

Options Evaluation Report (OER)

FY24-28 Circuit Breaker Renewal Program
OER- N2345 revision 5.0

Ellipse project no(s):

TRIM file: [TRIM No]

Project reason: Capability - Asset Replacement for end of life condition

Project category: Prescribed - Asset Renewal Strategies

Approvals

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Change history

Revision	Date	Amendment
00	08/09/2021	Original issue
01	08/09/2021	Minor wording updates
02	22/10/2021	Updated risks and formatting
03	10/11/2021	Minor update of option evaluation discussion
04	18/10/22	Updated analysis and evaluation including: <ul style="list-style-type: none">• Analysis updated with FY22 values• Amendment of environmental disproportionality factors• Removal of reputational risk Reduction in program size based on updated evaluation
05	01/11/2022	Version history added

Executive summary

Circuit breakers (CBs) are essential for controlling and protecting the high voltage network by switching both load currents and fault currents. Circuit breakers approaching end of life present an increased risk of failure, causing unplanned network outages, catastrophic failure causing safety and environmental hazards. 184 CBs across TransGrid's network have been identified as requiring consideration for renewal in the 2023 – 2028 regulatory period based on their effective age. These assets have been assessed through TransGrid's risk assessment methodology and evaluated for renewal which is expected to meet an economic benefits need.

Circuit breakers considered for renewal are typically live head circuit breaker (LHCB) construction. Dead tank circuit breakers (DTCBs) incorporate current transformers (CTs). Where CTs are installed in the same network location as a LHCB being evaluated for replacement, both LHCB replacement (Option A) and DTCB (Option B) are evaluated.

The assessment of the options considered to address this identified need appears in Table 1. The result is that 122 of the 184 circuit breaker projects were selected to be included in the program based on the option meeting the following criteria:

- Meets the need,
- Is technically feasible,
- Has a positive net present value,
- Provides the highest net present value among the options evaluated, and
- The optimal project timing is earlier than the end of the 2023 – 2028 regulatory period.

The remaining 62 circuit breakers out of the 184 CBs evaluated do not meet the above criteria and are not recommended to be replaced under this need.

The option evaluation summary for the recommended 122 circuit breaker replacements is shown in Table 1, comprises of:

- 67 LHCBs where Option A is the highest ranked and only option; and
- 55 DTCBs where Option B is the highest ranked option.

Table 1 - Evaluated options

Option	Description	Direct capital cost (\$m)	Network and corporate overheads (\$m)	Total capital cost ¹ (\$m)	Weighted NPV (PV, \$m)	Rank
Projects where Option A - LHCB is the highest ranked option – 67 Circuit Breakers						
Option A	Replace with conventional LHCB	16.55	3.01	19.56	321.39	1
Option B	Replace with conventional DTCB	No DTCB can be evaluated as there are no associated CTs considered for asset renewal.				
Projects where Option B - DTCB is the highest ranked option – 55 Circuit breakers						
Option A	Replace with conventional LHCB	10.90	2.19	13.09	96.61	2
Option B	Replace with conventional DTCB	18.74	3.20	21.94	180.72	1

Option C, non-conventional CB replacement solutions, was not evaluated for all replacements. All non-conventional solutions included a higher cost under Option C than Option A or Option B, without providing any additional economic benefits to offset the increased cost. However an additional allowance of \$0.38 million is recommended to implement a small number of SF₆ alternative insulation circuit breakers to support the long term strategic benefit of reducing reliance on SF₆. Further details are in section 3.

It is recommended to proceed with the replacement program comprising 122 circuit breakers with a program cost of \$41.88 million, consisting of:

- \$19.56 million LHCB replacements
- \$21.94 million DTCB replacements, and
- \$0.38 million for non-conventional CB replacement solutions.

The detailed option evaluation outcomes for each project is provided in Appendix B.

¹ Total capital cost is the sum of the direct capital cost and network and corporate overheads. Total capital cost is used in this OER for all analysis.

1. Need/opportunity

Circuit breakers are essential for the control and protection of the high voltage network. TransGrid has a range of circuit breakers operating from 11kV up to 500kV, with various ages and technologies. The circuit breakers are located across the network with a wide range of duty cycles, environmental exposure and loading. The impact of each circuit breaker failure varies with where it is located in the network. Failure of a circuit breaker to operate will result in an uncleared fault that must be cleared with a larger outage (via a circuit breaker failure back up protection operation) and possible loss of customer load and economic loss from unserved energy.

The existing in-service circuit breaker population has been assessed through the application of the Network Asset Risk Assessment Methodology as follows:

- Circuit breaker health index scores are calculated based on condition data including defect rates, defect cost, age, operations count, reactive switching duty, condition monitoring data and design reliability.
- Health index scores are mapped to an effective age
- Circuit breakers are assigned an individual probability of failure based on its individual effective age
- Consequences of a circuit breaker failure and the likelihood of the consequences occurring are calculated based on network criticality, public and worker safety risk exposure, environmental risk and financial risk for each asset.
- The consequence and probability of failure are combined to determine the annual economic risk cost for each circuit breaker for use in the evaluation for the renewal of each circuit breaker.

There are 184 circuit breakers identified as nearing end of life by the end of the 2023 - 2028 Regulatory Period and have been included in this option evaluation report for consideration of replacement. Each asset is evaluated individually to determine if either of the options should be implemented in the 2023 - 2028 Regulatory Period.

This is an economic benefits need with the following identified benefits:

- Reduction of risk valued as a direct impact to TransGrid and consumers including:
 - Impact of expected unserved energy;
 - Safety and environmental hazards associated with a catastrophic failure.
- Avoided operating expenditure related to corrective maintenance.

2. Related needs/opportunities

Assets considered within this circuit breaker program (need N2345) include circuit breakers and, where relevant, the associated current transformers (CTs); these assets are also considered for renewal under need N2347 - FY24-28 CT Renewal Program.

These needs have been reconciled to ensure no duplication in project scope or risk and benefit calculations within the final replacement programs.

3. Options

3.1. Base case

Under the 'Base Case' scenario, there is no consideration for replacement of the assets evaluated under this need. This is a 'run to fail' scenario and will lead to an increase in the identified risks under this need, the eventual failure of the assets and the materialisation of the expected consequences. This case shall only be considered a last resort should no option be deemed viable through the economic evaluation process.

Increased operating and maintenance costs are included as an opex cost against the assets under this scenario. The increased cost is modelled based on historical breakdown (corrective) repair costs and represents an operating cost benefit when mitigated through an asset replacement.

3.2. Options evaluated

Option A — Replace with conventional LHCB [[NOSA N2345](#), [OFS N2345A](#)]

This option considers the replacement of an existing live head circuit breaker (LHCB) with a new conventional (typical SF₆ insulated) LHCB. In this option, associated CTs are excluded from the replacement project.

Where a dead tank circuit breaker (DTCB) is currently installed, a LHCB installation with additional separate live head CTs is not evaluated due to the benefits of retaining a DTCB installation. These benefits include a lower total installation cost, lower asset failure risk compared to separate LHCB and CTs.

Of the 184 circuit breakers in this need 182 are evaluated under Option A. The 2 CBs not evaluated under Option A are existing DTCBs.

Option A fully addresses the identified need by installation of a new condition circuit breaker with very low probability of failure and associated risk cost.

The replacement costs under Option A for each project within this program are included in Appendix B, with an expected duration of 1 year for each individual replacement project.

Replacement work may include the following:

- High voltage and civil design work
- Secondary system design work
- Plant procurement and transportation
- Civil work (e.g.: footing replacement or modifications as required)
- Site work and commissioning

Option B — Replace with conventional DTCB [[NOSA N2345](#), [OFS N2345B](#)]

This option considers replacing an existing LHCB and the associated CTs, or replacing the existing DTCB with a new conventional (typical SF₆ insulated) DTCB. Where a DTCB is not technically feasible (e.g. at 500kV), there are no associated CTs in the bay, or the associated CTs have substantial remaining life, the

DTCB option is not evaluated. Of the 184 circuit breakers in this need 65 are evaluated under Option B and 119 CBs are not evaluated under Option B due to one of these reasons.

Option B fully addresses the identified need by installation of a new circuit breaker with very low probability of failure and associated risk cost. The use of a DTCB removes the separate CT assets from the network therefore removing the associated failure risk and maintenance costs.

The replacement costs under Option B for each project within this program are included in Appendix B, with an expected duration of 1 year for each individual replacement project.

Replacement work may include the following:

- High voltage and civil design work
- Secondary system design work
- Plant procurement and transportation
- Civil work (e.g.: footing replacement or modifications as required)
- Site work and commissioning

Option C — Replace with non-conventional solution [[NOSA N2345](#), [OFS N2345C](#)]

This option was included to consider LHCB and DTCB replacements using the following non-conventional solutions:

1. Retrofit of the existing CB with new modern design poles and mechanism
2. SF₆ alternative insulation with reduced global warming potential², including use of vacuum interrupter technology.

1. Retrofit of existing CB with new poles and mechanisms

This option considered engaging the original equipment manufacturer of the currently installed make/model CB for new modern design poles and mechanisms compatible with the existing footing, structure, and cable entry locations.

The detailed analysis of this aspect of Option C was not progressed in the OER due to the higher cost estimate as compared to Option A and Option B, without providing any additional economic or strategic benefits to offset the increased cost.

2. SF₆ alternative technologies

Investigation into non-conventional circuit breaker replacement options identified circuit breakers with design alternatives to minimised or remove SF₆ as an insulation and arc quenching medium. Due to the significant CO₂ equivalent value of SF₆, equipment manufacturers are expanding their SF₆ alternative product options.

Based on federal and state government emissions target policies, there is community expectation for ongoing reductions in carbon emissions and the potential for explicit future emissions restrictions or a carbon tax to be imposed on TransGrid or equipment importers. In response to these external drivers, it is recommended to procure and install a small number of the mature equipment designs utilising non-SF₆ technologies as part of this circuit breaker replacement program to take the initial steps as part of a longer term strategy of reducing TransGrid's reliance on SF₆.

² SF₆ is a reportable gas under the National Greenhouse and Energy Reporting scheme.

These initial replacements will provide the following benefits:

- This will improve the organisational experience with reliability, operability and maintainability
- Enable TransGrid to prepare for a potential future carbon tax environment which may need to be responded to more urgently
- Inform cost estimates to support future option analysis to improve long-term asset lifecycle cost performance of assets and provide the optimal outcome for consumers.
- Trial and evaluate available technologies, suppliers and designs to achieve better outcomes for future larger scale implementation
- Reduce implementation costs for subsequent assets
- Provide supplier feedback on design and implementation issues

The following additional costs are proposed to be included in this CB replacement program based on the comparison with the existing standard evaluated SF₆ replacement options:

Table 2 – Project cost for SF₆ alternative technology (\$ thousand)

Items	Typical SF ₆ cost (Option A or B)	Proposed Non-SF ₆ Cost (Option C)	Proposed increase
2 x 66kV LHCBs	376.8	539.8	163
1 x 66kV DTCTB	357.9	431.6	73.7
2 x 132kV LHCBs	430.8	576.5	145.7

It is noted that the above costs included initial development costs which would not be required for subsequent replacements.

Therefore an additional \$0.38 million (0.9% of the program) is included in this OER for this purpose. The specific assets to be used as part of this initial program will be determined during the design scoping phase.

3.3. Options considered and not progressed

The following options were considered but not progressed:

Table 3 - Options not progressed

Option	Reason for not progressing
D – refurbishment and overhaul	<p>The refurbishment/overhaul scope of work involves renewing all deteriorating components of a circuit breaker that is typically >30 years old. In TransGrid's experience, the cost of such overhauls is a substantial portion of replacement works considered under other options while presenting the following additional risks:</p> <ul style="list-style-type: none"> • Outdated and suboptimal component design may be retained in the overhaul. • Parts and technician support is expected to be limited or unavailable.

Option	Reason for not progressing
	<ul style="list-style-type: none"> Continuous current and fault level ratings may not be suitable. Local overhaul is expected to result in higher defect and failure rates to factory manufacturing processes. With consideration the potential for life extension is expected to be no more than 10 years. <p>The option has not been progressed as it is considered not economically feasible.</p>
Increased maintenance or inspections	The condition issues have already been identified and cannot be rectified through increased maintenance or inspections, and therefore is not technically feasible to address the need.
Elimination of all associated risk	This can only be achieved by retiring the assets, which is not technically feasible due to the requirement to maintain the existing network reliability.
Non-network solutions	It is not technically feasible for non-network solutions to provide the functionality of the equipment under this need.

4. Evaluation

4.1. Commercial evaluation methodology

The economic assessment undertaken for this project includes three scenarios that reflect a central set of assumptions based on current information that is most likely to eventuate (central scenario), a set of assumptions that give rise to a lower bound for net benefits (lower bound scenario), and a set of assumptions that give rise to an upper bound on benefits (higher bound scenario).

Assumptions for each scenario are set out in the table below.

Table 4 - Scenario assumptions

Parameter	Central scenario	Lower bound scenario	Higher bound scenario
Discount rate	5.5%	7.5%	2.3%
Capital cost	100%	125%	75%
Operating expenditure benefit	100%	75%	125%
Risk costs benefit	100%	75%	125%
Other benefits	Not applicable in this assessment		
Scenario weighting	50%	25%	25%

Parameters used in this commercial evaluation are shown in Table 5

Table 5 - Commercial evaluation parameters

Parameter	Parameter Description	Value used for this evaluation
Discount year	Year that dollar values are discounted to	2021/22
Base year	The year that dollar value outputs are expressed in real terms	2021/22
Period of analysis	Number of years included in economic analysis with remaining capital value included as terminal value at the end of the analysis period.	25 years
ALARP disproportionality	Multiplier of the safety risk cost included in NPV analysis to demonstrate implementation of obligation to reduce to ALARP. There has been no disproportionality multiplier applied to environmental risks including SF6.	Refer to section 4.3 for details.

The capex figures in this OER do not include any real cost escalation.

4.2. Commercial evaluation results

The commercial evaluation of the technically feasible options is set out in Table 6, showing 122 circuit breaker projects where the highest ranked option for each evaluated project:

- Meets the need,
- Is technically feasible,
- Has a positive net present value,
- Provides the highest net present value among the options evaluated,
- Optimal project timing is earlier than the end of the 2023 – 2028 regulatory period.

62 circuit breakers evaluated did not meet the criteria under any option and are not included in Table 6.

Table 6 shows 122 circuit breakers that met the criteria, 67 circuit breakers had associated CTs which did not meet the criteria set out under Option B for consideration of replacement with a DTCTB and so can only be replaced under Option A with a LHCB; these provide an NPV of \$321.39 million. The remaining 55 CBs that met the criteria were evaluated under both Option A and Option B, with Option B providing the highest NPV of \$180.72 million. In total, the replacement of 67 CBs with LHCBs and 55 CBs with DTCTBs results in a total weighted NPV of \$502.11 million.

Further details appear in Appendix A.

Table 6 - Commercial evaluation (\$ million)

Option	Capital Cost PV	Central scenario NPV	Lower bound scenario NPV	Higher bound scenario NPV	Weighted NPV	Ranking
Projects where Option A (LHCB) is the highest ranked option - 67 Circuit Breakers						
Option A	14.19	263.91	131.65	626.09	321.39	1
Option B	No DTCTB is able to be evaluated as there are no associated CTs considered for asset renewal.					
Projects where Option B (DTCTB) is the highest ranked option - 55 Circuit Breakers						
Option A	9.22	78.59	36.45	192.55	96.54	2
Option B	15.91	147.73	69.67	357.72	180.72	1

4.3. ALARP evaluation

TransGrid manages and mitigates bushfire and safety risk to ensure they are below risk tolerance levels or 'As Low As Reasonably Practicable' ('ALARP'), in accordance with the regulation obligations and TransGrid's business risk appetite. Under the Electricity Supply (Safety and Network Management) Regulation 2014 Section 5 'A network operator must take all reasonable steps to ensure that the design, construction, commissioning, operation and decommissioning of its network (or any part of its network) is safe.' TransGrid maintains an Electricity Network Safety Management System (ENSMS) to meet this obligation.³

In its Network Risk Assessment Methodology, under the ALARP test with the application of a gross disproportionate factor⁴, the weighted benefits are expected to exceed the cost. TransGrid's analysis concludes that the costs are less than the weighted benefits from mitigating bushfire and safety risks. The proposed investment will enable TransGrid to continue to manage and operate this part of the network to a safety and risk mitigation level of ALARP.

Evaluation of the above options has been completed in accordance with As Low As Reasonably Practicable (ALARP) obligations. The Network Safety Risk Reduction is calculated as 1 x Bushfire Risk Reduction + 1 x other Environmental Risks + 3 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction.

Results of the ALARP evaluation are set out in Table 7. This table shows results for 61 of the 122 circuit breakers identified in this OER which are justifiable under the ALARP evaluation.

Table 7 - Reasonably practicable test (\$ million)

Option	Network Safety Risk Reduction	Annualised Capex	Reasonably Practicable? ⁵
A	1.22	0.46	Y (28 CBs)
B	1.93	0.79	Y (33 CBs)

³ TransGrid's ENSMS follows the International Organization for Standardization's ISO31000 risk management framework which requires following hierarchy of hazard mitigation approach

⁴ The values of the disproportionality factors were determined through a review of practises and legal interpretations across multiple industries, with particular reference to the works of the UK Health and Safety Executive. The methodology used to determine the disproportionality factors in this document is in line with the principles and examples presented in the AER Replacement Planning Guidelines and is consistent with TransGrid's Revised Revenue Proposal 2023/24- 2027/28.

⁵ Reasonably practicable is defined as whether the annualised CAPEX is less than the Network Safety Risk Reduction.

4.4. Preferred option

The list of the projects and options for each of the 184 CBs evaluated is included in Appendix B.

This criteria results in 122 circuit breaker replacement projects that are recommended to be progressed at a total program cost of \$41.50 million. This includes:

- 67 circuit breakers under Option A (LHCB) with total cost of \$19.56 million, and
- 55 circuit breakers under Option B (DTCBs) with total cost of \$21.94 million.

A list of the 122 recommended CB replacement projects is included in Appendix C.

An additional \$0.38 million to trial CBs utilising SF₆ alternative technologies is also recommended, which increases the program total to \$41.88 million.

Replacement of a circuit breaker under the preferred option fully meets the need by achieving the risk reduction outlined in Section 3.

The remaining 67 circuit breakers evaluated do not meet this criteria and are not recommended to be replaced under this need.

Capital and Operating Expenditure

Opex cost benefits associated reduced corrective expenditure has been allowed for in economic evaluation and optimal timing evaluation.

There are no capex to opex trade-offs considered in this evaluation.

Regulatory Investment Test

The program and estimate allows for the appropriate regulatory approvals as required.

5. Optimal Timing

The test for optimal timing of the preferred option has been undertaken. The approach taken is to identify the optimal commissioning year for the preferred option where net benefits (including avoided costs and safety disproportionality tests) of the preferred option exceeds the annualised cost of the option.

The results of optimal timing analysis for each circuit breaker project within the program is included in Appendix B.

This OER recommends progressing only positive business cases which are optimally timed before the end of the 2023 - 2028 Regulatory Period, hence all projects are evaluated for benefit in the final year of the period. The summary of the optimal timing at the program level is:

- Evaluation commissioning year: 2027/28
- Commissioning year annual benefit: \$23.78 million
- Annualised cost: \$2.59 million

6. Recommendation

It is recommended to proceed with implementing N2345 circuit breaker program replacement of 122 circuit breakers at a total program cost of \$41.88 million consisting of \$19.56 million LHCB replacements, \$21.94 million DTCTB replacements, and \$0.38 million for non-conventional CB replacement solutions.

The total program cost includes an allowance of \$10.40 million to progress the project to from Decision Gate 1 (DG1) to Decision Gate 2 (DG2).

The list of the 122 recommended CB replacement projects are included in Appendix C.

Appendix A – Option Summaries

Project Description		FY24-28 Circuit Breaker Renewal Program	
Option Description		Option A — Replace with conventional LHCB – 67 CBs	
Project Summary			
Option Rank	1	Investment Assessment Period	25
Asset Life	40	NPV Year	2022
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, \$m)	[Net Present Value (Standard - OER)] 263.91	Annualised CAPEX (\$m)	Annualised Capex - Standard (Business Case) 1.22
NPV @ Lower Bound Scenario (PV, \$m)	[Net Present Value (Upper Bound)] 131.65	Network Safety Risk Reduction (\$m)	Network Safety Risk Reduction 2.17
NPV @ Higher Bound Scenario (PV, \$m)	[Net Present Value (Lower Bound)] 626.09	ALARP	ALARP Compliant? <i>Program – See Appendix B</i>
NPV Weighted (PV, \$m)	[Net Present Value (Weighted)] 321.39	Optimal Timing	Optimal timing (Business Case) 2028
Cost			
Direct Capex (\$m)	16.55	Network and Corporate Overheads (\$m)	3.01
Total Capex (\$m)	19.56	Cost Capex (PV,\$m)	14.19
Terminal Value (\$m)	7.34	Terminal Value (PV,\$m)	1.40
Risk (central scenario)	Pre	Post	Benefit
Reliability (PV,\$m)	Reliability Risk (Pre) 321.72	Reliability Risk (Post) 64.07	Pre – Post 257.56
Financial (PV,\$m)	Financial Risk (Pre) 3.76	Financial Risk (Post) 0.79	Pre – Post 2.97
Operational/Compliance (PV,\$m)	Operational Risk (Pre) 0.00	Operational Risk (Post) 0.00	Pre – Post 0.00
Safety (PV,\$m)	Safety Risk (Pre) 16.49	Safety Risk (Post) 3.59	Pre – Post 12.90
Environmental (PV,\$m)	Environmental Risk (Pre) 0.91	Environmental Risk (Post) 0.20	Pre – Post 0.71
Reputational (\$m)	Reputational Risk (Pre) 0.00	Reputational Risk (Post) 0.00	Pre – Post 0.00
Total Risk Benefit (PV,\$m)	Total Risk (Pre) 342.88	Total Risk (Post) 68.65	Pre – Post 274.23
OPEX Benefit (PV,\$m)			OPEX Benefit 2.48
Other benefit (PV,\$m)			Incremental Net Benefit 0.00
Total Benefit (PV,\$m)			Business Case Total Benefit 276.71

Project Description		FY24-28 Circuit Breaker Renewal Program	
Option Description		Option B — Replace with conventional DTCB – 55 CBs	
Project Summary			
Option Rank	1	Investment Assessment Period	25
Asset Life	40	NPV Year	2022
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, \$m)	[Net Present Value (Standard - OER)] 147.73	Annualised CAPEX (\$m)	Annualised Capex - Standard (Business Case) 1.37
NPV @ Lower Bound Scenario (PV, \$m)	[Net Present Value (Upper Bound)] 69.67	Network Safety Risk Reduction (\$m)	Network Safety Risk Reduction 1.93
NPV @ Higher Bound Scenario (PV, \$m)	[Net Present Value (Lower Bound)] 357.72	ALARP	ALARP Compliant? <i>Program – See Appendix B</i>
NPV Weighted (PV, \$m)	[Net Present Value (Weighted)] 180.72	Optimal Timing	Optimal timing (Business Case) 2028
Cost			
Direct Capex (\$m)	18.74	Network and Corporate Overheads (\$m)	3.20
Total Capex (\$m)	21.94	Cost Capex (PV,\$m)	15.91
Terminal Value (\$m)	8.23	Terminal Value (PV,\$m)	1.56
Risk (central scenario)	Pre	Post	Benefit
Reliability (PV,\$m)	Reliability Risk (Pre) 179.10	Reliability Risk (Post) 38.49	Pre – Post 140.61
Financial (PV,\$m)	Financial Risk (Pre) 2.26	Financial Risk (Post) 0.50	Pre – Post 1.76
Operational/Compliance (PV,\$m)	Operational Risk (Pre) 0.00	Operational Risk (Post) 0.00	Pre – Post 0.00
Safety (PV,\$m)	Safety Risk (Pre) 21.64	Safety Risk (Post) 4.85	Pre – Post 16.79
Environmental (PV,\$m)	Environmental Risk (Pre) 1.79	Environmental Risk (Post) 0.40	Pre – Post 1.39
Reputational (\$m)	Reputational Risk (Pre) 0.00	Reputational Risk (Post) 0.00	Pre – Post 0.00
Total Risk Benefit (PV,\$m)	Total Risk (Pre) 204.79	Total Risk (Post) 44.23	Pre – Post 160.55
OPEX Benefit (PV,\$m)			OPEX Benefit 1.53
Other benefit (PV,\$m)			Incremental Net Benefit 0.00
Total Benefit (PV,\$m)			Business Case Total Benefit 162.08

Appendix B – CB Option Evaluation Summary

The following table provides a summary of the individual option evaluations of the 184 circuit breakers evaluated under this OER. The alternate cell shading is provided to group options evaluated for a single circuit breaker replacement. Each circuit breaker is evaluated under option A, Option B or both; refer to 3.2 Options evaluated for further details.

A circuit breaker project is included in the final program if it is NPV positive, highest rank (“Rank 1”) and is optimally timed prior to 2027/28. 122 circuit breakers which meet the criteria are recommended to proceed under this OER and are indicated in the table where indicated with “Yes” in the “Included in the final program” column. Where the optimal timing is calculated as prior to 2023/24 the year is stated as 2023/24 which is the earliest practicable year for completion. The actual program phasing will depend on the final developed portfolio. The 122 recommended circuit breaker replacements are also shown in Appendix C.

Bay	Option	Capex	NPV (weighted)	ALARP	Optimal Timing	Total Benefit	Annual Capex	Preferred Option	Included in final program
CMSDPT1D1	A	\$438,529	-\$32,091	No	2042/43	\$12,174	\$27,329	Rank 1	No
CMSDPT1K	A	\$438,529	-\$43,442	No	2043/44	\$11,456	\$27,329	Rank 1	No
CMSDPT1Q	A	\$438,529	-\$8,651	No	2040/41	\$13,398	\$27,329	Rank 1	No
CMSDPT2A1	A	\$257,597	\$989,834	Yes	2023/24	\$58,465	\$16,054	Rank 1	Yes
CMSDPT2D1	A	\$257,597	\$386,886	No	2023/24	\$28,402	\$16,054	Rank 1	Yes
CMSDPT2D2	A	\$257,597	\$779,688	Yes	2023/24	\$48,131	\$16,054	Rank 2	No
CMSDPT2D2	B	\$417,717	\$1,619,637	Yes	2023/24	\$100,101	\$26,032	Rank 1	Yes
CMSDPT2E1	A	\$257,597	\$425,818	Yes	2023/24	\$30,730	\$16,054	Rank 1	Yes
CMSDPT2E2	A	\$257,597	\$779,688	Yes	2023/24	\$48,131	\$16,054	Rank 2	No
CMSDPT2E2	B	\$417,717	\$1,573,424	Yes	2023/24	\$96,896	\$26,032	Rank 1	Yes
CMSDPT2F	A	\$257,597	\$2,133,345	Yes	2023/24	\$114,697	\$16,054	Rank 1	Yes
CMSDPT2J2	A	\$269,354	\$119,311	No	2031/32	\$12,724	\$16,786	Rank 1	No
CMSDPT2M	A	\$257,597	\$411,140	No	2023/24	\$29,577	\$16,054	Rank 1	Yes
CMSDPT2V1	A	\$257,597	\$791,702	Yes	2023/24	\$48,722	\$16,054	Rank 1	Yes
CMSDPT2W	A	\$257,597	\$806,113	Yes	2023/24	\$49,431	\$16,054	Rank 2	No
CMSDPT2W	B	\$417,717	\$1,705,330	Yes	2023/24	\$104,479	\$26,032	Rank 1	Yes
CMSKCR0B2	A	\$545,165	\$44,283	No	2037/38	\$20,075	\$33,975	Rank 1	No
CMSRGV2C	A	\$215,410	\$246,156	No	2024/25	\$17,123	\$13,424	Rank 1	Yes

Bay	Option	Capex	NPV (weighted)	ALARP	Optimal Timing	Total Benefit	Annual Capex	Preferred Option	Included in final program
CMSRGV2E	A	\$270,577	\$162,954	No	2029/30	\$14,796	\$16,862	Rank 1	No
CMSRGV2F	A	\$270,577	\$146,011	No	2030/31	\$13,805	\$16,862	Rank 1	No
CMSRGV2G	A	\$215,410	\$286,837	No	2024/25	\$18,034	\$13,424	Rank 1	Yes
CMSRGV2K	A	\$215,410	\$13,468,943	Yes	2023/24	\$566,452	\$13,424	Rank 1	Yes
CMSSE12B2	A	\$215,410	\$65,550	No	2033/34	\$9,218	\$13,424	Rank 1	No
CMSSE12HU	A	\$269,354	\$66,537	No	2034/35	\$11,388	\$16,786	Rank 1	No
CMSSE12LU	A	\$215,410	\$427,114	No	2023/24	\$23,098	\$13,424	Rank 1	Yes
CMSSYN1G2	A	\$438,529	-\$63,013	No	2045/46	\$10,694	\$27,329	Rank 1	No
CMSSYN1L3	A	\$438,529	\$11,774	No	2039/40	\$15,117	\$27,329	Rank 1	No
CMSSYS1D1	A	\$438,529	\$409,860	No	2023/24	\$38,844	\$27,329	Rank 2	No
CMSSYS1D1	B	\$757,449	\$947,234	Yes	2023/24	\$83,245	\$47,204	Rank 1	Yes
CMSSYS1J3	A	\$438,529	\$380,145	No	2023/24	\$36,828	\$27,329	Rank 1	Yes
CMSSYS1N2	A	\$438,529	\$1,185,918	Yes	2023/24	\$78,104	\$27,329	Rank 1	Yes
CMSSYS1N3	A	\$438,529	\$1,217,766	Yes	2023/24	\$79,735	\$27,329	Rank 1	Yes
CMSSYS1S3	A	\$438,529	\$40,402	No	2037/38	\$15,395	\$27,329	Rank 1	No
CMSSYS2W	A	\$215,410	\$5,034,731	Yes	2023/24	\$224,590	\$13,424	Rank 1	Yes
CMSSYW1B1	A	\$438,529	\$417,450	No	2026/27	\$30,083	\$27,329	Rank 1	Yes
CMSSYW1C1	A	\$438,529	\$674,141	No	2023/24	\$42,049	\$27,329	Rank 1	Yes
CMSSYW1E3	A	\$438,529	\$489,798	No	2025/26	\$33,685	\$27,329	Rank 1	Yes
CMSSYW1H3	A	\$438,529	\$668,274	No	2023/24	\$44,273	\$27,329	Rank 1	Yes
CMSSYW1L2	A	\$438,529	\$860,525	No	2023/24	\$52,728	\$27,329	Rank 1	Yes
CMSSYW1N	A	\$438,529	\$71,641	No	2036/37	\$16,307	\$27,329	Rank 1	No
CMSSYW1Q	A	\$438,529	\$613,836	No	2023/24	\$41,116	\$27,329	Rank 1	Yes
CMSSYW2C2	A	\$257,597	\$1,870,133	Yes	2023/24	\$85,944	\$16,054	Rank 2	No
CMSSYW2C2	B	\$417,717	\$4,838,094	Yes	2023/24	\$248,281	\$26,032	Rank 1	Yes
CMSSYW2H	A	\$257,597	\$342,926	No	2023/24	\$22,949	\$16,054	Rank 1	Yes
CMSSYW2L	A	\$257,597	\$251,699	No	2025/26	\$19,083	\$16,054	Rank 1	Yes

Bay	Option	Capex	NPV (weighted)	ALARP	Optimal Timing	Total Benefit	Annual Capex	Preferred Option	Included in final program
CMSSYW2M	A	\$257,597	\$2,969,652	Yes	2023/24	\$139,349	\$16,054	Rank 1	Yes
CMSSYW2P	A	\$257,597	\$2,406,244	Yes	2023/24	\$116,610	\$16,054	Rank 2	No
CMSSYW2P	B	\$417,717	\$6,360,470	Yes	2023/24	\$349,259	\$26,032	Rank 1	Yes
CMSVYD1AE	A	\$438,529	\$569,062	No	2023/24	\$39,182	\$27,329	Rank 2	No
CMSVYD1AE	B	\$757,449	\$1,195,207	No	2023/24	\$79,896	\$47,204	Rank 1	Yes
CMSVYD1BD	A	\$438,529	\$566,401	No	2023/24	\$39,067	\$27,329	Rank 2	No
CMSVYD1BD	B	\$757,449	\$1,186,896	No	2023/24	\$79,505	\$47,204	Rank 1	Yes
CMSVYD1BE	A	\$438,529	\$474,485	No	2025/26	\$33,754	\$27,329	Rank 2	No
CMSVYD1BE	B	\$757,449	\$1,100,588	No	2023/24	\$74,466	\$47,204	Rank 1	Yes
CMSVYD2B	A	\$215,410	\$447,658	No	2023/24	\$26,997	\$13,424	Rank 2	No
CMSVYD2B	B	\$363,970	\$986,953	No	2023/24	\$61,582	\$22,683	Rank 1	Yes
CMSVYD2G	A	\$215,410	\$544,557	No	2023/24	\$28,302	\$13,424	Rank 2	No
CMSVYD2G	B	\$363,970	\$1,218,010	No	2023/24	\$69,153	\$22,683	Rank 1	Yes
CMSVYD2H	A	\$215,410	\$163,097	No	2028/29	\$13,105	\$13,424	Rank 2	No
CMSVYD2H	B	\$363,970	\$514,897	No	2023/24	\$36,109	\$22,683	Rank 1	Yes
CMSVYD2J	A	\$215,410	\$634,223	No	2023/24	\$33,245	\$13,424	Rank 2	No
CMSVYD2J	B	\$363,970	\$1,326,901	No	2023/24	\$75,471	\$22,683	Rank 1	Yes
COSFB22G	A	\$215,410	\$3,687,745	Yes	2023/24	\$202,504	\$13,424	Rank 1	Yes
COSFB24S1	A	\$188,400	\$1,366,520	No	2023/24	\$60,222	\$11,741	Rank 1	Yes
COSMTP2F	A	\$215,410	\$275,799	Yes	2023/24	\$22,053	\$13,424	Rank 2	No
COSMTP2F	B	\$363,970	\$505,204	Yes	2023/24	\$38,690	\$22,683	Rank 1	Yes
COSPKS1B1	A	\$215,410	\$7,404,436	Yes	2023/24	\$320,774	\$13,424	Rank 2	No
COSPKS1B1	B	\$363,970	\$14,337,074	Yes	2023/24	\$697,345	\$22,683	Rank 1	Yes
COSPKS1D	A	\$215,410	\$3,001,205	Yes	2023/24	\$134,203	\$13,424	Rank 2	No
COSPKS1D	B	\$363,970	\$7,104,086	Yes	2023/24	\$354,078	\$22,683	Rank 1	Yes
COSPKS1G	A	\$215,410	\$2,412,891	No	2023/24	\$102,735	\$13,424	Rank 2	No
COSPKS1G	B	\$363,970	\$6,597,535	Yes	2023/24	\$328,934	\$22,683	Rank 1	Yes

Bay	Option	Capex	NPV (weighted)	ALARP	Optimal Timing	Total Benefit	Annual Capex	Preferred Option	Included in final program
COSPKS2B	A	\$188,400	\$4,310,283	Yes	2023/24	\$185,101	\$11,741	Rank 2	No
COSPKS2B	B	\$357,873	\$7,085,947	Yes	2023/24	\$339,581	\$22,303	Rank 1	Yes
COSPKS2M	A	\$188,400	\$77,471	No	2032/33	\$8,867	\$11,741	Rank 2	No
COSPKS2M	B	\$357,873	\$279,798	No	2025/26	\$25,343	\$22,303	Rank 1	Yes
COSWL12E	A	\$215,410	\$443,213	No	2023/24	\$24,264	\$13,424	Rank 1	Yes
COSWL12L	A	\$215,410	\$2,031,079	Yes	2023/24	\$128,797	\$13,424	Rank 1	Yes
COSWL12M	A	\$215,410	\$339,600	Yes	2023/24	\$29,619	\$13,424	Rank 1	Yes
COSWL12T	A	\$215,410	\$180,918	No	2027/28	\$13,506	\$13,424	Rank 1	Yes
COSWW11B5	A	\$438,529	\$46,943	No	2036/37	\$19,686	\$27,329	Rank 1	No
COSWW11C2	A	\$438,529	\$30,146	No	2038/39	\$18,899	\$27,329	Rank 1	No
COSWW11C2	B	\$757,449	-\$33,225	No	2042/43	\$26,223	\$47,204	Rank 2	No
COSWW11C3	A	\$438,529	\$43,282	No	2036/37	\$19,823	\$27,329	Rank 1	No
NNSBAY1BE2	A	\$438,529	\$160,753	No	2028/29	\$26,241	\$27,329	Rank 1	No
NNSLD11AC2	A	\$438,529	-\$75,564	No	2047/48	\$11,126	\$27,329	Rank 1	No
NNSLD11AD2	A	\$438,529	-\$118,316	No	2052/53	\$8,539	\$27,329	Rank 1	No
NNSLD11BD2	A	\$438,529	-\$63,835	No	2046/47	\$11,852	\$27,329	Rank 1	No
NNSLD11BG2	A	\$438,529	-\$108,103	No	2051/52	\$9,146	\$27,329	Rank 1	No
NNSLD11BJ2	A	\$438,529	-\$119,956	No	2052/53	\$8,475	\$27,329	Rank 1	No
NNSLD11BK2	A	\$438,529	\$113,005	No	2032/33	\$22,533	\$27,329	Rank 1	No
NNSLD11C	A	\$438,529	-\$55,189	No	2045/46	\$12,456	\$27,329	Rank 1	No
NNSMN11A3	A	\$438,529	-\$40,027	No	2044/45	\$13,823	\$27,329	Rank 1	No
NNSMN11AE2	A	\$438,529	-\$54,335	No	2046/47	\$13,374	\$27,329	Rank 1	No
NNSMN11BE2	A	\$438,529	-\$54,335	No	2046/47	\$13,374	\$27,329	Rank 1	No
NNSMN11BF2	A	\$438,529	-\$65,054	No	2047/48	\$12,664	\$27,329	Rank 1	No
NNSMN11C3	A	\$438,529	-\$54,335	No	2046/47	\$13,374	\$27,329	Rank 1	No
NNSNEW2A1	A	\$257,597	\$622,599	Yes	2023/24	\$40,406	\$16,054	Rank 1	Yes
NNSNEW2HZ	A	\$269,354	\$181,999	No	2029/30	\$15,513	\$16,786	Rank 1	No

Bay	Option	Capex	NPV (weighted)	ALARP	Optimal Timing	Total Benefit	Annual Capex	Preferred Option	Included in final program
NNSNEW2N	A	\$257,597	\$358,793	No	2023/24	\$25,816	\$16,054	Rank 1	Yes
NNSNEW2P	A	\$215,410	\$496,760	Yes	2023/24	\$32,143	\$13,424	Rank 1	Yes
NNSNEW2V	A	\$257,597	\$489,765	No	2023/24	\$32,390	\$16,054	Rank 1	Yes
NNSPMQ2B1	A	\$215,410	\$1,167,440	No	2023/24	\$62,722	\$13,424	Rank 2	No
NNSPMQ2B1	B	\$363,970	\$2,338,327	Yes	2023/24	\$130,279	\$22,683	Rank 1	Yes
NNSPMQ2E	A	\$215,410	\$207,494	No	2023/24	\$20,116	\$13,424	Rank 1	Yes
NNSWRH2C1	A	\$215,410	\$376,954	No	2023/24	\$29,237	\$13,424	Rank 2	No
NNSWRH2C1	B	\$363,970	\$569,044	No	2023/24	\$44,031	\$22,683	Rank 1	Yes
NNSWRH2C2	A	\$215,410	\$342,581	No	2023/24	\$27,066	\$13,424	Rank 2	No
NNSWRH2C2	B	\$363,970	\$534,375	No	2023/24	\$42,065	\$22,683	Rank 1	Yes
NNSWRH2M	A	\$215,410	\$444,339	No	2023/24	\$32,864	\$13,424	Rank 2	No
NNSWRH2M	B	\$363,970	\$650,230	No	2023/24	\$48,445	\$22,683	Rank 1	Yes
NNSWRH2Q	A	\$215,410	\$343,642	No	2023/24	\$27,122	\$13,424	Rank 2	No
NNSWRH2Q	B	\$363,970	\$552,396	No	2023/24	\$43,223	\$22,683	Rank 1	Yes
NNSWRH2V	A	\$215,410	\$445,293	No	2023/24	\$32,915	\$13,424	Rank 2	No
NNSWRH2V	B	\$363,970	\$688,305	No	2023/24	\$51,068	\$22,683	Rank 1	Yes
NNSWRH2X2	A	\$215,410	\$369,038	No	2023/24	\$28,811	\$13,424	Rank 2	No
NNSWRH2X2	B	\$363,970	\$555,629	No	2023/24	\$43,323	\$22,683	Rank 1	Yes
NNSWRH2X3	A	\$215,410	\$331,130	No	2023/24	\$26,457	\$13,424	Rank 2	No
NNSWRH2X3	B	\$363,970	\$534,930	No	2023/24	\$42,445	\$22,683	Rank 1	Yes
NTSAR12Z	A	\$270,577	\$211,866	No	2027/28	\$17,821	\$16,862	Rank 1	Yes
NTSCOF2L	A	\$270,577	\$130,107	No	2030/31	\$14,073	\$16,862	Rank 2	No
NTSCOF2L	B	\$442,412	\$369,971	No	2026/27	\$31,239	\$27,571	Rank 1	Yes
NTSGN22A1	A	\$215,410	\$7,340,668	Yes	2023/24	\$399,278	\$13,424	Rank 2	No
NTSGN22A1	B	\$363,970	\$9,250,168	Yes	2023/24	\$503,795	\$22,683	Rank 1	Yes
NTSGN22B1	A	\$215,410	\$6,717,616	Yes	2023/24	\$357,203	\$13,424	Rank 1	Yes
NTSGN22E	A	\$215,410	\$3,238,708	Yes	2023/24	\$178,911	\$13,424	Rank 1	Yes

Bay	Option	Capex	NPV (weighted)	ALARP	Optimal Timing	Total Benefit	Annual Capex	Preferred Option	Included in final program
NTSGN22H	A	\$215,410	\$3,142,848	Yes	2023/24	\$176,005	\$13,424	Rank 1	Yes
NTSGN24A	A	\$188,400	\$3,963,287	Yes	2023/24	\$210,479	\$11,741	Rank 2	No
NTSGN24A	B	\$357,873	\$5,129,422	Yes	2023/24	\$277,277	\$22,303	Rank 1	Yes
NTSGN24B	A	\$188,400	\$3,962,759	Yes	2023/24	\$210,452	\$11,741	Rank 2	No
NTSGN24B	B	\$357,873	\$5,568,692	Yes	2023/24	\$309,028	\$22,303	Rank 1	Yes
NTSGN24H	A	\$188,400	\$185,221	No	2023/24	\$17,164	\$11,741	Rank 1	Yes
NTSGN24J	A	\$188,400	\$2,751,970	Yes	2023/24	\$150,350	\$11,741	Rank 1	Yes
NTSGN24K	A	\$188,400	\$187,202	No	2023/24	\$17,267	\$11,741	Rank 1	Yes
NTSGN24M	A	\$188,400	\$1,680,954	Yes	2023/24	\$94,776	\$11,741	Rank 2	No
NTSGN24M	B	\$357,873	\$2,216,818	Yes	2023/24	\$129,032	\$22,303	Rank 1	Yes
NTSINV2C2	A	\$215,410	\$3,913,567	Yes	2023/24	\$216,998	\$13,424	Rank 1	Yes
NTSINV2G2	A	\$215,410	\$3,766,521	Yes	2023/24	\$209,177	\$13,424	Rank 2	No
NTSINV2G2	B	\$363,970	\$6,177,550	Yes	2023/24	\$341,064	\$22,683	Rank 1	Yes
NTSINV4A	A	\$188,400	\$5,409,715	Yes	2023/24	\$291,889	\$11,741	Rank 2	No
NTSINV4A	B	\$357,873	\$7,025,972	Yes	2023/24	\$385,097	\$22,303	Rank 1	Yes
NTSINV4J	A	\$188,400	\$222,839	No	2023/24	\$19,355	\$11,741	Rank 2	No
NTSINV4J	B	\$357,873	\$357,027	No	2023/24	\$32,457	\$22,303	Rank 1	Yes
NTSINV4K	A	\$188,400	\$353,217	No	2023/24	\$26,206	\$11,741	Rank 2	No
NTSINV4K	B	\$357,873	\$516,595	No	2023/24	\$40,752	\$22,303	Rank 1	Yes
NTSKLK4B	A	\$188,400	\$53,921	No	2033/34	\$8,103	\$11,741	Rank 1	No
NTLSM1A1	A	\$438,529	-\$27,341	No	2042/43	\$12,363	\$27,329	Rank 1	No
NTLSM1B1	A	\$438,529	\$21,856	No	2038/39	\$15,254	\$27,329	Rank 1	No
NTLSM1C2	A	\$438,529	\$24,016	No	2038/39	\$14,728	\$27,329	Rank 1	No
NTLSM1D	A	\$489,954	-\$5,992	No	2040/41	\$15,443	\$30,534	Rank 1	No
NTLSM1J	A	\$489,954	\$137,572	No	2032/33	\$24,648	\$30,534	Rank 1	No
NTLSM2A	A	\$215,410	\$93,144	No	2031/32	\$10,544	\$13,424	Rank 2	No
NTLSM2A	B	\$363,970	\$439,540	Yes	2023/24	\$35,097	\$22,683	Rank 1	Yes

Bay	Option	Capex	NPV (weighted)	ALARP	Optimal Timing	Total Benefit	Annual Capex	Preferred Option	Included in final program
NTSLSM2B	A	\$215,410	\$1,392,951	No	2023/24	\$63,447	\$13,424	Rank 2	No
NTSLSM2B	B	\$363,970	\$3,841,633	Yes	2023/24	\$199,724	\$22,683	Rank 1	Yes
NTSLSM2C	A	\$215,410	\$117,359	No	2029/30	\$11,772	\$13,424	Rank 2	No
NTSLSM2C	B	\$363,970	\$454,839	Yes	2023/24	\$35,468	\$22,683	Rank 1	Yes
NTSLSM2F	A	\$215,410	\$112,261	No	2030/31	\$11,560	\$13,424	Rank 2	No
NTSLSM2F	B	\$363,970	\$424,004	Yes	2023/24	\$33,389	\$22,683	Rank 1	Yes
NTSLSM2J	A	\$270,577	\$1,567,590	No	2023/24	\$75,265	\$16,862	Rank 2	No
NTSLSM2J	B	\$442,412	\$4,088,373	Yes	2023/24	\$217,383	\$27,571	Rank 1	Yes
NTSLSM2L	A	\$215,410	\$2,155,337	Yes	2023/24	\$105,702	\$13,424	Rank 2	No
NTSLSM2L	B	\$363,970	\$4,662,812	Yes	2023/24	\$245,099	\$22,683	Rank 1	Yes
NTSMRE4G	A	\$188,400	\$1,786,137	Yes	2023/24	\$101,496	\$11,741	Rank 1	Yes
NTSMRE4K	A	\$188,400	\$387,969	Yes	2023/24	\$28,032	\$11,741	Rank 1	Yes
NTSNB24N	A	\$188,400	\$14,003	No	2038/39	\$6,196	\$11,741	Rank 2	No
NTSNB24N	B	\$357,873	\$107,414	No	2033/34	\$16,404	\$22,303	Rank 1	No
NTSTTF7A	A	\$188,400	\$500,425	No	2023/24	\$27,887	\$11,741	Rank 1	Yes
NTSTTF7F2	A	\$188,400	\$193,293	No	2024/25	\$14,624	\$11,741	Rank 1	Yes
NTSTTF7G2	A	\$188,400	\$177,463	No	2025/26	\$13,676	\$11,741	Rank 1	Yes
NTSTTF7K2	A	\$188,400	\$198,379	No	2024/25	\$14,844	\$11,741	Rank 1	Yes
SWSALB2J	A	\$215,410	\$3,852,589	Yes	2023/24	\$160,092	\$13,424	Rank 2	No
SWSALB2J	B	\$363,970	\$9,907,735	Yes	2023/24	\$476,035	\$22,683	Rank 1	Yes
SWSBKH3C2	A	\$489,954	\$1,171,848	No	2023/24	\$64,375	\$30,534	Rank 1	Yes
SWSBKH3C3	A	\$489,954	\$1,559,772	No	2023/24	\$86,750	\$30,534	Rank 1	Yes
SWSBKH3E2	A	\$438,529	\$104,402,420	Yes	2023/24	\$4,438,021	\$27,329	Rank 1	Yes
SWSBRG3C2	A	\$438,529	\$119,867,397	Yes	2023/24	\$5,286,608	\$27,329	Rank 1	Yes
SWSBRG3C3	A	\$489,954	\$1,886,472	No	2023/24	\$108,164	\$30,534	Rank 1	Yes
SWSBRG3D1	A	\$438,529	\$2,146,665	No	2023/24	\$103,223	\$27,329	Rank 1	Yes
SWSBRG3D3	A	\$489,954	-\$108,395	No	2050/51	\$11,418	\$30,534	Rank 1	No

Bay	Option	Capex	NPV (weighted)	ALARP	Optimal Timing	Total Benefit	Annual Capex	Preferred Option	Included in final program
SWSBRG3G1	A	\$438,529	\$1,262,746	No	2023/24	\$65,144	\$27,329	Rank 1	Yes
SWSDN22E	A	\$215,410	\$5,028,833	Yes	2023/24	\$266,128	\$13,424	Rank 1	Yes
SWSDNT2A	A	\$215,410	\$1,161,794	No	2023/24	\$54,038	\$13,424	Rank 2	No
SWSDNT2A	B	\$363,970	\$2,944,771	Yes	2023/24	\$150,547	\$22,683	Rank 1	Yes
SWSDNT2B	A	\$215,410	\$1,333,050	No	2023/24	\$63,520	\$13,424	Rank 2	No
SWSDNT2B	B	\$363,970	\$3,176,788	Yes	2023/24	\$164,138	\$22,683	Rank 1	Yes
SWSDNT2D	A	\$215,410	\$3,244,592	Yes	2023/24	\$174,730	\$13,424	Rank 2	No
SWSDNT2D	B	\$363,970	\$5,200,284	Yes	2023/24	\$280,110	\$22,683	Rank 1	Yes
SWSDNT2E1	A	\$215,410	\$2,876,727	Yes	2023/24	\$159,891	\$13,424	Rank 1	Yes
SWSDNT2F	A	\$215,410	\$2,993,939	Yes	2023/24	\$163,985	\$13,424	Rank 1	Yes
SWSDNT3C	A	\$438,529	\$57,562	No	2036/37	\$18,339	\$27,329	Rank 2	No
SWSDNT3C	B	\$757,449	\$130,034	No	2035/36	\$32,783	\$47,204	Rank 1	No
SWSDNT3D	A	\$438,529	-\$15,436	No	2041/42	\$13,674	\$27,329	Rank 2	No
SWSDNT3D	B	\$757,449	\$70,441	No	2037/38	\$28,884	\$47,204	Rank 1	No
SWSDNT3E1	A	\$438,529	-\$31,109	No	2042/43	\$12,750	\$27,329	Rank 1	No
SWSDNT3F	A	\$489,954	-\$32,285	No	2042/43	\$14,643	\$30,534	Rank 1	No
SWSDNT6C	B	\$423,328	\$31,295	No	2037/38	\$17,207	\$26,382	Rank 1	No
SWSDNT6D	B	\$423,328	-\$59,216	No	2046/47	\$11,400	\$26,382	Rank 1	No
SWSFNY1A1	A	\$215,410	\$1,641,373	No	2023/24	\$71,998	\$13,424	Rank 2	No
SWSFNY1A1	B	\$363,970	\$3,083,235	No	2023/24	\$147,241	\$22,683	Rank 1	Yes
SWSFNY2F	A	\$188,400	\$114,249	No	2029/30	\$10,332	\$11,741	Rank 2	No
SWSFNY2F	B	\$357,873	\$354,443	No	2024/25	\$28,470	\$22,303	Rank 1	Yes
SWSGRF2B1	A	\$215,410	\$3,731,730	Yes	2023/24	\$151,849	\$13,424	Rank 1	Yes
SWSGRF6K	A	\$188,400	\$623,730	No	2023/24	\$33,827	\$11,741	Rank 2	No
SWSGRF6K	B	\$357,873	\$1,278,010	No	2023/24	\$72,052	\$22,303	Rank 1	Yes
SWSGRF6Q	A	\$188,400	\$2,795,471	Yes	2023/24	\$136,120	\$11,741	Rank 2	No
SWSGRF6Q	B	\$357,873	\$5,339,745	Yes	2023/24	\$270,352	\$22,303	Rank 1	Yes

Bay	Option	Capex	NPV (weighted)	ALARP	Optimal Timing	Total Benefit	Annual Capex	Preferred Option	Included in final program
SWSGRF6U	A	\$188,400	\$2,734,984	Yes	2023/24	\$133,320	\$11,741	Rank 2	No
SWSGRF6U	B	\$357,873	\$5,301,004	Yes	2023/24	\$269,444	\$22,303	Rank 1	Yes
SWSGRF6V	A	\$188,400	\$2,438,331	Yes	2023/24	\$115,654	\$11,741	Rank 2	No
SWSGRF6V	B	\$357,873	\$5,039,479	Yes	2023/24	\$254,196	\$22,303	Rank 1	Yes
SWSGRF6X	A	\$188,400	\$49,300	No	2033/34	\$8,869	\$11,741	Rank 2	No
SWSGRF6X	B	\$357,873	\$92,669	No	2033/34	\$16,518	\$22,303	Rank 1	No
SWSLT11HA	A	\$438,529	-\$111,635	No	2051/52	\$9,005	\$27,329	Rank 1	No
SWSLT11HB	A	\$438,529	-\$81,117	No	2048/49	\$10,891	\$27,329	Rank 1	No
SWSLT11JA	A	\$438,529	-\$102,560	No	2050/51	\$9,576	\$27,329	Rank 1	No
SWSLT11JB	A	\$438,529	-\$92,404	No	2049/50	\$10,203	\$27,329	Rank 1	No
SWSMUR1GA	A	\$438,529	\$202,678	No	2028/29	\$27,005	\$27,329	Rank 1	No
SWSMUR1GB	A	\$438,529	\$268,573	No	2024/25	\$31,906	\$27,329	Rank 1	Yes
SWSMUR1LA	A	\$438,529	\$244,217	No	2027/28	\$27,840	\$27,329	Rank 1	Yes
SWSMUR1MB	A	\$438,529	\$199,736	No	2027/28	\$27,586	\$27,329	Rank 1	Yes
SWSMUR1NB	A	\$438,529	\$563,534	Yes	2023/24	\$54,281	\$27,329	Rank 1	Yes
SWSMUR1PA	A	\$438,529	\$408,085	No	2023/24	\$42,425	\$27,329	Rank 1	Yes
SWSUT11E2	A	\$438,529	-\$47,900	No	2045/46	\$13,008	\$27,329	Rank 1	No
SWSUT11S2	A	\$438,529	-\$65,893	No	2046/47	\$11,985	\$27,329	Rank 1	No
SWSWG12N	A	\$215,410	\$499,813	No	2023/24	\$27,096	\$13,424	Rank 2	No
SWSWG12N	B	\$363,970	\$1,331,558	No	2023/24	\$74,997	\$22,683	Rank 1	Yes
SWSWG24AN	A	\$256,231	\$170,056	No	2028/29	\$15,817	\$15,968	Rank 1	No
SYSCA11M2	A	\$438,529	-\$77,501	No	2047/48	\$10,596	\$27,329	Rank 1	No
SYSCA11M3	A	\$438,529	-\$25,907	No	2042/43	\$13,743	\$27,329	Rank 1	No
SYSCA12C1	A	\$215,410	\$148,443	No	2028/29	\$12,521	\$13,424	Rank 1	No
SYSMNY2A1	A	\$215,410	\$1,393,376	No	2023/24	\$63,464	\$13,424	Rank 1	Yes
SYSMNY2B1	A	\$215,410	\$1,396,233	No	2023/24	\$63,580	\$13,424	Rank 1	Yes
SYSMNY2E	A	\$215,410	\$1,498,330	No	2023/24	\$69,143	\$13,424	Rank 1	Yes

Bay	Option	Capex	NPV (weighted)	ALARP	Optimal Timing	Total Benefit	Annual Capex	Preferred Option	Included in final program
SYSMRN1F	A	\$438,529	-\$38,187	No	2044/45	\$14,572	\$27,329	Rank 1	No
SYSMRN1F	B	\$757,449	-\$89,988	No	2046/47	\$22,931	\$47,204	Rank 2	No
SYSMRN2G	A	\$215,410	\$6,423,306	Yes	2023/24	\$268,183	\$13,424	Rank 2	No
SYSMRN2G	B	\$363,970	\$9,050,292	Yes	2023/24	\$401,412	\$22,683	Rank 1	Yes
SYSMRN2J	A	\$215,410	\$5,659,197	Yes	2023/24	\$226,945	\$13,424	Rank 2	No
SYSMRN2J	B	\$363,970	\$11,278,279	Yes	2023/24	\$511,389	\$22,683	Rank 1	Yes
SYSMRNDB2	A	\$438,529	-\$55,128	No	2046/47	\$13,546	\$27,329	Rank 1	No
SYSMRNDB2	B	\$757,449	-\$155,495	No	2052/53	\$19,409	\$47,204	Rank 2	No
SYSMRNDB3	A	\$215,410	-\$39,578	No	2047/48	\$5,030	\$13,424	Rank 2	No
SYSMRNDB3	B	\$363,970	-\$7,126	No	2041/42	\$11,691	\$22,683	Rank 1	No
SYSMRNDGB	A	\$438,529	\$123,936	No	2032/33	\$22,096	\$27,329	Rank 1	No
SYSYSNAJ1	A	\$489,954	-\$102,475	No	2049/50	\$11,434	\$30,534	Rank 1	No
SYSYSNBAB1	A	\$489,954	-\$98,329	No	2048/49	\$11,607	\$30,534	Rank 1	No

Appendix C - N2345 Circuit Breaker Replacement Program

The table below identifies each of the 122 circuit breaker replacement projects recommended to progress under this OER. The table includes PIC (unique asset identifier) reference to the currently installed circuit breakers and where relevant for DTCTB replacements, the associated CTs.

Bay	Bay Description	PIC	OFS Estimate	Capex	NPV (weighted)	ALARP	Optimal Timing
CMSDPT2A1	NO1 TRANSFORMER 132KV A BUS CB BAY	CB-EC00002828	Live Tank 132kV 50kA	\$257,597	\$989,834	Yes	2023/24
CMSDPT2D1	NO3 TRANSFORMER 132KV A BUS CB BAY	CB-EC00002693	Live Tank 132kV 50kA	\$257,597	\$386,886	No	2023/24
CMSDPT2D2	NO3 TRANSFORMER 132KV B BUS CB BAY	CB-EC00002694 CT-EC00002822 CT-EC00002820 CT-EC00002780	Dead Tank 132kV 50kA	\$417,717	\$1,619,637	Yes	2023/24
CMSDPT2E1	NO4 TRANSFORMER 132KV A BUS CB BAY	CB-EC00002823	Live Tank 132kV 50kA	\$257,597	\$425,818	Yes	2023/24
CMSDPT2E2	NO4 TRANSFORMER 132KV B BUS CB BAY	CB-EC00002824 CT-EC00002819 CT-EC00002846 CT-EC00005306	Dead Tank 132kV 50kA	\$417,717	\$1,573,424	Yes	2023/24
CMSDPT2F	98W MT TERRY 132KV FEEDER	CB-EC00002831	Live Tank 132kV 50kA	\$257,597	\$2,133,345	Yes	2023/24
CMSDPT2M	982 SPRINGHILL 132KV FEEDER	CB-EC00002830	Live Tank 132kV 50kA	\$257,597	\$411,140	No	2023/24
CMSDPT2V1	988 FAIRFAX LANE TEE 132KV FEEDER	CB-EC00002825	Live Tank 132kV 50kA	\$257,597	\$791,702	Yes	2023/24
CMSDPT2W	984 TALLAWARRA 132KV FEEDER	CB-EC00002947 CT-EC00002818 CT-EC00002817 CT-EC00005310	Dead Tank 132kV 50kA	\$417,717	\$1,705,330	Yes	2023/24
CMSRGV2C	238 PENRITH 132KV FEEDER	CB-ETA2314	Live Tank	\$215,410	\$246,156	No	2024/25

Bay	Bay Description	PIC	OFS Estimate	Capex	NPV (weighted)	ALARP	Optimal Timing
			132kV 40kA				
CMSRGV2G	232 GLENMORE PARK 132KV FEEDER	CB-ETA2313	Live Tank 132kV 40kA	\$215,410	\$286,837	No	2024/25
CMSRGV2K	NO1 BUS COUPLER 132KV BAY	CB-ETA2309	Live Tank 132kV 40kA	\$215,410	\$13,468,943	Yes	2023/24
CMSSE12LU	NO7 TRANSFORMER 132KV CB BAY	CB-EC00020243	Live Tank 132kV 40kA	\$215,410	\$427,114	No	2023/24
CMSSYS1D1	NO5 TRANSFORMER 330KV CB BAY	CB-EC00017375 CT-BESS11/3 CT-BESS15/3 CT-EC00001476	Dead Tank 330kV 50kA	\$757,449	\$947,234	Yes	2023/24
CMSSYS1J3	13 KEMPS CREEK 330KV B BUS CB BAY	CB-EC00017378	Live Tank 330kV 50kA	\$438,529	\$380,145	No	2023/24
CMSSYS1N2	12 LIVERPOOL 330KV A BUS CB BAY	CB-EC00017379	Live Tank 330kV 50kA	\$438,529	\$1,185,918	Yes	2023/24
CMSSYS1N3	12 LIVERPOOL 330KV B BUS CB BAY	CB-EC00017368	Live Tank 330kV 50kA	\$438,529	\$1,217,766	Yes	2023/24
CMSSYS2W	914 BANKSTOWN 132KV FEEDER BAY	CB-ETA2581	Live Tank 132kV 40kA	\$215,410	\$5,034,731	Yes	2023/24
CMSSYW1B1	NO2 TRANSFORMER 330KV CB BAY	CB-ETA2366	Live Tank 330kV 50kA	\$438,529	\$417,450	No	2026/27
CMSSYW1C1	NO3 TRANSFORMER 330KV CB BAY	CB-ETA2302	Live Tank 330kV 50kA	\$438,529	\$674,141	No	2023/24
CMSSYW1E3	1C HOLROYD 330KV B BUS CB BAY	CB-EC00024686	Live Tank 330kV 50kA	\$438,529	\$489,798	No	2025/26
CMSSYW1H3	32 BAYSWATER 330KV B BUS CB BAY	CB-EC00025072	Live Tank 330kV 50kA	\$438,529	\$668,274	No	2023/24
CMSSYW1L2	26 MUNMORAH 330KV A BUS CB	CB-EC00024723	Live Tank 330kV 50kA	\$438,529	\$860,525	No	2023/24
CMSSYW1Q	38 REGENTVILLE 330KV FEEDER BAY	CB-ETA3135	Live Tank 330kV 50kA	\$438,529	\$613,836	No	2023/24
CMSSYW2C2	NO3 TRANSFORMER 132KV B BUS CB BAY	CB-ETA1735	Dead Tank	\$417,717	\$4,838,094	Yes	2023/24

Bay	Bay Description	PIC	OFS Estimate	Capex	NPV (weighted)	ALARP	Optimal Timing
		CT-EC00022720 CT-EC00022721 CT-EC00022746	132kV 50kA				
CMSSYW2H	93U ABBOTSBURY 132KV FEEDER BAY	CB-ETA1704	Live Tank 132kV 50kA	\$257,597	\$342,926	No	2023/24
CMSSYW2L	9J2 BLACKTOWN 132KV FEEDER BAY	CB-ETA1709	Live Tank 132kV 50kA	\$257,597	\$251,699	No	2025/26
CMSSYW2M	9J1 BLACKTOWN 132KV FEEDER BAY	CB-ETA1710	Live Tank 132kV 50kA	\$257,597	\$2,969,652	Yes	2023/24
CMSSYW2P	B1-2 132KV BUS SECTION	CB-EC00023997 CT-EC00006072 CT-EC00006061 CT-EC00006059	Dead Tank 132kV 50kA	\$417,717	\$6,360,470	Yes	2023/24
CMSVYD1AE	25 ERARING 330KV A BUS CB BAY	CB-EC00024030 CT-ETA2261 CT-ETA2260 CT-ETA2262	Dead Tank 330kV 50kA	\$757,449	\$1,195,207	No	2023/24
CMSVYD1BD	29 SYDNEY WEST 330KV C BUS CB BAY	CB-EC00024028 CT-ETA2067 CT-ETA2068 CT-ETA2071	Dead Tank 330kV 50kA	\$757,449	\$1,186,896	No	2023/24
CMSVYD1BE	25 ERARING 330KV B BUS CB BAY	CB-EC00024029 CT-ETA2064 CT-ETA2069 CT-ETA2072	Dead Tank 330kV 50kA	\$757,449	\$1,100,588	No	2023/24
CMSVYD2B	NO2 TRANSFORMER 132KV CB BAY	CB-EC00023222 CT-EC00022776 CT-EC00022783 CT-EC00022784	Dead Tank 132kV 40kA	\$363,970	\$986,953	No	2023/24
CMSVYD2G	227 HAWKESBURY 132KV FDR BAY	CB-EC00023219	Dead Tank	\$363,970	\$1,218,010	No	2023/24

Bay	Bay Description	PIC	OFS Estimate	Capex	NPV (weighted)	ALARP	Optimal Timing
		CT-EC00022790 CT-EC00022786 CT-EC00022792	132kV 40kA				
CMSVYD2H	NO1 BUS COUPLER 132KV BAY	CB-EC00023217 CT-EC00022791 CT-ETA1307 CT-EC00022789	Dead Tank 132kV 40kA	\$363,970	\$514,897	No	2023/24
CMSVYD2J	234 HAWKESBURY 132KV FDR BAY	CB-EC00023220 CT-EC00022782 CT-EC00022780 CT-EC00022785	Dead Tank 132kV 40kA	\$363,970	\$1,326,901	No	2023/24
COSFB22G	94U PARKES 132 - 132KV FEEDER BAY	CB-EC00002297	Live Tank 132kV 40kA	\$215,410	\$3,687,745	Yes	2023/24
COSFB24S1	896 WEST JEMALONG 66KV CB BAY	CB-ETA1711	Live Tank 66kV 40kA	\$188,400	\$1,366,520	No	2023/24
COSMTP2F	NO3 TRANSFORMER 132KV CB BAY/94Y FDR	CB-EC00013840 CT-EC00013909 CT-EC00013910 CT-EC00013906	Dead Tank 132kV 40kA	\$363,970	\$505,204	Yes	2023/24
COSPKS1B1	NO2 TRANSFORMER 132KV CB BAY	CB-EC00023210 CT-EC00022728 CT-EC00022725 CT-EC00022733	Dead Tank 132kV 40kA	\$363,970	\$14,337,074	Yes	2023/24
COSPKS1D	94U FORBES 132KV FEEDER BAY	CB-EC00023213 CT-EC00022729 CT-EC00022723 CT-EC00022722	Dead Tank 132kV 40kA	\$363,970	\$7,104,086	Yes	2023/24
COSPKS1G	94K WELLINGTON TEE WELLINGTON WEST 132KV	CB-EC00023211 CT-EC00022732	Dead Tank 132kV 40kA	\$363,970	\$6,597,535	Yes	2023/24

Bay	Bay Description	PIC	OFS Estimate	Capex	NPV (weighted)	ALARP	Optimal Timing
		CT-EC00022731 CT-EC00022730					
COSPKS2B	NO2 TRANSFORMER 66KV CB BAY	CB-EC00023231 CT-EC00023205 CT-EC00023201 CT-EC00023207	Dead Tank 66kV 40kA	\$357,873	\$7,085,947	Yes	2023/24
COSPKS2M	898 TRUNDLE 66KV FEEDER BAY	CB-EC00023232 CT-EC00023202 CT-EC00023200 CT-EC00023199	Dead Tank 66kV 40kA	\$357,873	\$279,798	No	2025/26
COSWL12E	94B BERYL 132KV FEEDER BAY	CB-ETA1695	Live Tank 132kV 40kA	\$215,410	\$443,213	No	2023/24
COSWL12L	A1-2 132KV BUS SECTION CB	CB-EC00024111	Live Tank 132kV 40kA	\$215,410	\$2,031,079	Yes	2023/24
COSWL12M	9GY DUBBO SOUTH 132KV FEEDER BAY	CB-EC00015157	Live Tank 132kV 40kA	\$215,410	\$339,600	Yes	2023/24
COSWL12T	947 ORANGE NORTH TEE B'DONG 132 FDR BAY	CB-ETA1696	Live Tank 132kV 40kA	\$215,410	\$180,918	No	2027/28
NNSNEW2A1	NO1 TRANSFORMER 132KV A BUS CB BAY	CB-EC00005981	Live Tank 132kV 50kA	\$257,597	\$622,599	Yes	2023/24
NNSNEW2N	96Z MARYLAND 132KV FEEDER	CB-EC00010030	Live Tank 132kV 50kA	\$257,597	\$358,793	No	2023/24
NNSNEW2P	NO1-2 132KV B BUS SECTION	CB-EC00013833	Live Tank 132kV 40kA	\$215,410	\$496,760	Yes	2023/24
NNSNEW2V	9NA BERESFIELD 132KV FEEDER	CB-EC00005978	Live Tank 132kV 50kA	\$257,597	\$489,765	No	2023/24
NNSPMQ2B1	NO2 TRANSFORMER 132KV CB BAY	CB-EC00020412 CT-EC00013894 CT-EC00013887 CT-EC00013888	Dead Tank 132kV 40kA	\$363,970	\$2,338,327	Yes	2023/24
NNSPMQ2E	96G KEMPSEY 132KV FEEDER	CB-EC00009154	Live Tank	\$215,410	\$207,494	No	2023/24

Bay	Bay Description	PIC	OFS Estimate	Capex	NPV (weighted)	ALARP	Optimal Timing
			132kV 40kA				
NNSWRH2C1	NO 3 TRANSFORMER 132KV A CIRCUIT BREAKER	CB-EC00013845 CT-EC00020917 CT-EC00020923 CT-EC00020916	Dead Tank 132kV 40kA	\$363,970	\$569,044	No	2023/24
NNSWRH2C2	NO 3 TRANSFORMER 132KV B CIRCUIT BREAKER	CB-EC00005975 CT-EC00020914 CT-EC00020894 CT-EC00020890	Dead Tank 132kV 40kA	\$363,970	\$534,375	No	2023/24
NNSWRH2M	96Y MAYFIELD WEST 132KV FEEDER	CB-EC00013837 CT-EC00020919 CT-EC00020915 CT-EC00013933	Dead Tank 132kV 40kA	\$363,970	\$650,230	No	2023/24
NNSWRH2Q	962 TOMAGO 132 SS - 132KV FEEDER	CB-EC00013836 CT-EC00020913 CT-EC00013924 CT-EC00020912	Dead Tank 132kV 40kA	\$363,970	\$552,396	No	2023/24
NNSWRH2V	96X KOORAGANG 132KV FEEDER	CB-EC00013844 CT-EC00020918 CT-EC00020895 CT-EC00020889	Dead Tank 132kV 40kA	\$363,970	\$688,305	No	2023/24
NNSWRH2X2	95N NEWCASTLE 132KV A BUS CB BAY	CB-EC00013846 CT-EC00020922 CT-EC00020920 CT-EC00020921	Dead Tank 132kV 40kA	\$363,970	\$555,629	No	2023/24
NNSWRH2X3	95N NEWCASTLE 132KV B BUS CB BAY	CB-EC00013843 CT-EC00020897 CT-EC00020896 CT-EC00020892	Dead Tank 132kV 40kA	\$363,970	\$534,930	No	2023/24

Bay	Bay Description	PIC	OFS Estimate	Capex	NPV (weighted)	ALARP	Optimal Timing
NTSAR12Z	NO1 132KV CAPACITOR	CB-ETA3333	Live Tank 132kV 40kA POW	\$270,577	\$211,866	No	2027/28
NTSCOF2L	NO4 132KV CAPACITOR	CB-ETA3838 CT-ETA6724 CT-ETA6723 CT-ETA6722	Dead Tank 132kV 40kA POW	\$442,412	\$369,971	No	2026/27
NTSGN22A1	NO1 TRANSFORMER 132KV CB BAY	CB-EC00009631 CT-EC00022771 CT-EC00022715 CT-TG013133	Dead Tank 132kV 40kA	\$363,970	\$9,250,168	Yes	2023/24
NTSGN22B1	NO2 TRANSFORMER 132KV CB BAY	CB-EC00009632	Live Tank 132kV 40kA	\$215,410	\$6,717,616	Yes	2023/24
NTSGN22E	969 TAMWORTH 132KV FEEDER	CB-EC00009634	Live Tank 132kV 40kA	\$215,410	\$3,238,708	Yes	2023/24
NTSGN22H	9U3 BOGGABRI EAST TEE GUNNEDAH EAST 132	CB-EC00009633	Live Tank 132kV 40kA	\$215,410	\$3,142,848	Yes	2023/24
NTSGN24A	NO1 TRANSFORMER 66KV CB BAY	CB-EC00007882 CT-EC00008073 CT-EC00008071 CT-EC00008075	Dead Tank 66kV 40kA	\$357,873	\$5,129,422	Yes	2023/24
NTSGN24B	NO2 TRANSFORMER 66KV CB BAY	CB-EC00007883 CT-EC00006860 CT-EC00007974 CT-EC00007987	Dead Tank 66kV 40kA	\$357,873	\$5,568,692	Yes	2023/24
NTSGN24H	88K GUNNEDAH 66 SS - 66KV FEEDER	CB-EC00007872	Live Tank 66kV 40kA	\$188,400	\$185,221	No	2023/24
NTSGN24J	NO2 66KV BUS SECTION	CB-EC00007871	Live Tank 66kV 40kA	\$188,400	\$2,751,970	Yes	2023/24
NTSGN24K	88L GUNNEDAH 66 SS - 66KV FEEDER	CB-EC00007869	Live Tank 66kV 40kA	\$188,400	\$187,202	No	2023/24

Bay	Bay Description	PIC	OFS Estimate	Capex	NPV (weighted)	ALARP	Optimal Timing
NTSGN24M	877 KEEPIT PS 66KV FEEDER	CB-EC00007863 CT-EC00008023 CT-EC00008016 CT-EC00008019	Dead Tank 66kV 40kA	\$357,873	\$2,216,818	Yes	2023/24
NTSINV2C2	9U2 MOREE 132KV CB BAY	CB-EC00005965	Live Tank 132kV 40kA	\$215,410	\$3,913,567	Yes	2023/24
NTSINV2G2	96N ARMIDALE 330 - 132KV CB BAY	CB-EC00005967 CT-EC00005995 CT-EC00006037 CT-EC00006040	Dead Tank 132kV 40kA	\$363,970	\$6,177,550	Yes	2023/24
NTSINV4A	NO1 TRANSFORMER 66KV CB BAY	CB-EC00007536 CT-EC00007355 CT-EC00007361 CT-EC00007363	Dead Tank 66kV 40kA	\$357,873	\$7,025,972	Yes	2023/24
NTSINV4J	733 GLEN INNES 66 - 66KV FEEDER	CB-EC00007537 CT-EC00007931 CT-EC00007944 CT-EC00007938	Dead Tank 66kV 40kA	\$357,873	\$357,027	No	2023/24
NTSINV4K	734 INVERELL 66 - 66KV FEEDER	CB-EC00007538 CT-EC00006859 CT-EC00006857 CT-EC00006868	Dead Tank 66kV 40kA	\$357,873	\$516,595	No	2023/24
NTSLSM2A	NO1 TRANSFORMER 132KV CB BAY	CB-EC00023639 CT-EC00023689 CT-EC00023690 CT-EC00023688	Dead Tank 132kV 40kA	\$363,970	\$439,540	Yes	2023/24
NTSLSM2B	NO2 TRANSFORMER 132KV CB BAY	CB-EC00023638 CT-EC00023682 CT-EC00023684	Dead Tank 132kV 40kA	\$363,970	\$3,841,633	Yes	2023/24

Bay	Bay Description	PIC	OFS Estimate	Capex	NPV (weighted)	ALARP	Optimal Timing
		CT-EC00023683					
NTSLSM2C	967 KOOLKHAN 132KV FEEDER	CB-EC00023630 CT-EC00023662 CT-EC00023663 CT-EC00023661	Dead Tank 132kV 40kA	\$363,970	\$454,839	Yes	2023/24
NTSLSM2F	9U9 LISMORE 132KV FEEDER	CB-EC00023632 CT-EC00023669 CT-EC00023667 CT-EC00023668	Dead Tank 132kV 40kA	\$363,970	\$424,004	Yes	2023/24
NTSLSM2J	NO2 132KV CAPACITOR	CB-ETA3587 CT-EC00023675 CT-EC00023673 CT-EC00023674	Dead Tank 132kV 40kA POW	\$442,412	\$4,088,373	Yes	2023/24
NTSLSM2L	96L TENTERFIELD 132KV FEEDER	CB-EC00023636 CT-EC00023681 CT-EC00023679 CT-EC00023680	Dead Tank 132kV 40kA	\$363,970	\$4,662,812	Yes	2023/24
NTSMRE4G	721 MOREE 66KV FEEDER	CB-EC00006744	Live Tank 66kV 40kA	\$188,400	\$1,786,137	Yes	2023/24
NTSMRE4K	722 MOREE 66KV FEEDER	CB-EC00006749	Live Tank 66kV 40kA	\$188,400	\$387,969	Yes	2023/24
NTSTTF7A	NO1 TRANSFORMER 22KV CB BAY	CB-ETA2835	Live Tank 33kV 40kA	\$188,400	\$500,425	No	2023/24
NTSTTF7F2	NO3 (TIMBARRA MINE) 22KV CB BAY	CB-ETA2875	Live Tank 33kV 40kA	\$188,400	\$193,293	No	2024/25
NTSTTF7G2	NO4 (TSC 22/11KV SS) 22KV CB BAY	CB-ETA2876	Live Tank 33kV 40kA	\$188,400	\$177,463	No	2025/26
NTSTTF7K2	NO6 (TENTERFIELD TOWN) 22KV CB BAY	CB-ETA2761	Live Tank 33kV 40kA	\$188,400	\$198,379	No	2024/25
SWSALB2J	NO2-3 132KV BUS SECTION	CB-ETA1598	Dead Tank	\$363,970	\$9,907,735	Yes	2023/24

Bay	Bay Description	PIC	OFS Estimate	Capex	NPV (weighted)	ALARP	Optimal Timing
		CT-EC00024682 CT-EC00024683 CT-EC00024684	132kV 40kA				
SWSBKH3C2	X2 BURONGA 220KV NO.1 REACTOR BAY	CB-EC00014814	Live Tank 220kV 50kA POW	\$489,954	\$1,171,848	No	2023/24
SWSBKH3C3	X2 BURONGA 220KV NO.2 REACTOR BAY	CB-EC00014805	Live Tank 220kV 50kA POW	\$489,954	\$1,559,772	No	2023/24
SWSBKH3E2	X4 BROKEN HILL MINES 220KV CB BAY	CB-EC00014803	Live Tank 220kV 50kA	\$438,529	\$104,402,420	Yes	2023/24
SWSBRG3C2	X2 BROKEN HILL 220KV CB BAY	CB-EC00014806	Live Tank 220kV 50kA	\$438,529	\$119,867,397	Yes	2023/24
SWSBRG3C3	X2 BROKEN HILL 220KV REACTOR BAY	CB-EC00014810	Live Tank 220kV 50kA POW	\$489,954	\$1,886,472	No	2023/24
SWSBRG3D1	X3 BALRANDALD 220KV CB BAY	CB-EC00014808	Live Tank 330kV 50kA	\$438,529	\$2,146,665	No	2023/24
SWSBRG3G1	0X1 RED CLIFFS 220KV CB BAY	CB-EC00014809	Live Tank 330kV 50kA	\$438,529	\$1,262,746	No	2023/24
SWSDN22E	99L COLEAMBALLY 132 - 132KV FEEDER	CB-EC00013841	Live Tank 132kV 40kA	\$215,410	\$5,028,833	Yes	2023/24
SWSDNT2A	NO1 TRANSFORMER 132KV A BUS CB BAY	CB-EC00013851 CT-EC00013932 CT-EC00013931 CT-EC00013937	Dead Tank 132kV 40kA	\$363,970	\$2,944,771	Yes	2023/24
SWSDNT2B	NO2 TRANSFORMER 132KV B BUS CB BAY	CB-EC00013850 CT-EC00013928 CT-EC00013916 CT-EC00013920	Dead Tank 132kV 40kA	\$363,970	\$3,176,788	Yes	2023/24
SWSDNT2D	99T/1 COLEAMBALLY 132KV FEEDER	CB-EC00013835	Dead Tank	\$363,970	\$5,200,284	Yes	2023/24

Bay	Bay Description	PIC	OFS Estimate	Capex	NPV (weighted)	ALARP	Optimal Timing
		CT-EC00013915 CT-EC00013917 CT-EC00013925	132kV 40kA				
SWSDNT2E1	99R HAY CB BAY	CB-EC00006571	Live Tank 132kV 40kA	\$215,410	\$2,876,727	Yes	2023/24
SWSDNT2F	99K GRIFFITH 132KV FEEDER	CB-EC00006570	Live Tank 132kV 40kA	\$215,410	\$2,993,939	Yes	2023/24
SWSFNY1A1	NO1 TRANSFORMER 132KV CB BAY	CB-EC00020413 CT-EC00020909 CT-EC00020901 CT-EC00020902	Dead Tank 132kV 40kA	\$363,970	\$3,083,235	No	2023/24
SWSFNY2F	84B FINLEY 66KV FEEDER	CB-EC00019187 CT-EC00017016 CT-EC00017028 CT-EC00017024	Dead Tank 66kV 40kA	\$357,873	\$354,443	No	2024/25
SWSGRF2B1	NO2 TRANSFORMER 132KV CB BAY	CB-EC00020422	Live Tank 132kV 40kA	\$215,410	\$3,731,730	Yes	2023/24
SWSGRF6K	79F YENDA 33KV FEEDER	CB-ETA1754 CT-ETA2498 CT-ETA2496 CT-ETA2497	Dead Tank 33kV 40kA	\$357,873	\$1,278,010	No	2023/24
SWSGRF6Q	79L BEELBANGERA 33KV FEEDER	CB-ETA1929 CT-ETA1886 CT-ETA1885 CT-ETA1876	Dead Tank 33kV 40kA	\$357,873	\$5,339,745	Yes	2023/24
SWSGRF6U	79R THARBOGANG 33KV BAY	CB-ETA1930 CT-ETA5589 CT-ETA1887 CT-ETA1889	Dead Tank 33kV 40kA	\$357,873	\$5,301,004	Yes	2023/24
SWSGRF6V	NO2-3 33KV BUS SECTION	CB-ETA2495	Dead Tank	\$357,873	\$5,039,479	Yes	2023/24

Bay	Bay Description	PIC	OFS Estimate	Capex	NPV (weighted)	ALARP	Optimal Timing
		CT-ETA1891 CT-ETA1890 CT-ETA1892	33kV 40kA				
SWSMUR1GB	M13 Murray2 330kV B Bus CB Bay(Un.13-14)	CB-TG008701	Live Tank 330kV 50kA	\$438,529	\$268,573	No	2024/25
SWSMUR1LA	M1 Murray1 330kV A Bus CB Bay(Units 1-2)	CB-TG013518	Live Tank 330kV 50kA	\$438,529	\$244,217	No	2027/28
SWSMUR1MB	M3 Murray1 330kV B Bus CB Bay(Units 3-4)	CB-TG013517	Live Tank 330kV 50kA	\$438,529	\$199,736	No	2027/28
SWSMUR1NB	M5 Murray1 330kV B Bus CB Bay(Units 5-6)	CB-TG008703	Live Tank 330kV 50kA	\$438,529	\$563,534	Yes	2023/24
SWSMUR1PA	M7 Murray1 330kV A Bus CB Bay(Units 7-8)	CB-TG013519	Live Tank 330kV 50kA	\$438,529	\$408,085	No	2023/24
SWSWG12N	132KV "A" BUS SECTION 1-2	CB-EC00013852 CT-EC00013941 CT-EC00013942 CT-EC00013943	Dead Tank 132kV 40kA	\$363,970	\$1,331,558	No	2023/24
SYSMNY2A1	NO1 TRANSFORMER 132KV CB BAY	CB-EC00013855	Live Tank 132kV 40kA	\$215,410	\$1,393,376	No	2023/24
SYSMNY2B1	NO2 TRANSFORMER 132KV CB BAY	CB-EC00013858	Live Tank 132kV 40kA	\$215,410	\$1,396,233	No	2023/24
SYSMNY2E	97K COOMA TEE 132KV FEEDER	CB-EC00013854	Live Tank 132kV 40kA	\$215,410	\$1,498,330	No	2023/24
SYSMRN2G	972 GOULBURN 132KV FEEDER	CB-EC00020424 CT-EC00020954 CT-EC00020951 CT-EC00020952	Dead Tank 132kV 40kA	\$363,970	\$9,050,292	Yes	2023/24
SYSMRN2J	98C FAIRFAX LANE 132KV FEEDER	CB-EC00020425 CT-EC00020950 CT-EC00020953 CT-EC00020957	Dead Tank 132kV 40kA	\$363,970	\$11,278,279	Yes	2023/24

Approval Record

WF Ref:	Process Name	Actioned By	Action	Comments	Date
198574	Document Review	Dutta Debashis	Reviewed	comments included and sent to Evan L.	03-08-2021
198574	Document Review	Lamplough Evan	Reviewed		29-07-2021
200146	Document Review	Lamplough Evan	Reviewed		25-08-2021
200466	Document Review	Dutta Debashis	Reviewed		31-08-2021
201323	Document Approval	Wee Lance	Approve	Approved. Subject to changes per my email to Tim Blair.	08-09-2021
201377	Document Approval	Wee Lance	Approve		08-09-2021
204270	Document Review	Dutta Debashis	Reviewed		22-10-2021
204270	Document Review	Lamplough Evan	Reviewed		21-10-2021
204363	Document Approval	Wee Lance	Approve		22-10-2021
206032	Document Review	Lamplough Evan	Reviewed		10-11-2021
206089	Document Approval	McAlpine Andrew	Approve		11-11-2021
213363	Document Review	Dutta Debashis	Reviewed		10-03-2022
228944	Document Review	Lamplough Evan	Reviewed		19-10-2022
229113	Document Review	Lamplough Evan	Reviewed		19-10-2022
229249	Document Review	Dutta Debashis	Reviewed		21-10-2022
229425	Document Approval	Wee Lance	Approve		21-10-2022
230123	Document Review	Lamplough Evan	Reviewed		01-11-2022
230153	Document Approval	Wee Lance	Approve		01-11-2022