NEED/OPPORTUNITY STATEMENT & OPTION SCREENING ASSESSMENT (NOSA)

Snowy 2 Transmission Investment

NOSA- 000000001901 revision 2.0

Ellipse project no(s):
TRIM file: [TRIM No]

Project reason: Reliability - To meet overall network reliability requirements and realise market benefits
Project category: Prescribed - Connection

Approvals

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Approved	Andrew Kingsmill	Manager/Network Planning
Date submitted for approval	1 December 2017	

Change history

Revision	Date	Amendment
0	November 2017	Initial issue
1	December 2017	Updated project triggers

1. Background

As the NEM transitions to a cleaner future, it is crucial that customers continue to receive a secure and reliable electricity supply, at an affordable price.

In March 2017, the Prime Minister announced a feasibility study to add 2,000 MW of pumped storage to the Snowy Hydro scheme. This feasibility study is expected to be completed in December 2017, following which the project ("Snowy 2.0") may become committed new generation in the NEM.

1.1 Reliable supply – the need for firm generation capacity

A key risk to the provision of reliable supply going forward is an emerging lack of firm generation capacity.

In September 2017, AEMO released the 2017 Electricity Statement of Opportunities (ESOO) which provides an integrated assessment of electricity and gas supply adequacy for eastern and south-eastern Australia over the next 10 years. AEMO's assessment is that the potential for Unserved Energy and not meeting the current reliability standard is projected to increase in New South Wales after Liddell Power Station closes (announced as 2022) .[1]

Looking further ahead, the potential retirement of Vales Point Power Station, which reaches 50 years of age in 2028/29, is expected to raise further concerns in relation to supply adequacy.

The NEM Reliability Panel determines the required 'reliability standard'[2] for the market, which is currently set at 0.002% Unserved Energy (USE). AEMO reports annually through its ESOO on whether the level of generation in each region is expected to be sufficient to meet this standard over the next ten years, under a range of future states of the world.

Even where the reliability standard is met overall, there remains a substantial risk of supply being disrupted when high demand occurs at the same time as reduced output from intermittent generation. The 10 February 2017 event in New South Wales is an example of the conditions which can lead to the risk of load shedding and curtailment. AEMO has recently highlighted the on-going risk of such events in New South Wales.

Transmission augmentations can mitigate the risk of such supply disruptions occurring where they provide access to additional non-intermittent generation (including in this case the pumped storage capacity of Snowy 2.0).

1.2 Affordable price – reduction in dispatch costs would drive lower prices for consumers

Much of the existing New South Wales transmission network faces constraints that effectively limit any further wind or solar connecting, particularly in Southern New South Wales. Transmission augmentation in Southern New South Wales that relieves these constraints and allows further renewable generation to connect will lower the average dispatch cost of generation in the NEM and, consequently, flow through to lower electricity costs for customers.

The connection of new low-emission sources of generation is also consistent with the NEM's general transition towards a cleaner future.

1.3 System security – improvements to support transition to low carbon economy

Facilitating access to the output from pumped storage capacity (in this case Snowy 2.0) is also expected to assist with increasing security of supply challenges as non-synchronous generation in New South Wales continues to rise and additional conventional generation retires. TransGrid considers that such system security issues are particularly relevant after the potential retirement of Vales Point in 2028/29, which may lead to supply disruptions.

[1] AEMO, *Electricity Statement of Opportunities for the National Electricity Market*, September 2017, p. 1).

[2] The 'reliability standard' specifies that the level of expected unserved energy should not exceed 0.002% of consumption per region, in any financial year.

2. Need/opportunity

Preliminary modelling undertaken indicates there are likely to be significant market benefits from transmission to connect the new Snowy 2.0. The market benefits are from the following key sources:

- Lower costs associated with meeting the supply reliability standard in New South Wales, through facilitating access to the output from expanded Snowy 2.0 generation;
- A reduction in the risk of blackouts (and therefore unserved energy) at times where demand is high and the output from renewable generators is low, such as occurred in the summer of 2016/17; and
- Lower market dispatch costs (and hence lower prices for consumers) resulting from the additional output from Snowy 2.0 and the facilitation of additional output from new renewable generators.

There is an opportunity to expand the transmission network to realise the market and economic benefits of transmission capacity from the new Snowy 2.0 to New South Wales and the NEM.

3. Related needs/opportunities

Need 1528 – Reinforcement of Southern Network

This project is to reinforce the existing network to cater for additional generation in a geographical area that is broader than the Snowy Mountains, and may be triggered by separate generation investment and with separate timing than Snowy 2.0.

4. Options Summary

The options being considered are listed below.

4.1 Northern Options

Table 1 — New South Wales Options

Option	Short Description	
0	Do-nothing option (OFS not required)	
	1 Direct route from Snowy 2.0- Bannaby	2 Snowy 2.0 – Wagga – Bannaby – Snowy 2.0
A **330 kV option utilising existing network paths**	Cut Snowy 2.0 in to lines O1 and 2 and rebuild them D/C 330 kV, and rebuild line 9 D/C 330 kV and new D/C 330 kV from Yass to Bannaby OFS – Yes Feasible – TBC Snowy 2.0 capacity – 1250[3]-2000[4]MW Estimated cost – $744m Estimated duration – Up to 6 years	Cut Snowy 2.0 in to lines O1 and 2 and rebuild them D/C 330 kV, and rebuild line 9 D/C 330 kV, new D/C 330 kV from Yass to Bannaby. Also construct 330 kV Wagga connection (Snowy 2.0-Wagga-Bannaby) OFS – Yes Feasible – TBC Snowy 2.0 capacity – 2000MW Estimated cost – To be determined Estimated duration – To be determined

[3] When VIC – NSW transfer = 500 MW and renewable generation in Yass/Canberra = 600MW

[4] When VIC – NSW transfer = 0 MW and renewable generation in Yass/Canberra = 0MW

Option	Short Description	
B **330 kV option utilising new network paths**	New 2x S/C 330 kV lines (Invar conductor) from Snowy 2.0 to Bannaby 330 kV, line 64 cut-in loop in/out at Snowy 2.0 OFS – Yes Feasible – TBC Snowy 2.0 capacity – 1200[5]-2310[6]MW Estimated cost – $687m Estimated duration – 3 years	New S/C 330 kV lines (Invar conductor) from Snowy 2.0 to Bannaby, Snowy 2.0 to Wagga, Wagga to Bannaby, line 64 cut-in loop in/out at Snowy 2.0 OFS – Yes Feasible – TBC Snowy 2.0 capacity – 1080[7]-2210[8]MW Estimated cost – To be determined Estimated duration - To be determined
C **500 kV construction, initial 330 kV operation**	New 2x S/C 500 kV **(initially operated at 330 kV)** lines from Snowy 2.0 to Bannaby, line 64 cut-in loop in/out at Snowy 2.0 OFS – Yes Feasible – TBC Snowy 2.0 capacity – 1150[9]-2260[10]MW Estimated cost – To be determined Estimated duration - To be determined	New S/C 500 kV **(initially operated at 330 kV)** lines from Snowy 2.0 to Bannaby, Snowy 2.0 to Wagga, Wagga to Bannaby, line 64 cut-in loop in/out at Snowy 2.0 OFS – Yes Feasible – TBC Snowy 2.0 capacity – 1180[11]-2260[12]MW Estimated cost – To be determined Estimated duration - To be determined
D **500 kV option**	New 2x S/C 500 kV lines from Snowy 2.0 to Bannaby, line 64 cut-in loop in/out at Snowy 2.0, 3 x 1500 MW 500/330 kV transformers OFS – Yes Feasible – Yes Snowy 2.0 capacity – 1860[13]-3000[14]MW Estimated cost – $1,102m Estimated duration – To be determined	New S/C 500 kV lines from Snowy 2.0 to Bannaby, Snowy 2.0 to Wagga, Wagga to Bannaby, line 64 cut-in loop in/out at Snowy 2.0, 4 x 1500 MW 500/330 kV transformers (1 at Wagga and 3 at Snowy 2.0) OFS – Yes Feasible – Yes Snowy 2.0 capacity – 1910[15]-3000[16]MW Estimated cost – $1,205m Estimated duration - To be determined
E	Generation runback and load curtailment OFS – Yes Feasible – Yes Snowy 2.0 capacity – ~1500 MW (for system normal, thermal limit only, no voltage assessment yet) Estimated cost – TBC Estimated duration – TBC	

[5] When VIC – NSW transfer = 500 MW and renewable generation in Yass/Canberra = 600MW
[6] When VIC – NSW transfer = 0 MW and renewable generation in Yass/Canberra = 0MW
[7] When VIC – NSW transfer = 500 MW and renewable generation in Yass/Canberra = 600MW
[8] When VIC – NSW transfer = 0 MW and renewable generation in Yass/Canberra = 0MW
[9] When VIC – NSW transfer = 500 MW and renewable generation in Yass/Canberra = 600MW
[10] When VIC – NSW transfer = 0 MW and renewable generation in Yass/Canberra = 0MW
[11] When VIC – NSW transfer = 500 MW and renewable generation in Yass/Canberra = 600MW
[12] When VIC – NSW transfer = 0 MW and renewable generation in Yass/Canberra = 0MW
[13] When VIC – NSW transfer = 500 MW and renewable generation in Yass/Canberra = 600MW
[14] When VIC – NSW transfer = 0 MW and renewable generation in Yass/Canberra = 0MW
[15] When VIC – NSW transfer = 500 MW and renewable generation in Yass/Canberra = 600MW
[16] When VIC – NSW transfer = 0 MW and renewable generation in Yass/Canberra = 0MW

4.2 Southern Options

Table 2 — Victorian Options

Option	Short description
0	Do-nothing
A(V)	New single circuit 330 kV line Murray to Dederang and Dederang transformer
B(V)	New single circuit 330 kV line Murray to Dederang to South Morang and a South Morang transformer
C(V)	New double circuit (strung on 1 side) 330 kV line Murray to Dederang to South Morang and a South Morang transformer
D(V)	Transmission development in north-west Victoria (currently under regulatory consultation by AEMO)
E(V)	Non-network options (Generation runback and load curtailment)

This document analyses both the New South Wales and Victorian connection options in order to evaluate transmission investment throughout the NEM as a whole. However, it will be AEMO's responsibility as the Victorian transmission planner to manage transmission network development in Victoria. The options outlined above are those that TransGrid would consider for the Victorian connection include and will be including in the analysis.

4.3 Options Feasibility Studies

NP&O/Project Development shall undertake Options Feasibility Studies for the options indicated in Table 2 above. The assessments shall include consideration of the cost, timing of activities, risk analysis and practicality of being able to carry out the works.

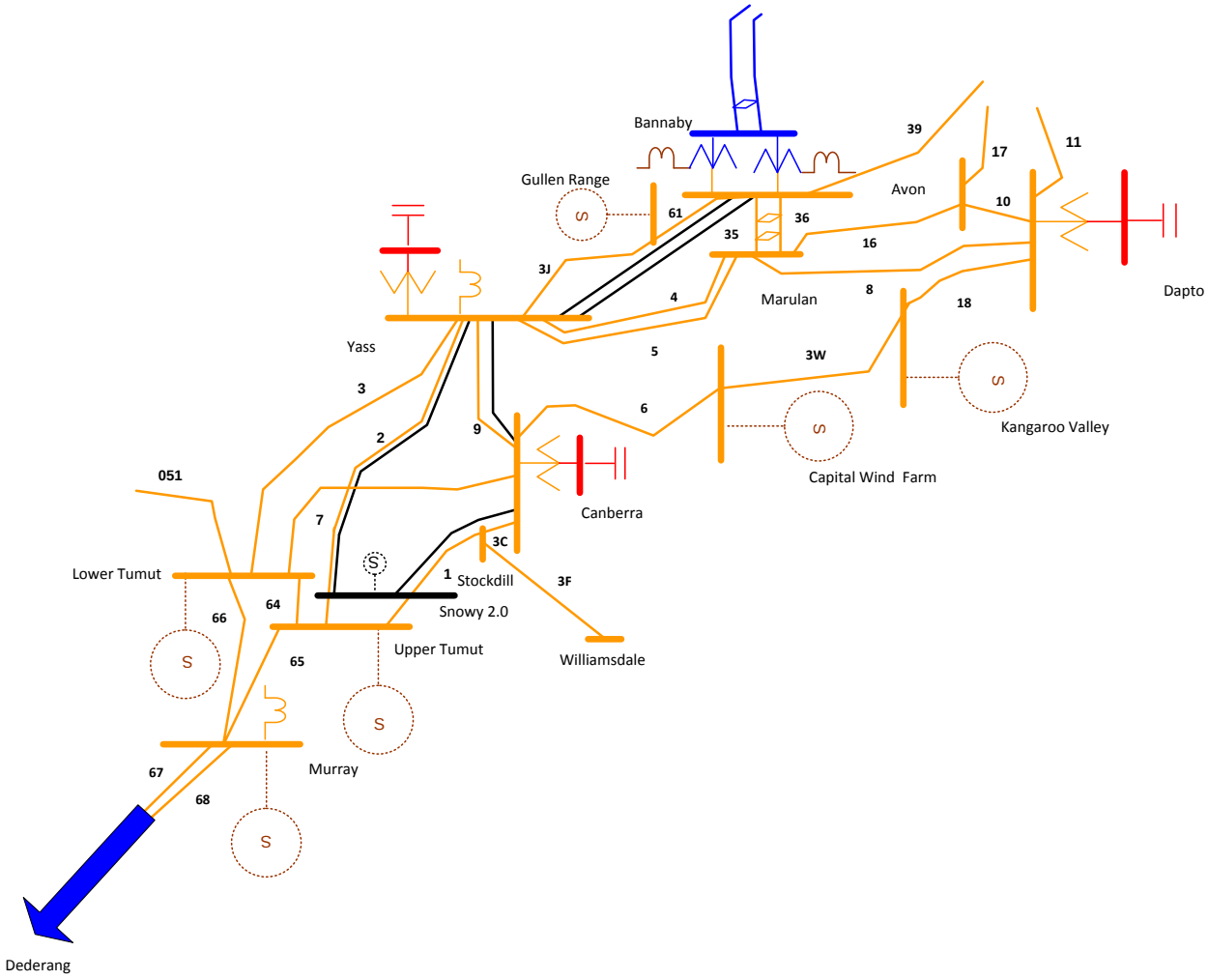
The Option Feasibility Study for Option D2 is required by 31 October 2017. The studies for the other options are required 30 April 2018, and high level costings to be provided by February 2018.

5. Options

5.1 Option 0: Do-nothing

As initial modelling has shown that there are likely to be net market benefits of transmission development if Snowy 2.0 is committed, the 'do-nothing' option is not considered economically feasible.

5.2 Option A1: Reinforce 330 kV Snowy 2.0 – Canberra – Yass – Bannaby



This option involves cutting in to lines O1 (Upper Tumut – Canberra) and 2 (Upper Tumut – Yass) and rebuild as double circuit 330 kV (line O1 – 100 km, line 2 – 147 km), and rebuild line 9 (Canberra – Yass) as double circuit 330 kV (42 km), and new double circuit 330 kV from Yass to Bannaby (126 km).

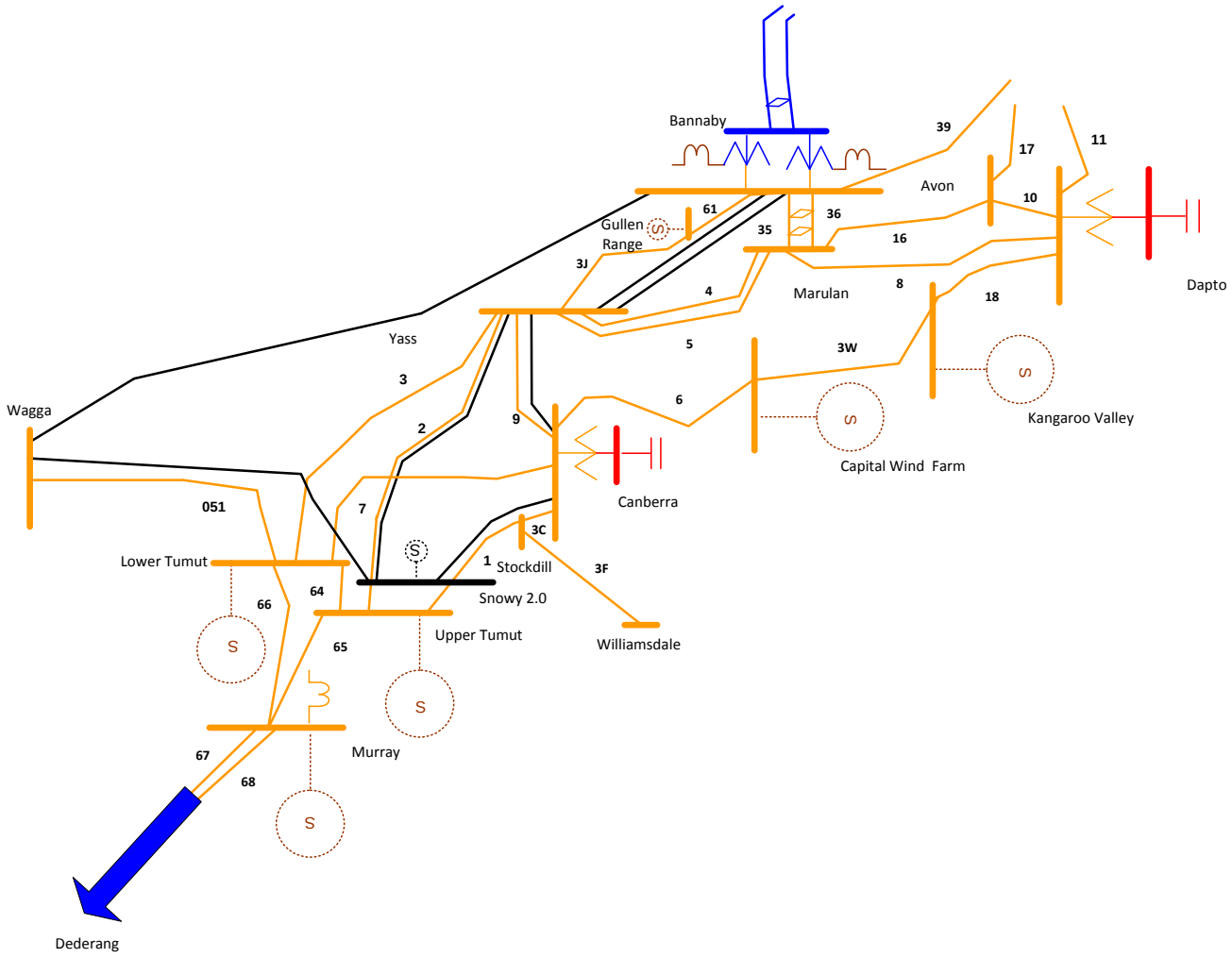
This option would have a Snowy 2.0 capacity of 1250[17] – 2000[18] MW.

This option was scoped in OFS-1901AA. Refer to this report for substation and other works details.

[17] When VIC – NSW transfer = 500 MW and renewable generation in Yass/Canberra = 600MW

[18] When VIC – NSW transfer = 0 MW and renewable generation in Yass/Canberra = 0MW

5.3 Option A2: Reinforce 330 kV Snowy 2.0 – Canberra – Yass – Bannaby, plus 330 kV transmission line Snowy 2.0 – Wagga and Wagga – Bannaby



This option involves cutting in to lines O1 (Upper Tumut – Canberra) and 2 (Upper Tumut – Yass) and rebuild as double circuit 330 kV (line O1 – 100 km, line 2 – 147 km), and rebuild line 9 (Canberra – Yass) as double circuit 330 kV (42 km), new double circuit 330 kV from Yass to Bannaby (126 km), and new single circuit 330 kV transmission lines from Snowy 2.0 – Wagga and Wagga – Bannaby.

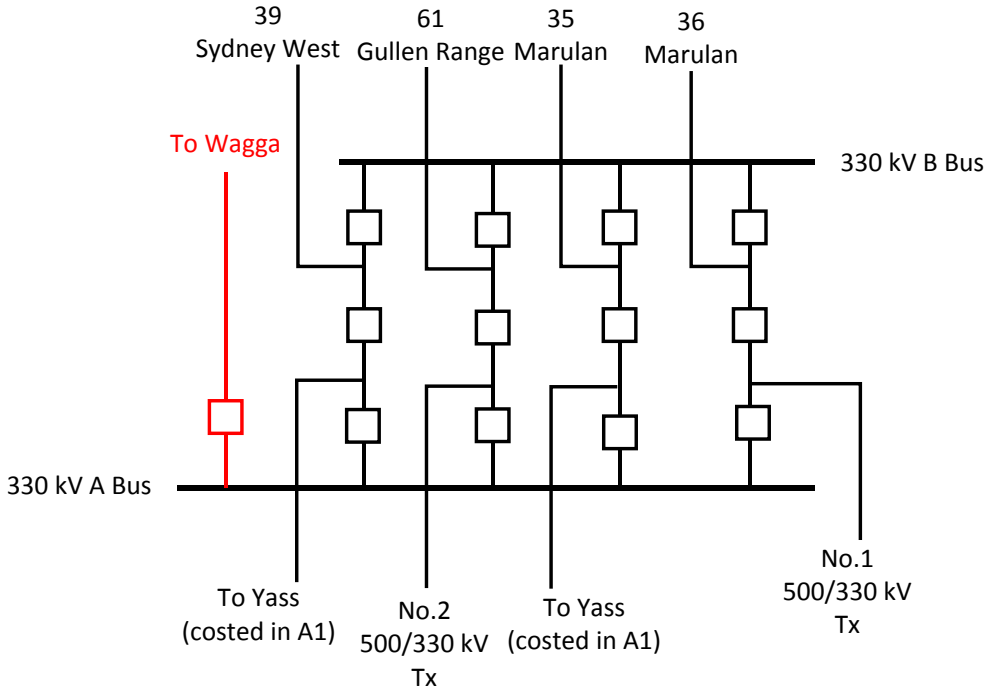
This option would have a Snowy 2.0 capacity of 2000 MW.

The A1 component of this option was scoped in OFS-1901AA. Refer to this report for substation and other works details (as per previous option). See below for additional substation work details.

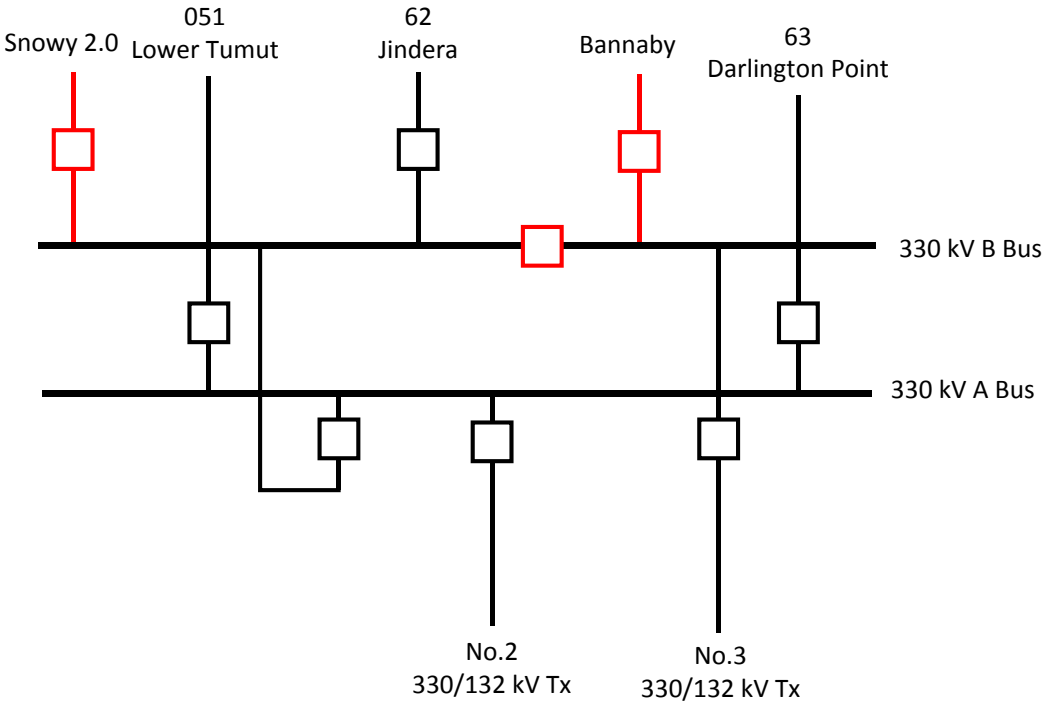
Drawings for additional works for the lines to Wagga are included below.

Substation works:

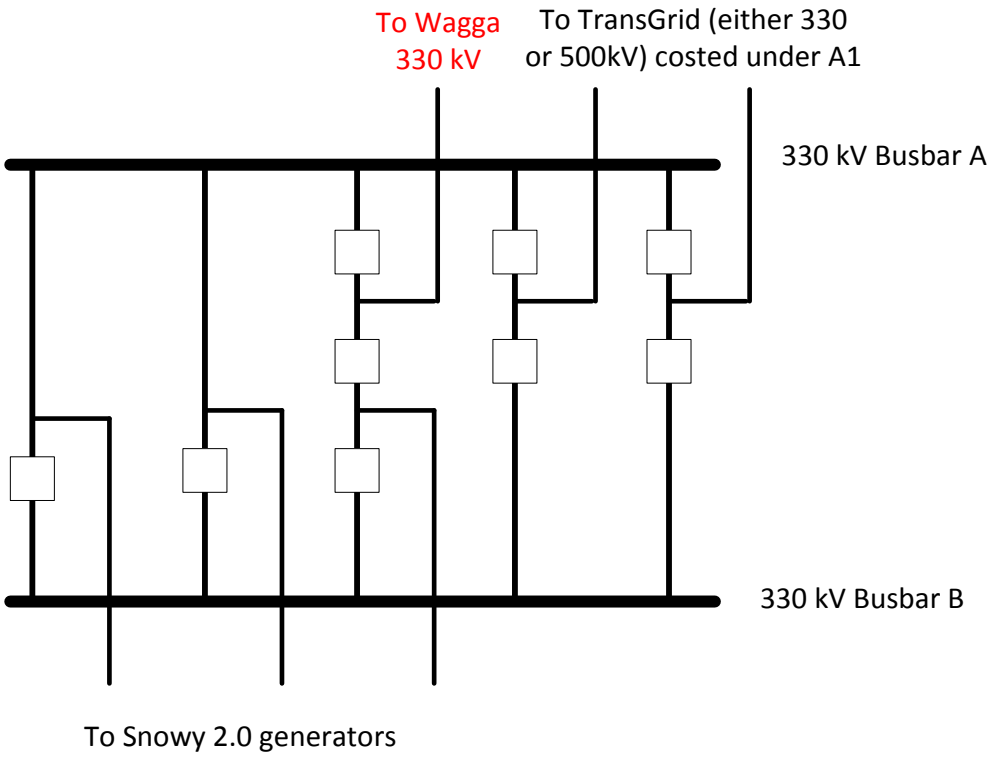
Bannaby 500/330 kV Substation



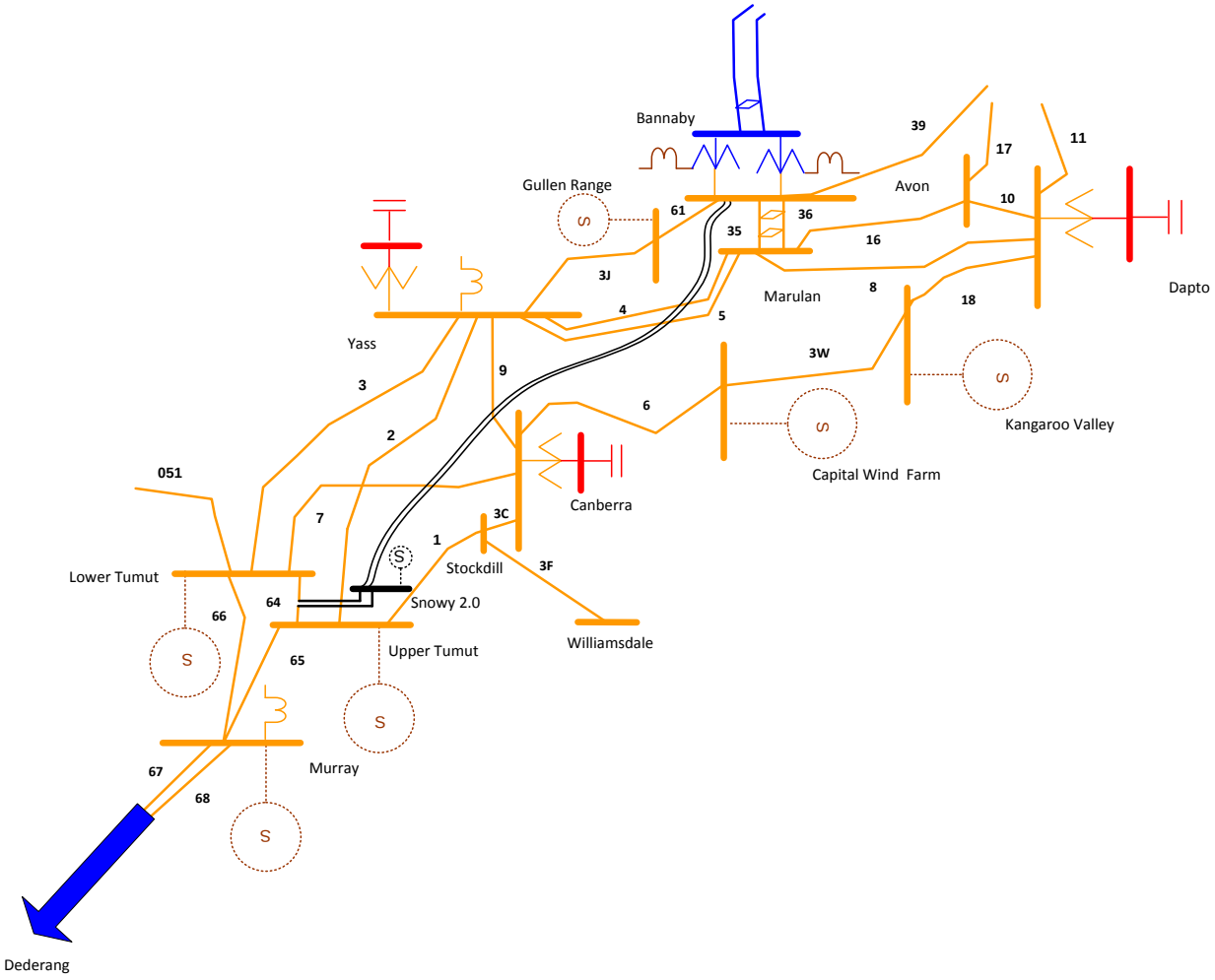
Wagga 330/132 kV Substation



Snowy 2.0 Switching Station



5.4 Option B1: Two single circuit 330 kV lines Snowy 2.0- Bannaby (Invar)



This option involves constructing 2x single circuit 330 kV lines (Invar conductor) from Tumut to Bannaby 330 kV (260km) plus line 64 cut-in loop in/out at Tumut.

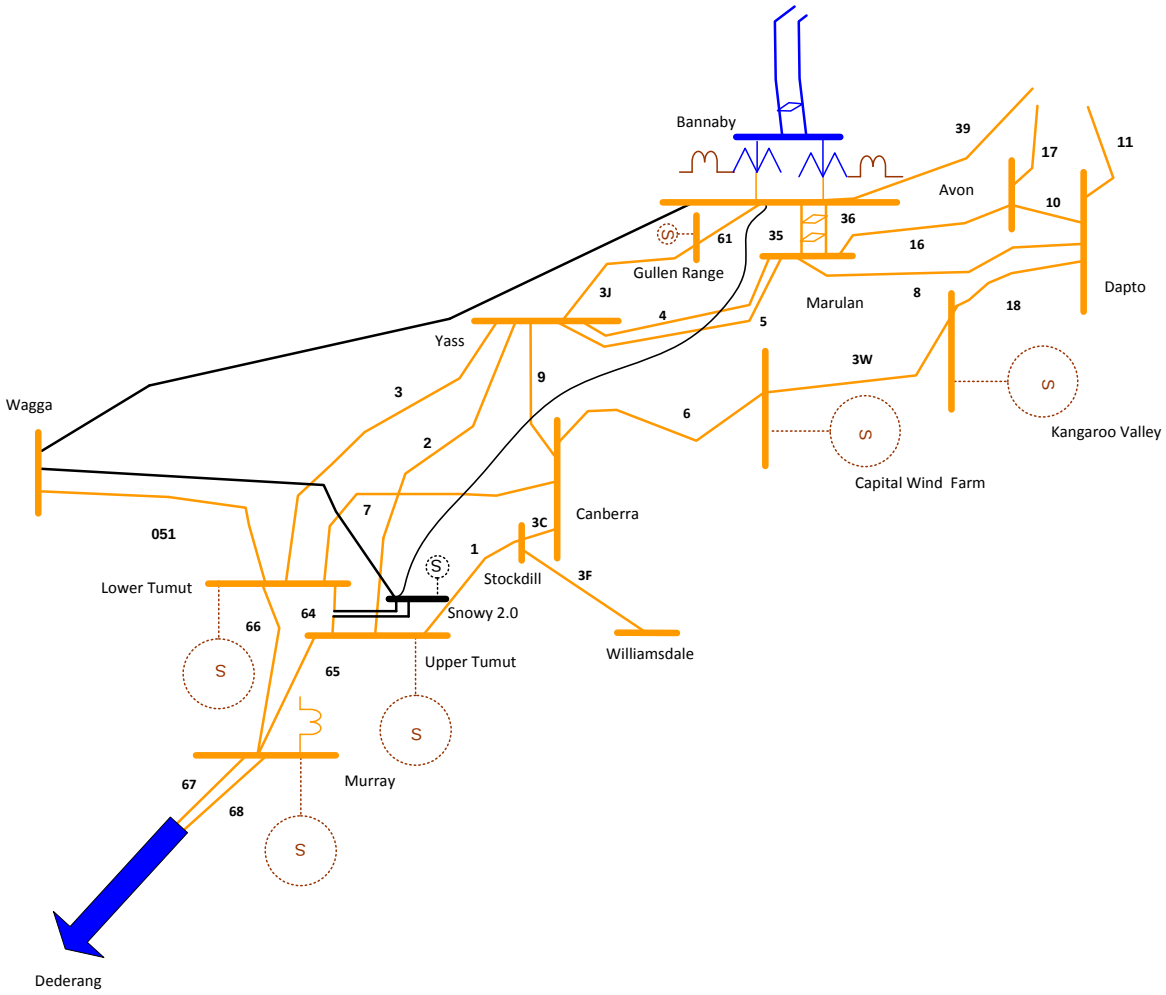
This option would have a Snowy 2.0 capacity of 1200[19] – 2310[20] MW.

This option was scoped in OFS-1901BA. Refer to this report for substation and other works details.

[19] When VIC – NSW transfer = 500 MW and renewable generation in Yass/Canberra = 600MW

[20] When VIC – NSW transfer = 0 MW and renewable generation in Yass/Canberra = 0MW

5.5 Option B2: New single circuit 330 kV lines (Invar conductor): Snowy 2.0-Bannaby, Snowy 2.0-Wagga and Wagga - Bannaby



This option involves constructing 3 x single circuit 330 kV lines (Invar conductor) from Snowy 2.0 to Bannaby, Snowy 2.0 to Wagga and Wagga to Bannaby, plus line 64 cut-in loop in/out at Tumut.

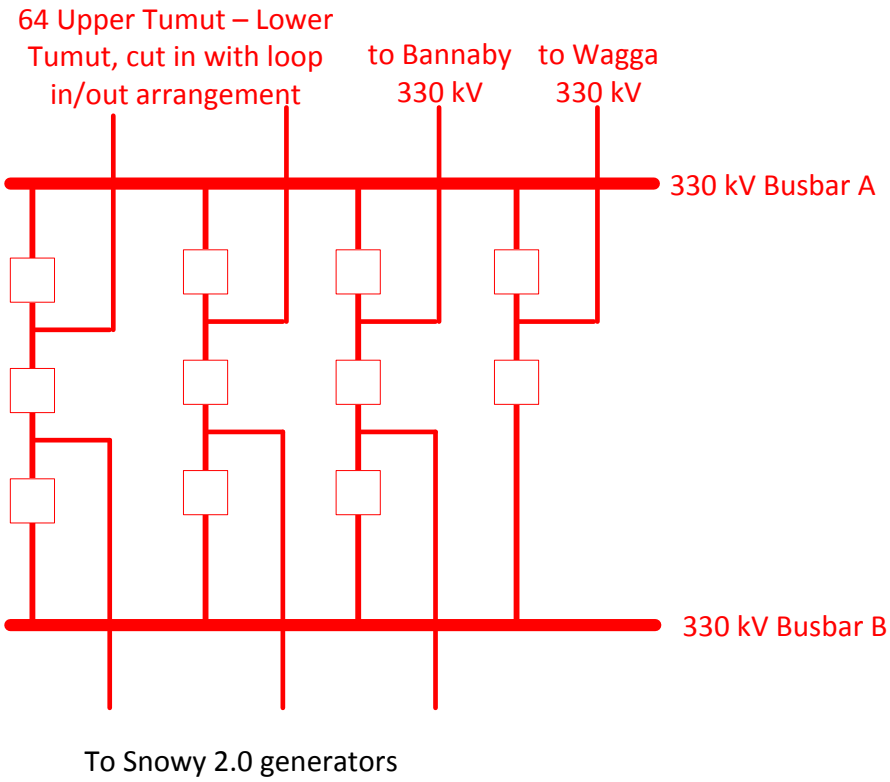
This option would have a Snowy 2.0 capacity of 1080[21] – 2210[22] MW.

Substation works included below.

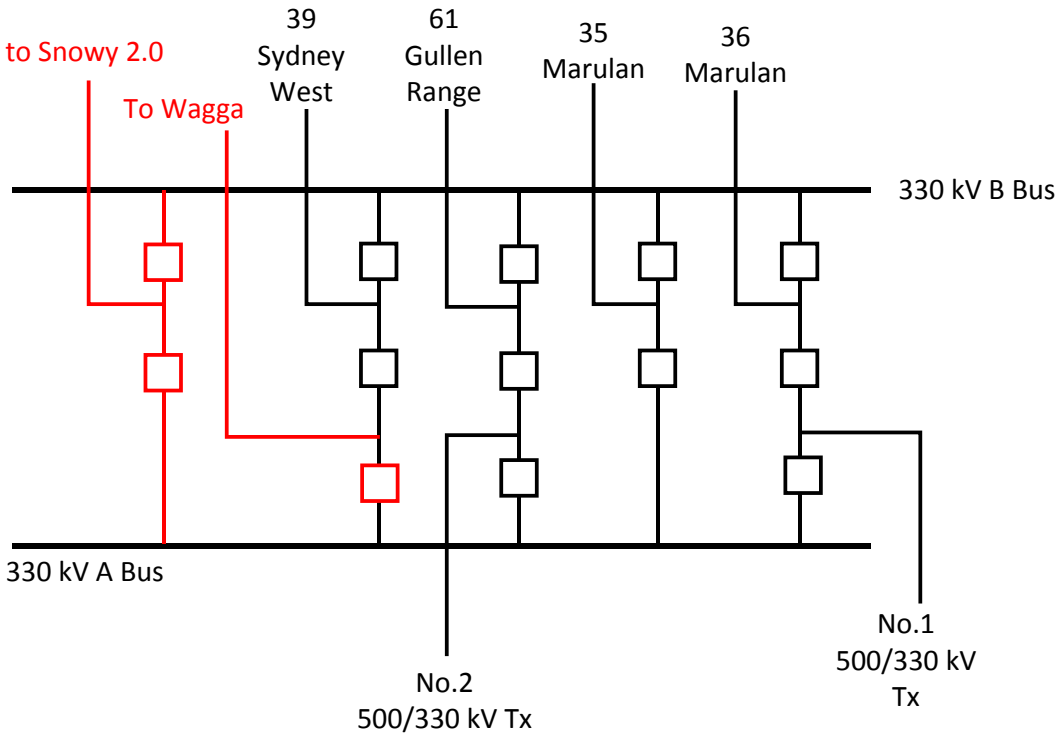
[21] When VIC – NSW transfer = 500 MW and renewable generation in Yass/Canberra = 600MW

[22] When VIC – NSW transfer = 0 MW and renewable generation in Yass/Canberra = 0MW

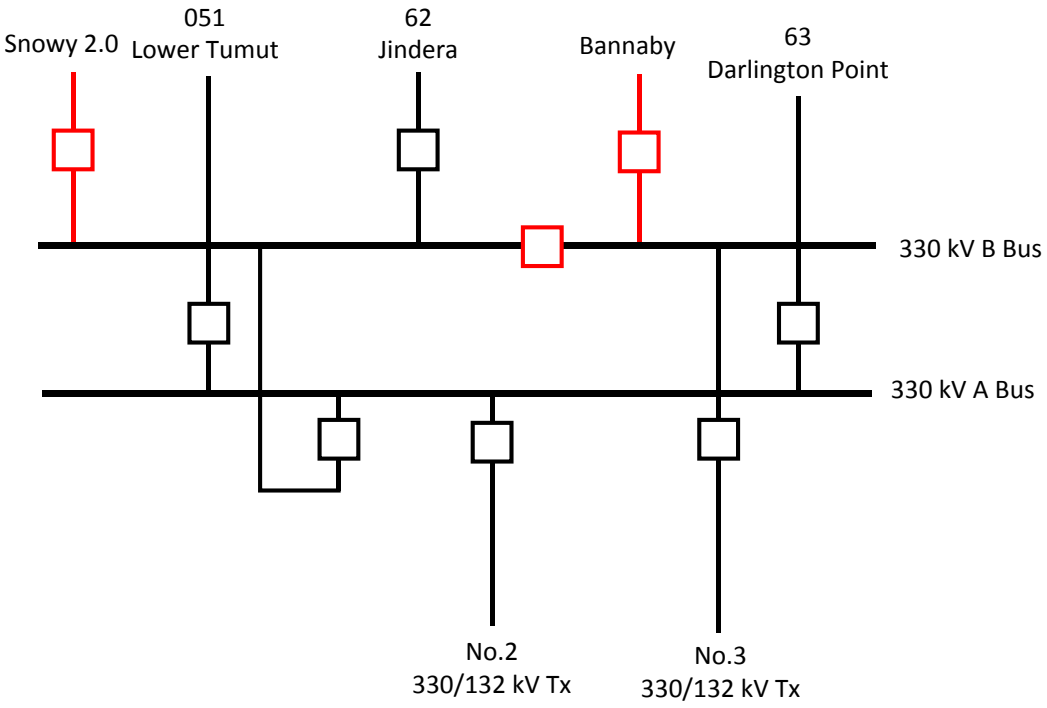
Snowy 2.0 Switching Station



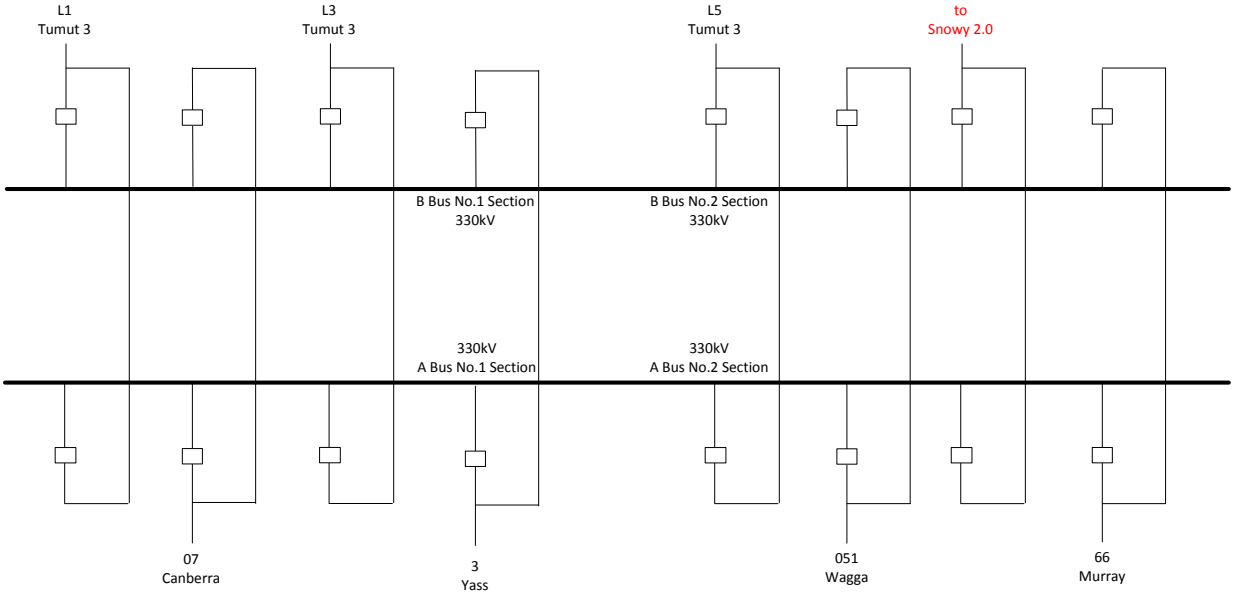
Bannaby 330 kV Substation



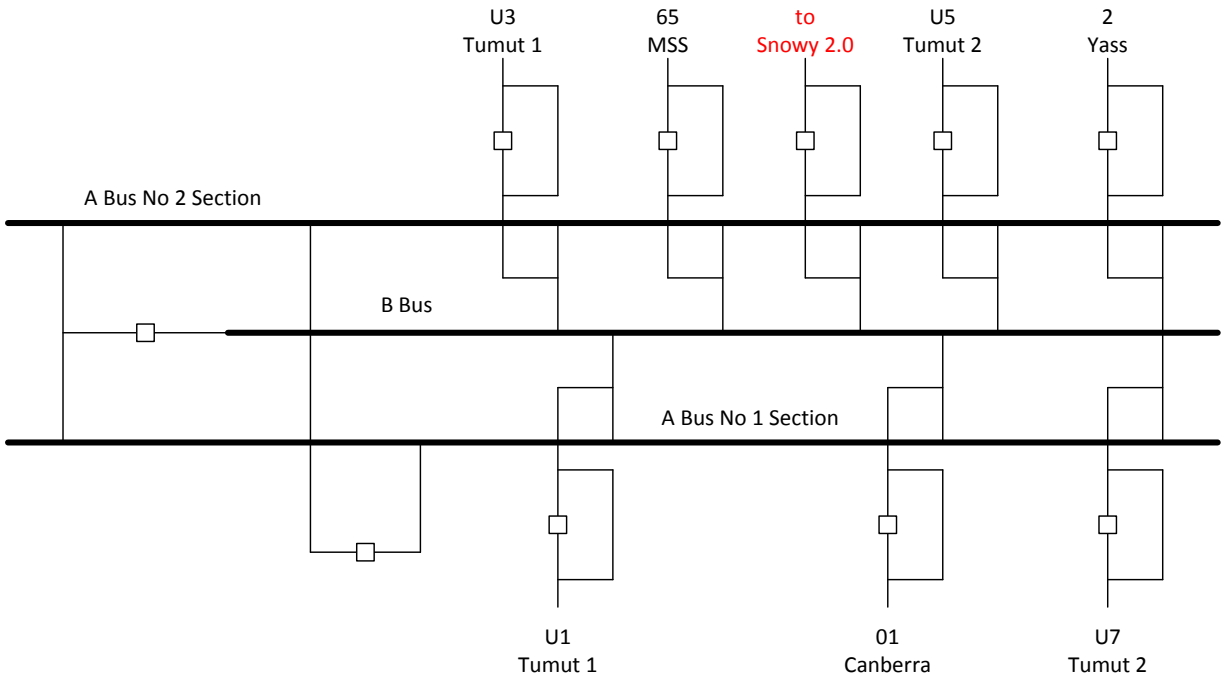
Wagga 330/132 kV Substation



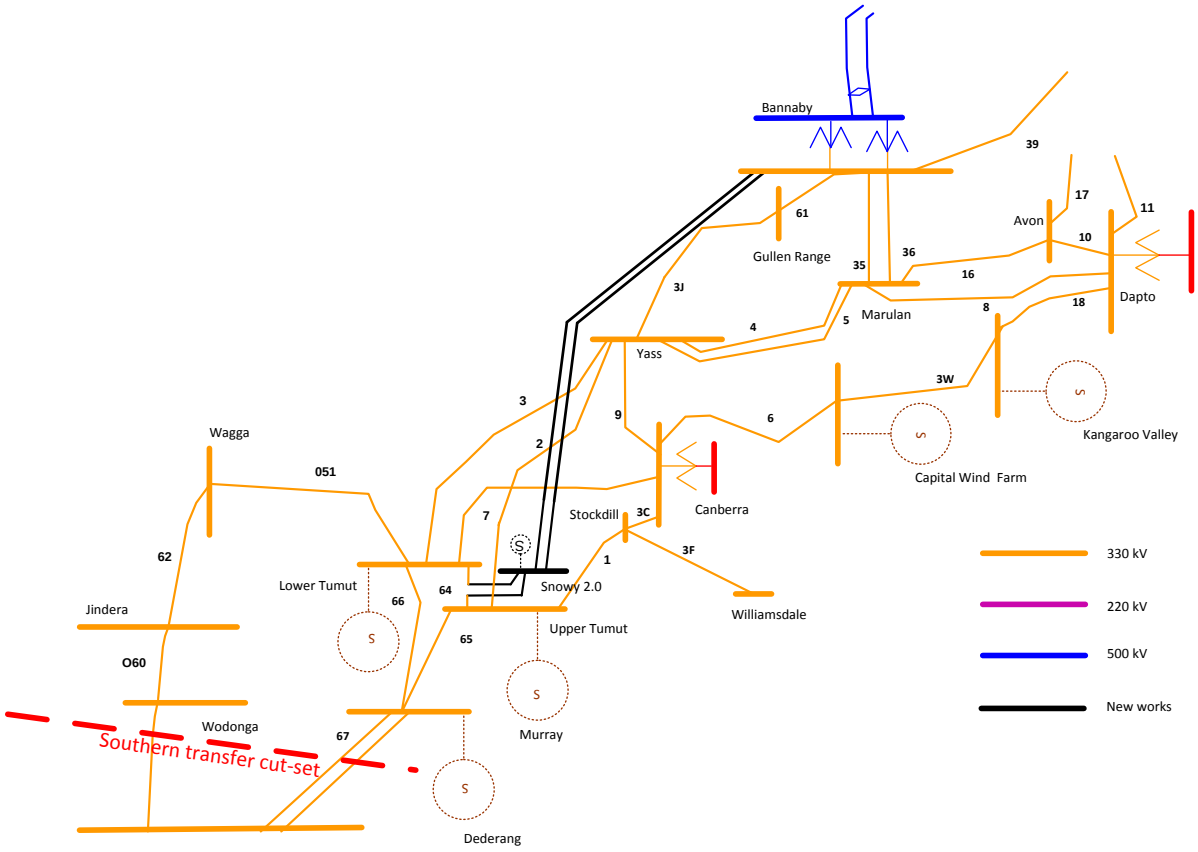
Lower Tumut Switching Station



Upper Tumut Switching Station



5.6 Option C1: Two single circuit 330 kV transmission lines Tumut – Bannaby (500 kV construction)



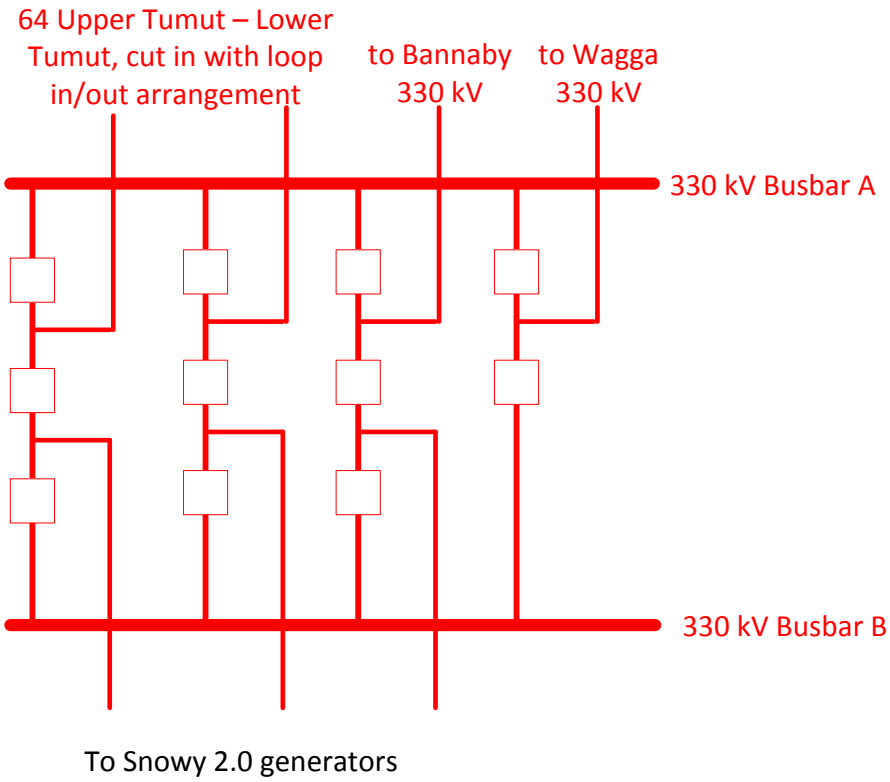
This option involved constructing 2x single circuit 500 kV (operate at 330 kV) lines (using standard conductors) from Snowy 2.0 to Bannaby (260km) and line 64 cut-in loop in/out at Snowy 2.0.

This option would have a Snowy 2.0 capacity of 1150[23] – 2260[24] MW.

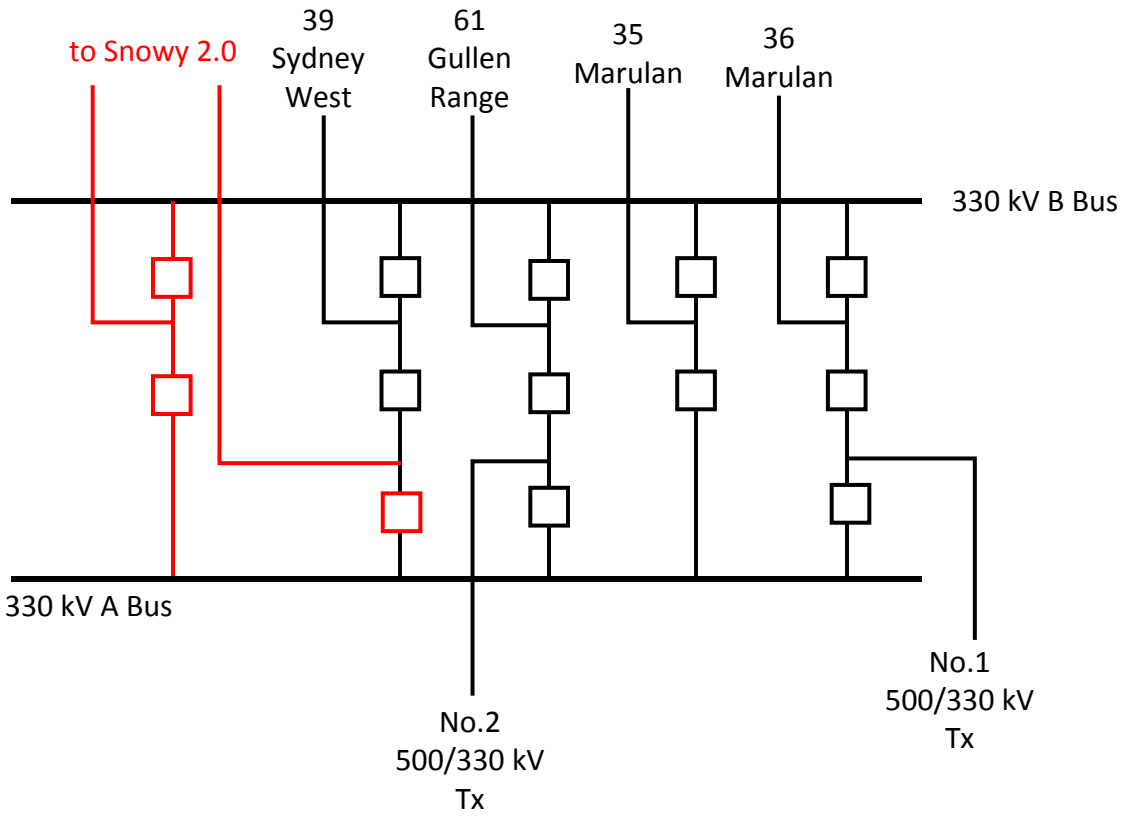
[23] When VIC – NSW transfer = 500 MW and renewable generation in Yass/Canberra = 600MW

[24] When VIC – NSW transfer = 0 MW and renewable generation in Yass/Canberra = 0MW

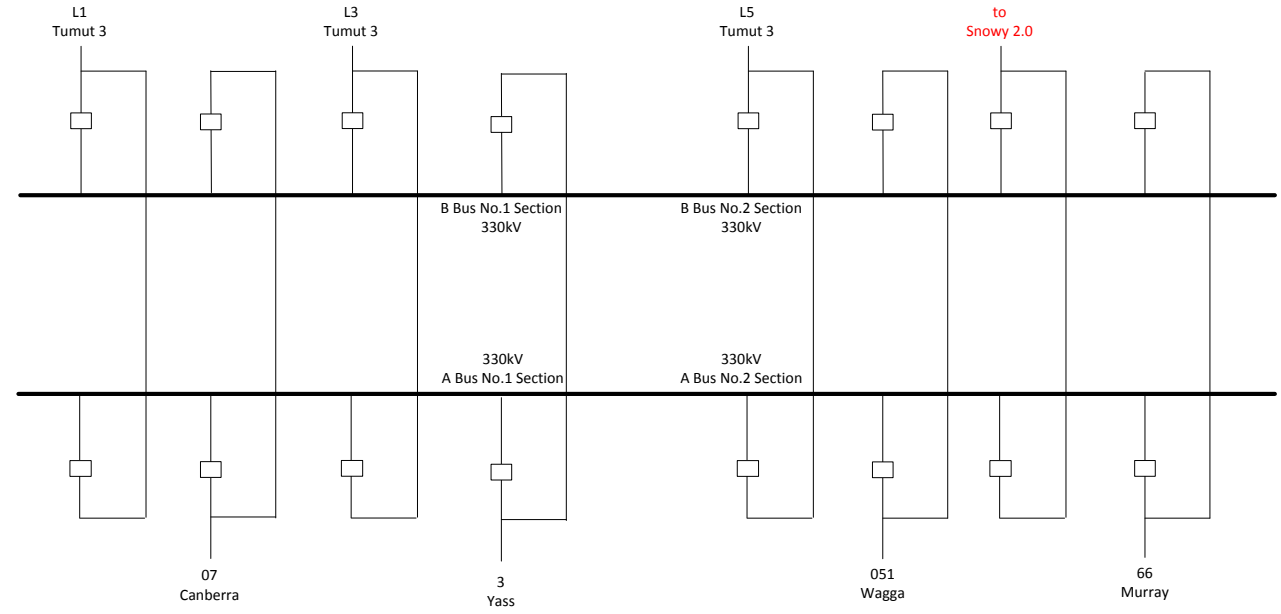
Snowy 2.0 Switching Station



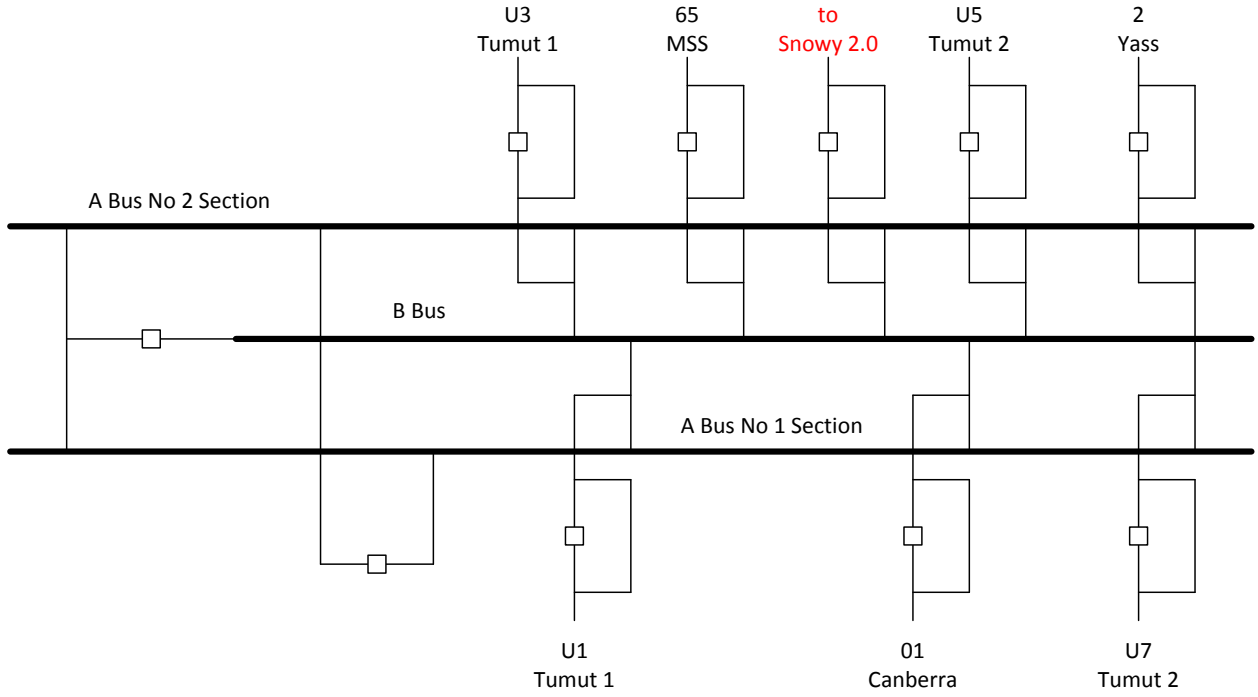
Bannaby 330 kV Substation



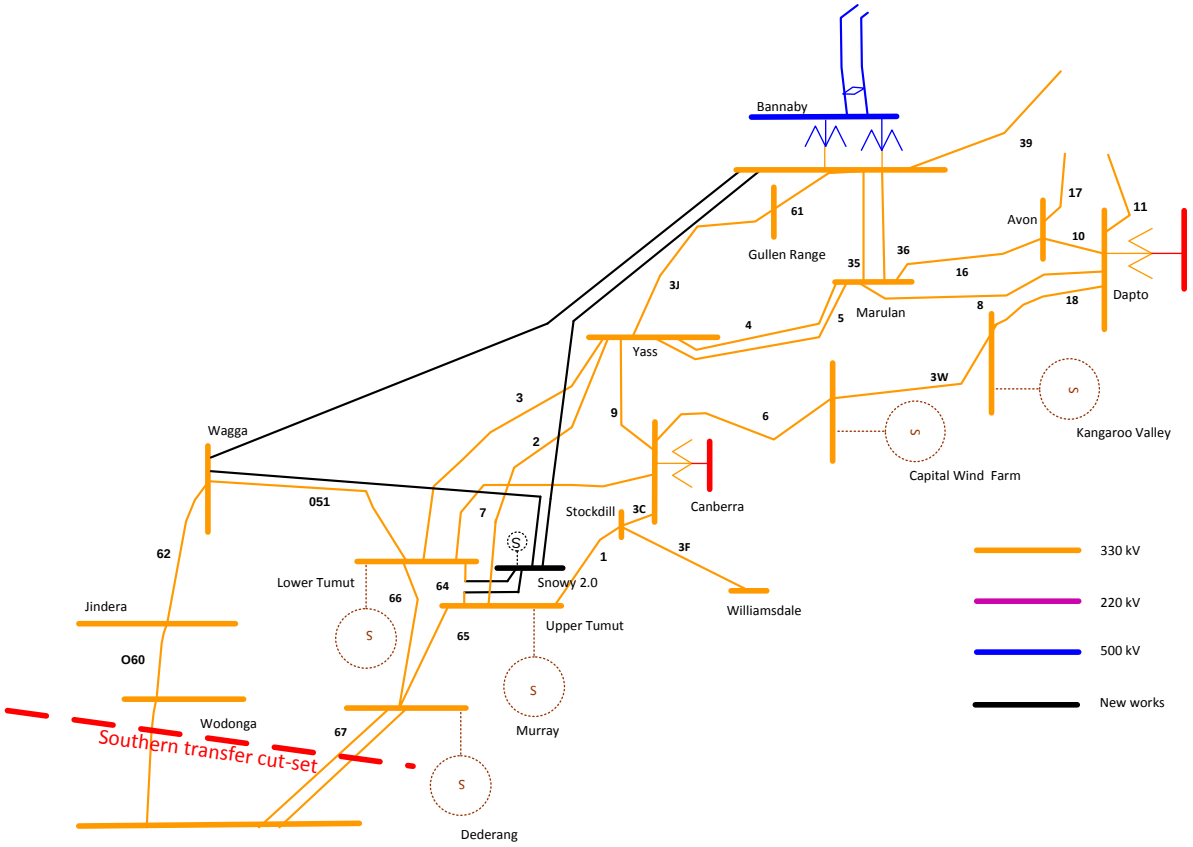
Lower Tumut Switching Station



Upper Tumut Switching Station



5.7 Option C2: New single circuit 330 kV transmission lines Snowy 2.0 – Bannaby, Snowy 2.0 – Wagga and Wagga - Bannaby (500 kV construction)



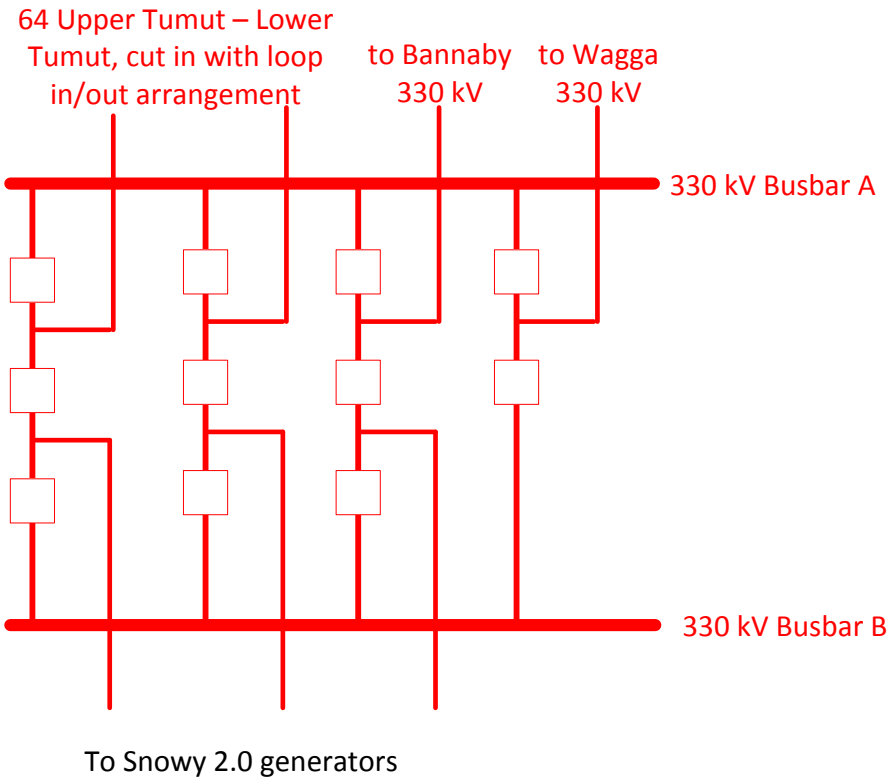
This option involved constructing 3 x single circuit 500 kV (operate at 330 kV) lines (using standard conductors) from Snowy 2.0 to Bannaby, Snowy 2.0 to Wagga and Wagga to Bannaby and line 64 cut-in loop in/out at Snowy 2.0.

This option would have a Snowy 2.0 capacity of 1910[25] – 3000[26] MW.

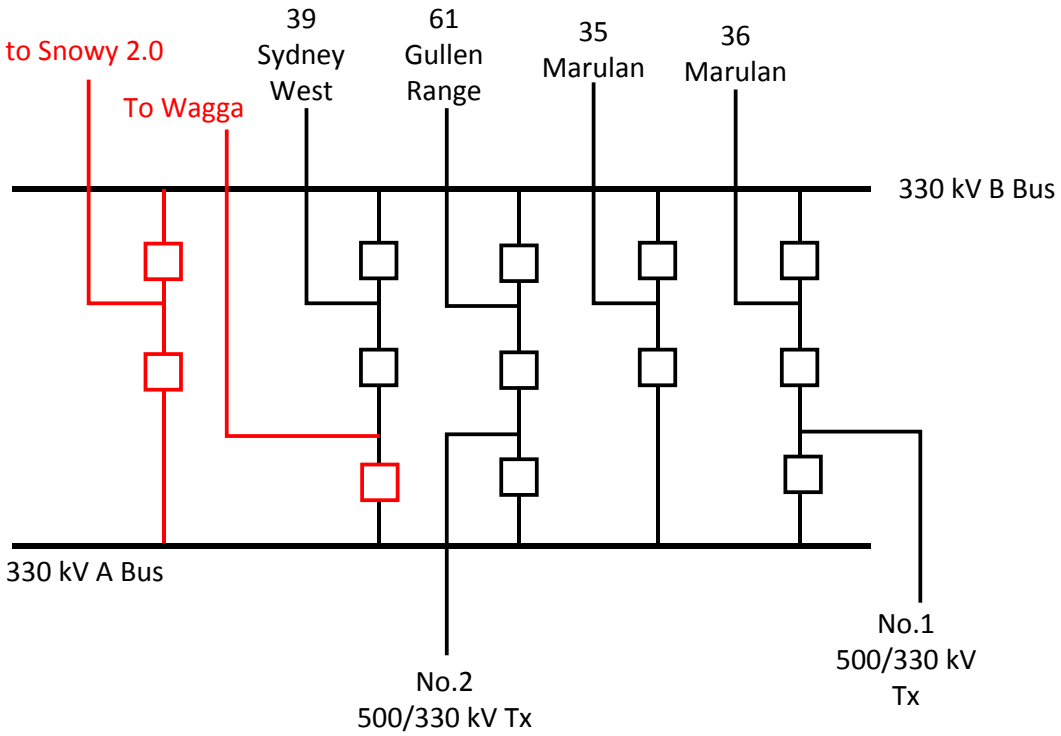
[25] When VIC – NSW transfer = 500 MW and renewable generation in Yass/Canberra = 600MW

[26] When VIC – NSW transfer = 0 MW and renewable generation in Yass/Canberra = 0MW

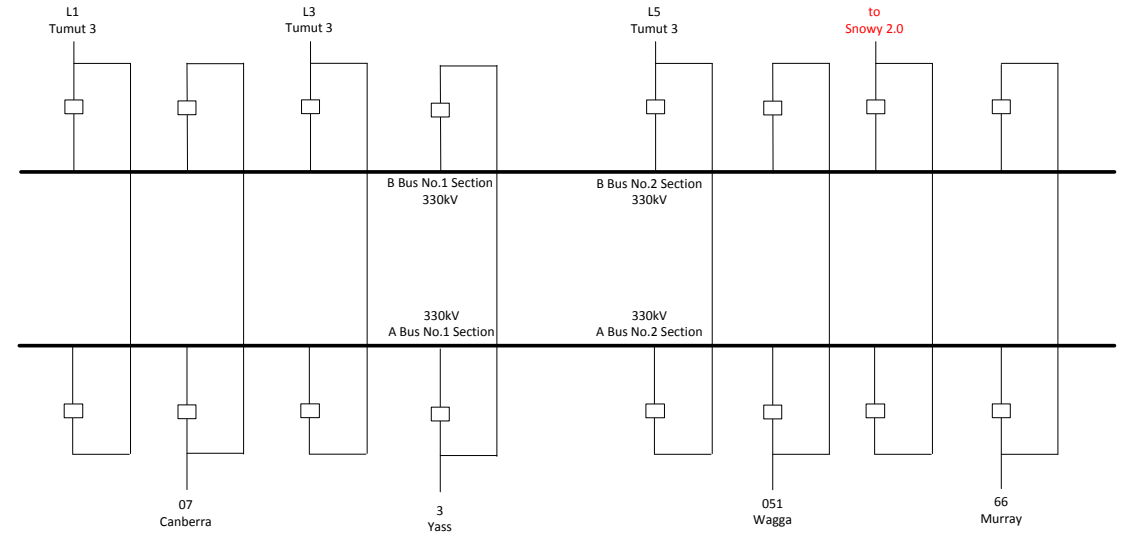
Snowy 2.0 Switching Station



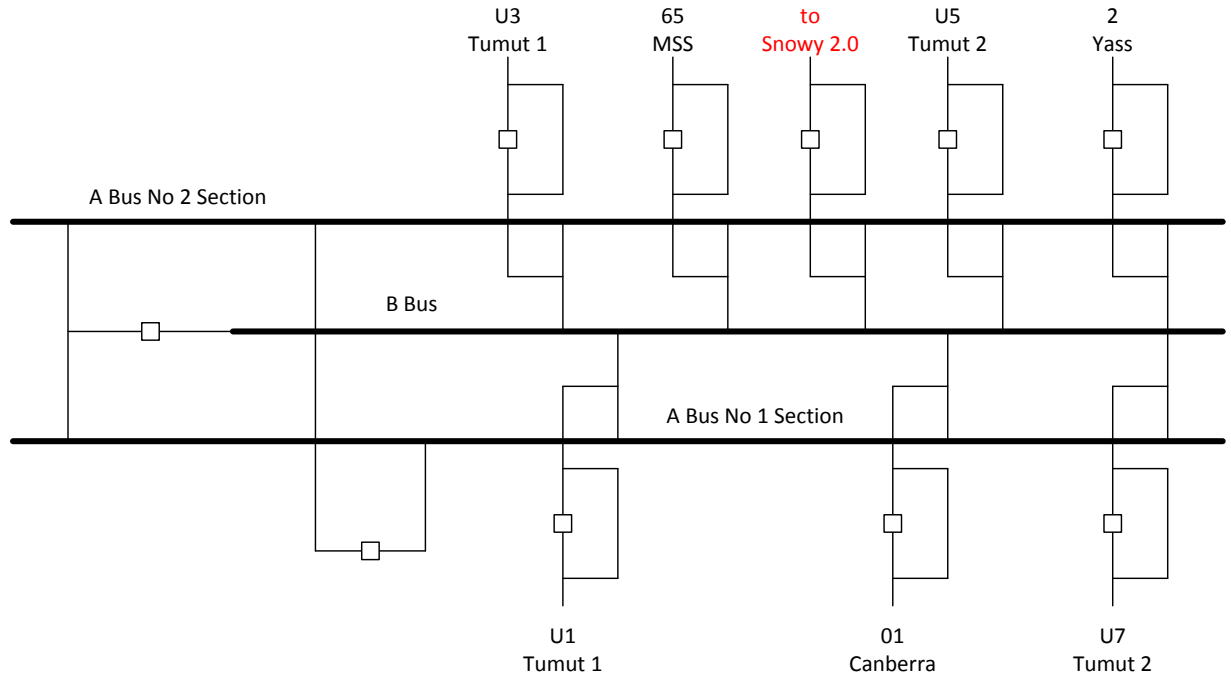
Bannaby 330 kV Substation



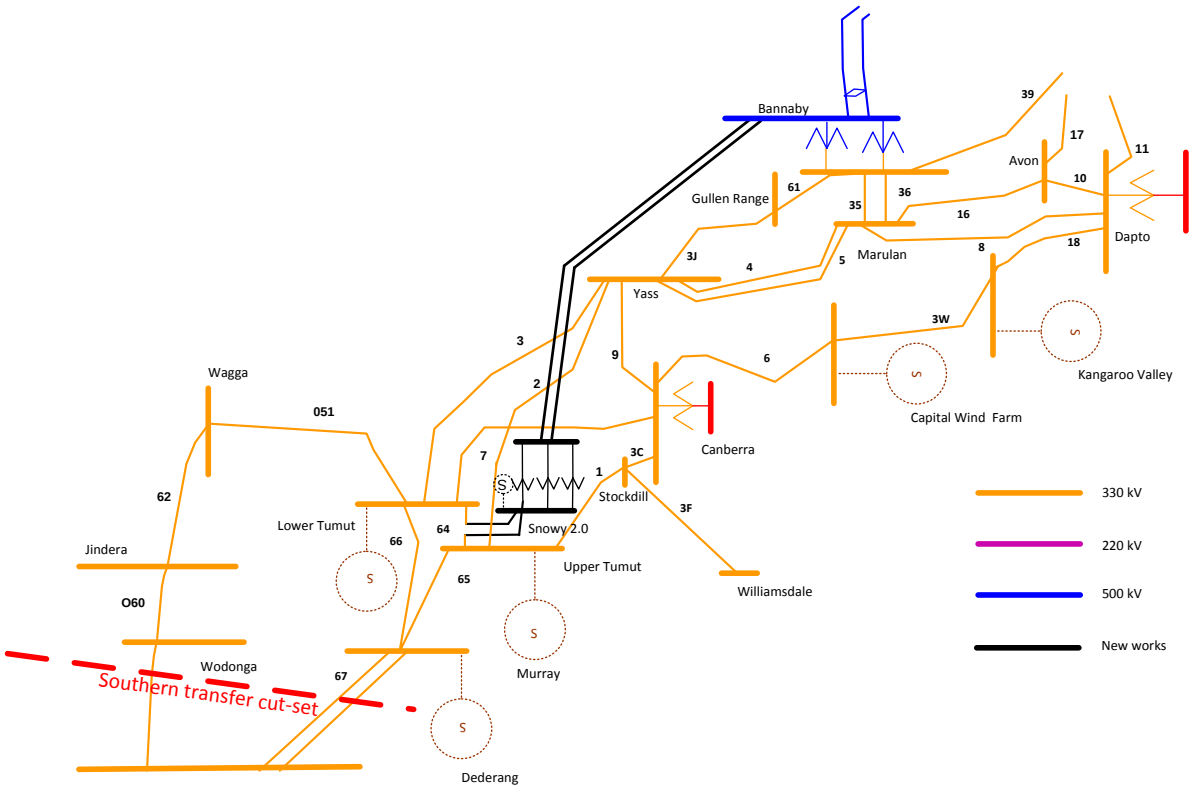
Lower Tumut Switching Station



Upper Tumut Switching Station



5.8 Option D1: Two single circuit 500 kV transmission lines Tumut - Bannaby



This option consists of constructing 2x single circuit 500 kV lines from Snowy 2.0 to Bannaby (260km), line 64 cut-in loop in/out at Snowy 2.0, 3 x 1500 MW 500/330 kV transformers.

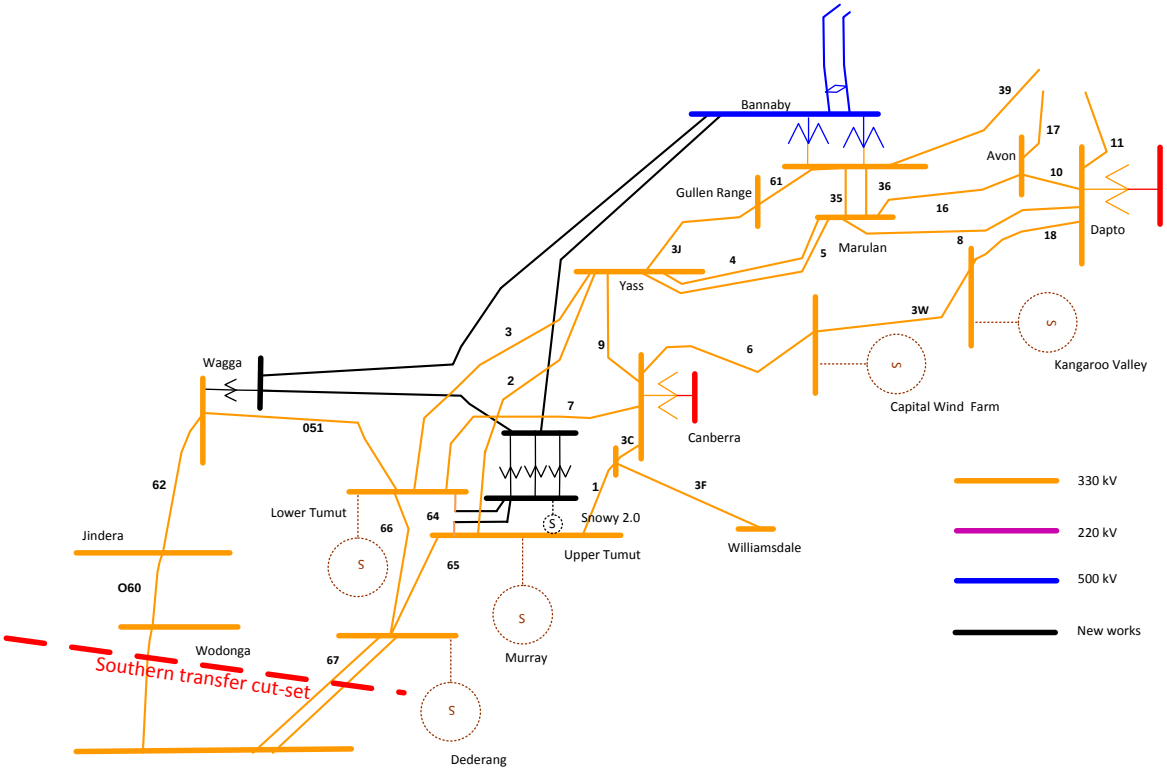
This option would have a Snowy 2.0 capacity of 1860[27] – 3000[28] MW.

This option was scoped and costed in PCCE C0220 – Snowy Hydro 2 Option 7 and 8 OoM Rev 0 (issued 26/09/2017). Refer to these reports for substation and other works details.

[27] When VIC – NSW transfer = 500 MW and renewable generation in Yass/Canberra = 600MW

[28] When VIC – NSW transfer = 0 MW and renewable generation in Yass/Canberra = 0MW

5.9 Option D2: 500 kV Snowy 2.0 – Bannaby and Snowy 2.0 – Wagga and Wagga – Bannaby



This option would have a Snowy 2.0 capacity of 1910[29] – 3000[30] MW.

500 kV - 1 x single circuit from Snowy 2.0 to Bannaby + 1 x single circuit from Snowy 2.0 to Wagga + 1 x single circuit from Wagga to Bannaby + 64 line cut-in, 4 x 1500 MW 500/330 kV transformers (1 at Wagga and 3 at Snowy 2.0).

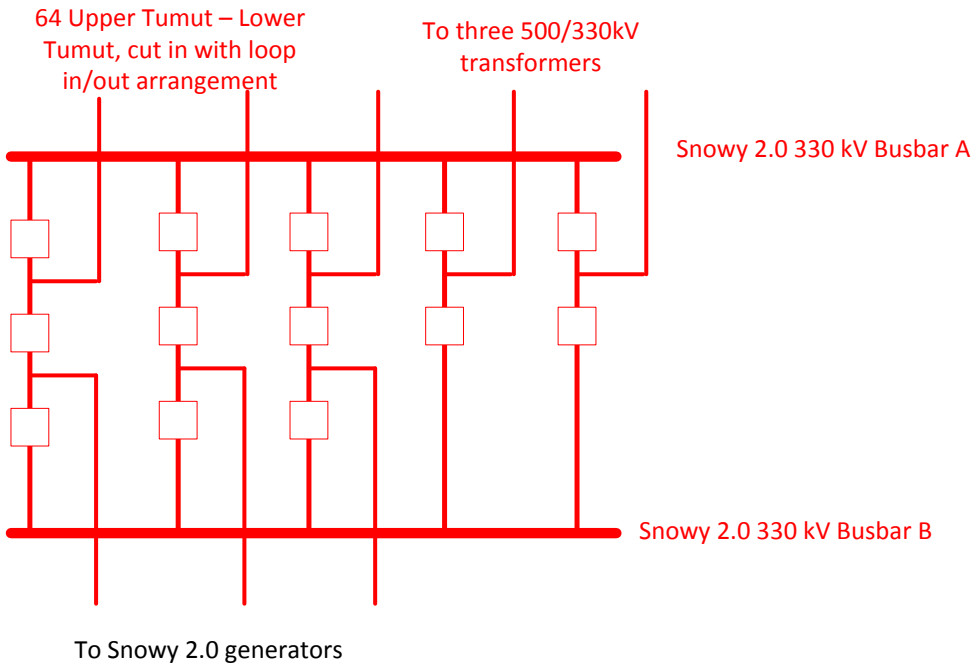
This option has received a high level cost assessment of $1,205m from Project Development.

[29] When VIC – NSW transfer = 500 MW and renewable generation in Yass/Canberra = 600MW

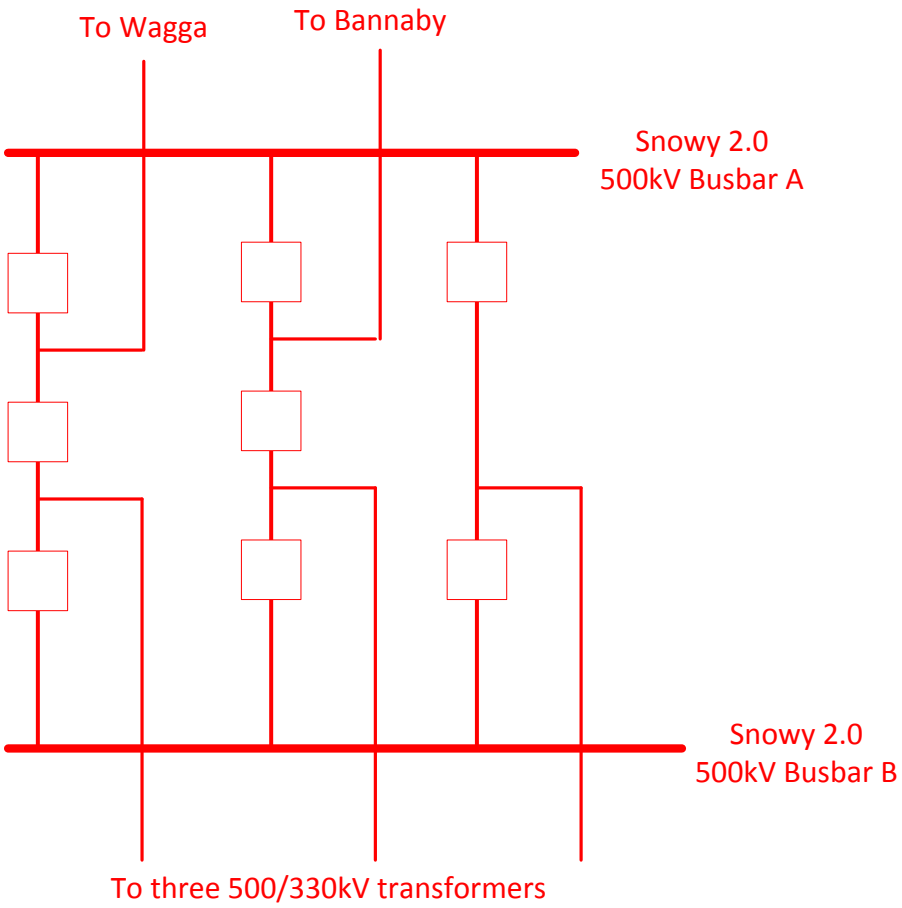
[30] When VIC – NSW transfer = 0 MW and renewable generation in Yass/Canberra = 0MW

Substation works:

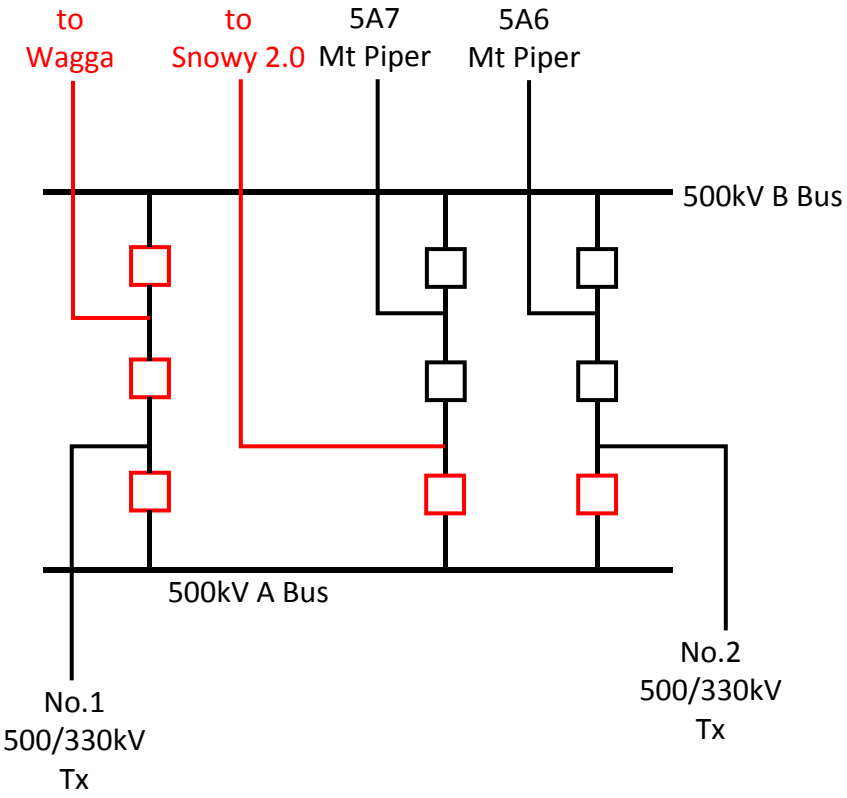
Snowy 2.0 330 kV



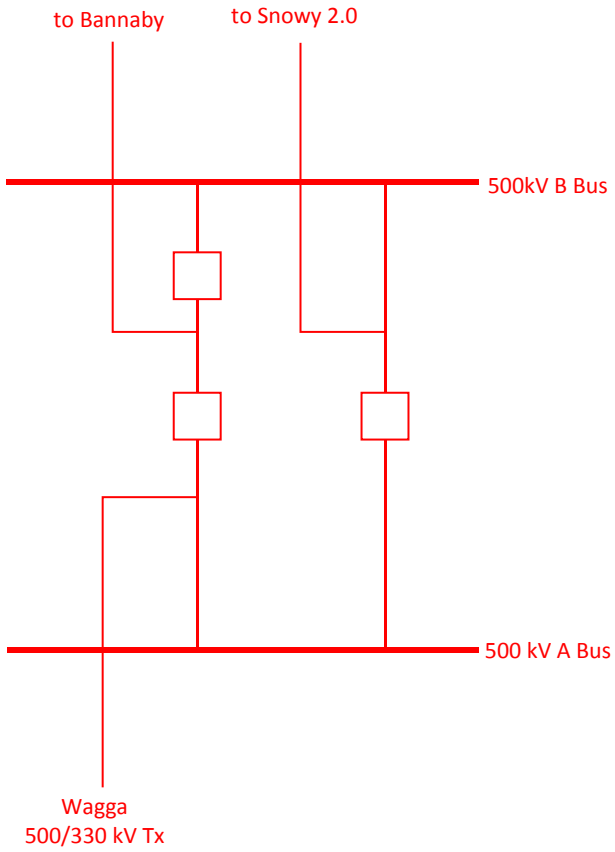
Snowy 2.0 500 kV



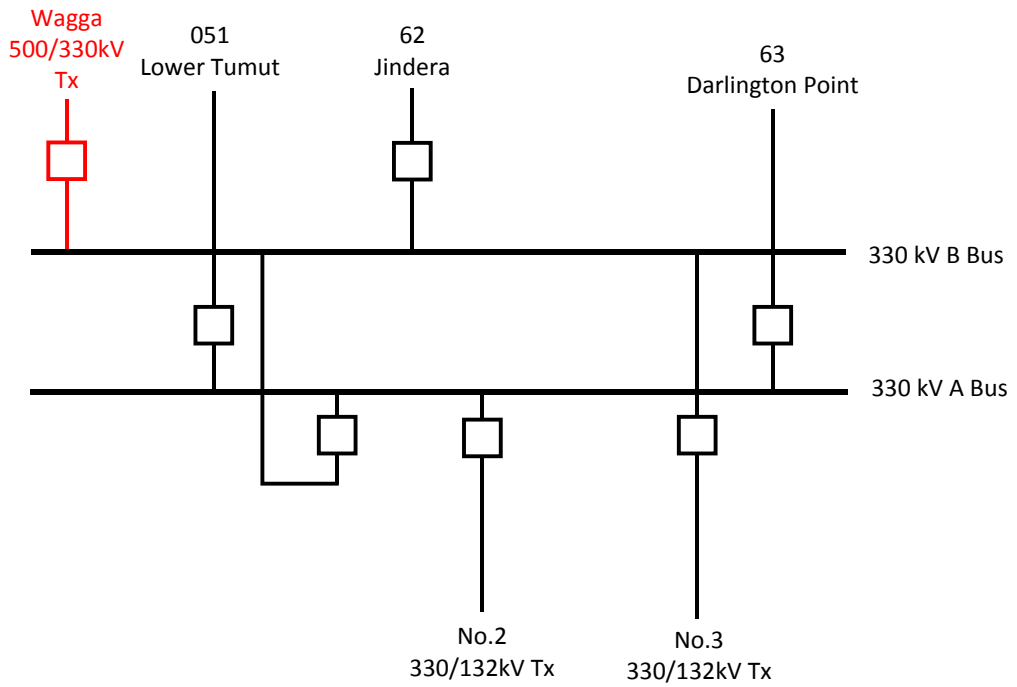
Bannaby 500 kV Substation



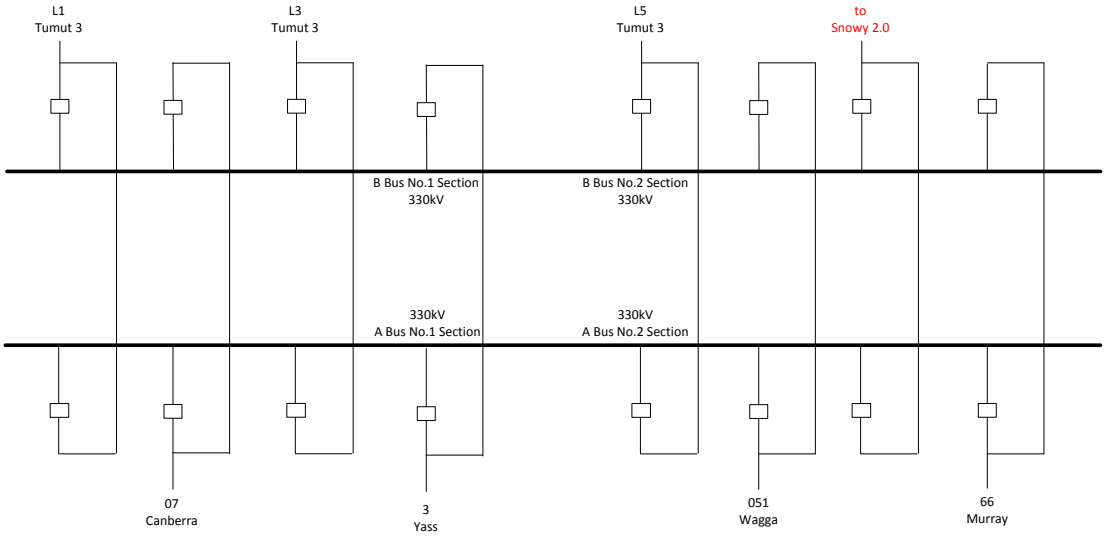
Wagga 500 kV Substation



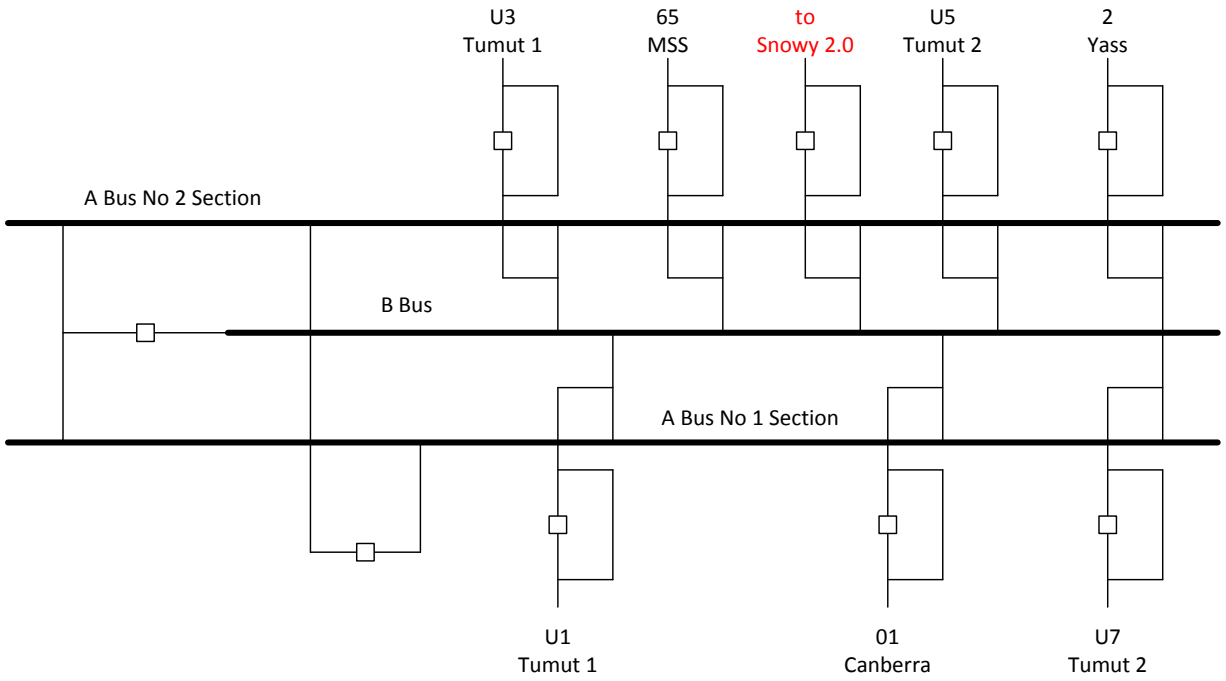
Wagga 330/132 kV Substation



Lower Tumut Switching Station



Upper Tumut Switching Station



5.10 Option E: Generation runback and load curtailment

This option involves:

- Generation at south of Snowy 2.0 is runback within 5 minutes
- Load at north of Bannaby is curtailed within 5 minutes

For system normal it is possible to run Snowy 2.0 at 1500MW. However, after a contingency causing overload on one of the following lines (1, 2, 3 and 7), the following three combinations of generation runback and load curtailment to be considered:

a. 500MW generation runback and 500MW of load curtailment

b. 1000MW generation runback and 1000MW of load curtailment

c. 1500MW generation runback and 1500MW of load curtailment

An assessment of the generation available for runback and load available for curtailment for the three scenarios a, b and c listed above. The assessment shall include costs and any restrictions associated with provision of this service.

The above options will also require provision of appropriate monitoring and control measures to:

- Monitor the loading of lines 1, 2, 3 and 7
- If any of the above line loading exceeds contingency rating, initiate runback of generation and load curtailment
- Send appropriate trigger alarms to the generation and loads identified
- The ability to enable/disable this scheme and change settings (ratings, selected generation, loads) using SCADA.

6. Recommendation

It is recommended that options be considered to address the identified need/opportunity and further progressed to undertake Option Feasibility Studies.

It is also recommended that TransGrid propose a contingent project for the transmission network developments in New South Wales southern network in the revised revenue proposal for 2018-2023 if a commitment is made to build Snowy 2.0. The contingent project would have the following triggers:

(a) Notification from Snowy Hydro that its Board has made a final investment decision to proceed with Snowy 2.0

(b) Two or more of the following:

  (i) Inclusion of the Snowy 2.0 transmission augmentation in AEMO's Integrated Grid Plan or similar plan as recommended by the Independent Review in to the Future Security of the National Electricity Market by Professor Alan Finkel and accepted by the COAG Energy Council

  (ii) Notification to TransGrid by the Federal Government, COAG Energy Council, NSW Government, Victorian Government or the Energy Security Board that it considers that augmentation of the transmission network to deliver increased output from Snowy 2.0 is required in order to meet or manage the expected demand for prescribed transmission services or comply with an applicable regulatory obligation or requirement associated with the provision of prescribed transmission services

  (iii) Successful completion of a RIT-T or alternate framework introduced in response to the recommendation of the Independent Review in to the Future Security of the National Electricity Market by Professor Alan Finkel and accepted by the COAG Energy Council (including comprehensive assessment of credible options) demonstrating that a Snowy 2.0 transmission augmentation is the option that maximises the positive net economic benefits

  (iv) Determination by the AER that the proposed investment satisfies the RIT-T or above mentioned alternate framework

(c) TransGrid Board commitment to proceed with the project subject to the AER amending the revenue determination pursuant to the Rules.

The trigger is specific and capable of objective verification, relates to a specific location or locations, and is probable but too uncertain to include the proposed contingent project in the forecast capital expenditure in this proposal.