

OPTIONS EVALUATION REPORT (OER)

Protection - GE Multilin Condition

OER 000000001379 revision 1.0



Ellipse project no.: P0008031

TRIM file: [TRIM No]

Project reason: Reliability - To meet overall network reliability requirements

Project category: Prescribed - Asset Renewal Strategies

Approvals

Author	Hazem Khamis	A/Secondary Systems and Communications Asset Manager
Endorsed	Adam Hoare	Senior Secondary Systems Analyst
	Azil Khan	Investment Analysis Manager
Approved	Lance Wee	M/Asset Strategy
Date submitted for approval	15 December 2016	

Change history

Revision	Date	Amendment
0	29 June 2016	Initial issue
1	28 October 2016	Update to 2016/17 dollars and SFAIRP/ALARP data
2	15 December 2016	Update to format

1. Need/opportunity

The assets raised within this Need have exhibited an increased defect rate resulting in a high consequence failure mode. These assets have additionally created an above average amount of corrective maintenance works and expenditure which has resulted in the application of operational resources exceeding the expected requirements for modern microprocessor based protection relays.

The use of duplicated protection schemes across all transmission lines and transformers are a continuing requirement of the Australian Energy Regulator (AER) as outlined in the National Electricity Rules (NER). These protection schemes are required into the foreseeable future.

2. Related Needs/opportunities

The following Needs address parts of the omitted relays covered by this Need:

- > Need ID 1180 – Wagga 330kV Secondary Systems Renewal
- > Need ID 1186 – Murrumburrah Secondary Systems Renewal
- > Need ID 1191 – Deniliquin Secondary Systems Renewal
- > Need ID 1192 – Lower Tumut Secondary Systems Renewal
- > Need ID 1193 – Broken Hill Secondary Systems Renewal
- > Need ID 1194 – Tenterfield Secondary Systems Renewal
- > Need ID 1196 – Coleambally Secondary Systems Renewal
- > Need ID 1243 – Tamworth 330kV Secondary Systems Renewal
- > Need ID 1244 – Wallerawang 330kV Secondary Systems Renewal
- > Need ID 1246 – Panorama Secondary Systems Renewal
- > Need ID 1247 – Muswellbrook Secondary Systems Renewal
- > Need ID 1252 – Cowra Secondary Systems Renewal
- > Need ID 1253 – Darlington Point Secondary Systems Renewal
- > Need ID 1255 – Ingleburn Secondary Systems Renewal
- > Need ID 1258 – Regentville Secondary Systems Renewal
- > Need ID 1263 – Tuggerah Secondary Systems Renewal
- > Need ID 1266 – Marulan Secondary Systems Renewal
- > Need ID 1267 – Molong Secondary Systems Renewal
- > Need ID 1599 – Liverpool Secondary Systems Renewal

3. Options

All dollar values in this document are expressed in un-escalated 2016/17 dollars.

Base Case

The Base Case for this Need is to run these assets to failure. This approach does not address the increasing failure rates or the risk cost associated with the Need. At \$26.00m per annum, the risks are significant and foreseen to increase as the probability of failure of the assets will also likely increase. Key drivers for this risk cost are:

- > Probability of asset failure is approximately 3.10% for L90, 8.50% for D60, and 19.0% for T60
- > Consequence assumes black start for assets protecting primary plant at 330kV and above with “N-1” redundancy. The restoration time has been set as 8 hours with an assumed 1,296MW of load interrupted to mixed customers (residential, commercial, and agricultural) to model a number of potential network scenarios based on this consequence.
- > The large population of this asset group at 434 units across all voltage levels and sites within the network.

Increasing the maintenance for the assets cannot reduce the probability of failure in order to reduce the risk cost.

Option A — Replacement of individual Assets [[OFR 1379A](#), [OFS 1379A](#)]

This option covers the replacement of assets in a “like for like” manner. This involves removing the panel and replacing it with a new relay panel utilising the same features currently in use. This option doesn’t include any upgrade of systems to maximise the utilisation of available technology.

Operating costs have been estimated at \$53k per annum for this option based on current maintenance plan settings.

Due to the “like for like” nature of this option, no benefit has been calculated in accordance with TransGrid’s Renewal and Maintenance Strategy for Secondary Systems Site Installations¹.

The expected total capital cost to replace every asset identified under this Need is \$45.50m. This costing is estimated using TransGrid’s “Success” estimating system. This cost has been adjusted to \$35.40m for analysis in this OER to account for the reduction of 131 assets that will be replaced under Secondary Systems Renewal Needs or are utilised on negotiated services. This adjustment has been carried out using the unit costs provided in the Option Feasibility Study (OFS).

The residual risk associated with this option upon completion of the project amounts to \$2.92m per annum (base case risk cost = \$26.00m). The risk reduction is realised through the reduction in the probability of failure for all assets.

The assets under investigation have been categorised into three broad categories:

Assets protecting primary assets <330kV and <150MW

This configuration covers only replacing the assets protecting primary assets where the peak load at risk is less than 150MW and service voltage is less than 330kV.

The expected capital cost to replace this category of assets is \$11.10m. This costing was estimated using the unit costs provided under OFS 1379A and applying them to those assets that would be replaced. These costs are broken down in Table 1.

¹ Refer SSA Strategy - Renewal and Maintenance -Secondary Systems Site Installations

Table 1 – Expected costs for replacing assets protecting primary assets <330kV and <150MW (\$ thousand)

Item	Unit Cost, Including Labour	Quantity	Total Cost
Distance <= 132kV	94.30	43	4,050
Line Differential <= 132kV	94.00	11	1,030
Transformer <= 132kV	130	46	5,980
Total estimated cost			11,100

The residual risk associated with this portion of assets upon completion of the project amounts to \$0.27m per annum (base case risk cost component = \$3.03m). The risk reduction is realised through the reduction in the probability of failure for the affected assets.

Assets protecting primary assets <330kV and >150MW

This configuration covers only replacing the assets classified as protecting where the peak load is greater than 150MW and service voltage is less than 330kV.

The expected capital cost to replace this category of assets is \$3.57m. This costing was estimated using the unit costs provided under OFS 1379A and applying them to those assets that would be replaced. These costs are broken down in Table 2.

Table 2 – Expected costs for replacing assets protecting primary assets <330kV and >150MW (\$ thousand)

Item	Unit Cost, Including Labour	Quantity	Total Cost
Distance <= 132kV	94.30	2	189
Line Differential <= 132kV	94.00	36	3,380
Transformer <= 132kV	130	0	0
Total estimated cost			3,570

The residual risk associated with this portion of assets upon completion of the project amounts to \$0.63m per annum (base case risk cost component = \$2.30m). The risk reduction is realised through the reduction in the probability of failure for the affected assets.

Assets protecting primary assets >=330kV

This configuration covers only replacing the assets classified as protecting primary assets operating at 330kV and above.

The expected capital cost is \$20.70m. This costing was estimated using the unit costs provided under OFS 1379A and applying them to those assets that would be replaced. These costs are broken down in Table 3.

Table 3 – Expected costs for replacing assets protecting primary assets <330kV and >150MW (\$ thousand)

Item	Unit Cost, Including Labour	Quantity	Total Cost
Distance <= 132kV	123	83	10,200
Line Differential <= 132kV	123	19	2,340
Transformer <= 132kV	130	63	8,190

Item	Unit Cost, Including Labour	Quantity	Total Cost
Total estimated cost			20,700

The residual risk associated with this portion of upon completion of the project amounts to \$1.57m per annum (base case risk cost component = \$20.50m). The risk reduction is realised through the reduction in the probability of failure for the affected assets.

4. Evaluation

Evaluation of the proposed options has been completed using the ALARP (As Low as Reasonably Practicable) regulatory requirements and economic considerations. The results of this evaluation are outlined below.

4.1 Commercial evaluation

The result of commercial evaluation for each of the technically feasible options is summarised in Table 4.

Table 4 – Commercial evaluation (\$ million)

Option	Description	Total capex	Annual opex	Annual post project risk cost	Economic NPV @10%	Financial NPV @10%	Rank
Base case	Run-to-fail	N/A	0.07	26.0	N/A	N/A	2
A	Replace individual Assets	35.40	0.05	2.92	81.7	(1.24)	1
i)	Replace <150MW Assets	11.10	0.02	0.27	4.54	(0.23)	-
ii)	Replace >150MW Assets	3.57	0.01	0.63	5.12	(2.01)	-
iii)	Replace >=330kV Assets	20.70	0.03	1.57	73.70	1.00	-

The commercial evaluation is based on:

- > Economic life of the assets is assumed 15 years, hence this assessment period has been applied
- > Write-offs have not been estimated
- > Capital cost is not escalated and it does not include capitalised interest

Sensitivities on economic Net Present Value (NPV) for the options with changing discount rates are shown in Table 5.

Table 5 – Discount rate sensitivities (\$ million)

Option	Description	Economic NPV @13%	Economic NPV @6.75%
A	Replace individual Assets	55.70	124.00
i)	Replace <150MW Assets	1.82	9.13

Option	Description	Economic NPV @13%	Economic NPV @6.75%
ii)	Replace >150MW Assets	3.30	8.11
iii)	Replace >=330kV Assets	51.80	109.00

4.2 SFAIRP/ALARP evaluation

Options to reduce the network safety risk as per the risk treatment hierarchy have been considered in other lifecycle stages of the asset, and it has been determined that no reasonably practicable options exist to reduce the risk further than those capital investment options listed below.

Evaluation of the proposed options has been completed against the SFAIRP (So Far As Is Reasonably Practicable)/ALARP (As Low As Reasonably Practical) obligation, as required by the Electricity Supply (Safety and Network Management) Regulation 2014 and the Work Health and Safety Act 2011. The Key Hazardous Events and the disproportionality multipliers considered in the evaluation are as follows:

- > Conductor drop/structure failure - 6 times the bushfire risk, 6 times the safety risk and 10% of the reliability risk (applicable to safety)

The results of this evaluation are summarised in the tables below.

Table 6 – Feasible options (\$ thousand)

Option	Description	CAPEX	Expected Life	Annualised CAPEX
Base	Run-to-fail	N/A	N/A	N/A
A	Replace individual Assets	35,400	15 years	2,360

Table 7 – Annual risk calculations (\$ thousand)

Option	Annual Residual Risk			Annual Risk Savings		
	Safety Risk	Reliability Risk	Bushfire Risk	Safety Risk	Reliability Risk	Bushfire Risk
Base	20	20,090	140	N/A	N/A	N/A
A	0	2,530	20	20	17,560	120

Table 8 – Reasonably practicable test (\$ thousand)

Option	Network Safety Risk Reduction ²	Annualised CAPEX	Reasonably practicable ³ ?
A	2,536	2,360	Yes

Option A is reasonably practicable.

² The Network Safety Risk Reduction is calculated as 6 x Bushfire Risk Reduction + 3 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction

³ Reasonably practicable is defined as whether the annualised CAPEX is less than the Network Safety Risk Reduction

4.3 Preferred option

The outcome of the SFAIRP/ALARP evaluation is that Option A is the preferred option as it is reasonably practicable and provides the greatest network safety risk reduction, and is therefore required to satisfy the organisation's SFAIRP/ALARP obligations.

The option to address the condition of the identified assets, Option A – Replacement of individual Assets is the preferred option for each of the three category of assets identified.

This option has been selected due to its technical viability and reduction in reliability risk. This option provides significant technical benefits and provides the greatest positive NPV.

Refer to Attachment 1 for details of the assets to be replaced under this Need.

Capital and operating expenditure

There is negligible difference in predicted ongoing operational expenditure between the option and Base Case. Implementing Option A will reduce callouts to address defects and this benefit has been captured in the risk assessment. These have been captured as benefits for delivering the project.

Regulatory Investment Test

A Regulatory Investment Test for Transmission (RIT-T) is not required as this is an asset replacement project with no augmentation component.

5. Recommendation

It is recommended to proceed with the replacement of all 303 identified assets.

Attachment 1 – Assets for replacement

A.1 Assets protecting <150MW

A.1.1 D60

D60 <150MW EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000845803	PT	COPBERCR55T4J1	86J DUNEDOO 66KV FEEDER NO1 PROTECTION	BER
000000057936	PT	COPPKSCRD012L1	89L PARKES 66 - 66KV FDR NO1 PROTECTION	PKS
000000057939	PT	COPPKSCRE022M1	898 TRUNDLE 66KV FDR NO1 PROTECTION	PKS
000000020583	PT	NNPPMQCRE8T6G1	703 BORONIA ST 33KV FDR NO1 PROTECTION	PMQ
000000020595	PT	NNPPMQCRF8T6T1	711 LAURIETON 33KV FEEDER NO1 PROTECTION	PMQ
000000020589	PT	NNPPMQCRF9T6P1	708 OWEN ST 33KV FDR NO1 PROTECTION	PMQ
000000048680	PT	NTPAR1CR1592M1	965 KEMPSEY 132KV FEEDER NO1 PROTECTION	AR1
000000048827	PT	NTPGN2CRD092H1	9U3 BOGGABRI EAST 132KV FEEDER NO1 PROT	GN2
000000048833	PT	NTPGN2CRE8T4M1	877 KEEPIT PS 66KV FEEDER NO1 PROTECTION	GN2
000000048839	PT	NTPGN2CRF4T4H1	88K GUNNEDAH 66 - 66KV FEEDER NO1 PROT	GN2
000000048836	PT	NTPGN2CRF7B4K1	88L GUNNEDAH 66 - 66KV FEEDER NO1 PROT	GN2
000000048922	PT	NTPKLKCRB164P1	0896 MACLEAN 66KV FEEDER NO1 PROTECTION	KLK
000000049553	PT	NTPMRECRA304L1	876 BELLATA 66KV FEEDER NO1 PROTECTION	MRE
000000049535	PT	NTPMRECRB202E1	9U2 INVERELL 132 - 132KV FEEDER NO1 PROT	MRE
000000049538	PT	NTPMRECRB242G1	96M NARRABRI 132 - 132KV FEEDER NO1 PROT	MRE
000000049583	PT	NTPNB2CRA222G1	96M MOREE 132KV FEEDER NO1 PROTECTION	NB2
000000077084	PT	NTPTA1CR41T2D1	968 NARRABRI 132 - 132KV FEEDER NO1 PROT	TA1
000000077085	PT	NTPTA1CR42T2V1	969 GUNNEDAH 132 - 132KV FEEDER NO1 PROT	TA1

D60 <150MW EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000062450	PT	SWPGRFCRA202H1	99K DARLINGTON PT 132KV FEEDER NO1 PROT	GRF
000000062470	PT	SWPGRFMAA2T6K1	79F YENDA 33KV FEEDER NO1 PROTECTION	GRF
000000062473	PT	SWPGRFMAA4T6M1	79G GRIFFITH WEST 33KV FEEDER NO1 PROT	GRF
000000062476	PT	SWPGRFMAA5T6N1	79J GRIFFITH 33KV FEEDER NO1 PROTECTION	GRF
000000060494	PT	SWPGRFMAA6T6AH1	FREQ INJECT 33KV FEEDER NO1 PROTECTION	GRF
000000062479	PT	SWPGRFMBB1T6Q1	79L BEELBANGERA 33KV FEEDER NO1 PROT	GRF
000000062482	PT	SWPGRFMBB2T6R1	79M HANWOOD 33KV FEEDER NO1 PROTECTION	GRF
000000140497	PT	SWPGRFMBB4T6T1	79P GOOLGOWI 33KV FFEEDER NO1 PROTECTION	GRF
000000062485	PT	SWPGRFMBB5T6U1	79R THARBOGANG 33KV FDR NO1 PROTECTION	GRF
000000060491	PT	SWPGRFMCC122M1	99J YANCO 132KV FEEDER NO1 PROTECTION	GRF
000000071505	PT	SWPGRFMCC2T6X1	79U GRIFFITH 33KV FEEDER NO1 PROT	GRF
000000062649	PT	SWPTU2MAA1T4F1	828 GUNDAGAI 66KV FEEDER NO1 PROTECTION	TU2
000000062631	PT	SWPTU2MAA202E1	097B BLOWERING 132KV FDR NO1 PROTECTION	TU2
000000062628	PT	SWPTU2MAA222D1	99P GADARA 132KV FEEDER NO1 PROTECTION	TU2
000000062634	PT	SWPTU2MBB222G1	992 BURRINJUCK 132KV FDR NO1 PROTECTION	TU2
000000062828	PT	SWPYA2CRB166Q1	7L6 WHITTON 33KV FEEDER NO1 PROTECTION	YA2
000000062819	PT	SWPYA2CRB226G1	7L3 KAMARAH 33KV FEEDER NO1 PROTECTION	YA2
000000081018	PT	SYPGTHCRRPA1D1	97G/3 GEEHI TEE 132KV FEEDER NO1 PROT	GTH
000000084109	PT	SYPYSNCR67B2E1	976/2 SPRING FLAT TEE 132KV FDR NO1 PROT	YSN
000000084112	PT	SYPYSNCRF052F1	971 GOULBURN TEE 132KV FEEDER NO1 PROT	YSN
000000084115	PT	SYPYSNCRF072G1	999 COWRA 132KV FEEDER NO1 PROTECTION	YSN

D60 <150MW EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000084118	PT	SYPYSNCRF092H1	99M MURRUMBURRAH 132KV FDR NO1 PROTN	YSN
000000084127	PT	SYPYSNCRG022M1	970 BURRINJUCK 132KV FDR NO1 PROTECTION	YSN
000000084124	PT	SYPYSNCRG042L1	990 WAGGA 132 - 132KV FDR NO1 PROTECTION	YSN
000000084121	PT	SYPYSNCRG062K1	973 COWRA 132KV FEEDER NO1 PROTECTION	YSN

A.1.2 L90

L90 <150MW EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000006792	PT	CMPBFWCRBC22C2	264 KINGSFORD 132KV FDR NO2 PROTECTION	BFW
000000020789	PT	NNPVP1CR4002F12	957 OURIMBAH TEE 132KV FEEDER NO2 PROT	VP1
000000020798	PT	NNPWRHCRB062F1	9N9 BROADMEADOW TEE 132KV FDR NO1 PROT	WRH
000000020802	PT	NNPWRHCRC8B2M2	96Y MAYFIELD WEST 132KV FEEDER NO2 PROT	WRH
000000020814	PT	NNPWRHCRD132V2	96X KOORAGANG 132KV FEEDER NO2 PROT	WRH
000000049641	PT	NTPTA1CR39T2M1	97B TAMWORTH 132 - 132KV FEEDER NO1 PROT	TA1
000000076686	PT	NNPMN1CR1572AF2	97E CHARMHAVEN TEE 132KV FEEDER NO2 PROT	MN1
000000152170	PT	COPONOMAA302P2	94G CADIA 132KV FEEDER NO2 PROTECTION	ONO
000000155639	PT	NNPVP1CR4102E12	95T LAKE MUNMORAH 132KV FEEDER NO2 PROT	VP1
000000458832	PT	COPONOMAA252S2	9MC CADIA 132KV FEEDER NO2 PROTECTION	ONO
000000469084	PT	SYPCMACRA112H1	97R STEEPLE FLAT 132KV FDR NO1 PROT	CMA

A.1.3 T60

T60 <150MW EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000092009	PT	COPMTPCR02D6A1	NO1 33KV REACTOR NO1 PROTECTION	MTP
000000092005	PT	COPMTPCR02H6B1	NO2 33KV REACTOR NO1 PROTECTION	MTP

T60 <150MW EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000090812	PT	COPPKSCRC101A1	NO1 132/66/11KV TRANSFORMER NO1 PROT	PKS
000000101543	PT	NNPBAYCRF136A1	NO1 33KV REACTOR NO1 PROTECTION	BAY
000000101541	PT	NNPBAYCRF7T6B1	NO2 33KV REACTOR NO1 PROTECTION	BAY
000000020543	PT	NNPPMQCRB102A2	NO1 132/33/11KV TRANSFORMER NO2 PROT	PMQ
000000020546	PT	NNPPMQCRB112B2	NO2 132/33/11KV TRANSFORMER NO2 PROT	PMQ
000000020558	PT	NNPPMQCRB122C1	NO3 132/33/11KV TRANSFORMER NO1 PROT	PMQ
000000048716	PT	NTPAR1CR84T2E1	NO2 132/66/11KV TRANSFORMER NO1 PROT	AR1
000000048713	PT	NTPAR1CR85T2F1	NO1 132/66/11KV TRANSFORMER NO1 PROT	AR1
000000092573	PT	NTPCOFCRC4T2B1	NO2 132/66/11KV TRANSFORMER NO1 PROT	COF
000000048794	PT	NTPCOFCRC5B2C2	NO3 132/66/11KV TRANSFORMER NO2 PROT	COF
000000048821	PT	NTPGN2CRA5T2A1	NO1 132/66/11KV TRANSFORMER NO1 PROT	GN2
000000048824	PT	NTPGN2CRA7T2B1	NO2 132/66/11KV TRANSFORMER NO1 PROT	GN2
000000087225	PT	NTPGNSCR03C2A1	NO1 132/66/11KV TRANSFORMER NO1 PROT	GNS
000000087228	PT	NTPGNSCR03G2B1	NO2 132/66/11KV TRANSFORMER NO1 PROT	GNS
000000048929	PT	NTPKLKCRA222B1	NO2 132/66/11KV TRANSFORMER NO1 PROT	KLK
000000049790	PT	NTPKS2CRA102C1	NO1 132/33/11KV TRANSFORMER NO1 PROT	KS2
000000049793	PT	NTPKS2CRA122B1	NO2 132/33/11KV TRANSFORMER NO1 PROT	KS2
000000049556	PT	NTPMRECRB8T2A1	NO1 132/66/11KV TRANSFORMER NO1 PROT	MRE
000000092335	PT	NTPNAMCRD022B1	NO2 132/66/11KV TRANSFORMER NO1 PROT	NAM
000000076942	PT	NTPNAMCRD032A2	NO1 132/66/11KV TRANSFORMER NO2 PROT	NAM
000000049605	PT	NTPNB2CRA142C1	NO3 132/66/11KV TRANSFORMER NO1 PROT	NB2

T60 <150MW EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000049599	PT	NTPNB2CRA6T2A1	NO1 132/66/11KV TRANSFORMER NO1 PROT	NB2
000000062171	PT	SWPANMCR0D62A1	NO1 132/11/11KV TRANSFORMER NO1 PROT	ANM
000000062177	PT	SWPANMCRD4T2C1	NO3 132/11/11KV TRANSFORMER NO1 PROT	ANM
000000062174	PT	SWPANMCRD6T2B1	NO2 132/11/11KV TRANSFORMER NO1 PROT	ANM
000000076690	PT	SWPBRDCRT111A2	NO1 220/22KV TRANSFORMER NO2 PROT	BRD
000000062436	PT	SWPFNYCRC111A1	NO1 132/66/11KV TRANSFORMER NO1 PROT	FNY
000000090887	PT	SWPFNYCRC9T1B1	NO2 132/66/11KV TRANSFORMER NO1 PROT	FNY
000000062460	PT	SWPGRFMAA152A1	NO1 132/33/11KV TRANSFORMER NO1 PROT	GRF
000000062463	PT	SWPGRFMBB152B1	NO2 132/33/11KV TRANSFORMER NO1 PROT	GRF
000000071545	PT	SWPGRFMCC152C1	NO3 132/33/11KV TRANSFORMER NO1 PROT	GRF
000000062652	PT	SWPTU2MAA3T4J1	827 TUMUT 66 - 66KV FDR NO1 PROTECTION	TU2
000000062640	PT	SWPTU2MAA8T2A1	NO1 132/66/11KV TRANSFORMER NO1 PROT	TU2
000000062655	PT	SWPTU2MBB4T4L1	829 TUMUT 66 - 66KV FDR NO1 PROTECTION	TU2
000000062643	PT	SWPTU2MBB8T2B1	NO2 132/66/11KV TRANSFORMER NO1 PROT	TU2
000000091966	PT	SWPWGNCRD2T1B21	NO2 132/66/11KV TRANSFORMER NO1 PROT	WGN
000000403271	PT	SWPYA2CRA142B1	NO2 132/33/11KV TRANSFORMER NO1 PROT	YA2
000000062811	PT	SWPYA2CRA162A1	NO1 132/33/11KV TRANSFORMER NO1 PROT	YA2
000000062843	PT	SWPYA2CRB264D1	NO4 66/33KV TRANSFORMER NO1 PROTECTION	YA2
000000057466	PT	SYPMNYCR0C22B1	NO2 132/33/11KV TRANSFORMER NO1 PROT	MNY
000000057463	PT	SYPMNYCRC042A1	NO1 132/33/11KV TRANSFORMER NO1 PROT	MNY
000000138830	PT	SYPQBYCRB1T2B21	NO2 132/66/11KV TRANSFORMER NO1 PROT	QBY

T60 <150MW EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000138827	PT	SY PQBYCRB2T2A21	NO1 132/66/11KV TRANSFORMER NO1 PROT	QBY
000000084099	PT	SY PYSNCRF012D1	NO3 132/66/11KV TRANSFORMER NO1 PROT	YSN

A.2 Assets protecting >150MW

A.2.1 D60

D60 >150MW EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000010162	PT	CMPDPTCR3032V11	988 FAIRFAX LANE TEE 132KV FDR NO1 PROT	DPT
000000011530	PT	COPWL1CRF6T2M1	94K PARKES 132 - 132KV FEEDER NO1 PROT	WL1

A.2.2 L90

L90 >150MW EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000172162	PT	CMPBFNMAA132V2	261 CLOVELLY TEE 132KV NO1 PROT EQUIP	BFN
000000172165	PT	CMPBFNMAA242Q2	91M/3 BUNNERONG 132KV NO2 PROT EQUIP	BFN
000000172184	PT	CMPBFNMAA252S2	9S2 HAYMARKET 132KV NO2 PROT EQUIP	BFN
000000172190	PT	CMPBFNMAA332V2	91A ST PETERS 132KV NO2 PROT EQUIP	BFN
000000172159	PT	CMPBFNMAA362W2	260 CLOVELLY TEE 132KV NO2 PROT EQUIP	BFN
000000172193	PT	CMPBFNMAA552H2	91B CHULLORA TEE 132KV NO2 PROT EQUIP	BFN
000000172187	PT	CMPBFNMAA592L2	9SE GREEN SQUARE 132KV NO2 PROT EQUIP	BFN
000000200696	PT	CMPBFSMAA102D2	9F6 MARRICKVILLE 132KV NO2 PROT EQUIP	BFS
000000200693	PT	CMPBFSMAA132E2	92P BELMORE PK 132KV NO2 PROT EQUIP	BFS
000000200690	PT	CMPBFSMAA242Q2	9SA CAMPBELL ST 132KV NO2 PROT EQUIP	BFS
000000200687	PT	CMPBFSMAA252S2	91U MARRICKVILLE 132KV NO2 PROT EQUIP	BFS
000000172149	PT	CMPBFSMAA282T2	264 KINGSFORD 132KV NO2 PROT EQUIP	BFS

L90 >150MW EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000172494	PT	CMPBFSMAA552H2	9S4 HAYMARKET 132KV NO2 PROTECTION EQUIP	BFS
000000170448	PT	CMPBFSMAA562K2	91X CHULLORA TEE 132KV NO2 PROT EQUIP	BFS
000000010175	PT	CMPDPTCR2242L2	98Y SPRINGHILL 132KV FDR NO2 PROTECTION	DPT
000000010166	PT	CMPDPTCR3022S2	987 TALLAWARRA 132KV FDR NO2 PROT	DPT
000000010160	PT	CMPDPTCR3212W2	984 TALLAWARRA 132KV FDR NO2 PROTECTION	DPT
000000010169	PT	CMPDPTCR3232R2	983 TALLAWARRA 132KV FDR NO2 PROTECTION	DPT
000000010172	PT	CMPDPTCR3282M2	982 SPRINGHILL 132KV FDR NO2 PROTECTION	DPT
000000007284	PT	CMPSE1CR1942GT2	9E5 WILLOUGHBY 132KV FDR NO2 PROTECTION	SE1
000000007272	PT	CMPSE1CR2032FS2	9E3 WILLOUGHBY 132KV FDR NO2 PROTECTION	SE1
000000009995	PT	CMPSYSCR2092L2	916 KURNELL TEE 132KV NO2 PROTECTION	SYS
000000009998	PT	CMPSYSCR2112M2	917 KURNELL TEE 132KV FDR NO2 PROTECTION	SYS
000000009959	PT	CMPSYSCR2132N2	91F PEAKHURST 132KV FDR NO2 PROTECTION	SYS
000000009962	PT	CMPSYSCR2152P2	91J PEAKHURST 132KV FDR NO2 PROTECTION	SYS
000000009977	PT	CMPSYSCR2222U2	911 CHULLORA TEE 132KV NO2 PROTECTION	SYS
000000009974	PT	CMPSYSCR2242V2	910 CHULLORA TEE 132KV NO2 PROTECTION	SYS
000000009989	PT	CMPSYSCR2262W2	914 BANKSTOWN 132KV FDR NO2 PROTECTION	SYS
000000009992	PT	CMPSYSCR2262X2	915 BANKSTOWN 132KV FDR NO2 PROTECTION	SYS
000000011528	PT	COPWL1CRF4B2X2	94F DUBBO 132KV FDR NO2 PROTECTION	WL1
000000020491	PT	NNPNEWCR66B2H2	952 RATHMINES 132KV FDR NO2 PROTECTION	NEW
000000020497	PT	NNPNEWCR70B2M2	950 JESMOND 132KV FEEDER NO2 PROTECTION	NEW
000000020500	PT	NNPNEWCR72T2N2	96Z MARYLAND 132KV FEEDER NO2 PROTECTION	NEW

L90 >150MW EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000020521	PT	NNPNEWCR74B2R2	960 CHARLESTOWN TEE 132KV FDR NO2 PROT	NEW
000000020524	PT	NNPNEWCR76B2S2	961 MEREWETHER TEE 132KV FEEDER NO2 PROT	NEW
000000020530	PT	NNPNEWCR86T2U2	9NA BERESFIELD 132KV FDR NO2 PROTECTION	NEW

A.2.3 T60

NIL

A.3 Assets protecting >330kV

A.3.1 D60

D60 >=330kV EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000010120	PT	CMPDPTMA1101P1	18 KANGAROO VALLEY 330KV NO1 PROTECTION	DPT
000000010130	PT	CMPDPTMA15B1H2	11 SYDNEY SOUTH 330KV FDR NO2 PROTECTION	DPT
000000010127	PT	CMPDPTMA17B1K2	8 MARULAN 330KV FEEDER NO2 PROTECTION	DPT
000000010124	PT	CMPDPTMA18B1N2	10 AVON 330KV FEEDER NO2 PROTECTION	DPT
000000456229	PT	CMPHLDMA09T1D41	1F SYDNEY WEST 330KV NO1 PROTECTION	HLD
000000622446	PT	CMPHLDMA12T1D11	44 ROOKWOOD RD 330KV NO1 PROTECTION	HLD
000000622443	PT	CMPHLDMA13T1E11	43 ROOKWOOD RD 330KV NO1 PROTECTION	HLD
000000457511	PT	CMPHLDMA16T1E41	1C SYDNEY WEST 330KV NO1 PROTECTION	HLD
000000007161	PT	CMPKCR CRA3B0G1	5A2 ERARING 500 - 500KV FEEDER NO1 PROT	KCR
000000007157	PT	CMPKCR CRB5T0B1	5A1 ERARING 500 - 500KV FEEDER NO1 PROT	KCR
000000007183	PT	CMPKCR CRG6T1A1	37 MACARTHUR 330KV FEEDER NO1 PROTECTION	KCR
000000007203	PT	CMPKV SCRLPA1D1	3W CAPITAL WIND FARM 330KV FDR NO1 PROT	KVS
000000007206	PT	CMPKV SCRLPA1G1	18 DAPTO 330KV FEEDER NO1 PROTECTION	KVS

D60 >=330kV EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000088443	PT	CMPMACCRD7T1E11	17 AVON 330KV FEEDER NO1 PROTECTION	MAC
000000088447	PT	CMPMACCRD8T1F11	37 KEMPS CREEK 330KV FDR NO1 PROTECTION	MAC
000000644696	PT	CMPRWRMA12T1B11	44 HOLROYD NO1 PROTECTION EQUIPMENT	RWR
000000644699	PT	CMPRWRMA13T1C11	43 HOLROYD NO1 PROTECTION EQUIPMENT	RWR
000000009922	PT	CMPSYSCR0171J1	13 KEMPS CREEK 330KV FDR NO1 PROTECTION	SYS
000000009931	PT	CMPSYSCR0241N1	12 LIVERPOOL 330KV FEEDER NO1 PROTECTION	SYS
000000009929	PT	CMPSYSCR10B1R2	76 WALLERAWANG 330 - 330KV FDR NO2 PROT	SYS
000000070991	PT	CMPVYDCRD011D1	29 SYDNEY WEST 330KV FEEDER NO1 PROT	VYD
000000070994	PT	CMPVYDCRE041E1	25 ERARING 500 - 330KV FEEDER NO1 PROT	VYD
000000092576	PT	COPMTPCR2KT0C41	5A7 BANNABY - 500KV FDR NO1 PROTECTION	MTP
000000092590	PT	COPMTPCR2LT0D41	5A6 BANNABY - 500KV FDR NO1 PROTECTION	MTP
000000092593	PT	COPMTPCR2ST0C11	5A5 WOLLAR - 500KV FEEDER NO1 PROTECTION	MTP
000000092583	PT	COPMTPCR2TT0D11	5A3 BAYSWATER - 500KV FEEDER NO1 PROT	MTP
000000019672	PT	COPMTPCRA181F1	70 WALLERAWANG 330 - 330KV FDR NO1 PROT	MTP
000000011233	PT	COPMTPCRB131B1	72 WELLINGTON 330KV FDR NO1 PROTECTION	MTP
000000011236	PT	COPMTPCRB161A1	36 FIELD TERMINATED 330KV FDR NO1 PROT	MTP
000000011494	PT	COPWL1CRD5T1D11	79 WOLLAR 330KV FEEDER NO1 PROTECTION	WL1
000000104497	PT	COPWL1CRD6B1F11	72 MT PIPER 500 - 330KV FEEDER NO1 PROT	WL1
000000088482	PT	COPWOLCR2GT0A11	5A4 BAYSWATER 500KV FDR NO1 PROTECTION	WOL
000000088485	PT	COPWOLCR2HT0B11	5A5 MT PIPER 500 - 500KV FEEDER NO1 PROT	WOL
000000088488	PT	COPWOLCR3ET1A1	79 WELLINGTON 330KV FDR NO1 PROTECTION	WOL

D60 >=330kV EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000092444	PT	NNPBAYCRC100AC11	5A3 MT PIPER 500 - 500KV FEEDER NO1 PROT	BAY
000000092440	PT	NNPBAYCRC130AD11	5A4 WOLLAR 500KV FEEDER NO1 PROTECTION	BAY
000000020118	PT	NNPBAYCRG061AC2	34 LIDDELL 330KV FEEDER NO2 PROTECTION	BAY
000000020121	PT	NNPBAYCRG101AD2	33 LIDDELL 330KV FEEDER NO2 PROTECTION	BAY
000000020126	PT	NNPBAYCRH101AF1	32 SYDNEY WEST 330KV FDR NO1 PROTECTION	BAY
000000020189	PT	NNPER0CRC160CF1	5A1 KEMPS CREEK 500KV FDR NO1 PROTECTION	ER0
000000020224	PT	NNPER0CRF141AD11	25 VINEYARD 330KV FEEDER NO1 PROTECTION	ER0
000000020227	PT	NNPER0CRG121AF1	90 NEWCASTLE 330KV FEEDER NO1 PROTECTION	ER0
000000090874	PT	NNPER0CRXXX1AE11	24 VALES POINT 330KV FDR NO1 PROTECTION	ER0
000000020281	PT	NNPLD1CR2971BK1	84 TAMWORTH 330 - 330KV FEEDER NO1 PROT	LD1
000000020345	PT	NNPMN1CR1391AA1	2M TUGGERAH 330KV FEEDER NO1 PROTECTION	MN1
000000020348	PT	NNPMN1CR1531AC1	23 VALES POINT 330KV FDR NO1 PROTECTION	MN1
000000020468	PT	NNPNEWCR1191M1	95 TOMAGO 330 - 330KV FEEDER NO1 PROT	NEW
000000109067	PT	NNPNEWCR1241N11	96 WARATAH WEST 330KV FDR NO1 PROTECTION	NEW
000000020443	PT	NNPNEWCR1271H1	90 ERARING 500 - 330KV FEEDER NO1 PROT	NEW
000000020648	PT	NNPTOMCRA8T1J1	82 LIDDELL 330KV FEEDER NO1 PROTECTION	TOM
000000020642	PT	NNPTOMCRD081G1	94 NEWCASTLE 330KV FDR NO1 PROTECTION	TOM
000000073952	PT	NNPTOMCRD2T1F1	9W WARATAH WEST 330KV FDR NO1 PROTECTION	TOM
000000020757	PT	NNPVP1CR5501B1	24 ERARING 500 - 330KV FEEDER NO1 PROT	VP1
000000020748	PT	NNPVP1CR8241AE1	92 NEWCASTLE 330KV FEEDER NO1 PROTECTION	VP1
000000020751	PT	NNPVP1CR8411AF1	23 MUNMORAH 330KV FEEDER NO1 PROTECTION	VP1

D60 >=330kV EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000107580	PT	NNPWRHCRE031E11	96 NEWCASTLE 330KV FEEDER NO1 PROTECTION	WRH
000000084045	PT	NNPWRHCRE051D1	9W TOMAGO 330 - 330KV FEEDER NO1 PROT	WRH
000000048674	PT	NTPAR1CR0421F1	87 COFFS HARBOUR 330KV FEEDER NO1 PROT	AR1
000000104564	PT	NTPAR1CR1602B21	965 PHASE SHIFT TRANSFORMER NO1 PROT	AR1
000000084961	PT	NTPCOFCRA121A1	89 LISMORE 330 - 330KV FEEDER NO1 PROT	COF
000000084964	PT	NTPCOFCRB131B1	87 ARMIDALE 330 - 330KV FEEDER NO1 PROT	COF
000000053780	PT	NTPLSMCRA031C1	89 COFFS HARBOUR 330KV FEEDER NO1 PROT	LSM
000000062369	PT	SWPDNTECRB2T1G1	63 WAGGA 330 - 330KV FDR NO1 PROTECTION	DNT
000000096601	PT	SYPBBCYCR2ET1A11	36 MARULAN 330KV FEEDER NO1 PROTECTION	BBY
000000096604	PT	SYPBBCYCR2FT1F11	35 MARULAN 330KV FEEDER NO1 PROTECTION	BBY
000000096589	PT	SYPBBCYCR2GT0F11	5A7 MT PIPER 500 - 500KV FDR NO1 PROT	BBY
000000096607	PT	SYPBBCYCR2GT1B11	61 GULLEN RANGE 330KV FEEDER NO1 PROT	BBY
000000096610	PT	SYPBBCYCR2HT1G11	39 SYDNEY WEST 330KV FEEDER NO1 PROT	BBY
000000096592	PT	SYPBBCYCR2MT0B11	5A6 MT PIPER 500 - 500KV FDR NO1 PROT	BBY
000000057292	PT	SYPCA1CR1041M1	6 CAPITAL WIND FARM 330KV FDR NO1 PROT	CA1
000000170999	PT	SYPCA1CR1071F1	3C WILLIAMSDALE 330KV FDR NO1 PROTECTION	CA1
000000057289	PT	SYPCA1CR1251L1	9 YASS 330 - 330KV FDR NO1 PROTECTION	CA1
000000081496	PT	SYPUT1MA07T1F1	01 CANBERRA 330KV FEEDER NO1 PROTECTION	UT1
000000082707	PT	SYPUT1MA11T1J1	65 MURRAY 330KV FEEDER NO1 PROTECTION	UT1
000000082704	PT	SYPUT1MA13T1X1	64 LOWER TUMUT 330KV FDR NO1 PROTECTION	UT1
000000082700	PT	SYPUT1MA16T1V1	2 YASS 330 - 330KV FEEDER NO1 PROTECTION	UT1

D60 >=330kV EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000141905	PT	SYPWDLCR07T1D11	3C CANBERRA 330KV FDR NO1 PROTECTION	WDL
000000084066	PT	SYPYSNCRC021B1	4 MARULAN 330KV FEEDER NO1 PROTECTION	YSN
000000084079	PT	SYPYSNCRD051G1	3 LOWER TUMUT 330KV FDR NO1 PROTECTION	YSN
000000084075	PT	SYPYSNCRE021F1	2 UPPER TUMUT 330KV FDR NO1 PROTECTION	YSN
000000084089	PT	SYPYSNCRE041AF1	3J GULLEN RANGE 330KV FEEDER NO1 PROT	YSN
000000084072	PT	SYPYSNCRE061E1	9 CANBERRA 330KV FEEDER NO1 PROTECTION	YSN
000000084069	PT	SYPYSNCRE081D1	5 MARULAN 330KV FEEDER NO1 PROTECTION	YSN

A.3.2 L90

L90 >=330kV EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000007201	PT	CMPKVSCRLPB1C2	19 BENDEELA 330KV FEEDER NO2 PROTECTION	KVS
000000006769	PT	CMPBFWCRAB91AB1	41 SYDNEY STH 330KV FDR NO1 PROTECTION	BFW
000000082680	PT	SYPMP2CRLPBM112	M11 MSS 330KV FEEDER NO2 PROTECTION	MP2
000000082690	PT	SYPMP1CRLPAM72	M7 MSS 330KV FEEDER NO2 PROTECTION	MP1
000000082691	PT	SYPMP1CRLPAM92	M9 MSS 330KV FEEDER NO2 PROTECTION	MP1
000000076360	PT	CMPSYSCR53T1S11	41 BEACONSFIELD WST 330KV NO1 PROTECTION	SYS
000000082692	PT	SYPMP2CRLPBM132	M13 MSS 330KV FEEDER NO2 PROTECTION	MP2
000000082689	PT	SYPMP1CRXPBM52	M5 MSS 330KV FEEDER NO2 PROTECTION	MP1
000000082717	PT	SYPUT1CRRC21L2	U3 TUMUT 1 PS 330KV FEEDER NO2 PROTN	UT1
000000082720	PT	SYPUT1MA05B1E2	U7 TUMUT 2 PS 330KV FEEDER NO2 PROTN	UT1
000000082604	PT	SYPMURCRRPB1N2	M5 MURRAY 1 PS 330KV FEEDER NO2 PROTN	MUR
000000082607	PT	SYPMURCRLPA1P2	M7 MURRAY 1 PS 330KV FEEDER NO2 PROTN	MUR

L90 >=330kV EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000082610	PT	SYPMURCRLPA1Q2	M9 MURRAY 1 PS 330KV FEEDER NO2 PROTN	MUR
000000082613	PT	SYPMURCRRPB1F2	M11 MURRAY 2 PS 330KV FEEDER NO2 PROTN	MUR
000000082616	PT	SYPMURCRRPB1G2	M13 MURRAY 2 PS 330KV FEEDER NO2 PROTN	MUR
000000101439	PT	SYPBBYCR3FT0B43	NO2 500/330/33KV TX 500KV IZ NO1 PROT	BBY
000000101442	PT	SYPBBYCR3ET0A43	NO1 500/330/33KV TX 500KV IZ NO1 PROT	BBY
000000101445	PT	SYPBBYCR3ET1A41	NO1 500/330/33KV TX 330KV IZ NO1 PROT	BBY
000000101448	PT	SYPBBYCR3FT1B41	NO2 500/330/33KV TX 330KV IZ NO1 PROT	BBY

A.3.3 T60

T60 >=330kV EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000172155	PT	CMPBFNMAA372C1	NO5 TX NO1 PROTECTION EQUIPMENT	BFN
000000200698	PT	CMPBFNMAA7T2A1	NO6 TX NO1 PROTECTION EQUIPMENT	BFN
000000172491	PT	CMPBFSMAA372B2	NO4 TRANSFORMER 330KV NO2 PROT EQUIP	BFS
000000170774	PT	CMPBFSMAA7B2A2	NO3 330/132/11KV TRANSFORMER NO2 PROT	BFS
000000006779	PT	CMPBFWCRA111B1	NO2 330/132/11KV TRANSFORMER NO1 PROT	BFW
000000006772	PT	CMPBFWCRB111A1	NO1 330/132/11KV TRANSFORMER NO1 PROT	BFW
000000010141	PT	CMPDPTCR3121D1	NO3 330/132/11KV TRANSFORMER NO1 PROT	DPT
000000010135	PT	CMPDPTMA1141A1	NO1 330/132/11KV TRANSFORMER NO1 PROT	DPT
000000010138	PT	CMPDPTMA1181B1	NO2 330/132/11KV TRANSFORMER NO1 PROT	DPT
000000010144	PT	CMPDPTMA1231E1	NO4 330/132/11KV TRANSFORMER NO1 PROT	DPT
000000457514	PT	CMPHLDMA05T1A21	NO1 330/132KV TX NO1 PROTECTION EQUIP	HLD
000000465889	PT	CMPHLDMA20T1B21	NO2 330/132KV TX NO1 PROTECTION EQUIP	HLD

T60 >=330kV EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000007171	PT	CMPKCRCRC110B41	NO2 500/330/33KV TRANSFORMER NO1 PROT	KCR
000000007174	PT	CMPKCRCRC7T0C11	NO3 500/330/33KV TRANSFORMER NO1 PROT	KCR
000000010436	PT	CMPKCRCRXXX1D21	SPARE 500/330/33KV TRANSFORMER NO1 PROT	KCR
000000084023	PT	CMPLP1CRD121C1	NO3 330/132/11KV TRANSFORMER NO1 PROT	LP1
000000088437	PT	CMPMACCRC1T1A1	NO1 330/132/11KV TRANSFORMER NO1 PROT	MAC
000000088440	PT	CMPMACCRC6T1C1	NO3 330/66/11KV TRANSFORMER NO1 PROT	MAC
000000644708	PT	CMPRWRMA05T1A21	NO1 330/138/11KV TRANSF NO1 PROT EQUIP	RWR
000000657814	PT	CMPRWRMA09T1B21	NO2 330/138/11KV TRANSF NO1 PROT EQUIP	RWR
000000658438	PT	CMPRWRMA16T1C21	NO3 330/138/11KV TRANSF NO1 PROT EQUIP	RWR
000000007244	PT	CMPSE1CR1681A1	NO1 330/132/16KV TRANSFORMER NO1 PROT	SE1
000000007247	PT	CMPSE1CR1701B1	NO2 330/132/16KV TRANSFORMER NO1 PROT	SE1
000000007250	PT	CMPSE1CR1721C1	NO3 330/132/16KV TRANSFORMER NO1 PROT	SE1
000000404552	PT	CMPSE1CR1741D1	NO4 330/132/11KV TRANSFORMER NO1 PROT	SE1
000000009934	PT	CMPSYSCR4031A1	NO1 330/132/11KV TRANSFORMER NO1 PROT	SYS
000000009937	PT	CMPSYSCR4081E1	NO2 330/132/11KV TRANSFORMER NO1 PROT	SYS
000000009943	PT	CMPSYSCR4131C1	NO4 330/132/11KV TRANSFORMER NO1 PROT	SYS
000000009940	PT	CMPSYSCR4271B1	NO3 330/132/11KV TRANSFORMER NO1 PROT	SYS
000000141448	PT	CMPVYDCRF021C1	NO3 TRANSFORMER 330/132/11KV NO1 PROT	VYD
000000071001	PT	CMPVYDCRF051B11	NO2 TRANSFORMER 330/132/11KV NO1 PROT	VYD
000000070997	PT	CMPVYDCRF081A11	NO1 TRANSFORMER 330/132/11KV NO1 PROT	VYD
000000092603	PT	COPMTPCR02B0A41	NO1 500/330/33KV TRANSFORMER NO1 PROT	MTP

T60 >=330kV EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000092655	PT	COPMTPCR02F0B41	NO2 500/330/33KV TRANSFORMER NO1 PROT	MTP
000000011588	PT	COPMTPCRA111C41	NO3 330/132/11KV TRANSFORMER NO1 PROT	MTP
000000011502	PT	COPWL1CRD1T1A1	NO1 330/132/11KV TRANSFORMER NO1 PROT	WL1
000000011505	PT	COPWL1CRD3T1B1	NO2 330/132/11KV TRANSFORMER NO1 PROT	WL1
000000088479	PT	COPWOLCR02C0A51	NO1 500/330/33KV TRANSFORMER NO1 PROT	WOL
000000092437	PT	NNPBAYCRC110BD11	NO3 GEN 500KV INTERZONE NO1 PROTECTION	BAY
000000092423	PT	NNPBAYCRC140BE11	NO4 GEN 500KV INTERZONE NO1 PROTECTION	BAY
000000092429	PT	NNPBAYCRF110A21	NO1 500/330/33KV TX NO1 PROTECTION	BAY
000000092426	PT	NNPBAYCRF5T0B21	NO2 500/330/33KV TX NO1 PROTECTION	BAY
000000020423	PT	NNPNEWCR14T1A1	NO1 330/132/11KV TRANSFORMER NO1 PROT	NEW
000000020426	PT	NNPNEWCR15T1B1	NO2 330/132/16KV TRANSFORMER NO1 PROT	NEW
000000020430	PT	NNPNEWCR19T1C1	NO3 330/132/16KV TRANSFORMER NO1 PROT	NEW
000000138401	PT	NNPTOMMA01T1N21	NO6 330/132/11KV TRANSFORMER NO1 PROT	TOM
000000204001	PT	NNPTOMMA03T1P21	NO7 330/132/11KV TRANSFORMER NO1 PROT	TOM
000000138404	PT	NNPTOMMA12T1Q21	NO8 330/132/11KV TRANSFORMER NO1 PROT	TOM
000000020767	PT	NNPVP1CR3101BH1	NO1 330/132/11KV TIE TRANSF NO1 PROT	VP1
000000020754	PT	NNPVP1CR3501AH1	NO2 330/132/11KV TIE TRANSF NO1 PROT	VP1
000000107583	PT	NNPWRHCRD061A11	NO1 330/132/11KV TRANSFORMER NO1 PROT	WRH
000000084042	PT	NNPWRHCRD101C1	NO3 330/132/11KV TRANSFORMER NO1 PROT	WRH
000000084967	PT	NTPCOFCRA081D1	NO4 330/132/11KV TRANSFORMER NO1 PROT	COF
000000049647	PT	NTPTA1CR88T1B1	NO2 330/132/11KV TRANSFORMER NO1 PROT	TA1

T60 >=330kV EQUIP_NO	EQUIP_CLASS	PLANT_NO	ITEM_NAME_1	EQUIP_LOCATION
000000049644	PT	NTPTA1CR90T1A1	NO1 330/132/11KV TRANSFORMER NO1 PROT	TA1
000000096595	PT	SYPBBYCR02C0A41	NO1 500/330/33KV TX NO1 PROTECTION	BBY
000000096598	PT	SYPBBYCR02H0B41	NO2 500/330/33KV TX NO1 PROTECTION	BBY
000000057310	PT	SYPCA1CR15T1A1	NO1 330/132/11KV TRANSFORMER NO1 PROT	CA1
000000087092	PT	SYPMURCRRPA1AB1	NO.1 & 2 TRANSFORMERS NO.1 PROTECTION	MUR
000000141911	PT	SYPWDLCR10T1C11	NO3 330/132/11KV TRANSFORMER NO1 PROT	WDL
000000141908	PT	SYPWDLCR12T1A11	NO1 330/132/11KV TRANSFORMER NO1 PROT	WDL
000000084093	PT	SYPYSNCRD091AE1	NO1 330/132/11KV TRANSFORMER NO1 PROT	YSN
000000084096	PT	SYPYSNCRE101AB1	NO2 330/132/11KV TRANSFORMER NO1 PROT	YSN

Attachment 2 – Commercial evaluation report

Option A NPV calculation

Project_Option Name			Option A - Individual Asset Replacements - All Assets		
1. Financial Evaluation (excludes VCR benefits)					
NPV @ standard discount rate	10.00%	-\$1.24m	NPV / Capital (Ratio)	-0.03	
NPV @ upper bound rate	13.00%	-\$5.88m	Pay Back Period (Yrs)	0.09 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$6.95m	IRR%	9.39%	
2. Economic Evaluation (includes VCR benefits but excludes tax benefits from non-cash transactions, ENS penalty and overall tax cost)					
NPV @ standard discount rate	10.00%	\$81.69m	NPV / Capital (Ratio)	2.31	
NPV @ upper bound rate	13.00%	\$55.71m	Pay Back Period (Yrs)	1.54 Yrs	
NPV @ lower bound rate (WACC)	6.75%	\$124.16m	IRR%	33.27%	
Benefits					
Risk cost	As Is	To Be	Benefit	VCR Benefit	\$17.56m
Systems (reliability)	\$20.09m	\$2.53m	\$17.56m	ENS Penalty	\$0.00m
Financial	\$5.72m	\$0.37m	\$5.35m	All other risk benefits	\$5.49m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$23.05m
People (safety)	\$0.02m	\$0.00m	\$0.02m		
Environment	\$0.14m	\$0.02m	\$0.12m	Benefits in the financial NPV*	\$5.49m
Reputation	\$0.00m	\$0.00m	\$0.00m	*excludes VCR benefits	
Total Risk benefits	\$25.97m	\$2.92m	\$23.05m		
Cost savings and other benefits			\$0.00m	Benefits in the economic NPV**	\$23.05m
Total Benefits			\$23.05m	**excludes ENS penalty	
Other Financial Drivers					
Incremental opex cost pa (no depreciation)			-\$0.05m	Write-off cost	\$0.00m
Capital - initial \$m			-\$35.40m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment			\$0.00m	Re-investment capital	\$0.00m
Capitalisation period			5.00 Yrs	Start of the re-investment period	0.00 Yrs

Option A(i) NPV calculation

Project_Option Name

Option A - Individual Asset Replacements - Only assets <=150M

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	-\$0.23m	NPV / Capital (Ratio)	-0.02
NPV @ upper bound rate	13.00%	-\$1.72m	Pay Back Period (Yrs)	0.10 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$2.39m	IRR%	9.64%

2. Economic Evaluation (includes VCR benefits but excludes tax benefits from non-cash transactions, ENS penalty and overall tax cost)

NPV @ standard discount rate	10.00%	\$4.54m	NPV / Capital (Ratio)	0.41
NPV @ upper bound rate	13.00%	\$1.82m	Pay Back Period (Yrs)	4.04 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$9.13m	IRR%	16.04%

Benefits

Risk cost	As Is	To Be	Benefit	VCR Benefit	\$1.01m
Systems (reliability)	\$1.16m	\$0.15m	\$1.01m	ENS Penalty	\$0.00m
Financial	\$1.83m	\$0.12m	\$1.71m	All other risk benefits	\$1.75m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$2.76m
People (safety)	\$0.00m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$1.75m
Environment	\$0.04m	\$0.00m	\$0.04m	*excludes VCR benefits	
Reputation	\$0.00m	\$0.00m	\$0.00m	Benefits in the economic NPV**	\$2.76m
Total Risk benefits	\$3.03m	\$0.27m	\$2.76m	**excludes ENS penalty	
Cost savings and other benefits			\$0.00m		
Total Benefits			\$2.76m		

Other Financial Drivers

Incremental opex cost pa (no depreciation)	-\$0.02m	Write-off cost	\$0.00m
Capital - initial \$m	-\$11.07m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment	\$0.00m	Re-investment capital	\$0.00m
Capitalisation period	5.00 Yrs	Start of the re-investment period	0.00 Yrs

Option A(ii) NPV calculation

Project_Option Name

Option A - Individual Asset Replacements - Only assets >150MW

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	-\$2.01m	NPV / Capital (Ratio)	-0.56
NPV @ upper bound rate	13.00%	-\$2.00m	Pay Back Period (Yrs)	-0.05 Yrs
NPV @ lower bound rate (WACC)	6.75%	-\$1.97m	IRR%	-4.60%

2. Economic Evaluation (includes VCR benefits but excludes tax benefits from non-cash transactions, ENS penalty and overall tax cost)

NPV @ standard discount rate	10.00%	\$5.12m	NPV / Capital (Ratio)	1.43
NPV @ upper bound rate	13.00%	\$3.30m	Pay Back Period (Yrs)	2.15 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$8.11m	IRR%	26.61%

Benefits

Risk cost	As Is	To Be	Benefit	VCR Benefit	\$1.51m
Systems (reliability)	\$2.10m	\$0.59m	\$1.51m	ENS Penalty	\$0.00m
Financial	\$0.19m	\$0.04m	\$0.15m	All other risk benefits	\$0.16m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$1.67m
People (safety)	\$0.00m	\$0.00m	\$0.00m	Benefits in the financial NPV*	\$0.16m
Environment	\$0.01m	\$0.00m	\$0.01m	*excludes VCR benefits	
Reputation	\$0.00m	\$0.00m	\$0.00m	Benefits in the economic NPV**	\$1.67m
Total Risk benefits	\$2.30m	\$0.63m	\$1.67m	**excludes ENS penalty	
Cost savings and other benefits			\$0.00m		
Total Benefits			\$1.67m		

Other Financial Drivers

Incremental opex cost pa (no depreciation)	-\$0.01m	Write-off cost	\$0.00m
Capital - initial \$m	-\$3.58m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment	\$0.00m	Re-investment capital	\$0.00m
Capitalisation period	5.00 Yrs	Start of the re-investment period	0.00 Yrs

Option A(iii) NPV calculation

Project_Option Name

Option A - Individual Asset Replacements - assets >=330kV

1. Financial Evaluation (excludes VCR benefits)

NPV @ standard discount rate	10.00%	\$1.00m	NPV / Capital (Ratio)	0.05
NPV @ upper bound rate	13.00%	-\$2.17m	Pay Back Period (Yrs)	0.11 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$6.52m	IRR%	10.81%

2. Economic Evaluation (includes VCR benefits but excludes tax benefits from non-cash transactions, ENS penalty and overall tax cost)

NPV @ standard discount rate	10.00%	\$73.69m	NPV / Capital (Ratio)	3.55
NPV @ upper bound rate	13.00%	\$51.82m	Pay Back Period (Yrs)	1.10 Yrs
NPV @ lower bound rate (WACC)	6.75%	\$109.25m	IRR%	40.81%

Benefits

Risk cost	As Is	To Be	Benefit	VCR Benefit	\$15.39m
Systems (reliability)	\$16.74m	\$1.35m	\$15.39m	ENS Penalty	\$0.00m
Financial	\$3.70m	\$0.21m	\$3.49m	All other risk benefits	\$3.58m
Operational/compliance	\$0.00m	\$0.00m	\$0.00m	Total Risk benefits	\$18.97m
People (safety)	\$0.01m	\$0.00m	\$0.01m	Benefits in the financial NPV*	\$3.58m
Environment	\$0.09m	\$0.01m	\$0.08m	*excludes VCR benefits	
Reputation	\$0.00m	\$0.00m	\$0.00m	Benefits in the economic NPV**	\$18.97m
Total Risk benefits	\$20.54m	\$1.57m	\$18.97m	**excludes ENS penalty	
Cost savings and other benefits			\$0.00m		
Total Benefits			\$18.97m		

Other Financial Drivers

Incremental opex cost pa (no depreciation)	-\$0.03m	Write-off cost	\$0.00m
Capital - initial \$m	-\$20.76m	Major Asset Life (Yrs)	15.00 Yrs
Residual Value - initial investment	\$0.00m	Re-investment capital	\$0.00m
Capitalisation period	5.00 Yrs	Start of the re-investment period	0.00 Yrs