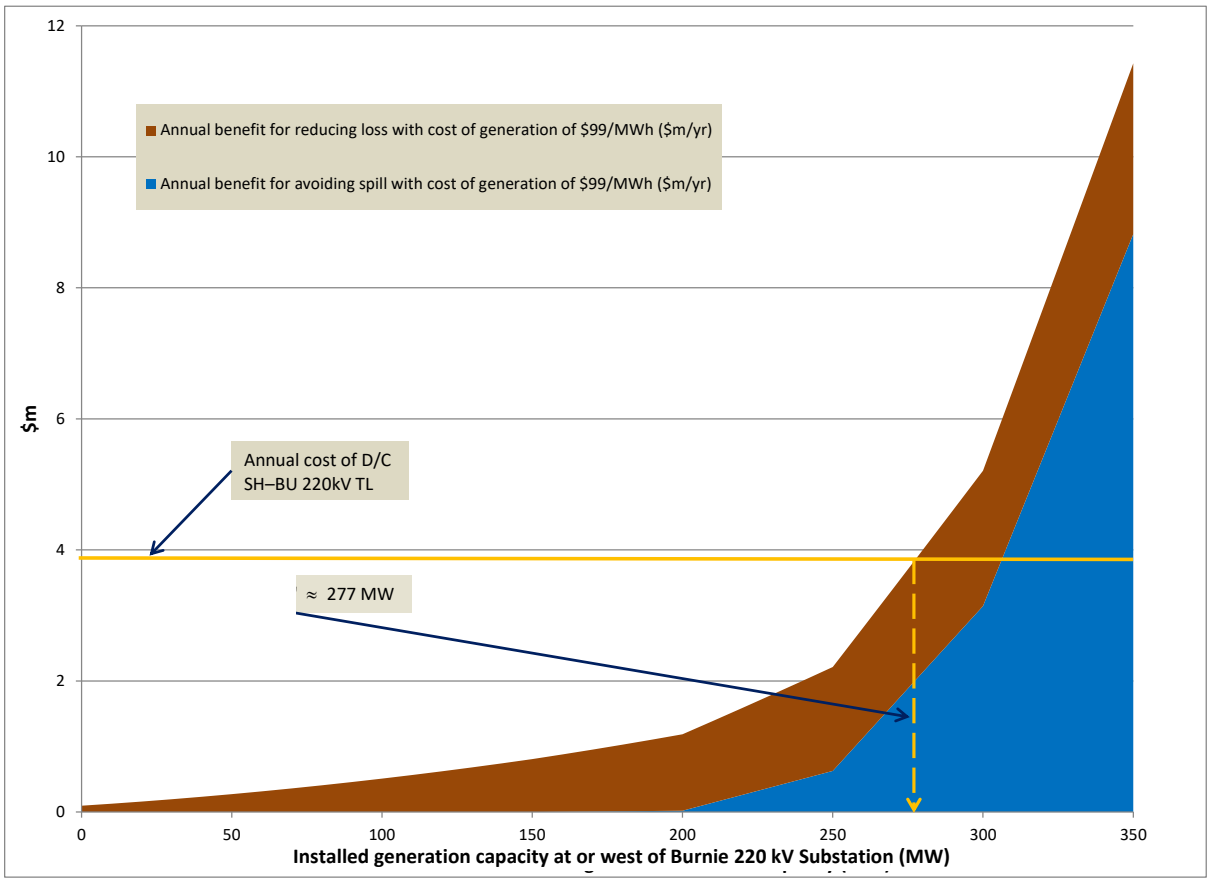
This is based on valuing the generation that would otherwise be constrained if the augmentation did not proceed and the associated reduction in losses on the basis of the cost of generation in Victoria of $99/MWh.

[6] 2015–16 financial year is considered abnormal due to the prolonged Basslink outage.

[7] The West Coast hydro power stations have relatively small water storages, and those in North West Tasmania are essentially run-of-the-river power stations.

[8] Annual volume weighted average spot prices

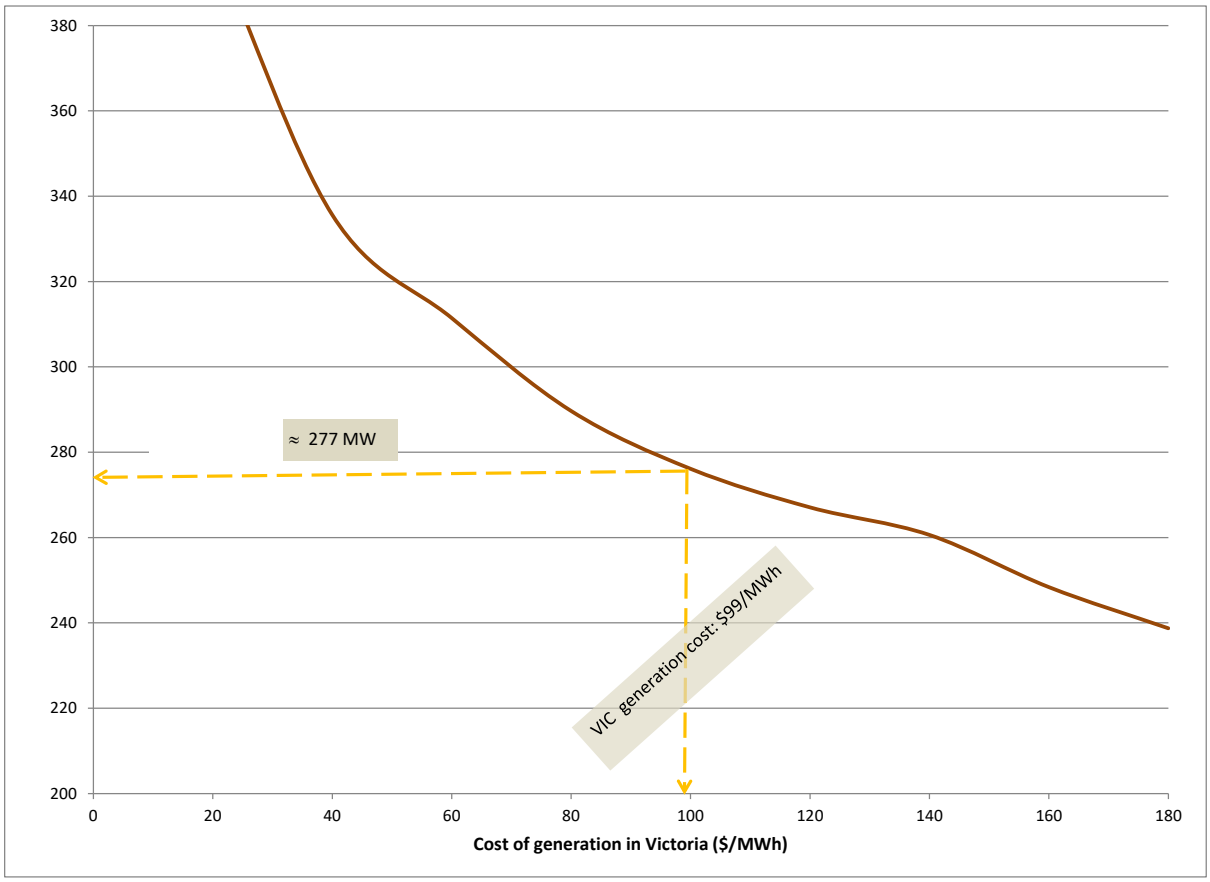
Figure 2: Annual market benefit of a new Sheffield–Burnie 220 kV transmission line



3.4.4 Sensitivity

The benefits assessment is weighted towards the value of generation cost. Going forward should the cost of generation in Victoria increase, the point at which the annual market benefit exceeds the annualised cost of the augmentation will reduce. Alternatively, if cost decreases, the point will increase. The relationship between the new generation connecting and cost of generation is presented in Figure 3.

Figure 3: Sensitivity variance against cost of generation in Victoria



4 Need analysis – a second Bass Strait interconnector

4.1 Overview

TasNetworks has established Project Marinus to assess the feasibility of a second interconnector between Tasmania and Victoria. Network augmentation would be required to support a second interconnector. For example, connection of a second interconnector in North West Tasmania, i.e. into or west of Burnie,[9] will require a significant increase of transmission capacity between Sheffield and Burnie substations.

4.2 The need

The Project Specification Consultation Report for Project Marinus identified that the development of the North West Tasmanian transmission corridor is likely to be required to support a second interconnector, where it connects in North West Tasmania.[10] This requirement is to support the second interconnector itself (in both import and export scenarios), and is not co-dependent on new generation also being developed.

4.3 Requirement for the augmentation

The augmentation of the Sheffield–Burnie 220 kV transmission line is required to release thermal constraints on Sheffield to Burnie transmission corridor. This section presents preliminary analysis of the effect of a second interconnector, which will be analysed in much more detail as part of Project Marinus.

4.3.1 Export from Tasmania

If a second interconnector (termed Marinus Link) was established in North West Tasmania, it will have a capacity of at least 600 MW for both export and import. Once Marinus Link export exceeds 600 MW, the existing single Sheffield–Burnie 220 kV circuit would need to carry a high percentage of the net power flow to the west of Burnie, which is presented in the following equation:

$$NetPowerFlow \cong 600 - NWWF_{MW} + DemandBUW_{MW} \quad (2)$$

Where:

$NetPowerFlow$: the total MW power flow through Sheffield to Burnie transmission corridor;

$NWWF_{MW}$: the total MW output from wind farms west of Burnie; and

$DemandBUW_{MW}$: the total MW demand west of Burnie

Figure 4 presents a load flow case where the Sheffield–Burnie 220 kV circuit (TL504) would load to 215% of its winter static rating if there were no augmentation on the existing Sheffield to Burnie

[9] Of the seven routes options for the second interconnector, six of them land at locations west to Burnie. Refer to page 41, Additional interconnection between Victoria and Tasmania, Project Specification Consultation Report, TasNetworks, July 2018. https://projectmarinus.tasnetworks.com.au/

[10] Page 29, Additional interconnection between Victoria and Tasmania, Project Specification Consultation Report, TasNetworks, July 2018. https://projectmarinus.tasnetworks.com.au/

transmission corridor, when Marinus Link was exporting 600 MWs. However, after the proposed Sheffield to Burnie 220 kV augmentation (Option 1), the load flow will be as presented in Figure 5 (76%).

Figure 4: Overload Sheffield–Burnie (TL504) when export 600 MW via Marinus Link

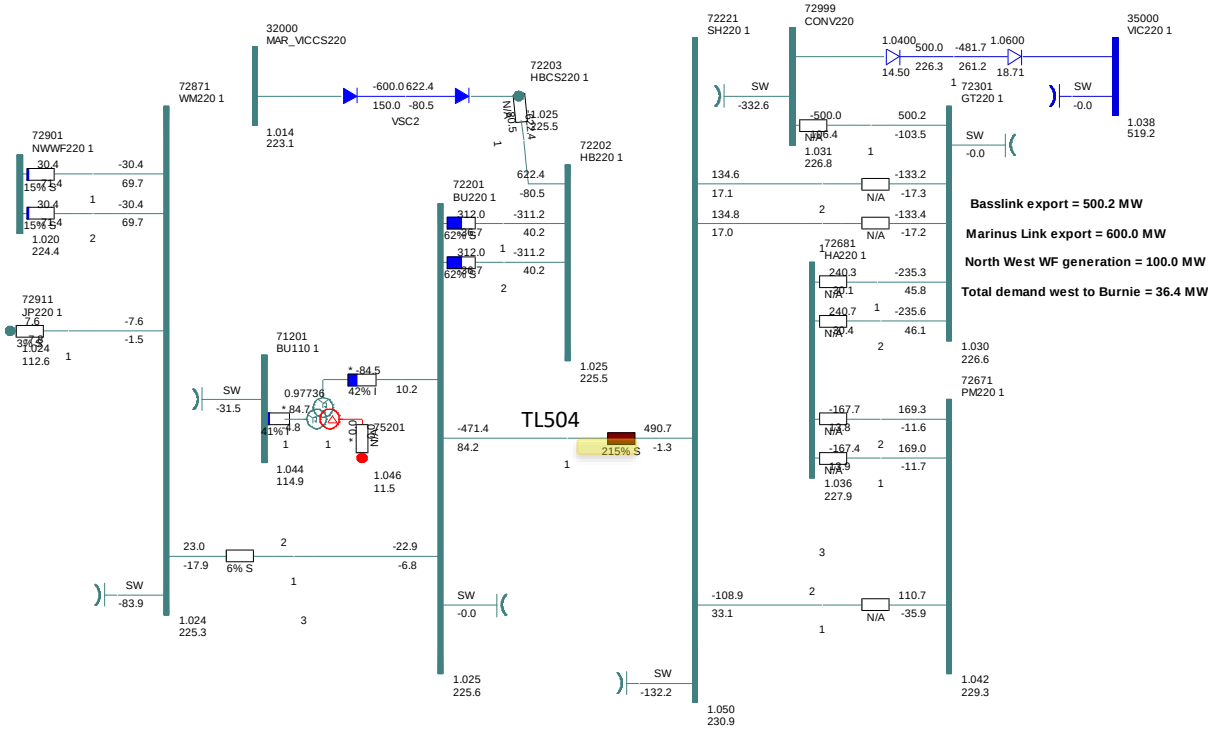
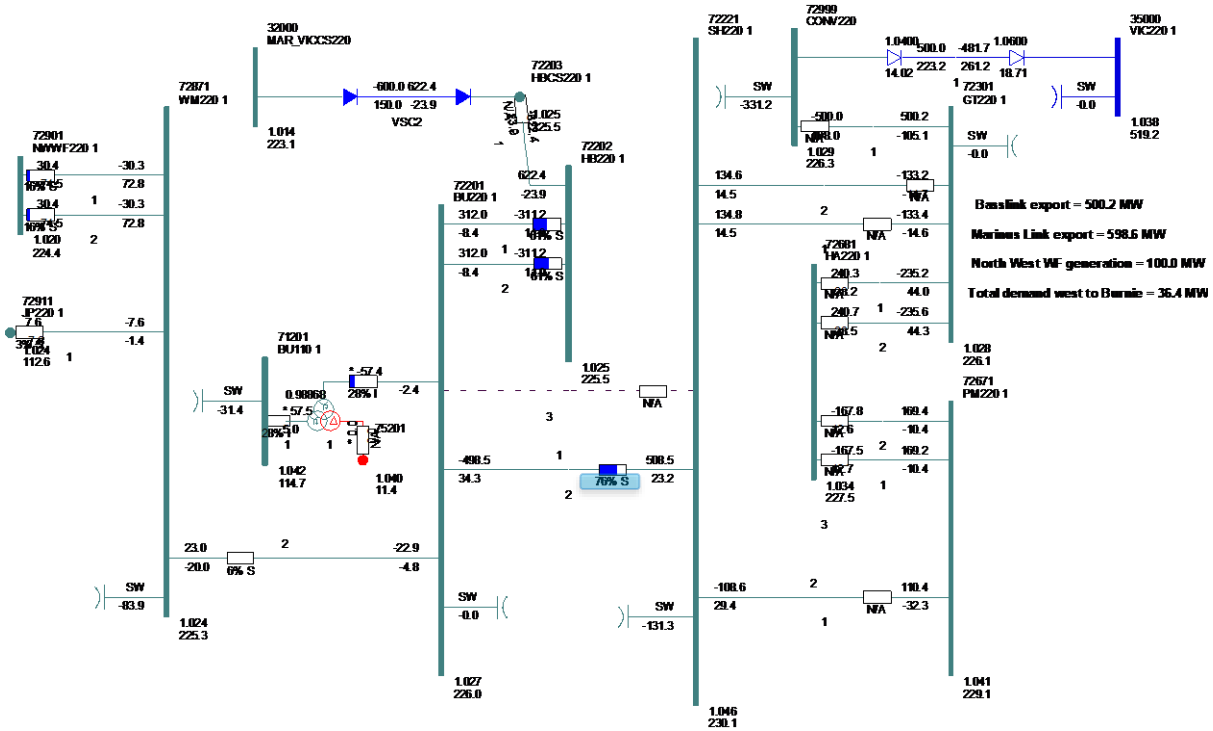


Figure 5: N–1 load flow on Sheffield–Burnie post the proposed augmentation



4.3.2 Import to Tasmania

Similarly, the proposed Sheffield to Burnie 220 kV augmentation is also required to release thermal capacity when Marinus Link is importing.

5 The trigger

We has identified two independent drivers for augmentation of the Sheffield to Burnie 220 kV transmission corridor:

- A net economic benefit from the release of low cost generation committed to connect at Burnie Substation in North West Tasmania; or
- A second Bass Strait interconnector connects in the Burnie area or far North West Tasmania.

5.1 New generation trigger

As presented in Section 3.2, new generation that connects at 220 kV at Burnie Substation in excess of 135 MW will need to be constrained or the constraint alleviated through the proposed augmentation in order to maintain the power system security requirements as stipulated in the Rules. The annual market benefit for the augmentation is expected to exceed the annualised cost when new generation connecting at Burnie Substation exceeds approximately 277 MW.

The total quantified market benefit for the augmentation estimated as part of this project need analysis report only includes two components, these being:

- Avoided wind spill in North West Tasmania, which results in avoided dispatch costs; and
- A reduction in transmission network loss in Tasmania.

As discussed in Section 3.1.2, there is currently 565 MW of new wind generation in North West Tasmania, however none are committed. With the amount of new generation proposed we consider that it is probable that more than 277 MW will have commitment to connect to Burnie Substation 220 kV during the 2019-24 regulatory control period.

5.2 Second Bass Strait interconnector trigger

As presented in Section 4, we are currently assessing the feasibility of a second Bass Strait interconnector. A second interconnector will require augmentation of the Sheffield to Burnie 220 kV transmission corridor.

The outcome of the feasibility study is due in December 2019 and it may recommend proceeding with the interconnector. Therefore, a decision to proceed with a second interconnector in the Burnie area of North West Tasmania has been included as a separate trigger for this contingent project.

TasNetworks notes that the augmentation of the Sheffield to Burnie 220 kV transmission corridor has not been included within the scope of the separate Project Marinus contingent project.

5.3 Proposed trigger events for the augmentation

The Sheffield to Burnie 220 kV augmentation should be accepted as a contingent project, due to the commitment of either new generation or a second Bass Strait interconnector, both in North West Tasmania, being probable in the 2019–24 regulatory control period.

The trigger events for this contingent project are:

a) A net economic benefit can be obtained by increasing transmission capacity for low cost generation committed to connect at or west of Burnie Substation in North West Tasmania; and/or

b) A commitment to proceed with a second Bass Strait interconnector connecting at 220 kV at or west of Burnie Substation.

c) Successful completion of a RIT-T and a determination by the AER that the proposed investment satisfies the RIT-T.

d) TasNetworks Board commitment to proceed with the project subject to the AER amending the revenue determination pursuant to the Rules.

In relation to (a), it is noted that our current analysis indicates that 277 MW of new generation connecting at or west of Burnie Substation would need to commit in order for the project to provide a net economic benefit. As explained in section 3.4.4, however, the required generation capacity may vary depending on a number of factors, including the wholesale generation price in Victoria.

The proposed triggers address the AER's concerns in its draft decision. In particular, the proposed triggers are specific and capable of objective verification, relate to a specific location, and although probable during the 2019–24 regulatory control period, the project is currently too uncertain to include in the forecast capital expenditure in TasNetworks Revenue Proposal.