OPTION FEASIBILITY STUDY (OFS)

Reinforcement of Southern Network

OFS- 000000001528B revision 1.0

Option description: Staged Line Upgrades, Phase Shifting Transformer and New Line

Ellipse project description: P0008823

Project reason: Reliability - To meet overall network reliability requirements
Project category: Prescribed - Augmentation

Approvals

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Approved	Colin Mayer	Acting Manager / Portfolio Management
Date submitted for approval	12 September 2016	

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1. Request

This Option Feasibility Study is provided in response to Option Feasibility Request 1528A Rev 0 – Reinforcement of Southern Network – Moderate 330kV Line Upgrade.

Contingent on the new generation connections and retirement of existing generation taking place there could be opportunity to provide market benefits to the NEM through reinforcing the transfer capability of the Yass/Canberra – Sydney transmission corridor.

Asset Management is requested to undertake a desktop assessment of the cost, timing of activities, risk analysis and practicality of carrying out the works.

2. Considerations

The following scope of works is required for this project option.

Stage 1

- Upgrade the 330kV Upper Tumut to Canberra 01 Line to an operating temperature of 120°C.
- Replacement of the 01 Line switchbay wave traps at Upper Tumut.
- Replacement of the 01 Line indication ammeter at Upper Tumut.
- Upgrade the 330kV Bannaby to Sydney West 39 Line to an operating temperature of 120°C.

Stage 2

- Upgrade the 330kV Yass to Marulan 4 Line to an operating temperature of 100°C.
- Upgrade the 330kV Yass to Marulan 5 Line to an operating temperature of 100°C.
- Establishment of new switchyard bench and installation of 330kV 1200MVA phase shifting transformers on the 39 and 61 Lines at Bannaby.
- Relocation of the 4/5 Line double circuit tower X4 (first structure out of Marulan)
- Extension of the switchyard bench and installation of 330kV 1200MVA phase shifting transformers on the 5 Line at Marulan.

Stage 3

- Construction of a new 330kV single circuit line between Yass and Bannaby with twin Olive conductor at an operating temperature of 120°C.
- Installation of 330kV line switchbays at Yass and Bannaby.
- CT ratio change on both 17 Line switchbays CTs at Macarthur.

2.1 Design Requirements

2.1.1 Equipment Ratings

The transmission lines and associated switchbays rating requirements are specified in the table, below.

Stage	Equipment	Operating Temperature (°C)	Summer Day Rating (MVA)
1	330kV Upper Tumut to Canberra 01 Line	120	1128
1	330kV Bannaby to Sydney West 39 Line	120	1121
2	330kV Yass to Marulan 4 Line	100	1008
2	330kV Yass to Marulan 5 Line	100	1008
2	Bannaby phase shifting transformers on the 39, 61 and 5 Lines	–	1200
3	330kV Yass to Bannaby Line	120	1367
3	Sydney South and Dapto 11 Line switchbays	–	1370
3	Avon and Macarthur 17 Line switchbays	–	1357

2.1.2 V-String Insulator Arrangement

It is proposed to install inverted V string insulator arrangements at both ends of a span for locations where clearance violations are less than 0.5m. This method is only possible for Suspension towers. This study has been completed on the basis that multiple D-String and V-String arrangements are allowed in each tension section.

2.1.3 D-String Insulator Arrangement

For locations where the clearance violation is up to 1.0m, it is proposed to install dummy tension insulator arrangements at both ends of the span to provide the additional clearance required. This method is only possible for Suspension towers. This study has been completed on the basis that multiple D-String and V-String arrangements are allowed in each tension section.

2.1.4 Structure Replacement

It is proposed to replace towers at locations where the additional clearance required is greater than 1.0m. To achieve the required mid-span clearance of greater than 1.0m, it is assumed that the tower replacement would only be required at one end of a violated span. It is expected that suspension towers will be replaced by standard TransGrid 330kV H-frame concrete pole structures and that tension towers will be replaced by steel lattice structures.

Poles will be jointed structures to allow bases to be installed prior to main structure erection and cutover of conductors. Pole structures will be erected on the centreline of the existing transmission line route, close to existing structures to minimise line impacts and design.

This option requires replacement of some tension structures. The replacement of tension structures with steel lattice towers is likely to be complex and may not be found feasible following completion of more detailed design. Designs will need to be assessed during project scoping to determine whether there are other feasible alternatives to replacement of these structures.

2.1.5 Terminal Palms

The 01, 39, 4 and 5 Lines were constructed with jumper connections using two hole terminal palms. Transmission Line Design has previously tested the two hole terminal palms for an operating temperature of 100°C and determined that the terminal palms have sufficient rating for an operating temperature of 100°C. Transmission Line Design believe the two hole terminal palms will have sufficient rating for an operating temperature of 120°C, however, it is recommended that the palms be tested at 120°C operating temperature to confirm their adequacy. Therefore, an allowance for testing of the two hole terminal palms at 120°C has been included in the cost estimate and the risk remains that the two hole terminal palms will not have sufficient rating to be operated at 120°C.

2.2 Transmission Line Works

2.2.1 330kV Upper Tumut to Canberra 01 Line

The 330kV Upper Tumut to Canberra 01 Line has 276 structures and is 100.5km in length.

Approximately 71.6km or 71.3% of the 01 Line traverses through National Parks, as detailed, below.

- Kosciuszko National Park (approximately 61.5km or 61.2% of the line)
- Bimberi Nature Reserve (approximately 2.3km or 2.3% of the line)
- Brindabella National Park (approximately 3.0km or 3.0% of the line)
- Namadgi National Park (approximately 3.7km or 3.7%of the line)
- Woodstock Nature Reserve (approximately 1.1km or 1.1% of the line)

Approximately 15% of the 01 Line traverses over flat to rolling hills terrain, approximately 45% of the 01 Line traverses over mountainous terrain and approximately 40% of the 01 Line traverses over alpine swampy terrain with approximately 60% of the line in forested areas.

Note, the 01 Line traverses above the snow line and can become inaccessible during winter. The project program should schedule the works on the 01 Line to occur outside of winter.

The scope of works required to uprate the 01 Line to 120°C operating temperature is specified in the table, below.

Description	Quantity
V-Strings (3 phases)	25
D-Strings (3 phases)	21
Structure Replacement	46

2.2.2 330kV Bannaby to Sydney West 39 Line

The 330kV Bannaby to Sydney West 39 Line has 272 structures and is 114.1km in length.

Approximately 18.3km or 16.0% of the 39 Line traverses through National Parks, State Conservation Areas or State Forests, as detailed, below.

- Jellore State Forest (approximately 1.6km or 1.4% of the line)
- Bargo State Conservation Area (approximately 12.2km or 10.7% of the line)
- Nattai National Park (approximately 2.2km or 1.9% of the line)
- Thirlmere Lakes National Park (approximately 2.3km or 2.0% of the line)

Approximately 40% of the 39 Line traverses over flat to rolling hills terrain and approximately 60% of the 39 Line traverses over mountainous terrain with approximately 50% of the line in forested areas.

The 39 Line is proposed to be diverted under the Western Sydney Airport TL 39 Diversion project which is required to provide space for the second Sydney airport near Badgerys Creek. The line diversion is proposed to be designed as a 330kV 1200MVA cable, and will have sufficient capacity to match the uprating of the 39 Line to 120°C operating temperature.

The scope of works required to uprate the 39 Line to 120°C operating temperature is specified in the table, below.

Description	Quantity
V-Strings (3 phases)	9
D-Strings (3 phases)	4
Structure Replacement	3

2.2.3 330kV Yass to Marulan 4 Line

The 330kV Yass to Marulan 4 Line has 260 structures and is 114km in length.

Approximately 1.8km or 1.5% of the 4 Line traverses through Mundoonen National Reserve. The remaining 4 Line does not traverse through any National Parks, State Conservations Areas or State Forests.

Approximately 85% of the 4 Line traverses over flat to rolling hills terrain and approximately 15% of the 4 Line traverses over mountainous terrain with approximately 10% of the line in forested areas.

The scope of works required to uprate the 4 Line to 100°C operating temperature is specified in the table, below.

Description	Quantity
V-Strings (3 phases)	39
D-Strings (3 phases)	35
Structure Replacement	48

2.2.4 330kV Yass to Marulan 5 Line

The 330kV Yass to Marulan 5 Line has 283 structures and is 118.2km in length.

Approximately 2.5km or 2.1% of the 5 Line traverses through Mundoonen National Reserve. The remaining 5 Line does not traverse through any National Parks, State Conservations Areas or State Forests.

Approximately 85% of the 5 Line traverses over flat to rolling hills terrain and approximately 15% of the 5 Line traverses over mountainous terrain with approximately 15% of the line in forested areas.

The scope of works required to uprate the 5 Line to 100°C operating temperature is specified in the table, below.

Description	Quantity
V-Strings (3 phases)	21
D-Strings (3 phases)	19
Structure Replacement	52

2.2.5 New Yass to Bannaby 330kV Line

TransGrid already owns and operates the Yass to Gullen Range 330kV 3J Line and the Gullen Range to Bannaby 330kV 61 Line. It is assumed for this feasibility study that the new line will be constructed adjacent to the existing 3J and 61 Lines.

Therefore, the new 330kV line will be constructed to the following requirements.

- 124.7km in length
- Single circuit steel lattice towers
- Twin Olive conductor
- Design operating temperature of 120°C

The 3J Line does not traverse through any National Parks, State Conservation Areas or State Forests, however, the 61 Line does traverse through the Tarlo River National Park for approximately 2.3km. Therefore, the proposed new line route will be designed to traverse around the Tarlo River National Park, and will not have a significant impact on the distance of the line route as the 61 Line traverses through the edge of the National Park.

Therefore, the proposed line will not traverse through any National Parks, State Conservation Areas or State Forests. Approximately 101km of the line route traverses over flat to rolling hills terrain and 24km traverses over mountainous terrain with approximately 30km of the line route traversing through forested area (6km over flat to rolling hills terrain and 24km over mountainous terrain).

2.3 Substation Works

2.3.1 Substation Works associated with Upper Tumut to Canberra 01 Line Uprating

The 330kV 01 Line switchbays will need to be rated at 1128MVA, or 1974A.

Line Rating Advice 01 UT1 – CA1 2013 states that all HV switchgear, HV conductors and connections and secondary circuits and settings have sufficient capacity to accommodate the new 01 Line rating, except for the following.

- 01 Line bay wave traps at Upper Tumut are limited to 1800A.
- 01 Line bay secondary indication circuits at Upper Tumut are limited to 1600A by an ammeter.

2.3.2 Substation Works associated with Bannaby to Sydney West 39 Line Uprating

The 330kV 39 Line switchbays will need to be rated at 1121MVA, or 1962A.

Line Rating Advice 39 BBY – SYW 2016 states that all HV switchgear, HV conductors and connections and secondary circuits and settings have sufficient capacity to accommodate the new 39 Line rating.

2.3.3 Substation Works associated with Yass to Marulan 4 Line Uprating

The 330kV 4 Line switchbays will need to be rated at 1132MVA, or 1981A.

Line Rating Advice 4 MRN – YSN 2016 states that all HV switchgear, HV conductors and connections and secondary circuits and settings have sufficient capacity to accommodate the new 4 Line rating.

2.3.4 Substation Works associated with Yass to Marulan 5 Line Uprating

The 330kV 5 Line switchbays will need to be rated at 1132MVA, or 1981A.

Line Rating Advice 5 MRN – YSN 2016 states that all HV switchgear, HV conductors and connections and secondary circuits and settings have sufficient capacity to accommodate the new 5 Line rating.

2.3.5 Bannaby Phase Shifting Transformer on 39 and 61 Lines and New Line Switchbay

Refer to Appendix A for the Single Line Diagrams which were provided by Power System Analysis for the new connections.

There is sufficient space to install the new line switchbay as requested in the single line diagram. A new 330kV line switchbay will be required to be installed.

Based on the layout of the existing Bannaby 330kV Switchyard, it will be very difficult to install the 330kV phase shifting transformers as requested in the single line diagram. Therefore, it is assumed as part of this feasibility study that a new switchyard will need to be established to accommodate the new 39 and 61 Line phase shifting transformers and associated switchbays, as shown in Figure 2.3.5.a, below.

Figure 2.3.5.a – Proposed Area for Phase Shifting Transformers at Bannaby

2.3.6 Yass New Line Switchbay

Refer to Appendix A for the Single Line Diagrams which were provided by Power System Analysis for the new connections.

It is assumed to be feasible to connect the new 330kV line switchbay as requested in the single line diagram, however, the landing span being installed over the No.2 Reactor, which may not be acceptable. If this proposal is not acceptable, there is another spare bay directly adjacent to the proposed location which would require the same scope of works to connect the new line.

2.3.7 Marulan Phase Shifting Transformer on 5 Line

Refer to Appendix A for the Single Line Diagrams which were provided by Power System Analysis for the new connections.

Based on the layout of the existing Marulan 330kV Switchyard, it will be very difficult to install the 330kV phase shifting transformers as requested in the single line diagram. Therefore, it is assumed as part of this feasibility study that a new switchyard will need to be established to accommodate the new 5 Line phase shifting transformer and associated switchbay, as shown in Figure 2.3.7.a, below. The 330kV 4/5 Line Structure X4 would also need to be relocated, however, simultaneous outages of the 4 and 5 line are not permissible. Therefore, it is assumed that two single circuit tension towers will be required.

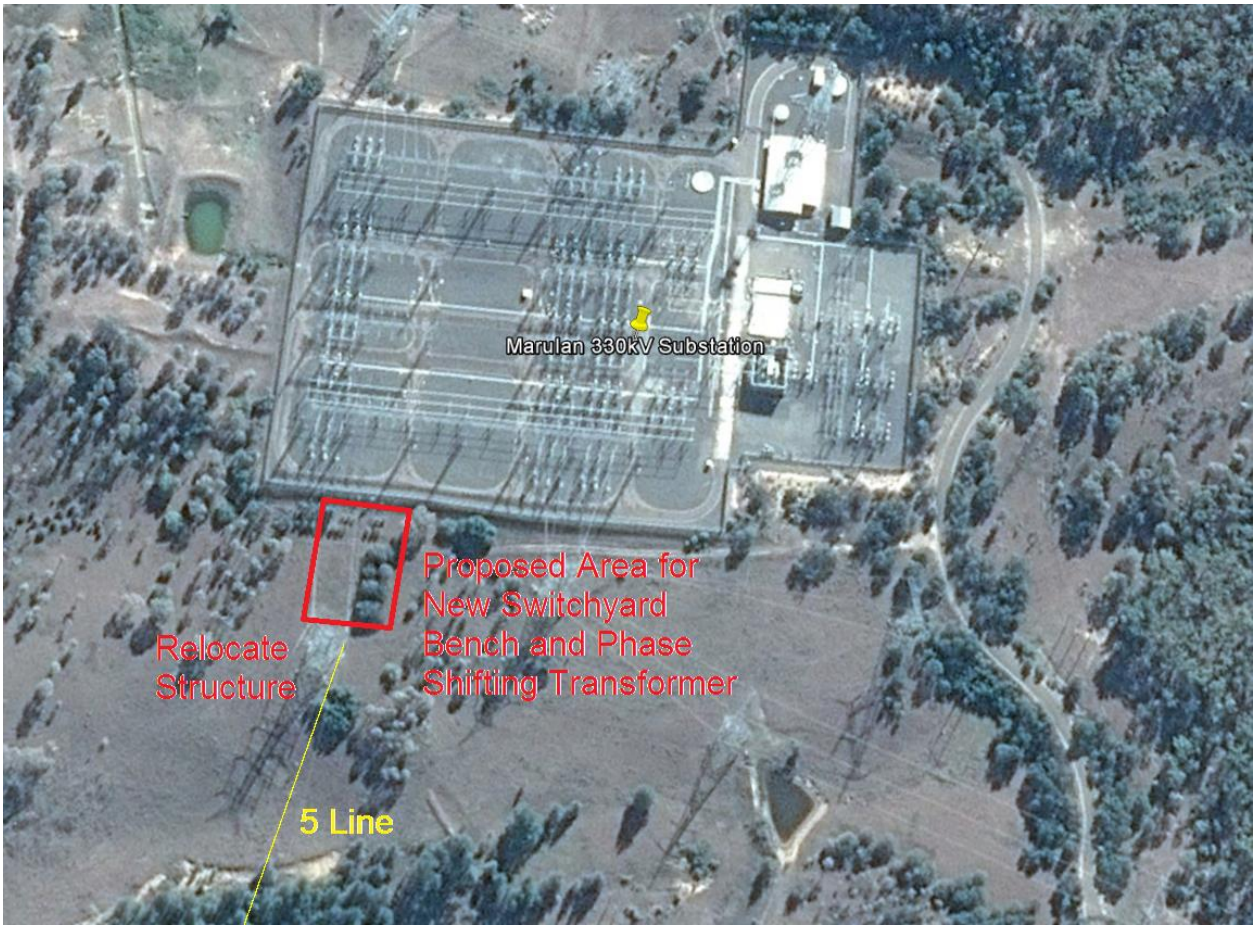


Figure 2.3.7.a – Proposed Area for Phase Shifting Transformer at Marulan

2.3.8 Substation Works associated with Uprating Sydney South to Dapto 11 Line Switchbay Equipment

The 330kV 11 Line switchbays will need to be rated at 1370MVA, or 2397A.

Line Rating Advice 11 SYS – DPT 2013 states that all HV switchgear, HV conductors and connections and secondary circuits and settings are rated above 1370MVA.

2.3.9 Substation Works associated with Uprating Avon to Macarthur 17 Line Switchbay Equipment

The 330kV 17 Line switchbays will need to be rated at 1357MVA, or 2375A.

Line Rating Advice 17 AVS – MAC 2012 states that all HV switchgear, HV conductors and connections and secondary circuits and settings are rated above 1357MVA, except for the following.

- 17 Line bay secondary indication circuits at Macarthur are limited to 1600A by the CT ratio (both line bays).

3. Outage requirements

Outages of the 01, 4, 5 and 39 are available year round, however, simultaneous outages of either two of the lines, except for 01, are not permissible. Simultaneous outages of 01 with 4, 5 or 39 may be permissible, subject to Power System Analysis studies.

Outages on these lines have a high likelihood of having impacts on the electricity market, so outages should be kept to daily outages where it is possible and practical to do so. It is anticipated that daily outages would be possible for the following works.

- Transmission line insulator replacements.
- Modification of secondary circuits.
- Line Trap replacements.
- Construction and commissioning of new switchbays and phase shifting transformers.

It is anticipated that suspension structure replacements can be carried out in 2 – 3 day outages while tension structure replacements may require 5 – 10 days outage.

Note that simultaneous outages of the 4 and 5 Lines are not permitted. It has been assumed as part of this feasibility study that the 4/5 Line 330kV double circuit structure relocation will need to be replaced by two single circuit structures due to outage restrictions, however, there may be an opportunity to develop a staging plan during project scoping that could cut over one circuit at a time to a new double circuit structure, hence, reducing the number of structures required.

4. Environmental and development approvals

4.1.1 Stage 1 and 2

It is not anticipated at this stage that the project will have a significant impact on the environment in accordance with Section 111 of the EP&A Act. This will be continually reviewed as the project develops but at this stage it is anticipated that an assessment in the form of a Review of Environmental Factors (REF) will be required. The REF will be tailored to the scale of the development.

The requirement to publicly consult on the project will be reviewed as the project develops but at this stage public consultation is anticipated. Based on the differing land tenures, the proposed works will require the approval of two separate determining authorities.

- National Parks and Wildlife Services for all works undertaken within National Parks or State Conservation Areas.
- TransGrid for all works outside the National Parks or State Conservation Areas.

For works within ACT, approval pursuant to *Planning and Development Act 2007* (ACT) will be required. The proposed works may require an Impact Track Assessment development application be prepared and approved. ACTPLA will be the likely determining authority.

4.1.2 Stage 3

This project has the potential to have a significant impact on the environment in accordance with section 111 of the EP&A Act and as such is likely to be assessed under Part 5.1 - State Significant Infrastructure (SSI). This project will require an EIS in accordance with Director General requirements and is likely to require ministerial approval.

A more detailed assessment of environmental risk at an early stage should be undertaken as timeframes for approval and potential biodiversity offsetting may be significant. This risk should be further investigated as part of early project development. The EIS will need to further consider the alternatives outlined in this report and associated environmental constraints.

Public consultation is a statutory requirement of this process.

5. Property considerations

The additional property required for the switchyard bench required at Bannaby and Marulan and the relocation of the 4/5 Line Structure X4 at Marulan will all be located on existing TransGrid property.

However, the acquisition of a 60m wide easement will be required for the new 330kV line between Bannaby and Yass.

6. Cost estimate

6.1 Capital Expenditure

It is estimated that this option would cost $263m ± 25% in $2016-17 as per the following table.

Item	Cost ($m)
Stage 1	18.3
Stage 2	122.2
Stage 3	122.0
TOTAL PROJECT COST	**262.5**

The expected expenditure profile for this project (excluding capitalised interest) based on a standard spending curve distribution is as follows:

	Total Project Base Cost	Year -8	Year -7	Year -6	Year -5	Year -4	Year -3	Year -2	Year -1	Year 0
Estimated Cost– non-escalated ($m 2016-17)	263	0.4	0.5	0.9	40.5	53.4	53.9	53.1	53.3	6.6

Notes:

1. The detailed breakdown provided in the above table is approximate only and is based on the total scope and nature of works included in the option. Individual numbers cannot be used for estimation of other projects or to separately cost components of this estimate.
2. The cost has been estimated from a scope of work determined by a limited review of the project, as detailed in section 2.
3. The values used in the estimate were generally obtained using PS / PSE's Estimating System.
4. The estimate has an uncertainty of +/- 25%
5. "Transmission Line 330 kV New", "PST 132 kV", "Transmission Line 330 kV Augmentation" and "Substation – 330 kV Augmentation" factors have been used.
6. No adjustment for forward escalation has been included in the totals above. Based on forecast commodity escalation, the nominal estimated cost in each year (i.e. the amount in 2018-19 is in forecast $2018-19) is as follows:

	Total Project Budget Cost	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26
Nominal escalated cost ($m) *	321	0.4	0.5	1.0	45.7	62.6	65.2	68.4	68.7	8.9

7. Project and implementation method

The project is expected to be completed in an estimated 87 months from the issue of a Request for Project Scoping. It is anticipated that the project will be delivered in three stages allowing for the issue of three PADs and sequential construction works for the three stages during the delivery of the project.

The key dates for this program are detailed below:

Milestone	Description	Duration (Months)	End of Month
1	Issue of RPS	0	0
2	Concept Design Complete – Stage 1 and 2	20	20
3	Concept Design Complete – Stage 3	30	30
4	Regulatory Approval Complete – Stage 1, 2 and 3	24	24
5	Environmental Approval Complete – Stage 1 and 2	14	19
6	Environmental Approval Complete – Stage 3	25	30
7	Issue PSS – Stage 1 and 2	12	22
8	Issue PSS – Stage 3	12	30
9	Issue PAD (DG2) – Stage 1	2	24
10	Advertise Specification Call Tenders – Stage 1	4	28
11	Award Contract – Stage 1	4	32
12	Possession of site – Stage 1	4	36
13	Practical Completion – Stage 1	10	46
14	In-Service Date – Stage 1	0	46
15	Issue PAD (DG2) – Stage 2	2	32
16	Advertise Specification Call Tenders – Stage 2	4	36
17	Award Contract – Stage 2	4	40
18	Possession of site – Stage 2	6	46
19	Practical Completion – Stage 2	21	67
20	In-Service Date – Stage 2	0	67
21	Issue PAD (DG2) – Stage 3	2	51
22	Advertise Specification Call Tenders – Stage 3	6	57
23	Award Contract – Stage 3	4	61
24	Possession of site – Stage 3	6	67
25	Practical Completion – Stage 3	18	85
26	In-Service Date – Stage 3	0	85

This program has been based on the standard program template for a Line – New (EIS) project, with the following adjustments:

a) The program has been modified to be delivered in three stages. It is assumed Stages 1 and 2 require REF environmental and Development Application approval, while Stage 3 requires EIS environmental approval.

This timeframe assumes the completion of the following steps prior to issue of the Project Scoping Study and PAD:

- Environmental Approval complete;
- Property acquisition has commenced and negotiations are expected to be complete within twelve months. Approval has been given for compulsory acquisition of those properties where negotiated settlements are not deemed possible.
- Concept design has been completed to the point of having a defined transmission line route plan including structure locations and sufficient design to allow costing accuracy to ±10%;
- Regulatory Approval processes complete;
- PAD issued within two months of completion of PSS.

For this option the following key risks to the program have been identified:

a) Environmental Approval of the project is subject to the level of community feedback and decisions by the Department of Planning and the Minister. Standard time frames allow for a "typical" process, however, if there is significant opposition to the project delays of up to 12 months could occur. It is likely that this risk could occur and the RPS should be issued with sufficient float to allow for this while still meeting the project needs date.

b) Property acquisition is likely to require some level of compulsory acquisition. The timing of this acquisition is subject to both completion of the environmental approval process and approval to progress to the stage of compulsory acquisition. Further delays could be experienced in this process which may delay Possession of Site for parts of the route. This risk is considered unlikely to occur due to the significant float allowed in the program.

c) The nominated construction period is based on a preliminary line route and assessment of terrain and conditions. No geotech or detailed environmental studies have been completed. As a result, the estimated construction period could vary for a number of reasons including, but not limited to:

   1. the final line route may require additional line length,
   2. non-standard construction methods, piled foundations or alternative access methods may be required;
   3. significant environmental works may need to be completed depending on the results of EIS processes;
   4. final approvals may impose restrictions on the way in which the line is constructed.

   It is possible that this risk could occur and the RPS should be issued with sufficient float to allow for this while still meeting the project needs date;

d) The project scoping period is dependent on completion of the Regulatory Approval process. Delays in this approval will impact on project completion.

e) The program is dependent on outages of the existing line for construction. These outages are dependent on system conditions and can be cancelled if the line is required in service to meet supply needs. This can significantly extend the construction period. Delays can also occur as a result of periods of wet weather coinciding with times when outages are possible for work. It is considered possible that delays to the program will occur as a result of one or both of these factors and this should be taken into account when determining the timing of RPS and PAD issue.

f) The program makes allowance for normal inclement weather. If periods of abnormal rainfall occur the program will be delayed.

g) It is assumed the works associated with the 01 Line uprating will occur simultaneously with the works associated with the 39 Line uprating. This simultaneous outage will be subject to Power System Analysis studies and if deemed unacceptable, the program may be delayed by an additional two months.

Transmission line works programs are inherently uncertain until such time as detailed studies and community consultation processes are completed. Accordingly it is likely that delays may occur to this project that result in a program that varies from that detailed above.

It is recommended that the RPS be issued with at least twelve months float to minimise the risk of the needs date not being met. Alternatively, contingency plans should be developed for the risk that the needs date cannot be met.

The program is based on the specific scope included in this report. If this option is combined with other options on the same site, the total project construction time frame will extend by a period that will be dependent on the availability of outages and staging of the total package of works. This should be allowed for when determining the date for issue of the RPS.

8. Project delivery risks

The key risks outlined in the table below have been identified and will need to be managed as part of this project. In the event that these risks occur there could be impacts to both project cost and time for completion. These risks should be assessed in detail during project scoping.

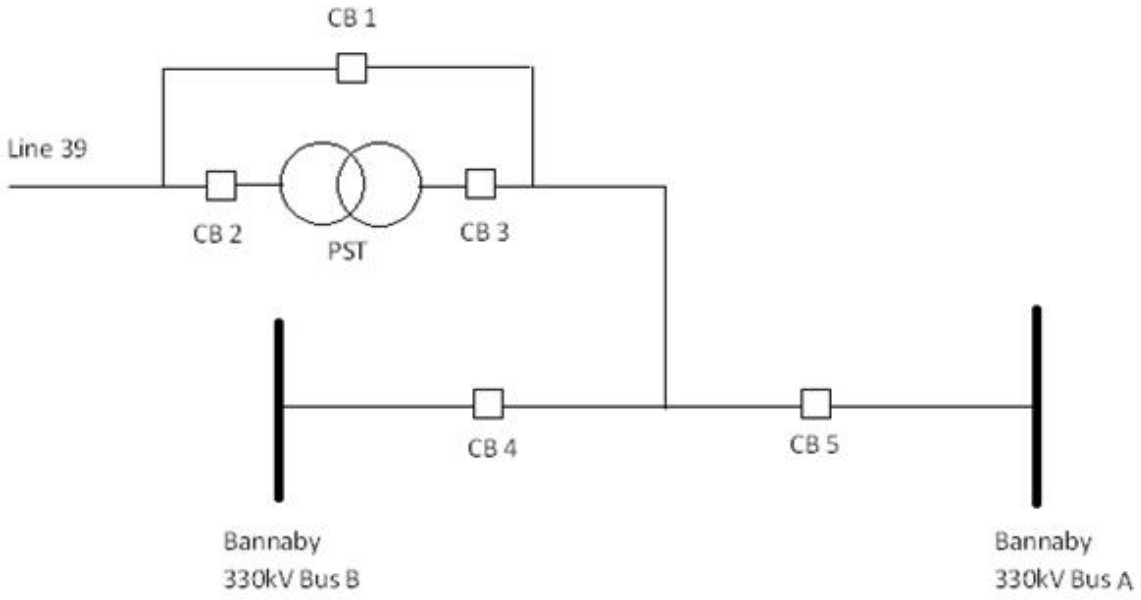
Risk	Treatment
Safety Risks	
There are the normal risks associated with working on a construction project on a transmission line.	Ensure that all works are carried out in accordance with TransGrid's Safety Rules and standard policies and procedures. All site works are to be managed using a site specific safety management plan.
There are normal risks associated with the design of substations and transmission lines and the associated access.	Ensure that all design works are carried out in accordance with TransGrid's standard designs, policies and procedures. Ensure that all design work is carried out in accordance with TransGrid's safety in design processes.
Environment Risks	
There are the normal risks associated with the delivery of large capital projects that may impact on the environment.	Conduct an Environmental Assessment of Project in accordance with TransGrid's standard policies and procedures.
Property Risks	
There is a risk that property acquisition will be required if new transmission line structures are offset from the existing transmission line alignment.	Complete concept transmission line design to such a level that the requirement for property acquisition is known before issue of the PAD.
Community Risks	
There are the normal risks associated with the delivery of large capital projects that may impact on local communities.	Implement a Communication Strategy in accordance with TransGrid's standard policies and procedures.
Project Delivery and Program Risks	
There are the normal risks associated with the delivery of capital projects.	Implement TransGrid's standard policies and procedures during all phases of the work.
Program may be delayed if Regulatory Approval has not been completed in time	Ensure that Regulatory Approval is completed in a timely manner.
Program may be delayed if outages cannot be obtained	Prepare an implementation plan and providing the earliest possible notification of the required outages.
Project may be delayed as a result of issues detailed in Section 7 of this report.	Issue RPS with sufficient float to ensure that the needs date can be met.

9. Change History

Revision	Approver	Amendments
0	J. Howland	Initial Issue
1	C. Mayer	Updated to 2016-17 costs.

Appendix A

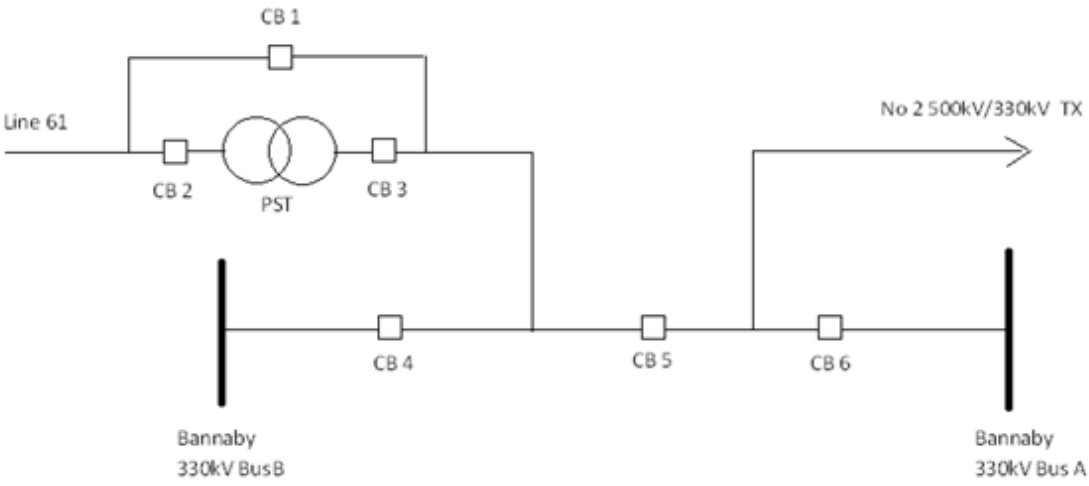
Single-line diagram for PST on Line 39 at Bannaby



CB 1, CB 2 and CB 3 are the new circuit breakers and disconnectors associated with the new PST.

CB 4 and CB 5 are the existing circuit breakers and disconnectors for Line 39

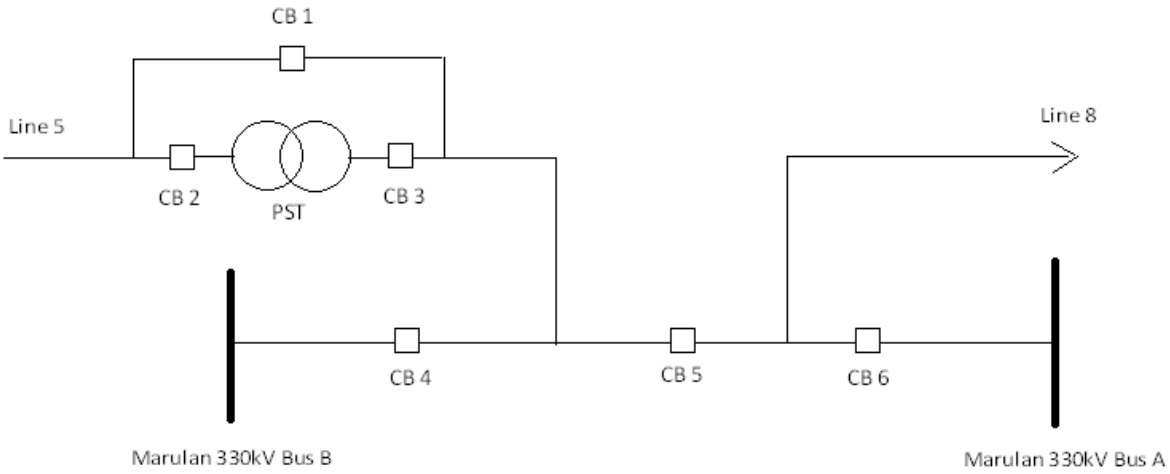
Single-line diagram for PST on Line 61 at Bannaby



CB 1, CB 2 and CB 3 are the new circuit breakers and disconnectors associated with the new PST on Line 61.

CB 4, CB 5 and CB 6 are the existing circuit breakers and disconnectors for the breaker-and-half arrangement for Line 61 and No2 500kV/330kV transformer.

Single-line diagram for PST on Line 5 at Marulan

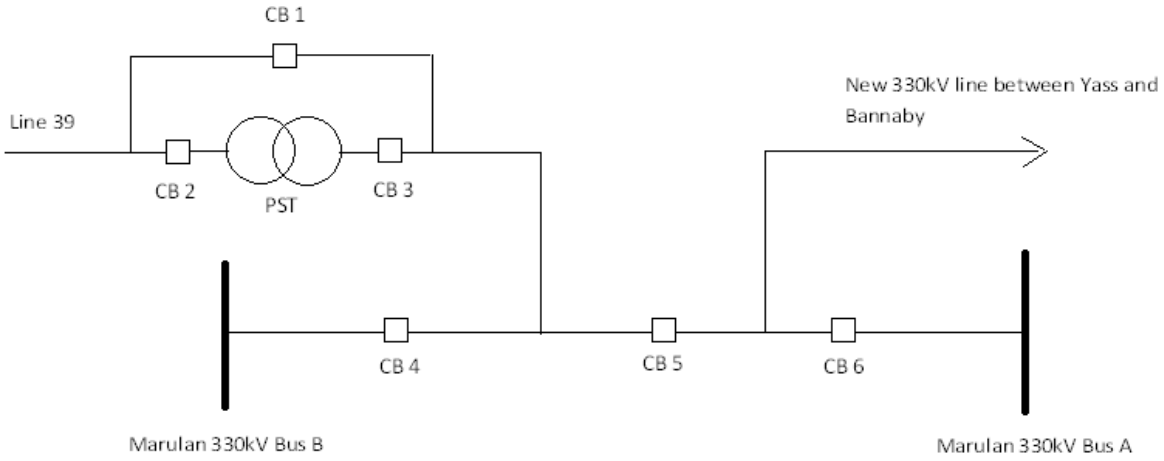


CB 1, CB 2 and CB 3 are the new circuit breakers and disconnectors associated with the new PST on Line 5.

CB 4, CB 5 and CB 6 are the existing circuit breakers and disconnectors for the breaker-and-half arrangement for Line 5 and Line 8.

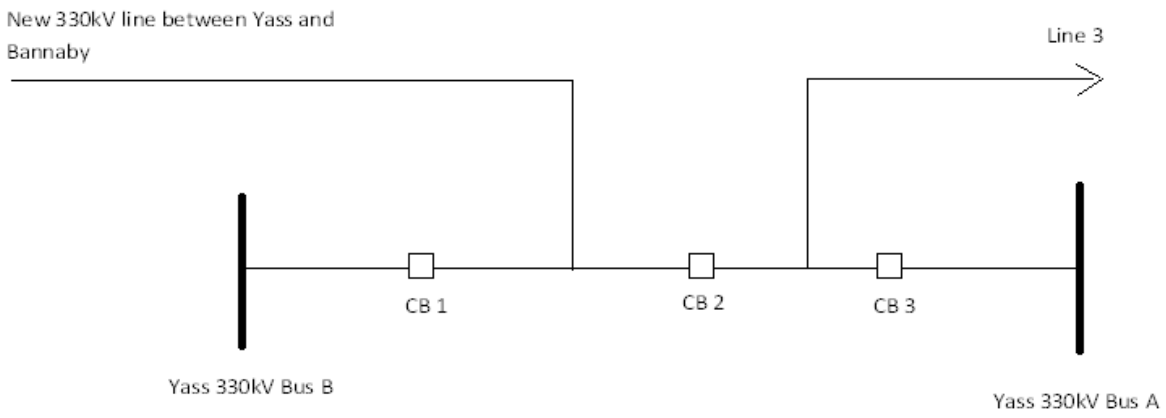
New 330kV circuit between Yass and Bannaby

At Bannaby end



CB 6 is the new circuit breaker and disconnectors that is required to form a breaker-and-half arrangement for the new 330kV circuit and Line 39 with its PST at Bannaby end.

At Yass end



CB 1 and CB 3 are the exiting circuit breakers and disconnectors for Line 3.

CB 2 is the new circuit breaker and disconnecots that is required to form a breaker-and-half arrangement for the new 330kV circuit and Line 3 at Yass end.