New Jimboomba West Zone Substation

Business Case
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energex
Part of Energy Queensland

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DOCUMENT VERSION

Version Number	Change Detail	Date	Updated by
1.0	Reviewed	08/12/2023	Principal Planning Engineer
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1 SUMMARY

Title	New Jimboomba West Zone Substation
DNSP	Energex
Expenditure category	☐ Replacement ☒ Augmentation ☐ Connections ☐ Non-Network
Identified need	☐ Legislation ☒ Regulatory compliance ☐ Reliability ☐ CECV ☐ Safety ☐ Environment ☐ Financial ☐ Other The identified need is to ensure supply in the Flagstone area remains compliant with Safety Net requirements, which is a regulatory obligation as outlined in the Distribution Authority. The investment is driven by safety net non-compliance as the load at risk following a N-1contingency at SSJBB or SSNMC is forecast to exceed the security standard constraint from 2026 and 2028, respectively.
Summary of preferred option	The proposed option is to establish a new 33/11kV Jimboomba West (SSJBW) zone substation to address the load at risk.
Expenditure	see table below
Benefits	This project is compliance driven expenditure under our Safety Net obligations. As such, it is a lowest cost option assessment.

Year	2025-26	2026-27	2027-28	2028-29	2029-30	2025-30
$m, direct 2022-23	-	0.297	0.588	1.765	9.082	11.732

2 BACKGROUND

The Queensland Government declared the Flagstone as a Priority Development Area in 2010. The Flagstone Priority Development Area is one of the largest urban growth areas in Australia, it covers an area of 7,188 hectares and is located west of Jimboomba and Mount Lindsay Highway. It will potentially develop into 54,145 dwellings to house a population of 145,000 people.

The Flagstone Priority Development Area is currently supplied by Jimboomba zone substation and North Maclean zone substation under the Jimboomba bulk supply area.

2.1 Network Arrangement

Jimboomba Bulk Substation (SSJBB BS) has 3 x 33kV feeders (of which F314 is a normally open feeder to Beaudesert) supplying 3 x zone substations including Jimboomba zone substation (SSJBB ZS), North Maclean (SSNMC), and Logan Village (SSLGV). SSJBB BS currently provides electricity supply to 22,925 predominantly residential customers in the North Maclean, Lyons, Cedar Grove, Munruben and Undullah areas.

The connected zone substations customers and loads are summarised below:

- **Jimboomba zone substation (SSJBB)** – is a 33/11kV zone substation supplying approximately 8,087 predominantly residential customers. The maximum recorded demand was 33.75 MVA in Summer 2022/23.
- **North Maclean zone substation (SSNMC)** – is a 33/11kV zone substation which supplies approximately 8,869 predominantly residential customers. The maximum recorded demand was 35.62 MVA in Summer 2022/23.
- **Logan Village zone substation (SSLGV)** – is a 33/11kV zone substation supplying approximately 5,969 predominantly commercial customers. The maximum recorded demand was 22.04 MVA in Summer 2022/23.

SSJBB zone substation is supplied by SSJBB bulk supply substation. SSJBB BS also supplies SSNMC zone substation, via 33kV feeder F479, and SSLGV zone substation, via 33kV feeder F470 respectively.

Currently, Flagstone Development area is supplied from SSJBB and SSNMC via 11kV feeders. Some of the 11kV feeders suppling this development are longer than 12km and requires several 11kV protection devices installed along the feeders for back-up protection purpose.

Figure 1 shows the network arrangement and Figure 2 shows the geographic layout of the Jimboomba area.

Figure 1 – Existing network diagram of the Jimboomba area

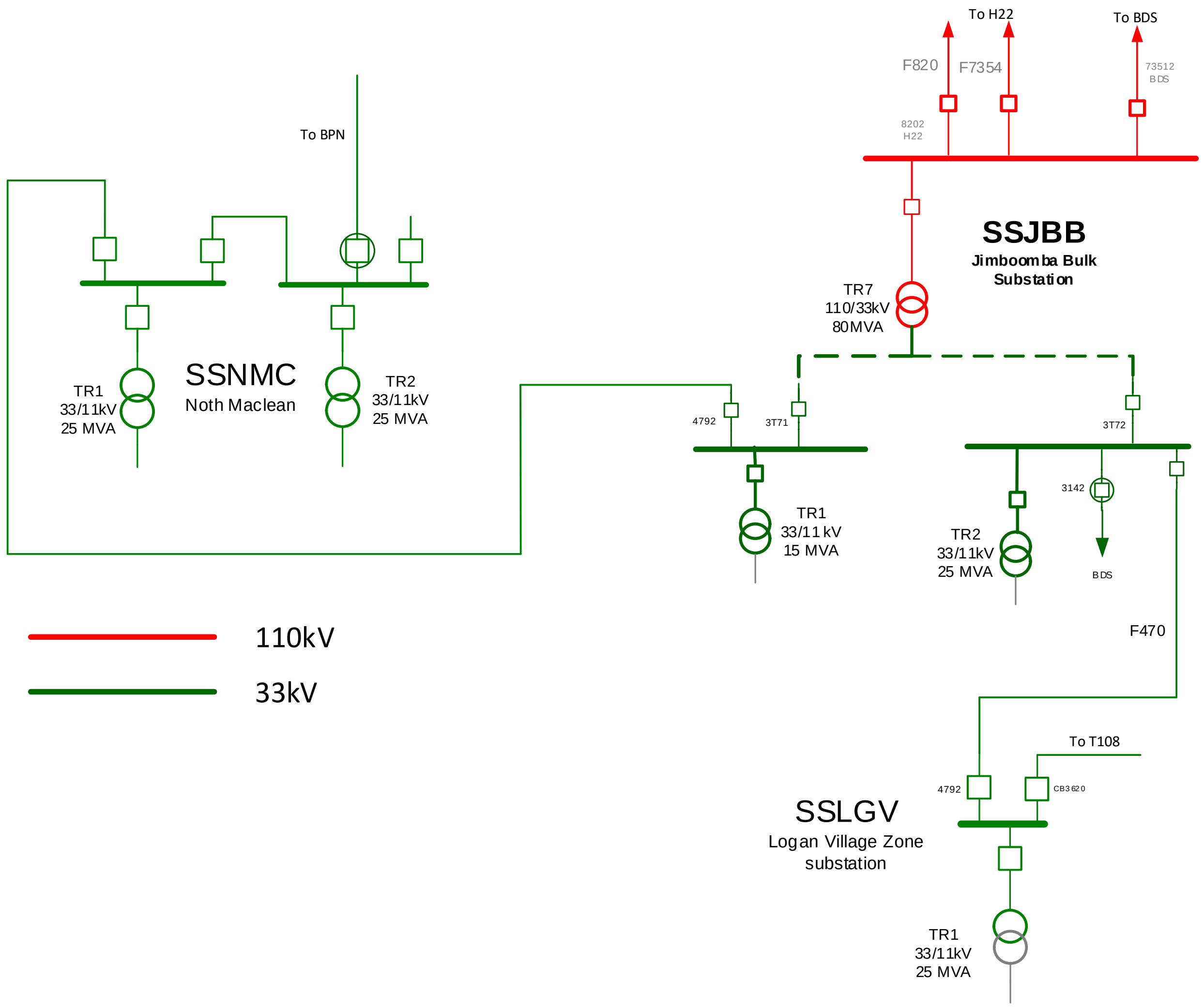
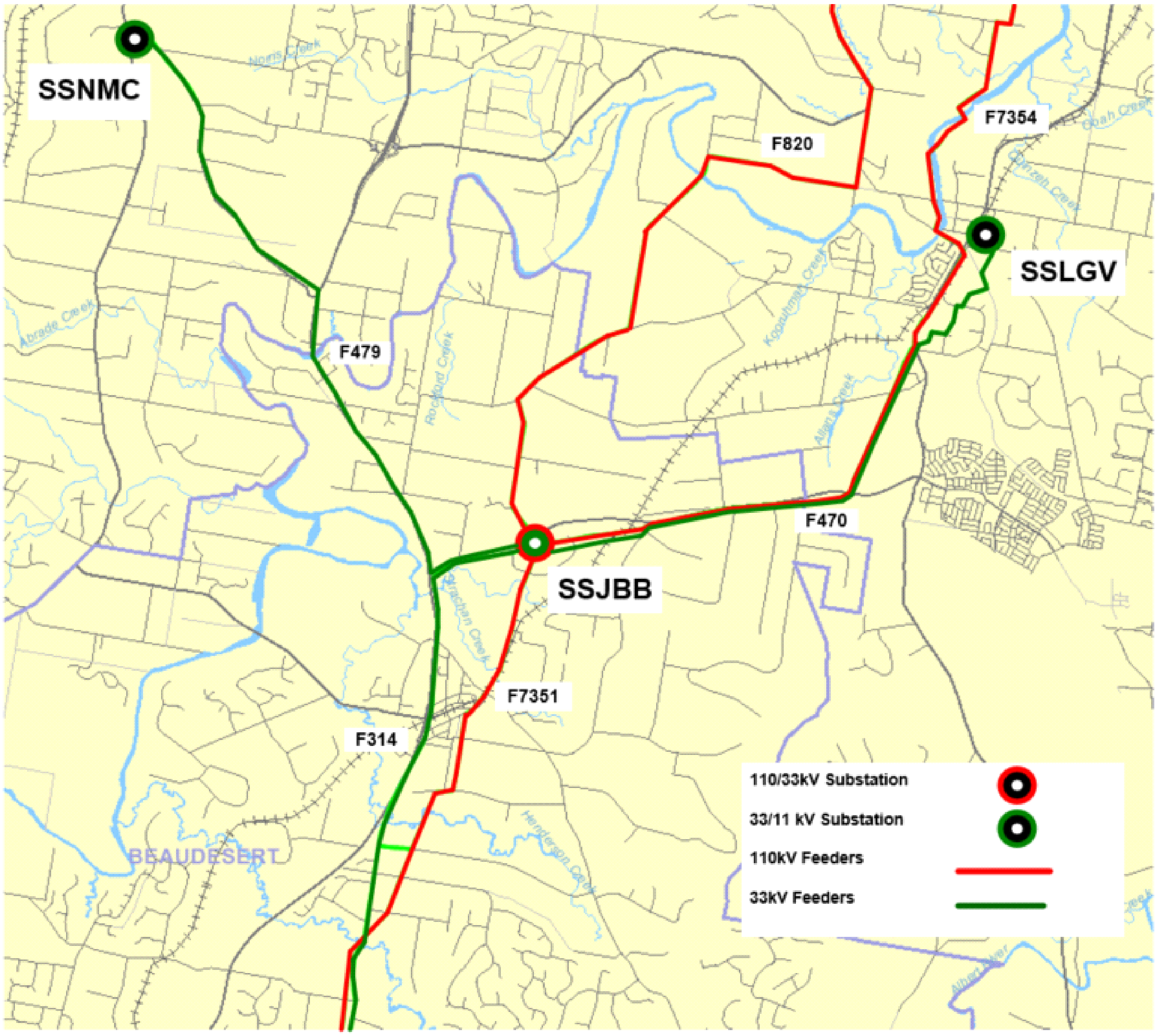


Figure 2 – Geographic view of the Jimboomba network



3 IDENTIFIED NEED

The identified need is to ensure supply in the Flagstone area remains compliant with Safety Net requirements, which is a regulatory obligation as outlined in the Distribution Authority.

The investment is driven by safety net non-compliance as the load at risk following a N-1contingency at SSJBB or SSNMC is forecast to exceed the security standard constraint from 2026 and 2028, respectively.

3.1 Compliance

3.1.1 Sub-transmission Network

Under its Distribution Authority, Energex must adhere to the Safety Net which identifies the principles that apply to the operation of network assets under network contingency conditions. System contingency related capability is assessed against a 50% probability of exceedance (PoE) load forecast, available load transfers, emergency cyclic capacity (ECC), non-network response, mobile plant, mobile generators, and short-term ratings of plant and equipment where available.

SSJBB and SSNMC zone substations are classified as Rural, and as such, the following Safety Net criteria apply:

Rural – following an N-1 event:

- No greater than 40MVA (16,000 customers) is without supply for more than 30 minutes;
- No greater than 15MVA (6,000 customers) is without supply for more than 4 hours; and
- No greater than 10MVA (4,000 customers) is without supply for more than 12 hours.

Further to an assessment against its Safety Net obligations, Energex also undertakes analysis of system capacity under normal conditions such that no sub-transmission network asset is planned to be operated above its normal cyclic capacity for a 10% probability of exceedance (PoE) load forecast.

3.1.2 Distribution network Transfer Capability

To meet Safety Net obligations Energex needs to maintain adequate automated, remote and manual transfer capability via its 11kV feeders without exceeding their rated capacities.

3.2 Sub-transmission Network Limitations

The network limitation that the proposed investment aims to address is the inability to supply all load at the Flagstone area following the loss of a transformer at SSJBB or SSNMC.

3.2.1 Jimboomba (SSJBB) Zone Substation Limitations

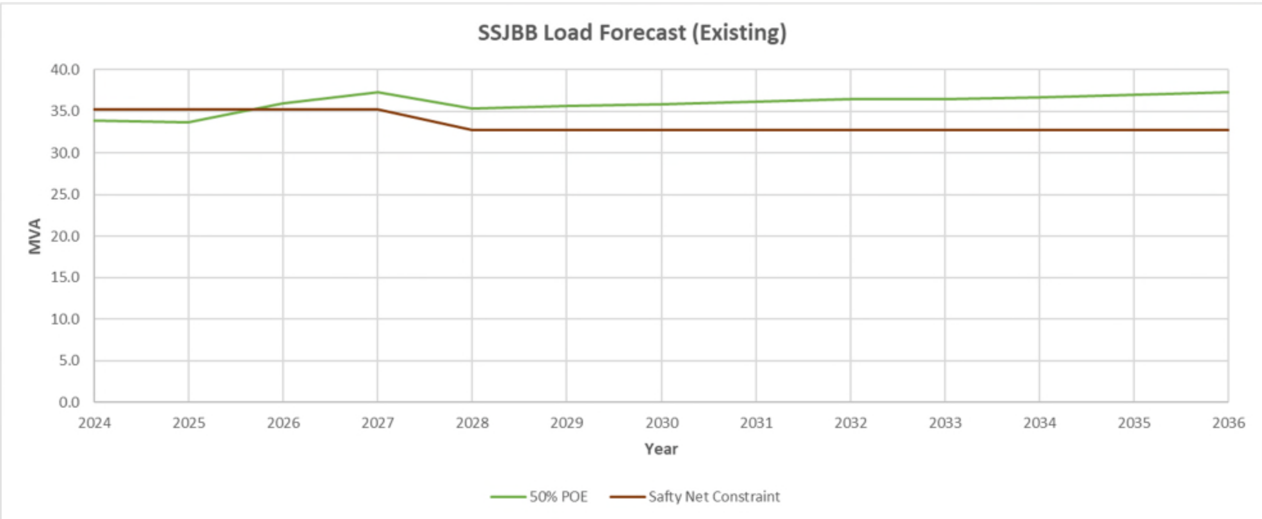
SSJBB is equipped with one 15MVA and one 25MVA 33/11kV transformer. The substation capacity is limited by the 11kV transformers and provides NCC, ECC and 2HEC as below:

- Normal Cyclic Capacity (NCC) – 45.0 MVA (see reasoning below)
- Emergency Cyclic Capacity (ECC) – 20.3 MVA
- 2 Hour Emergency Capacity (2HEC) – 21.8 MVA
- Security Standard Constraint – 35.2 MVA reducing to 32.7 MVA from 2028

The Security Standard Constraint includes all capabilities that can be made available within the required restoration timeframe for Rural category, following the loss of the transformer at SSJBB. Specifically, this comprises 4.9 MVA of manual transfer until 2028 and 2.4 MVA manual transfer after 2028, and 10 MVA of mobile generation. The reduction in manual transfer is due to a proposed project to transfer load from SSJBB to SSLGV.

Figure 3 shows the 50% POE load forecast and security standard constraint for SSJBB.

Figure 3 – SSJBB Load Forecast



As shown in the above figure, based on the 50%POE load forecast, there is a breach of the Safety Net at SSJBB in 2025/26, which results in substation Load at Risk (LAR) of 0.7 MVA under N-1 conditions and LAR will increase to 2.6 MVA in 2027/28.

3.2.2 North Maclean (SSNMC) Substation Limitations

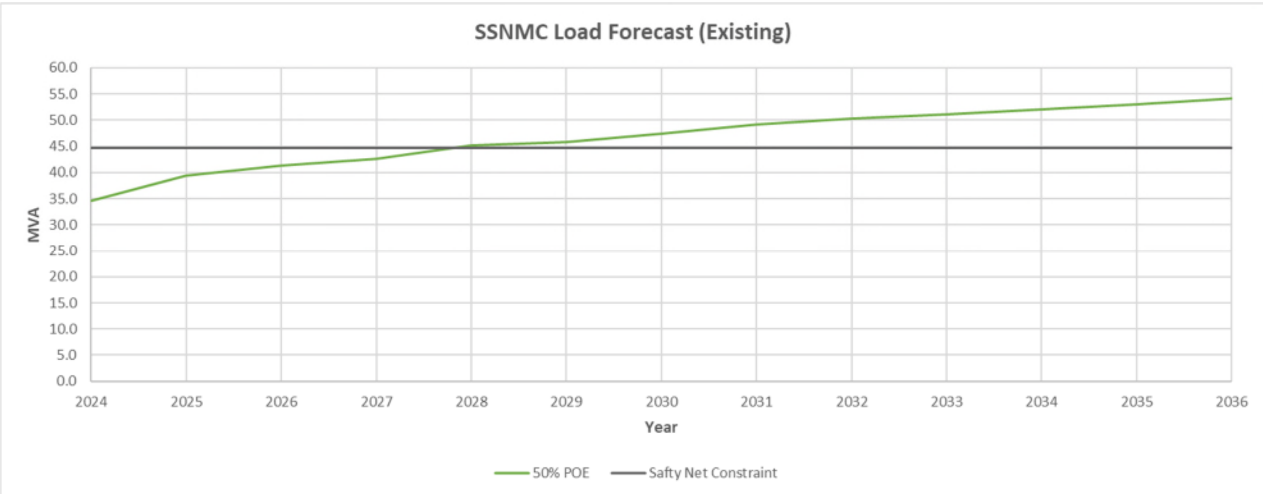
SSNMC is equipped with two 25MVA 33/11kV transformers. The substation capacity is limited by the 11kV transformers and provides a NCC, ECC and 2HEC as below:

- Normal Cyclic Capacity (NCC) – 59.7 MVA
- Emergency Cyclic Capacity (ECC) – 31.3 MVA
- 2 Hour Emergency Capacity (2HEC) – 33.8 MVA
- Security Standard Constraint – 44.7 MVA

The Security Standard Constraint includes all capabilities that can be made available within the required restoration timeframe for Rural category, following the loss of the transformer at SSNMC. Specifically, this comprises 3.4 MVA of manual transfer, and 10 MVA of mobile generation.

Figure 4 shows the 50% POE load forecast and security standard constraint for SSNMC.

Figure 4 – SSNMC Load Forecast



As shown in the above figure, based on the amount of 50%POE load forecast, we forecast there will be a breach of the Safety Net at SSNMC in 2027/28, which results in substation Load at Risk (LAR) of 0.5 MVA under N-1 conditions and LAR will increase to 1.2 MVA in 2028/29.

4 OPTIONS ANALYSIS

This section describes the credible options to address the identified need with comparison to the counter factual.

4.1 Options identification

In the process of determining the most cost-effective solution to address the identified network limitations, Energex has sought to identify a practicable range of technically feasible, alternative options that could satisfy the network requirements in a timely and efficient manner.

Three options have been identified to address the breach of Safety Net at SSJBB and SSNMC. Identified options are:

Option 1 – Establish a new zone substation at Jimboomba West (SSJBW)

Option 2 – Install additional capacity at Jimboomba zone substation and construct new 11kV feeders to supply customers in the Flagstone area

Option 3 – Install a standalone power system including battery and generator

4.2 Option 1 – Establish SSJBW

Energex owns the land for the establishment of Jimboomba West zone substation (SSJBW). The proposed Jimboomba West (SSJBW) is situated close to the load centre of the development area.

Currently, Flagstone Development area is supplied from SSJBB and SSNMC via long 11kV feeders. This option solves N-1 limitation at SSJBB and SSNMC by transferring the Flagstone load to the proposed SSJBW substation. The new substation will lower the distribution losses and improve customer reliability.

This option involves:

SSJBW Works:

- Establish modular (or similar) substation at Jimboomba West (SSJBW), which includes two 33/11kV 25MVA transformers.
- Construct a standard prefabricated building that consists of 4 x 33kV indoor circuit breakers, 7 x 11kV indoor circuit breakers, protection panels, COMMS and SCADA panels.
- Utilise existing 33kV feeder energised at 11kV (JBB4A) as 33kV feeder between JBW and P552312-B. Connect the 33kV feeder section to existing 33kV feeder F314 (Tee connection).
- Utilise existing 33kV feeder energised at 11kV (NMC13A) as 33kV feeder between NMC and P92014-D. Upgrade/Install approximately 4 km 33kV OH feeder section (40 MVA) from JBW to P92014-D to complete 33kV feeder JBW – NMC.
- Install 1 x 11kV UG feeder (approx. 4kms each) from SSJBW to Flagstone area.

SSJBB Works:

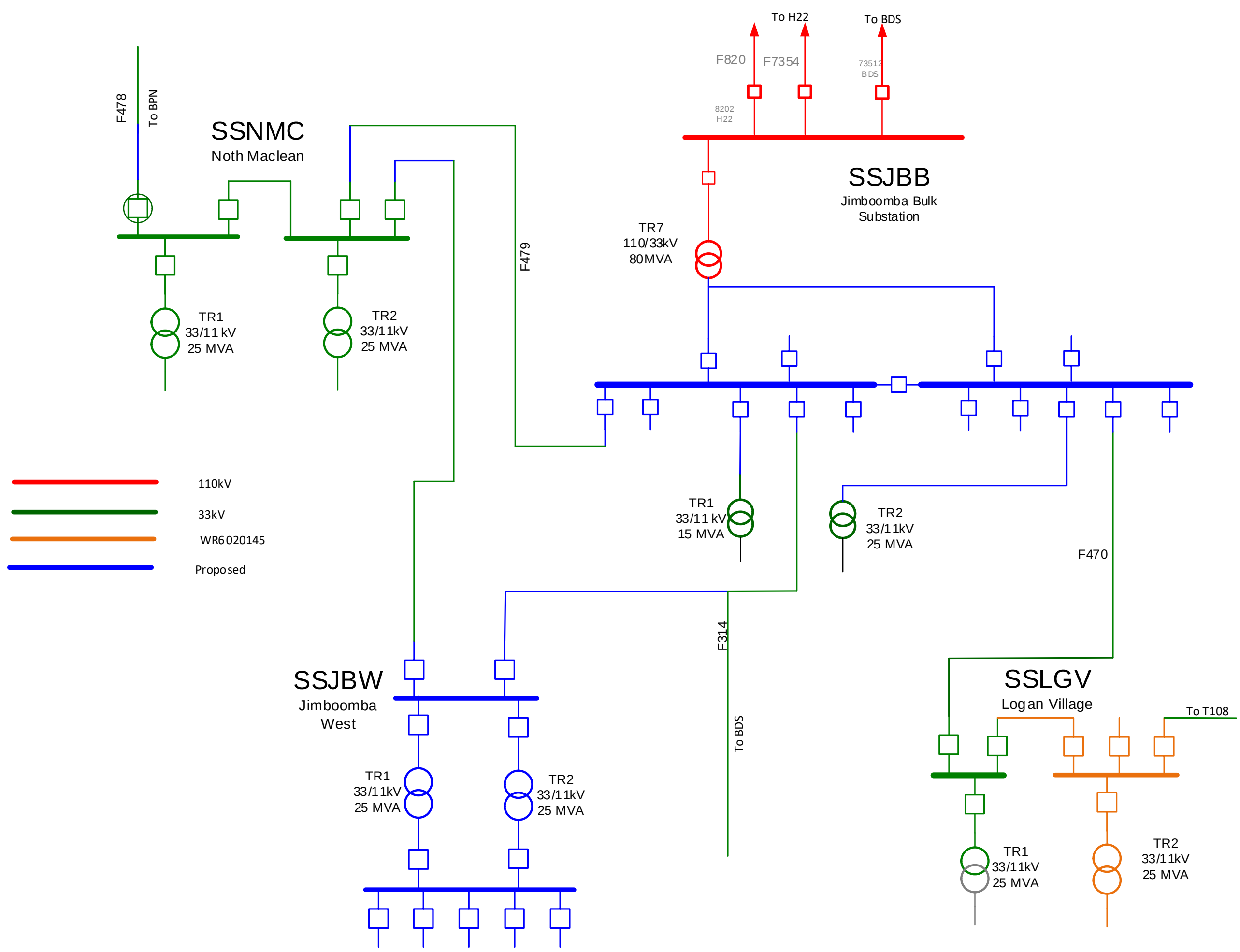
- Install 33kV switchgear prefabricated building (or equivalent) consist of 4 x 2000A transformer CBs, 10 x 1250A feeder CBs and 1 x 2000A bus section CB.
- Cutover 33kV feeders, 33/11kV transformers and 110/33 transformer to new switchboard.
- Recover existing 33kV switchgear in Modular 1 and Modular 2 for spares.

- Cutover 33/11kV transformer protection panels to new switchboard.
- Cutover 110/33kV transformer protection panel to new switchboard.

SSNMC Works:

- Swap 33kV feeders F479 and F478 and revise protection.

Figure 5 – Option 1 network diagram



4.2.1 Costs

Option 1 has an estimated initial direct cost of $22.2m, which has been factored into the NPV as a cost in 2028. OPEX for Option 1 is $45.1k / annum.

4.3 Option 2 – Upgrade Jimboomba Zone Substation

This option proposes to increase the capacity at Jimboomba zone substation (SSJBB), de-load North Maclean zone substation and supply additional new load in the Flagstone area by installing new 11kV feeders from SSJBB.

It is envisaged that the establishment of SSJBW will be required in 2039 as population continues to grow in Flagstone area.

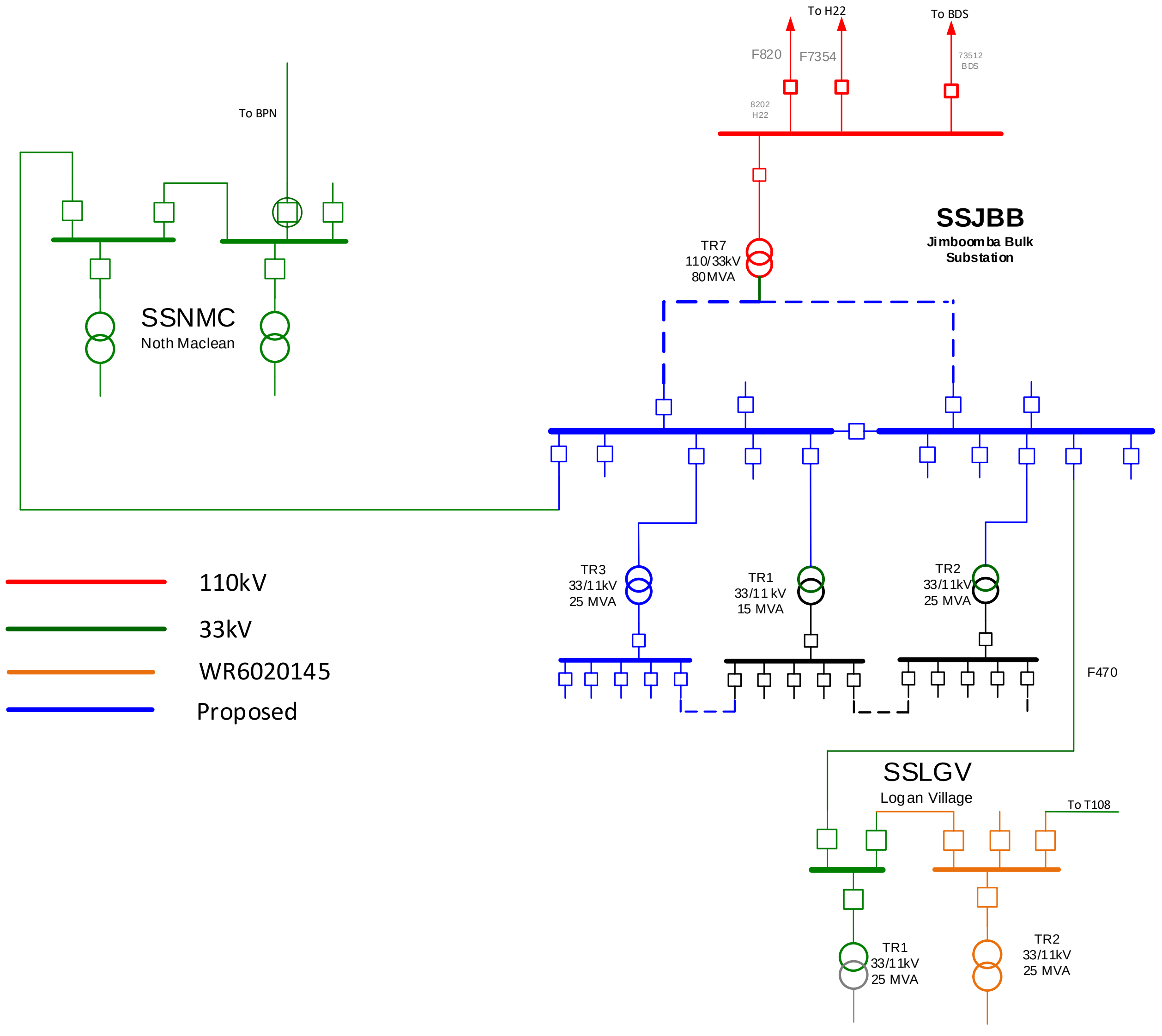
SSJBB substation works

- Install 33kV switchgear prefabricated building (or equivalent) consisting of 4 x 2000A transformer CBs, 10 x 1250A feeder CBs and 1 x 2000A bus section CB.
- Cutover 33kV feeders, 33/11kV transformers and 110/33kV transformer to new switchboard.
- Recover existing 33kV switchgear in Modular 1 and Modular 2 for spares.
- Cutover 33/11kV transformer protection panels to new switchboard.
- Cutover 110/33kV transformer protection panel to new switchboard.
- Install a new 33/11kV, 25MVA transformer.
- Install new 11kV single bus switchboard with 5 x 11kV feeder CBs, 1 x 11kV transformer CB and 1 x 11kV bus tie CB.
- Install 3 x 11kV feeders from SSJBB to Flagstone area (approximately 12kms).

4.3.1 Future Stages at SSJBW 2039

- Establish modular (or similar) substation at Jimboomba West (SSJBW), which includes two 33/11kV 25MVA transformer.
- Construct a standard prefabricated building that consists of 4 x 33kV indoor circuit breakers, 7 x 11kV indoor circuit breakers, protection panels, COMMS and SCADA panels.
- Utilise existing 33kV feeder energised at 11kV (JBB4A) as 33kV feeder between JBW and P552312-B. Connect the 33kV feeder section to existing 33kV feeder F314 (Tee connection).
- Utilise existing 33kV feeder energised at 11kV (NMC13A) as 33kV feeder between NMC and P92014-D. Upgrade/Install approximately 4 km 33kV OH feeder section (40 MVA) from JBW to P92014-D to complete 33kV feeder JBW – NMC.
- Install 1 x 11kV UG feeder (approx. 4kms each) from SSJBW to Flagstone area.

Figure 6 – Option 2 network diagram



4.3.2 Costs

Option 2 has an estimated initial direct cost of $23.6m in this regulatory period, which has been factored into the NPV as a cost in 2028. The direct cost of second stage for Option 2 is estimated as $17.4m. OPEX for this option is $42.5k / annum.

4.4 Option 3 Install Stand Alone Power System (Generators and Batteries)

Installation of Stand Alone Power Systems such as generators and batteries in a predominantly residential area does not meet community expectations in noise and environmental impacts for the area. Furthermore, such system will require a considerable area of land that exceeds the size of land that is owned by Energex. Therefore, this option was rejected and isn't considered any further.

5 ECONOMIC ANALYSIS

5.1 Cost summary 2025-30

Option 1 to establish a new SSJBW 33/11kV zone substation is the preferred option and has been estimated as $22.2m. The forecast expenditure would span over 6 years, the expenditure across the 2025-30 regulatory period is shown in Table 1.

Table 1 – Cost summary 2025-30

Option	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025-30
Establish a new SSJBW 33/11kV zone substation and replace 33kV bus at SSJBB	-	$0.297m	$0.588m	$1.765m	$9.082m	11.732m

5.2 NPV analysis

From the table below, Option 1 is the lowest cost option. The NPV under the base case is $-20.054m, with the Capex, Opex and Benefits NPV shown in Table 2. Table 3 shows the results having changed various inputs into the financial model.

Table 2 – Base Case NPV analysis

Option	Rank	Net NPV	Capex NPV	Opex NPV
Establish a new SSJBW 33/11kV zone substation and Replace 33kV bus at SSJBB	1	-$20.671m	-$19.452m	-$1.220m
Install 3rd 25MVA 33/11kV transformer, Replace 33kV Bus, install 3rd 11kV Bus	2	-$35.807m	-$33.963m	-$1.844m

Table 3 – NPV Sensitivity Analysis

Option	Discount rate	
	2.5%	4.5%
Establish a new SSJBW 33/11kV zone substation and Replace 33kV bus at SSJBB	-$19.554m	-$18.530m

Option	Discount rate	
	2.5%	**4.5%**
Install 3rd 25MVA 33/11kV transformer, replace 33kV Bus, install 3rd 11kV Bus	-$33.116m	-$30.671m

5.3 Optimal Timing

This is a Safety Net requirement and the optimum timing for this project is in 2028.

6 RECOMMENDATION

It is recommended to establish a new SSJBW 33/11kV zone substation to address the network security standard load at risk. Table 4 summarises the option under consideration.

Table 4 Options Analysis Scorecard

Criteria	Establish a new SSJBW 33/11kV zone substation and Replace 33kV bus at SSJBB	Install 3rd 25MVA 33/11kV transformer, replace 33kV Bus, install 3rd 11kV Bus
Net Present Value	-$20.671m	-$35.807m
Investment cost	$22.2m	$23.6m
Investment Risk	Medium	Medium
Delivery time	6 years	6 years
Detailed analysis – Risks	This option may present risk during upgrading two 33kV feeders (currently energised at 11kV) as these two feeders are supplying Flagstone development area	This Option may present risk during installation of 11kV feeders from SSJBB to Flagstone area 15kms away from SSJBB.
Detailed analysis - Advantages	Close to the Flagstone development area.	No obvious advantages.

Appendix 1: Alignment with the National Electricity Rules

Table 5 Recommended Option's Alignment with the National Electricity Rules

NER capital expenditure objectives	Rationale
A building block proposal must include the total forecast capital expenditure which the DNSP considers is required in order to achieve each of the following (the capital expenditure objectives):	
6.5.7 (a) (1) meet or manage the expected demand for standard control services over that period	Section 3, Section 4.2
6.5.7 (a) (2) comply with all applicable regulatory obligations or requirements associated with the provision of standard control services;	Section 3, Section 4.2
6.5.7 (a) (3) to the extent that there is no applicable regulatory obligation or requirement in relation to: (i) the quality, reliability or security of supply of standard control services; or (ii) the reliability or security of the distribution system through the supply of standard control services, to the relevant extent: (iii) maintain the quality, reliability and security of supply of standard control services; and (iv) maintain the reliability and security of the distribution system through the supply of standard control services	Section 3, Section 4.2
6.5.7 (a) (4) maintain the safety of the distribution system through the supply of standard control services.	Section 3, Section 4.2
NER capital expenditure criteria	**Rationale**
The AER must be satisfied that the forecast capital expenditure reflects each of the following:	
6.5.7 (c) (1) (i) the efficient costs of achieving the capital expenditure objectives	Section 4.5
6.5.7 (c) (1) (ii) the costs that a prudent operator would require to achieve the capital expenditure objectives	Section 4.5
6.5.7 (c) (1) (iii) a realistic expectation of the demand forecast and cost inputs required to achieve the capital expenditure objectives	Section 3.2, Section 4.5

Appendix 2: Reconciliation Table

Table 6 Reconciliation

Expenditure	2025-26	2026-27	2027-28	2028-29	2029-30	2025-30
Expenditure in business case $m, direct 2022-23	-	$0.297	$0.588	$1.765	$9.082	11.732