

# OPTIONS EVALUATION REPORT (OER)

Various Location Disconnecter Renewal

OER 000000001357 revision 5.0



**Ellipse project no.:** P0007982

**TRIM file:** [TRIM No]

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

**Project category:** Prescribed - Asset Renewal Strategies

## Approvals

|                                    |                  |                              |
|------------------------------------|------------------|------------------------------|
| <b>Author</b>                      | Evan Lamplough   | Substations Asset Strategist |
| <b>Endorsed</b>                    | Tony Gray        | Substations Asset Manager    |
|                                    | Azil Khan        | Investment Analysis Manager  |
| <b>Approved</b>                    | Lance Wee        | Manager / Asset Strategy     |
| <b>Date submitted for approval</b> | 16 December 2016 |                              |

## Change history

| Revision | Date             | Amendment  |
|----------|------------------|--|
| 0        | 24 June 2016     | Initial issue  |
| 1        | 30 June 2016     | Removal of SYN 330kV disconnector 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 <sup>1</sup> | Annualised CAPEX | Reasonably practicable <sup>2</sup> ? |
|--------|--|------------------|---------------------------------------|
| 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.

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

<sup>2</sup> 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                     |
| <b>Grand Total</b> | <b>62</b>              |

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<br>(or alt. reference) | Bay Reference | Name     | Voltage    | Replace based on<br>evaluation | NPV @ 10%,<br>as at Jun'19 |
|-----|-----------------------------------|---------------|----------|------------|--------------------------------|----------------------------|
| 1   | NNSTRE2BB3-DIS 4443               | NNSTRE2BB3    | DIS 4443 | 132        | Yes -Economic and<br>ALARP     | \$ 13,782,523              |
| 2   | NNSTRE2BB3-DIS 9633               | NNSTRE2BB3    | DIS 9633 | 132        | Yes -Economic and<br>ALARP     | \$ 13,752,919              |
| 3   | NNSTRE2BB3-DIS 4026               | NNSTRE2BB3    | DIS 4026 | 132        | Yes -Economic and<br>ALARP     | \$ 13,751,356              |
| 4   | NNSTRE2BB3-DIS 4118               | NNSTRE2BB3    | DIS 4118 | 132kV+1esw | Yes -Economic and<br>ALARP     | \$ 13,740,787              |
| 5   | SWSGRF2J1-DIS 99K3                | SWSGRF2J1     | DIS 99K3 | 132        | Yes -Economic and<br>ALARP     | \$ 11,706,382              |
| 6   | SWSGRF2J1-DIS 4413                | SWSGRF2J1     | DIS 4413 | 132        | Yes -Economic and<br>ALARP     | \$ 11,674,576              |
| 7   | SWSGRF2J2-DIS 4423                | SWSGRF2J2     | DIS 4423 | 132        | Yes -Economic and<br>ALARP     | \$ 11,674,576              |
| 8   | SWSGRF2J2-DIS 4106                | SWSGRF2J2     | DIS 4106 | 132        | Yes -Economic and<br>ALARP     | \$ 11,540,920              |
| 9   | SWSGRF2J2-DIS 4117                | SWSGRF2J2     | DIS 4117 | 132        | Yes -Economic and<br>ALARP     | \$ 11,540,920              |
| 10  | SWSTU22F1-DIS 97B3                | SWSTU22F1     | DIS 97B3 | 132        | Yes -Economic and<br>ALARP     | \$ 6,990,747               |
| 11  | SWSTU22F1-DIS 4413                | SWSTU22F1     | DIS 4413 | 132        | Yes -Economic and<br>ALARP     | \$ 6,943,257               |
| 12  | SWSTU22F2-DIS 4423                | SWSTU22F2     | DIS 4423 | 132        | Yes -Economic and<br>ALARP     | \$ 6,943,257               |

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

| No. | PIC Number<br>(or alt. reference)       | Bay Reference | Name                                | Voltage    | Replace based on<br>evaluation   | NPV @ 10%,<br>as at Jun'19 |
|-----|---|---------------|-------------------------------------|------------|--|----------------------------|
| 34  | NTSTA11F1-DIS 5107                      | NTSTA11F1     | DIS 5107                            | 330kV+1Esw | Yes -Economic and<br>ALARP   | \$ 507,507                 |
| 35  | NTSTA11F2-DIS 5108                      | NTSTA11F2     | DIS 5108                            | 330kV+1Esw | Yes -Economic and<br>ALARP   | \$ 507,507                 |
| 36  | CMSSYN2F-DIS 9271                       | CMSSYN2F      | DIS 9271                            | 132kV+1esw | Yes -Economic and<br>ALARP   | \$ 494,120                 |
| 37  | CMSSYN1K2-DIS 5433                      | CMSSYN1K2     | DIS 5433                            | 330kV+1Esw | Yes - Economic (Actual<br>disconnecter required in<br>this bay may change) | \$ 356,530                 |
| 38  | CMSSYN1J2-DIS 5443                      | CMSSYN1J2     | DIS 5443                            | 330kV+1Esw | Yes - Economic (Actual<br>disconnecter required in<br>this bay may change) | \$ 356,530                 |
| 39  | CMSSYN1K2-DIS 5118                      | CMSSYN1K2     | DIS 5118                            | 330kV+1Esw | Yes - Economic (Actual<br>disconnecter required in<br>this bay may change) | \$ 333,558                 |
| 40  | CMSSYN1J2-DIS 5108                      | CMSSYN1J2     | DIS 5108                            | 330kV+1Esw | Yes - Economic (Actual<br>disconnecter required in<br>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<br>ALARP   | \$ 251,285                 |
| 43  | H71494/3                                | CMSSYN2R      | 250 BEROWRA<br>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<br>132KV FEEDER          | 132kV+1esw | Yes - Economic   | \$ 200,451                 |
| 46  | A08675/1                                | NTSTA12E      | 97C<br>TAMWORTH132<br>132KV FEEDER  | 132kV+1esw | Yes - Economic   | \$ 149,210                 |
| 47  | A06588/1                                | SYSCA12S      | 977/1<br>QUEANBEYAN<br>132KV FEEDER | 132kV+1esw | Yes - Economic   | \$ 149,210                 |
| 48  | A07223/4                                | SWSALB2H1     | 997/1 COROWA<br>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<br>ALBURY 132kV<br>FEEDER | SWSHU22BB     | 995 ALBURY<br>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<br>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<br>(or alt. reference) | Bay Reference | Name                               | Voltage    | Replace based on<br>evaluation | NPV @ 10%,<br>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<br>TAMWORTH132<br>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                   |