

OPTIONS EVALUATION REPORT (OER)



Various Location Disconnecter Renewal

OER 000000001357 revision 5.0

Ellipse project no.: P0007982

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

Project category: Prescribed - Asset Renewal Strategies

Approvals

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Date submitted for approval	16 December 2016	

Change history

Revision	Date	Amendment
0	24 June 2016	Initial issue
1	30 June 2016	Removal of SYN 330kV disconnecter and updated affected information (Capex, risk, NPV and Attachment A)
2	28 October 2016	Updated risk costs, Capex figures, NPV, ALARP methodology and asset list in Attachment A
3	1 December 2016	Update to format
4	15 December 2016	Minor amendment to correct un-escalated dollars statement & 18/19 refs
5	16 December 2016	Minor amendment to correct reference error (PDF conversion)

1. Need/opportunity

Disconnectors are typically used within substations to provide visible isolation of associated switchgear from the network to allow work to be performed. As the isolation point itself cannot be worked on, the network outage required to access the disconnector itself is often wider due to the need to isolate via upstream disconnectors. As a result, preventative maintenance is not performed on most disconnectors and the disconnectors are essentially run until failure.

Earth switches are often integrated into the disconnector construction, being procured at the same time from the same manufacturer. Therefore replacement of the disconnector routinely requires the replacement of the associated earth switch where fitted.

2. Related Needs/opportunities

Separate programs for other substation assets are being developed and should be considered when packaging work.

3. Options

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

The Options Screening Report outlines the options which were considered as not feasible to address this Need, which included refurbishment which was excluded on the basis of cost and risk.

Base Case

The Base Case is to continue to try and maintain the disconnectors and run them to failure. The risk cost associated with this option is \$17.40m.

Option A — Replacement of disconnectors with new units [\[OFR 1357A, OFS 1357A\]](#)

This option involves the replacement of the identified disconnectors in order to reduce the risk of failure and the associated risk cost. The risk associated with the disconnectors is primarily a result of the reliability, financial and safety implications of the aging assets. The total Capex value differs from the value stated below because the number of individual assets that will be replaced has increased based on the evaluation in this OER.

There is a minor reduction in Opex associated with defect work resulting from the replacement of the disconnectors, however this has been excluded from the evaluation.

4. Evaluation

4.1 Commercial evaluation

The result of commercial evaluation for each of the options is summarised in Table 1.

Table 1 – Commercial evaluation (\$ million)

Option	Description	Total capex	Annual opex	Annual post project risk cost	Economic NPV @10%	Rank
Base Case	Do nothing and run-to-failure	-	-	17.4	-	2

Option	Description	Total capex	Annual opex	Annual post project risk cost	Economic NPV @10%	Rank
A	Replace with new disconnectors	10.7	-	0	185.1	1

The Net Present Value (NPV) analysis (discounted to June 2019) assumes that each asset replacement listed in Attachment A occurs during the 5 year regulatory period. The timing of the replacements should generally occur with the highest NPV replacements first. The NPVs listed in Attachment 1 are calculated with units being replaced in various years throughout the period which affects individual NPVs.

The economic evaluation is based on:

- > a discount rate of 10%.

Sensitivities on economic Net Present Value (NPV) for the option with changing discount rates are shown in Table 2.

The sensitivity analysis is based on TransGrid's current Australian Energy Regulator (AER)-determined pre-tax real regulatory Weighted Average Cost of Capital (WACC) of 6.75% and an upper bound of 13%. The sensitivity analysis demonstrates a positive NPV for the range of discount rates considered.

Table 2 – Discount rate sensitivities (\$ million)

Option	Description	Economic NPV @13%	Economic NPV @6.75%
A	Replace with new disconnectors	123.4	301.6

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 in Table 1.

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:

- > Catastrophic failure of asset/uncontrolled discharge or contact with electricity/ unauthorised access to site - 3 times the safety risk and 10% of the reliability risk (applicable to safety)
- > Unplanned outage of High Voltage (HV) equipment - 10% of the reliability risk (applicable to safety)

The results of this evaluation are summarised in the tables below which includes only those assets which are considered reasonably practicable (refer to Attachment 1 for the result on each asset).

Table 3 – Annual risk calculations (\$ thousand)

Option	Annual Residual Risk			Annual Risk Savings		
	Safety Risk	Reliability Risk	Bushfire Risk	Safety Risk	Reliability Risk	Bushfire Risk
Base	13	16,969	N/A	N/A	N/A	N/A
A	0	0	N/A	13	16,969	N/A

Table 4 – Reasonably practicable test (\$ thousand)

Option	Network Safety Risk Reduction ¹	Annualised CAPEX	Reasonably practicable ² ?
A	1,735	237	Refer to Attachment 1

The SFAIRP/ALARP evaluation has been completed for each individual asset. A summary of the results of the test included in Table 4 and the result for each individual asset is provided in Attachment 1.

4.3 Preferred option

The outcome of the SFAIRP/ALARP evaluation is that Option A is the preferred option for the relevant assets as it is reasonably practicable and is therefore required to satisfy the organisation's SFAIRP/ALARP obligations.

The outcome of the commercial evaluation is also to implement Option A for the particular assets which have a positive NPV.

Capital and operating expenditure

There are no other ongoing capital or operating expenditure considerations beyond the initial asset replacement 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 that Project Approval Documents be prepared to implement Option A for the replacement of the disconnectors identified in Attachment 1 (which includes assets justified under ALARP or economic evaluations), with a total capex of \$10.70m.

¹ The Network Safety Risk Reduction is calculated as 6 x Bushfire Risk Reduction + 3 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction

² Reasonably practicable is defined as whether the annualised CAPEX is less than the Network Safety Risk Reduction

Attachment 1

Table 5 provides a summary of the disconnectors requiring replacement and Table 6 shows the specific assets.

Table 5 – Summary of disconnector quantities

Voltage (kV)	Number of replacements
132	41
330	21
Grand Total	62

Table 6 should be read in conjunction with the following notes:

- > The “Replace based on evaluation” column confirms whether or not replacement is required based on either SFAIRP/ALARP or economic NPV evaluations or both.
- > The actual asset selected may be required to be substituted with another disconnector within the same bay, however this does not impact on the required Capex and all alternate assets have similar positive NPV.

Table 6 – Evaluation of individual assets

No.	PIC Number (or alt. reference)	Bay Reference	Name	Voltage	Replace based on evaluation	NPV @ 10%, as at Jun'19
1	NNSTRE2BB3-DIS 4443	NNSTRE2BB3	DIS 4443	132	Yes -Economic and ALARP	\$ 13,782,523
2	NNSTRE2BB3-DIS 9633	NNSTRE2BB3	DIS 9633	132	Yes -Economic and ALARP	\$ 13,752,919
3	NNSTRE2BB3-DIS 4026	NNSTRE2BB3	DIS 4026	132	Yes -Economic and ALARP	\$ 13,751,356
4	NNSTRE2BB3-DIS 4118	NNSTRE2BB3	DIS 4118	132kV+1esw	Yes -Economic and ALARP	\$ 13,740,787
5	SWSGRF2J1-DIS 99K3	SWSGRF2J1	DIS 99K3	132	Yes -Economic and ALARP	\$ 11,706,382
6	SWSGRF2J1-DIS 4413	SWSGRF2J1	DIS 4413	132	Yes -Economic and ALARP	\$ 11,674,576
7	SWSGRF2J2-DIS 4423	SWSGRF2J2	DIS 4423	132	Yes -Economic and ALARP	\$ 11,674,576
8	SWSGRF2J2-DIS 4106	SWSGRF2J2	DIS 4106	132	Yes -Economic and ALARP	\$ 11,540,920
9	SWSGRF2J2-DIS 4117	SWSGRF2J2	DIS 4117	132	Yes -Economic and ALARP	\$ 11,540,920
10	SWSTU22F1-DIS 97B3	SWSTU22F1	DIS 97B3	132	Yes -Economic and ALARP	\$ 6,990,747
11	SWSTU22F1-DIS 4413	SWSTU22F1	DIS 4413	132	Yes -Economic and ALARP	\$ 6,943,257
12	SWSTU22F2-DIS 4423	SWSTU22F2	DIS 4423	132	Yes -Economic and ALARP	\$ 6,943,257

No.	PIC Number (or alt. reference)	Bay Reference	Name	Voltage	Replace based on evaluation	NPV @ 10%, as at Jun'19
13	SWSTU22F1-DIS 99P3	SWSTU22F1	DIS 99P3	132	Yes -Economic and ALARP	\$ 6,855,050
14	SWSTU22F2-DIS 9923	SWSTU22F2	DIS 9923	132	Yes -Economic and ALARP	\$ 6,844,725
15	SWSTU22F2-DIS 4108	SWSTU22F2	DIS 4108	132	Yes -Economic and ALARP	\$ 6,843,250
16	SWSTU22F1-DIS 4107	SWSTU22F1	DIS 4107	132kV+1esw	Yes -Economic and ALARP	\$ 6,832,681
17	CMSSYW1H1-DIS 321	CMSSYW1H1	DIS 321	330kV+1Esw	Yes -Economic and ALARP	\$ 5,769,892
18	CMSSYN1K2-DIS 283	CMSSYN1K2	DIS 283	330kV+1Esw	Yes -Economic and ALARP	\$ 1,513,534
19	CMSSYN1J2-DIS 273	CMSSYN1J2	DIS 273	330kV+1Esw	Yes -Economic and ALARP	\$ 1,513,534
20	CMSSYW1K1-DIS 383	CMSSYW1K1	DIS 383	330kV+1Esw	Yes -Economic and ALARP	\$ 1,357,562
21	CMSSYW1M-29 VINEYARD 330KV FEEDER	CMSSYW1M	29 VINEYARD 330KV FEEDER	132kV+1esw	Yes -Economic and ALARP	\$ 1,181,215
22	CMSSYW1K1-DIS 303	CMSSYW1K1	DIS 303	330kV+1Esw	Yes -Economic and ALARP	\$ 967,071
23	H71507/3	CMSSYN2N	92B LANE COVE 132KV FEEDER	132kV+1esw	Yes -Economic and ALARP	\$ 770,489
24	H71502/1	CMSSYN2P	92A LANE COVE 132KV FEEDER	132kV+1esw	Yes -Economic and ALARP	\$ 770,489
25	A06589/4	SYSCA12L	NO2 LATHAM 132KV FEEDER	132kV+1esw	Yes -Economic and ALARP	\$ 657,148
26	A06585/1	SYSCA12M	976/1 QUEANBEYAN 132KV FEEDER	132kV+1esw	Yes -Economic and ALARP	\$ 598,772
27	A06587/1	SYSCA12R	NO3 GOLD CREEK 132KV FEEDER	132kV+1esw	Yes -Economic and ALARP	\$ 557,729
28	NTSTA11F2-DIS 883	NTSTA11F2	DIS 883	330	Yes -Economic and ALARP	\$ 531,047
29	NTSTA11F1-DIS 5413	NTSTA11F1	DIS 5413	330	Yes -Economic and ALARP	\$ 528,929
30	NTSTA11F2-DIS 5423	NTSTA11F2	DIS 5423	330	Yes -Economic and ALARP	\$ 528,929
31	A08677/2	NTSTA11F1	TA1 843	330	Yes -Economic and ALARP	\$ 527,831
32	NTSTA11F1-DIS 863	NTSTA11F1	DIS 863	330	Yes -Economic and ALARP	\$ 527,831
33	NTSTA11F2-TA1 853	NTSTA11F2	TA1 853	330	Yes -Economic and ALARP	\$ 527,831

No.	PIC Number (or alt. reference)	Bay Reference	Name	Voltage	Replace based on evaluation	NPV @ 10%, as at Jun'19
34	NTSTA11F1-DIS 5107	NTSTA11F1	DIS 5107	330kV+1Esw	Yes -Economic and ALARP	\$ 507,507
35	NTSTA11F2-DIS 5108	NTSTA11F2	DIS 5108	330kV+1Esw	Yes -Economic and ALARP	\$ 507,507
36	CMSSYN2F-DIS 9271	CMSSYN2F	DIS 9271	132kV+1esw	Yes -Economic and ALARP	\$ 494,120
37	CMSSYN1K2-DIS 5433	CMSSYN1K2	DIS 5433	330kV+1Esw	Yes - Economic (Actual disconnecter required in this bay may change)	\$ 356,530
38	CMSSYN1J2-DIS 5443	CMSSYN1J2	DIS 5443	330kV+1Esw	Yes - Economic (Actual disconnecter required in this bay may change)	\$ 356,530
39	CMSSYN1K2-DIS 5118	CMSSYN1K2	DIS 5118	330kV+1Esw	Yes - Economic (Actual disconnecter required in this bay may change)	\$ 333,558
40	CMSSYN1J2-DIS 5108	CMSSYN1J2	DIS 5108	330kV+1Esw	Yes - Economic (Actual disconnecter required in this bay may change)	\$ 333,558
41	A05948/5	CMSAVS1A	AVS 171	330kV+1Esw	Yes - Economic	\$ 285,982
42	TBA-VP1-95T7	NNSVP12E3	VP1 95T7	132	Yes -Economic and ALARP	\$ 251,285
43	H71494/3	CMSSYN2R	250 BEROWRA 132KV FEEDER	132kV+1esw	Yes - Economic	\$ 244,779
44	TBA-VP1-4938	NNSVP12E3	VP1 4938	132kV+1esw	Yes - Economic	\$ 240,717
45	A03077/1	CMSSYW2E	93X NEPEAN 132KV FEEDER	132kV+1esw	Yes - Economic	\$ 200,451
46	A08675/1	NTSTA12E	97C TAMWORTH132 132KV FEEDER	132kV+1esw	Yes - Economic	\$ 149,210
47	A06588/1	SYSCA12S	977/1 QUEANBEYAN 132KV FEEDER	132kV+1esw	Yes - Economic	\$ 149,210
48	A07223/4	SWSALB2H1	997/1 COROWA 132kV FEEDER	132kV+1esw	Yes - Economic	\$ 107,076
49	CMSSYN1L1-DIS 211	CMSSYN1L1	DIS 211	330kV+1Esw	Yes - Economic	\$ 58,231
50	TBA-VP1-4937	NNSVP12E3	VP1 4937	132kV+2esw	Yes - Economic	\$ 45,681
51	SWSHU22BB-995 ALBURY 132kV FEEDER	SWSHU22BB	995 ALBURY 132kV FEEDER	132	Yes - Economic	\$ 38,183
52	SWSHU22BB-NO2 TX	SWSHU22BB	NO2 TX	132	Yes - Economic	\$ 35,892
53	SWSHU22BB-NO3 TX	SWSHU22BB	NO3 TX	132	Yes - Economic	\$ 35,892
54	A07223/9	SWSALB2L	995 HUME 132kV FEEDER	132kV+1esw	Yes - Economic	\$ 27,615
55	SWSWG11F1	SWSWG11F1	WG1 621	330	Yes - Economic	\$ 16,686
56	CMSAVS1BB-AVS 173	CMSAVS1BB	AVS 173	330	Yes - Economic	\$ 16,345

No.	PIC Number (or alt. reference)	Bay Reference	Name	Voltage	Replace based on evaluation	NPV @ 10%, as at Jun'19
57	TBA-VP1-4947	NNSVP12F3	VP1 4947	132kV+1esw	Yes - Economic	\$ 13,450
58	TBA-VP1-4948	NNSVP12F3	VP1 4948	132kV+1esw	Yes - Economic	\$ 13,450
59	A08675/2	NTSTA12M	97D TAMWORTH132 132KV FEEDER	132kV+1esw	Yes - Economic	\$ 11,522
60	CMSSYN1B2-DIS 4429	CMSSYN1B2	DIS 4429	132	Yes - Economic	\$ 10,649
61	CMSSYN1C2-DIS 4439	CMSSYN1C2	DIS 4439	132	Yes - Economic	\$ 10,649
62	TBA-VP1-9577	NNSVP12F3	VP1 9577	132	Yes - Economic	\$ 5,329