OPTIONS EVALUATION REPORT (OER)

FY24-28 Prot - Line Renewal

OER- n2242 revision 0.0

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

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

Approvals

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Date submitted for approval	7 October 2021	

Change history

Revision	Date	Amendment
0	27/09/2021	Initial Revision

Executive summary

Line protection relays are used throughout the NSW network to isolate transmission line faults in order to reduce their impacts on system security, system reliability and network infrastructure. The relays under investigation are installed at 22kV, 33kV, 66kV, 132kV, 220kV and 330kV voltage levels. Representing a subset of TransGrid's transmission line protection relay asset base, there are currently 191 installed units under consideration for this Need. The units have installation dates from 1970.

A number of Line Protection Schemes are reaching end of life by 2027/28. Manufacturer support for the majority of models is limited or withdrawn, meaning that repair and replacement facilities are expected to be unavailable by 2027/28.

There is a need to address degrading asset health and increasing risks associated with the identified assets. Addressing this need will ensure TransGrid will continue to meet its regulatory obligations set out in the NER.

The assessment of the options considered to address the need appears in Table 1, which includes line protection schemes evaluated as NPV positive, and reaching end of life by 2027/28. A summary of all options considered are detailed below.

Base Case

Under the Base Case TransGrid continues to operate and maintain (O&M) the existing site secondary systems as required. This approach will not address the obsolescence and health of the sites ageing secondary system assets.

Option A — Renewal of Individual Assets

Option A involves individual replacements of 152 identified assets across 33 sites within the regulatory period. The option is based on a like-for-like approach whereby the asset is replaced by its modern equivalent. Additional system modifications or additional functionalities would not be deployed under this option.

Table 1 - Evaluated options

Option	Description	Direct capital cost ($m)	Overheads ($m)	Total capital cost[1] ($m)	Weighted NPV (PV, $m)	Rank
Option A – N2242A	Renewal of Individual Assets	11.87	3.96	15.82	74.32	1

It is the recommendation that Option A – Renewal of Individual Assets, be scoped in detail.

[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

Line protection relays are used throughout the NSW network to isolate transmission line faults in order to reduce their impacts on system security, system reliability and network infrastructure. The relays under investigation are installed at 22kV, 33kV, 66kV, 132kV, 220kV and 330kV voltage levels. Representing a subset of TransGrid's transmission line protection relay asset base, there are currently 191 installed units under consideration for this Need of which have installs dates from 1970.

A number of Line Protection Schemes are reaching end of life by 2027/28. Manufacturer support for many models is limited or withdrawn, meaning that repair and replacement facilities are expected to be unavailable by 2027/28.

Network Performance Requirements, set out in Schedule 5.1 of the NER, place an obligation on TNSPs to provide redundant protection schemes to ensure the transmission system is adequately protected. Schedule 5.1.9(c) of the NER requires a TNSP to provide sufficient primary and back-up protection systems, including any communications facilities and breaker fail protection systems, to ensure that a fault of any type anywhere on its transmission system is automatically disconnected.

Additionally, TNSPs are required to disconnect the unprotected primary systems where a secondary systems fault lasts for more than eight hours (for planned maintenance) or 24 hours (for unplanned outages). TNSPs must also ensure that all protection systems for lines at a voltage 66 kV or above are well-maintained in order to always be available excluding short periods (less than eight hours) for protection system maintenance. In the event of an unplanned outage, AEMO's Power System Security Guidelines require that the primary network assets must be taken out of service within 24 hours.

Though the replacement of failed secondary systems components is a possible interim measure, the approach is not sustainable as spare components may not be available due to supplier constraints and technological obsolescence in the future. Once manufacturer support ceases and subsequently, spares are depleted, defect repairs can no longer be a viable approach to maintain compliance with performance obligations.

In accordance with TransGrid's Renewal and Maintenance Strategy for Automation Systems[2], a pre-emptive approach to asset renewals is required to address several factors increasing the risk of identified assets including:

- Withdrawal of manufacturer support for repair and procurement.
- Depletion of spares
- Increasing probability of failure (for secondary system devices the majority of failure modes lead to the complete loss asset function resulting in replacement).

2. Related needs/opportunities

The following related needs could improve efficiency of delivery where timing is coordinated in alignment with risk profiles:

- N2246 – FY24-28 Prot - Busbar Renewal
- N2245 – FY24-28 Prot - Capacitor Renewal
- N2243 – FY24-28 Prot - Transformer Renewal
- N2244 – FY24-28 Prot - Reactor Renewal
- N2212 – FY24-28 Prot - UFLS Renewal

Appendix C lists related Needs that include works covered under this project and have had their associated assets removed.

[2] Refer to Renewal and Maintenance Strategy – Automation Systems

3. Options

3.1 Base case

The Base Case for this Need is to continue with TransGrid's business as usual operations and maintenance (O&M) for the identified assets. This approach does not address the deteriorating condition of the assets under evaluation or the risk cost associated with maintaining aging assets. The risk will likely increase due to:

- The probability of failure increasing as assets move further along their failure curves[3].
- TransGrid's inability to recover from asset failure in the future due to reducing levels of manufacturer support, and depletion of spares availability that would otherwise limit the overall consequence of asset failure.

Key drivers for this risk cost are:

- The assets identified will have reached their end of life or have limited spares and no manufacturer support. This increases the likelihood of a hazardous event occurring and decreases TransGrid's ability to mitigate or repair failures.
- Assets have increasing numbers of faults as they progress along their failure curves, degrading components or are prone to mechanical wear, increasing the likelihood of a hazardous event occurring.

Increasing maintenance on secondary systems equipment cannot reduce the probability of failure or reduce risk costs. This is because maintenance of secondary assets is focused on device inspection and functional performance checks only, the conduct of maintenance at an electronic component level is neither feasible nor practicable.

3.2 Options evaluated

Option A — Renewal of Individual Assets [NOSA N2242, OFS N2242A]

This option involves individual replacements of 152 identified assets (listed in Appendix B) across 33 sites within the regulatory period. The option is based on a like-for-like approach whereby the asset is replaced by its modern equivalent. Additional system modifications or additional functionalities would not be deployed under this option.

This option would deliver risk mitigation and reduced corrective maintenance benefits to consumers and the networks by only targeting the probability of failure of identified assets. This option will not deliver any additional operational benefits such as improved capabilities for remote interrogation and predictive activities.

This option will phase asset renewals across the regulatory control period. Deployments are prioritised based on investment benefit with consideration also given to efficient delivery strategies. Targeted assets will be in service for approximately 15 years, with some assets remaining at each site to incur investment in future years.

3.3 Options considered and not progressed

Table 2 - Option considered but not progressed

Option	Reason for not progressing
Secondary Systems Renewal	This option would have required the complete renewal of all secondary systems assets at each site. The condition of remaining assets at identified sites did not warrant additional expenditure. Therefore, this option is not commercially feasible.

[3] Refer to Network Asset Health Framework

Option	Reason for not progressing
Refurbishment of Individual Assets	This option is not technically feasible due to the specialised skillsets required and the inability to resolve the lack of support from manufacturers.
Asset Retirement	This can only be achieved through retirement of the associated primary assets, which is not technically or commercially feasible.
Non-network solutions	It is not technically feasible for non-network solutions to provide the functionality of secondary systems assets for protection, control, communications and metering

4. Evaluation

4.1 Commercial evaluation methodology

The economic assessment undertaken for this project includes three scenarios that reflect a central set 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 3 - Scenarios

Parameter	Central scenario	Lower bound scenario	Higher bound scenario
Discount rate	4.8%	7.37%	2.23%
Capital cost	100%	125%	75%
Operating expenditure benefit	100%	75%	125%
Risk costs benefit	100%	75%	125%
Other benefit	100%	75%	125%
Scenario weighting	**50%**	**25%**	**25%**

Parameters used in this commercial evaluation:

Table 4 - Parameters used in commercial evaluation

Parameter	Parameter Description	Value used for this evaluation
Discount year	Year that dollar values are discounted to	2020/21
Base year	The year that dollar value outputs are expressed in real terms	2020/21 dollars
Period of analysis	Number of years included in economic analysis with remaining capital value included as terminal value at the end of	15 years

	the analysis period.	
Safety disproportionality	Multiplier of the safety risk cost included in NPV analysis to demonstrate implementation of obligation to reduce safety to ALARP.	Refer to section 0 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 5. Details appear in Appendix A.

Table 5 - Commercial evaluation (PV, $ million)

Option	Capital Cost PV	Central scenario NPV	Lower bound scenario NPV	Higher bound scenario NPV	Weighted NPV	Ranking
Option A	12.52	68.58	31.25	128.89	74.32	1

Note: The evaluation above is a consolidation of line protection schemes that were individually evaluated as NPV positive, and reaching end of life by 2027/28. The individual protection schemes are listed in Appendix B.

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[4].

In its Network Risk Assessment Methodology, under the ALARP test with the application of a gross disproportionate factor[5], 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 6 x Bushfire Risk Reduction + 6 x Safety Risk Reduction + 3 x other Environmental Risk Reduction + 0.1 x Reliability Risk Reduction.

Results of the ALARP evaluation are set out in Table 6.

Table 6 - Reasonably practicable test ($ million)

Option	Network Safety Risk Reduction	Annualised Capex	Reasonably Practicable?[6]
A	4.24	1.50	Yes

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

[5] In accordance with the framework for applying the ALARP principle, a disproportionality factor of 6 has been applied to risk cost figures. 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.

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

The result of the ALARP evaluation is that the overall proposed program is required to be completed as soon as practicable to manage our network safety obligations.

4.4 Preferred option

The preferred option to meet the identified need by 2027/28 is Option A. Option A is the only technically and commercially feasible solution to enable TransGrid to continue meeting its regulatory obligations set out in Schedule 5.1 of the NER. Option A, was found to have significantly positive net economic benefit while also maintaining compliance with regulatory and safety obligations.

Capital and Operating Expenditure

There is negligible difference in predicted ongoing planned routine operational expenditure between the option and the Base Case.

Resultant corrective maintenance under the base case strategy will result in higher medium to long term expenditure. Delivery of proposed works under Option A will reduce direct defect response costs.

It has been modelled that those components with no manufacturer support and limited spares carry the potential for incurring aspects of the proposed capital expenditure as operational expenditure. In such a scenario these larger costs are attributed to significant design and preparation costs, and likely augmentation of linking systems required to move a system from one design solution to a differing solution. Such costs would not be present in cases where a like-for-like replacement is feasible.

These operating expenditure benefits have been captured in the economic 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 costs of the option. The commencement year is determined based on the required project disbursement to the meet the commissioning year based on the OFS.

The results of optimal timing analysis is:

- Optimal commissioning year: 2027/28
- Commissioning year annual benefit: $7.55 million
- Annualised cost: $1.5 million

Based on the optimal timing, the project is expected to commence in the 2023/24-2027/28 Regulatory Period.

6. Recommendation

It is the recommendation that Option A – Renewal of Individual Assets, be scoped in detail.

The total project cost is $15.82 million including an amount of $3.8 million to progress the project from DG1 to DG2.

Appendix A – Option Summaries

Project Description	FY24-28 Prot - Line Renewal		
Option Description	Option A - Replace Individual Assets		
Project Summary			
Option Rank	*1*	Investment Assessment Period	*15*
Asset Life	*15*	NPV Year	2020/21
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, $m)	68.58	Annualised CAPEX @ Central Benefit Scenario ($m)	Annualised Capex - Standard (Business Case) 1.50
NPV @ Lower Bound Scenario (PV, $m)	31.25	Network Safety Risk Reduction ($m)	Network Safety Risk Reduction 4.24
NPV @ Higher Bound Scenario (PV, $m)	128.89	ALARP	ALARP Compliant? Yes
NPV Weighted (PV, $m)	74.32	Optimal Timing	Optimal timing (Business Case) 2023/24
Cost (Central Scenario)			
Total Capex ($m)	15.82	Cost Capex (PV,$m)	12.54
Terminal Value ($m)	0.00	Terminal Value (PV,$m)	0.00
Risk (Central Scenario)	**Pre**	**Post**	**Benefit**
Reliability (PV,$m)	Reliability Risk (Pre) 24.54	Reliability Risk (Post) 14.70	Pre – Post 9.84
Financial (PV,$m)	Financial Risk (Pre) 63.90	Financial Risk (Post) 36.81	Pre – Post 27.09
Operational/Compliance (PV,$m)	Operational Risk (Pre) 0.00	Operational Risk (Post) 0.00	Pre – Post 0.00
Safety (PV,$m)	Safety Risk (Pre) 0.03	Safety Risk (Post) 0.02	Pre – Post 0.01
Environmental (PV,$m)	Environmental Risk (Pre) 75.76	Environmental Risk (Post) 43.15	Pre – Post 32.61
Reputational ($m)	Reputational Risk (Pre) 0.00	Reputational Risk (Post) 0.00	Pre – Post 0.00
Total Risk (PV,$m)	Total Risk (Pre) 164.22	Total Risk (Post) 94.67	Pre – Post 69.56
OPEX Benefit (PV,$m)			OPEX Benefit 0.00
Other benefit (PV,$m)			Incremental Net Benefit 11.57
Total Benefit (PV,$m)			Business Case Total Benefit 81.12

Appendix B – Asset Renewal Program

The table below identifies each of the 152 line protection relay replacements recommended to progress under this OER.

Asset ID	Model	Obsolete	Location	Plant Number	Voltage (kV)	Cost ($)	Weighted NPV($)	ALARP	Optimal Timing
62163	RAZFE	Y	ANM	SWDANM2E	132	$98,000	$840,229	YES	2023/24
62162	YTG	Y	ANM	SWDANM2E	132	$98,000	$837,622	YES	2023/24
62159	D60	N	ANM	SWDANM2G	132	$98,000	$194,931	NO	2023/24
20114	D60	N	BAY	NNDBAY1AG	330	$142,000	$515,929	YES	2023/24
20129	D60	N	BAY	NNDBAY1BG	330	$142,000	$515,929	YES	2023/24
1285725	7SD523	N	BFN	CMDBFN2T	132	$98,000	$446,410	YES	2023/24
172158	7SD523	N	BFN	CMDBFN2W	132	$98,000	$446,410	YES	2023/24
172161	7SD523	N	BFN	CMDBFN2E	132	$98,000	$446,410	YES	2023/24
172164	7SD523	N	BFN	CMDBFN2Q	132	$98,000	$446,410	YES	2023/24
172183	7SD523	N	BFN	CMDBFN2S	132	$98,000	$446,410	YES	2023/24
172186	7SD523	N	BFN	CMDBFN2L	132	$98,000	$446,410	YES	2023/24
172189	7SD523	N	BFN	CMDBFN2V	132	$98,000	$446,410	YES	2023/24
172192	7SD523	N	BFN	CMDBFN2H	132	$98,000	$446,410	YES	2023/24

Asset ID	Model	Obsolete	Location	Plant Number	Voltage (kV)	Cost ($)	Weighted NPV($)	ALARP	Optimal Timing
152583	7SD523	N	BFS	CMDBFS2W	132	$98,000	$178,630	NO	2023/24
155641	7SD523	N	BFS	CMDBFS2V	132	$98,000	$178,630	NO	2023/24
169364	7SD523	N	BFS	CMDBFS2P	132	$98,000	$178,630	NO	2023/24
170447	7SD523	N	BFS	CMDBFS2K	132	$98,000	$178,630	NO	2023/24
172148	7SD523	N	BFS	CMDBFS2T	132	$98,000	$178,630	NO	2023/24
172493	7SD523	N	BFS	CMDBFS2H	132	$98,000	$178,630	NO	2023/24
200686	7SD523	N	BFS	CMDBFS2S	132	$98,000	$178,630	NO	2023/24
200689	7SD523	N	BFS	CMDBFS2Q	132	$98,000	$178,630	NO	2023/24
200692	7SD523	N	BFS	CMDBFS2E	132	$98,000	$178,630	NO	2023/24
200695	7SD523	N	BFS	CMDBFS2D	132	$98,000	$178,630	NO	2023/24
92090	OH1-311	Y	BOS	NTDBOS2C	132	$98,000	$234,691	NO	2023/24
92093	OH1-311	Y	BOS	NTDBOS2E	132	$98,000	$234,135	NO	2023/24
57287	THR	Y	CA1	SYDCA11H	330	$142,000	$1,151,217	YES	2023/24
57290	SEL421	N	CA1	SYDCA11L	330	$142,000	$519,950	YES	2023/24
57343	OH1-311	Y	CA1	SYDCA12K	132	$98,000	$502,501	YES	2023/24
57346	OH1-311	Y	CA1	SYDCA12L	132	$98,000	$502,501	YES	2023/24

Asset ID	Model	Obsolete	Location	Plant Number	Voltage (kV)	Cost ($)	Weighted NPV($)	ALARP	Optimal Timing
57355	OH1-311	Y	CA1	SYDCA12R	132	$98,000	$502,501	YES	2023/24
57349	OH1-311	Y	CA1	SYDCA12M	132	$98,000	$268,930	NO	2023/24
57352	OH1-311	Y	CA1	SYDCA12S	132	$98,000	$265,483	NO	2023/24
10185	OH1-311	Y	DPT	CMDDPT2F	132	$98,000	$1,204,722	YES	2023/24
48843	THS	Y	GN2	NTPGN2CRF034G2	66	$98,000	$783,055	YES	2023/24
48846	THS	Y	GN2	NTPGN2CRXXX4L2	66	$98,000	$783,055	YES	2023/24
48842	YTG	Y	GN2	NTPGN2CRF4B4G1	66	$98,000	$780,126	YES	2023/24
48845	YTG	Y	GN2	NTPGN2CRXXX4L1	66	$98,000	$780,126	YES	2023/24
48833	D60	N	GN2	NTDGN24M	66	$98,000	$384,658	YES	2023/24
48836	D60	N	GN2	NTDGN24K	66	$98,000	$384,658	YES	2023/24
48839	D60	N	GN2	NTDGN24H	66	$98,000	$384,658	YES	2023/24
62555	OH1-311	Y	JDA	SWDJDA2F	132	$98,000	$284,905	YES	2023/24
62558	OH1-311	Y	JDA	SWDJDA2H	132	$98,000	$281,620	YES	2023/24
84390	OH-305	Y	KLK	NTDKLK4R	66	$98,000	$673,657	YES	2023/24
84631	OH-305	Y	KLK	NTDKLK4J	66	$98,000	$673,657	YES	2023/24
48919	LFZP112	Y	KLK	NTDKLK4N	66	$98,000	$554,376	YES	2023/24

Asset ID	Model	Obsolete	Location	Plant Number	Voltage (kV)	Cost ($)	Weighted NPV($)	ALARP	Optimal Timing
48917	OH-305	Y	KLK	NTDKLK4K	66	$98,000	$518,936	YES	2023/24
48904	OH1-311	Y	KLK	NTDKLK2H	132	$98,000	$317,878	NO	2023/24
48901	OH1-311	Y	KLK	NTDKLK2F	132	$98,000	$267,640	NO	2023/24
48913	OH1-311	Y	KLK	NTDKLK2M	132	$98,000	$210,107	NO	2023/24
48922	D60	N	KLK	NTDKLK4P	66	$98,000	$403,008	YES	2023/24
88465	OH1-311	Y	MAC	CMDMAC4G	66	$98,000	$220,526	NO	2023/24
88468	OH1-311	Y	MAC	CMDMAC4H	66	$98,000	$220,526	NO	2023/24
88471	OH1-311	Y	MAC	CMDMAC4K	66	$98,000	$220,526	NO	2023/24
88474	OH1-311	Y	MAC	CMDMAC4L	66	$98,000	$220,526	NO	2023/24
88459	OH1-311	Y	MAC	CMDMAC4E	66	$98,000	$220,506	NO	2023/24
88462	OH1-311	Y	MAC	CMDMAC4F	66	$98,000	$220,506	NO	2023/24
93230	7SD522	N	MAC	CMDMAC2A	132	$98,000	$119,494	NO	2023/24
76685	7SD523	N	MN1	NNDMN12AF	132	$98,000	$364,896	YES	2023/24
155631	OH1-311	Y	MNL	CODMNL2C	132	$98,000	$294,882	YES	2023/24
155634	OH1-311	Y	MNL	CODMNL2E	132	$98,000	$233,381	NO	2023/24
57457	SHPM	Y	MNY	SYDMNY2E	132	$98,000	$301,600	NO	2023/24

Asset ID	Model	Obsolete	Location	Plant Number	Voltage (kV)	Cost ($)	Weighted NPV($)	ALARP	Optimal Timing
57473	MCGG11	Y	MNY	SYDMNY6B	33	$98,000	$380,876	YES	2023/24
11252	THR	Y	MTP	CODMTP2F	132	$98,000	$733,978	YES	2023/24
11253	SHPM	Y	MTP	CODMTP2F	132	$98,000	$730,644	YES	2023/24
19678	MFAC	N	MTP	CODMTP1G4	330	$142,000	$186,098	NO	2023/24
19679	MFAC	N	MTP	CODMTP1G4	330	$142,000	$186,098	NO	2023/24
19681	MFAC	N	MTP	CODMTP1F4	330	$142,000	$186,098	NO	2023/24
19682	MFAC	N	MTP	CODMTP1F4	330	$142,000	$186,098	NO	2023/24
92073	OH1-311	Y	MVL	NTDMVL2E	132	$98,000	$214,463	NO	2023/24
92070	OH1-311	Y	MVL	NTDMVL2C	132	$98,000	$205,266	NO	2023/24
152151	OH1-311	Y	ONO	CODONO2D	132	$98,000	$558,333	YES	2023/24
152147	OH1-311	Y	ONO	CODONO2C	132	$98,000	$552,877	YES	2023/24
152157	OH1-311	Y	ONO	CODONO2U	132	$98,000	$452,580	YES	2023/24
152172	OH1-311	Y	ONO	CODONO2N	132	$98,000	$397,983	NO	2023/24
152154	OH1-311	Y	ONO	CODONO2H	132	$98,000	$363,364	NO	2023/24
1002547	OH1-311	Y	PKS	CODPKS2P	66	$98,000	$434,025	YES	2023/24
152586	OH1-311	Y	PKS	CODPKS1C	132	$98,000	$271,736	NO	2023/24

Asset ID	Model	Obsolete	Location	Plant Number	Voltage (kV)	Cost ($)	Weighted NPV($)	ALARP	Optimal Timing
20580	OH1-311	Y	PMQ	NNDPMQ6E	33	$98,000	$613,777	YES	2023/24
20601	OH1-311	Y	PMQ	NNDPMQ6V	33	$98,000	$613,777	YES	2023/24
20586	YTG	Y	PMQ	NNDPMQ6N	33	$98,000	$411,633	YES	2023/24
20564	OH1-311	Y	PMQ	NNDPMQ2J	132	$98,000	$323,846	YES	2023/24
140503	OH1-311	Y	PMQ	NNDPMQ2G	132	$98,000	$317,412	NO	2023/24
20561	OH1-311	Y	PMQ	NNDPMQ2E	132	$98,000	$284,202	NO	2023/24
138812	OH1-311	Y	QBY	SYDQBY2H	132	$98,000	$550,521	YES	2023/24
138818	OH1-311	Y	QBY	SYDQBY2E	132	$98,000	$550,521	YES	2023/24
138839	OH1-311	Y	QBY	SYDQBY4S	66	$98,000	$550,521	YES	2023/24
138842	OH1-311	Y	QBY	SYDQBY4P	66	$98,000	$550,521	YES	2023/24
138845	OH1-311	Y	QBY	SYDQBY4N	66	$98,000	$550,521	YES	2023/24
138854	OH1-311	Y	QBY	SYDQBY4F	66	$98,000	$550,521	YES	2023/24
138857	OH1-311	Y	QBY	SYDQBY4E	66	$98,000	$550,521	YES	2023/24
138860	OH1-311	Y	QBY	SYDQBY4D	66	$98,000	$550,521	YES	2023/24
138815	OH1-311	Y	QBY	SYDQBY2F	132	$98,000	$313,503	NO	2023/24
92083	OH1-311	Y	RAL	NTDRAL2E	132	$98,000	$227,183	NO	2023/24

Asset ID	Model	Obsolete	Location	Plant Number	Voltage (kV)	Cost ($)	Weighted NPV($)	ALARP	Optimal Timing
92080	OH1-311	Y	RAL	NTDRAL2C	132	$98,000	$222,271	NO	2023/24
9919	SHPM	Y	SYS	CMDSYS1H	330	$142,000	$4,180,918	YES	2023/24
84335	SEL421	N	SYS	CMDSYS1W1	330	$142,000	$275,996	NO	2023/24
9973	7SD523	N	SYS	CMDSYS2V	132	$98,000	$442,738	YES	2023/24
9976	7SD523	N	SYS	CMDSYS2U	132	$98,000	$442,738	YES	2023/24
9994	7SD523	N	SYS	CMDSYS2L	132	$98,000	$442,738	YES	2023/24
9997	7SD523	N	SYS	CMDSYS2M	132	$98,000	$442,738	YES	2023/24
82726	DL910	Y	T1P	SYDT1PU3	330	$142,000	$204,758	NO	2023/24
82732	DL910	Y	T1P	SYDT1PU1	330	$142,000	$204,328	NO	2023/24
82727	RADHL	Y	T1P	SYDT1PU3	330	$142,000	$198,263	NO	2023/24
82735	RADHL	Y	T1P	SYDT1PU1	330	$142,000	$197,831	NO	2023/24
82733	DL910	Y	T2P	SYDT2PU7	330	$142,000	$203,842	NO	2023/24
82731	DL910	Y	T2P	SYDT2PU5	330	$142,000	$203,401	NO	2023/24
82736	RADHL	Y	T2P	SYDT2PU7	330	$142,000	$197,342	NO	2023/24
82734	RADHL	Y	T2P	SYDT2PU5	330	$142,000	$196,899	NO	2023/24
49639	P546	N	TA1	NTDTA12E	132	$98,000	$229,312	NO	2023/24

Asset ID	Model	Obsolete	Location	Plant Number	Voltage (kV)	Cost ($)	Weighted NPV($)	ALARP	Optimal Timing
20671	D60	N	TRE	NNDTRE2H	132	$98,000	$239,183	YES	2023/24
49742	FP2000	Y	TTF	NTDTTF7F	22	$98,000	$871,032	YES	2023/24
49745	FP2000	Y	TTF	NTDTTF7G	22	$98,000	$871,032	YES	2023/24
49748	FP2000	Y	TTF	NTDTTF7K	22	$98,000	$871,032	YES	2023/24
49741	P121	Y	TTF	NTDTTF7F	22	$98,000	$873,436	YES	2023/24
49744	P121	Y	TTF	NTDTTF7G	22	$98,000	$873,436	YES	2023/24
49747	P121	Y	TTF	NTDTTF7K	22	$98,000	$873,436	YES	2023/24
49738	D60	N	TTF	NTDTTF2D	132	$98,000	$149,651	NO	2023/24
49735	D60	N	TTF	NTDTTF2C	132	$98,000	$128,440	NO	2023/24
81496	D60	N	UT1	SYDUT11F	330	$142,000	$451,546	YES	2023/24
82700	D60	N	UT1	SYDUT11V	330	$142,000	$206,519	NO	2023/24
82704	D60	N	UT1	SYDUT11X	330	$142,000	$185,488	NO	2023/24
71015	OH1-311	Y	VYD	CMDVYD2D	132	$98,000	$940,835	YES	2023/24
1188710	OH1-311	Y	WDL	SYDWDL2F	132	$98,000	$487,426	YES	2023/24
141927	OH1-311	Y	WDL	SYDWDL2J	132	$98,000	$487,426	YES	2023/24
141930	OH1-311	Y	WDL	SYDWDL2K	132	$98,000	$487,426	YES	2023/24

Asset ID	Model	Obsolete	Location	Plant Number	Voltage (kV)	Cost ($)	Weighted NPV($)	ALARP	Optimal Timing
141921	OH1-311	Y	WDL	SYDWDL2D	132	$98,000	$218,558	NO	2023/24
141924	OH1-311	Y	WDL	SYDWDL2E	132	$98,000	$216,624	NO	2023/24
91948	OH1-311	Y	WGN	SWDWGN1J	132	$98,000	$619,979	YES	2023/24
91972	OH1-311	Y	WGN	SWDWGN2J	66	$98,000	$619,979	YES	2023/24
91975	OH1-311	Y	WGN	SWDWGN2H	66	$98,000	$619,979	YES	2023/24
91978	OH1-311	Y	WGN	SWDWGN2G	66	$98,000	$619,979	YES	2023/24
91957	OH1-311	Y	WGN	SWDWGN1D	132	$98,000	$319,217	NO	2023/24
91954	OH1-311	Y	WGN	SWDWGN1G	132	$98,000	$306,461	NO	2023/24
91951	OH1-311	Y	WGN	SWDWGN1H	132	$98,000	$296,622	NO	2023/24
20805	THR	Y	WRH	NNDWRH2Q	132	$98,000	$813,546	YES	2023/24
20804	SHPM	Y	WRH	NNDWRH2Q	132	$98,000	$810,961	YES	2023/24
20813	7SD522	N	WRH	NNDWRH2V	132	$98,000	$177,722	NO	2023/24
20801	7SD522	N	WRH	NNDWRH2M	132	$98,000	$177,675	NO	2023/24
437521	OH1-311	Y	WWS	CODWWS2S	132	$98,000	$524,046	YES	2023/24
417657	OH1-311	Y	WWS	CODWWS4F	66	$98,000	$462,136	YES	2023/24
426595	OH1-311	Y	WWS	CODWWS4L	66	$98,000	$462,136	YES	2023/24

Asset ID	Model	Obsolete	Location	Plant Number	Voltage (kV)	Cost ($)	Weighted NPV($)	ALARP	Optimal Timing
426598	OH1-311	Y	WWS	CODWWS4K	66	$98,000	$462,136	YES	2023/24
426601	OH1-311	Y	WWS	CODWWS4M	66	$98,000	$462,136	YES	2023/24
426604	OH1-311	Y	WWS	CODWWS4C	66	$98,000	$462,136	YES	2023/24
427884	OH1-311	Y	WWS	CODWWS4H	66	$98,000	$462,136	YES	2023/24
427890	OH1-311	Y	WWS	CODWWS4J	66	$98,000	$462,136	YES	2023/24
429179	OH1-311	Y	WWS	CODWWS2P	132	$98,000	$462,136	YES	2023/24
429182	OH1-311	Y	WWS	CODWWS2J	132	$98,000	$462,136	YES	2023/24
429185	OH1-311	Y	WWS	CODWWS2K	132	$98,000	$462,136	YES	2023/24
437518	OH1-311	Y	WWS	CODWWS2Q	132	$98,000	$411,574	YES	2023/24
437510	OH1-311	Y	WWS	CODWWS2C	132	$98,000	$380,136	YES	2023/24
427887	OH1-311	Y	WWS	CODWWS4N	66	$98,000	$262,378	NO	2023/24

Appendix C Related Needs with Assets Removed

The following Needs contain assets that would otherwise be covered under this proposed program of work. These assets have been captured and justified within the relevant Option Evaluation Report for each Need below.

Need ID	Need Description
N2437	FY24-28 COF Secondary Systems Renewal
N2436	FY24-28 INV Secondary Systems Renewal
N2435	FY24-28 NB2 Secondary Systems Renewal
N2434	FY24-28 LSM Secondary Systems Renewal
N2433	FY24-28 TOM Secondary Systems Renewal
N2432	FY24-28 GN2 Secondary Systems Renewal
N2431	FY24-28 NAM Secondary Systems Renewal
N2430	FY24-28 FB2 Secondary Systems Renewal
N2429	FY24-28 VP1 Secondary Systems Renewal
N2428	FY24-28 CW2 Secondary Systems Renewal
N2427	FY24-28 RGV Secondary Systems Renewal
N2426	FY24-28 WW1 Secondary Systems Renewal
N2419	FY24-28 PMA Secondary Systems Renewal
N2411	FY24-28 WL1 Secondary Systems Renewal
N2410	FY24-28 FNY Secondary Systems Renewal
N2409	FY24-28 KS2 Secondary Systems Renewal
N2408	FY24-28 AR1 Secondary Systems Renewal
N2407	FY24-28 BRD Secondary Systems Renewal
N2406	FY24-28 GNS Secondary Systems Renewal
N2405	FY24-28 LT1 Secondary Systems Renewal
N2214	FY24-28 ER0 Secondary Systems Renewal

Need ID	Need Description
N2213	FY24-28 BER Secondary Systems Renewal
N2212	FY24-28 SE1 Secondary Systems Renewal
N2211	FY24-28 YSN Secondary Systems Renewal