NEED/OPPORTUNITY STATEMENT

Continuation of Supply to the ACT

NOS-0335 Revision 0

Ellipse project no(s): DCN335
TRIM file: MF1495

Project reason: Reliability - To meet connection point reliability requirements
Project category: Prescribed - Augmentation

Approvals

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Date submitted for approval	8 December 2016	

1. BACKGROUND

The Australian Capital Territory (ACT) is connected to the National Electricity Market (NEM) by TransGrid's electricity transmission network which supplies the territory's Distribution Network Service Provider (ActewAGL) at two bulk supply points (BSP): Canberra 330/132 kV substation, and Williamsdale 330/132 kV substation.

Canberra 330/132 kV substation is supplied by Upper Tumut and Lower Tumut at 330 kV. The Canberra 132 kV busbar provides one of two BSPs to ActewAGLs' distribution network supplying the ACT through Woden, Latham, Gold Creek, and Fyshwick (via Queanbeyan). Canberra substation is equipped with four 330/132 kV transformers, and four 132 kV capacitor banks.

Williamsdale 330/132 kV substation is solely supplied by Canberra 330/132 kV substation at 330 kV. The Williamsdale 132 kV busbar provides the second BSP to ActewAGLs' distribution network supplying the ACT through Gilmore and Theodore. Williamsdale substation is equipped with two 330/132 kV transformers and no reactive plant.

The following technical requirements relates to the serviceability of the network suppling the ACT during a High Impact Low Probability (HILP) event defined here as a 'special contingency event'.

The Code provides the definition in the Dictionary

> *(15)* ***special contingency event*** *means the unexpected disconnection of all or multiple elements at a single geographic location for an extended period of time and includes the loss of supply to connection points.*

Technical Requirements

The technical requirements for TransGrids' supply to the ACT are set out under its Utility Services Licence established under the Utilities Act 2000 (ACT), approved 11 July 2016. Under the licence issued by the Independent Competition and Regulatory Commission (ICRC), TransGrid (as the Licensee) is required to comply with the relevant commercial and technical requirements. The technical requirements regulate utilities on how the network is operated and maintained. This is intended to protect the serviceability of those networks in the long-term and is determined by the ACT Utilities Technical Regulator.

Code Section 4.1.1 – TransGrid (and its successors)

(1) TransGrid must plan, design, construct, test, commission, maintain, operate and manage its electricity transmission networks and geographically separate connection points that supply customers in the ACT and that will operate at 66 kV and above, whether or not those networks and connection points are in the ACT, to achieve the following:

(a) the provision of two or more geographically separate connection points operated at 132 kV and above to supply electricity to the ACT 132 kV network;

(b) at all times provide continuous electricity supply at maximum demand to the ACT 132 kV and 66 kV network throughout and following a single credible contingency event;

(c) until 31 December 2020, provide electricity supply at 30 MVA to the ACT 132 kV or 66 kV network within one hour following a single special contingency event and 375 MVA within 48 hours of this event; and

(d) from 31 December 2020, provide continuous electricity supply at 375 MVA to the ACT 132 kV network immediately following a single special contingency event and agreed maximum demand within 48 hours of this event.

2. NEED/OPPORTUNITY

2.1 Compliance with the Electricity Transmission Supply Code – Current Arrangement

The present electricity supply to the ACT compiles with the Code up until 31 December 2020. However, beyond 31 December 2020, the current supply arrangement would not be able to supply 375 MVA immediately following a single special contingency, nor will it be able to supply maximum demand within 48 hours of the special contingency event.

Current Compliance with the Code

The present electricity supply to the ACT complies with the Code.

4.1.1(1)(a) Canberra and Williamsdale 330/132 kV substations provides 132 kV supplies to the ACT. The two sites are set 43 km apart and are geographically separate.

4.1.1(1)(b) The present ACT supply arrangement is able to sustain the loss of any one element without impacting on the continuous electricity supply at *maximum demand*.

Maximum demand is defined in the Code as –

Dictionary

(10) maximum demand means the expected maximum demand across the ACT electricity network for the year agreed to by the relevant networks.

4.1.1(1)(c) The present ACT supply arrangement is able to provide electricity supply at 30 MVA to the ACT 132 kV or 66 kV network within one hour following a single special contingency event and 375 MVA within 48 hours of this event.

4.1.1(1)(d) The present ACT supply arrangement is being not capable of supplying 375 MVA to the ACT 132 kV network immediately following the loss of Canberra substation. Furthermore, the present arrangement cannot supply maximum demand within 48 hours of a special contingency event.

The present supply arrangement is therefore requires augmentation to be compliant with the Code.

For the critical special contingency of Canberra 330/132 kV substation (i.e. the complete loss of the substation), the 330 kV supply to Williamsdale from Line 3C Canberra to Williamsdale is interrupted, as is the 132 kV supply to Queanbeyan which supplies the ActewAGL Fyshwick load at 66 kV. As the ActewAGL network is supplied from Canberra, Williamsdale, and Queanbeyan, all supply is lost to the ACT.

A 330 kV Line 9 bypass of Canberra substation is available within 48-hours to connect Line 9 to Line 3C Canberra to Williamsdale, to re-energise Williamsdale substation from Yass. However, this does not meet the supply level set out in the Code Section 4.1.1(1)(d).

For the alternate credible special contingency of Williamsdale 330/132 kV substation, the entire ACT load can be supplied from Canberra substation as the 330 kV supply to Canberra substation is not interrupted by the loss of Williamsdale substation. Therefore the critical case is the loss of Canberra substation.

2.2 Need Date

TransGrid is required to comply with the Code as it is part of TransGrids' obligations under its Utilities Services Licence, and is a condition of the Lease.

The Code requires compliance by 31 December 2020, therefore the need date is 2020.

2.3 Risk Cost

The risk cost associated with a single 'special contingency event' was assessed against the base case scenario using the Investment Risk Tool (IRT) – refer to Attachment 1 for the summary. The base case is to maintain the

existing ACT supply arrangement, and operate the Line 9 330 kV bypass of Canberra substation within 48-hours of a special contingency event to supply 375 MVA of load.

The ACT is supplied at 132 kV from Canberra and Williamsdale substations. However, Williamsdale is supplied at 330 kV from Canberra substation such that on the loss of Canberra substation, the supply to Williamsdale is interrupted, as is the supply to the ACT.

Williamsdale substation can be re-energised within 48-hours but has a limited capacity of 375 MVA due to low voltages (i.e. below 0.9pu) in the ActewAGL 132 kV network.

- **Service Interruption (Electricity):** 1,832 MW for 2 months (equivalent)

  Energy at risk is calculated in two components: (i) prior to Line 9 bypass, and (ii) after Line 9 bypass until the Canberra substation is rebuilt, estimated at 2 years.

  (i) 0 to 48-hours – prior to Line 9 bypass of Canberra substation

  600 MW peak demand averaged (0.6 diversity factor) for 48 hours:

  (600*0.6)*48

  = 17,280 MWh

  (ii) 48-hours to 2 years

  600 MW peak demand less supplied from Line 9 (350 MW) averaged (0.6 diversity factor) for 2 years:

  ((600-350)*0.6)*(((2*365)-2)*24)

  = 150*17,472

  = 2,620,800 MWh

  The unserved energy calculation for (ii) is considered over the full restoration period as there are presently no emergency response plans or arrangements in place to set up temporary supplies and/or network rearrangements (beyond the Line 9 bypass) to reinforce the supply following a special contingency event.

  As such, any temporary supplies, such as line rearrangements and/or temporary generators, would be an addition and apply evenly to all options in both capital expenditure, and post-option risk reduction. Therefore, the temporary supply component does not affect the ranking of the options.

  TOTAL = 17,280 + 2,620,800

  = 2,638,080 MWh

  Equiv = 2,638,080 / (2*30*24)

  = 1,832 MW for 2 months

- **VCR:** $38.35/kWh
- **Repair Cost:** $49.4 million

  Based on Cooma substation establishment cost of $38.6M escalated at 2.5% pa for 10 years (2023) and take a minimum of 24 months.
- **Media Coverage Level:** National Media for 180 days
- **Consultation Level:** Moderate for 270 days

- **Increase in Customer Contacts:** 50%-100% increase for 180 days
- **Likelihood of Failure:** Loss of Canberra assumed to be 0.1% (or 1 in 1000 years)

TOTAL EXPECTED RISK COST: $101.3M per annum

2.3.1 Risk Cost Sensitivity

The expected risk cost is sensitive to variations in the probability of failure (PoF), and the Value of Customer Reliability (VCR).

The PoF is driven by the likelihood of an event capable of taking out of service all the elements at a single geographic location (i.e. a bulk supply point, such as Canberra or Williamsdale substation). To take out of service all elements at a BSP, the event would involve a series of failures, across multiple types of plant, and is outside of what is considered a credible network event. Such an event could include a physical external attack such as detonation of an explosive device, truck bomb, equipment sabotage etc. A 1-in-1000 probability is selected. This takes into account past occurrences of similar events locally and overseas. Whilst there has been no records of attacks on electricity infrastructure, given the present international security environment, such an event cannot be considered as improbable.

The VCR is driven by the types of load impacted on by the loss of a bulk supply point. The composition of load would vary with the time of day between residential, business, and direct-connected customer types.

The risk cost for a range of PoF and VCR are calculated in **Error! Not a valid bookmark self-reference.** to assess the sensitivity of the total expected risk cost. The range of PoF is selected based on a range of credible external attacks. The range of VCR is selected based on the expected impact of the load lost.

Table 1 - Expected Risk Cost for a range of VCR

Probability of Failure	1/500	1/1000	1/1500	1/2000	1/2500
VCR: $/kWh					
$20	$105.5M	$52.8M	$35.2M	$26.4M	$21.1M
$38	$200.5M	$100.2M	$66.8M	$50.1M	$40.1M
$50	$263.8M	$131.9M	$87.9M	$66.0M	$52.8M
$100	$527.6M	$263.8M	$175.9M	$131.9M	$105.5M
$200	$1,055.2M	$527.6M	$351.7M	$263.8M	$211.0M

The failure rate of a supply point is more likely to be biased towards being less frequent than 1-in-1000 rather than more.

The ACT load type is classified as ‘mixed’, therefore the VCR is $38.35 kWh. However, with the concentration of government, federal departments, and essential national services in the ACT, the VCR is more likely to be biased towards being significantly higher than $38.35 kWh rather than being less.

The risk cost is also sensitive to the repair and restoration time which is driven by the ability to (1) repair the damage, and (2) provide temporary supplies during the repair process.

The repair duration of two years is for the complete rebuild of a bulk supply point as the Code requires allowing for the loss (and therefore repair/replacement) of all elements in a single location. Whilst temporary supplies and/or

network rearrangements would reinforce the post-special contingency event supply, reducing the amount of unserved energy and therefore the risk cost, there are no emergency response plans or arrangements beyond the Line 9 bypass of Canberra substation to re-energise Williamsdale substation.

On balance of the bias towards a lower PoF but higher VCR, it is reasonable to have an expected risk cost of $101.3M.

Table 2 - Sensitivity of Risk Cost for a range of Repair Time (VCR: $100/kWh)

Probability of Failure	1/500	1/1000	1/1500	1/2000	1/2500
Repair/Restoration Time:					
1 month	$22.0M	$11.0M	$7.3M	$5.5M	$4.4M
3 months	$66.0M	$33.0M	$22.0M	$16.5M	$13.2M
6 months	$131.9M	$66.0M	$44.0M	$33.0M	$26.4M
1 year	$263.8M	$131.9M	$87.9M	$66.0M	$52.8M
2 years	$527.6M	$263.8M	$175.9M	$131.9M	$105.5M

For a VCR of $100/kWh, a repair/restoration period of 9 months would have a risk cost of $100M for a 1-in-1000 year event.

3. RELATED NEEDS/OPPORTUNITIES

3.1 West Belconnen Land Development Opportunities in the ACT

The rearrangement of the Canberra and Williamsdale supply to the ACT coincides with the prospective residential development of West Belconnen. The suburb of West Belconnen is proposed to be developed with a focus on housing, employment, community spaces, and nature conservation. The land use will be largely residential with a commercial hub near its centre.

Canberra substation is situated on the eastern edge of the proposed West Belconnen development, with 330 kV transmission lines approaching from the north (Line 6), north west (Line 9), west (Line 01 and Line 07), and south (Line 3C). All the lines enter through the substation's western aspect.

The transmission lines cut through large portions of the proposed residential area. If in the process of rearranging the supply to the ACT (to meet the Code requirements) the lines can be deviated to free up additional areas for development, secondary benefits for the ACT government can be realised.

3.2 ActewAGL West Belconnen Zone Substation Development

- NOS-1443 – 132 kV Connection of ActewAGL's proposed West Belconnen ZS.

ActewAGL is also proposing to establish a new West Belconnen 132 kV zone substation between the present Canberra and Woden substations. The new zone substation will be located near or adjacent to the existing Canberra substation and is expected to be established by 2020.

3.3 Canberra Piecemeal Replacement

- PSS-DCN238 – Canberra Substation Condition

Canberra substation was constructed in 1967. Augmentations over its service life have seen the extension of the 330 kV busbar in 1973; extension of the 132kV busbar in 1980; installation of No 1 and No 4 Transformers in 1987

and 2002 respectively; and installation of 132kV Capacitor Banks No 1, No 2 and No 3 in 1980, 1992 and 2003 respectively.

Condition assessment of the substation identified a scope of work required by existing policies, including:

- Replacement of the No.2 transformer;
- Replacement of secondary systems;
- Remediate switchyard surface, and
- Increase spill oil tank capacity.

The No.3 transformer will be removed, leaving three transformers at Canberra substation, in positions No.1, 2, and 4.

4. RECOMMENDATION

It is recommended that suitable options be identified and scoped to address the identified need by the specified Need Date.

5. ATTACHMENT 1 – Investment Risk Tool Output

Identified Failure Modes - Detailed

Major Component	No.	Minor Component	Sel. Hazardous Event	LoC x CoF	Failure Mechanism	NoxLoCxCoF	PoF (Yr 1)	Total Risk	Risk (Rel)	Risk (Op)	Risk (Fin)	Risk (Peo)	Risk (Env)	Risk (Rep)
Canberra Substation	1	Winding and Core	Complete Loss of Canberra Sub	01,253,295,300	Failure	,253,295,300	0.10%	$101,253,300	$101,172,583		$49,651		$8	$31,059
				01,253,295,300		,253,295,300		$101,253,300	$101,172,583		$49,651		$8	$31,059
						Total VCR Risk:	$101.17		Total ENS Risk:	$0.00				

Identified Probability of Failure for each Failure Mode

Minor Component	Failure Mechanism	Yr 1 (2016)	Yr 3 (2018)	Yr 5 (2020)	Yr 10 (2025)	Yr 15 (2030)	Yr 20 (2035)	Comment
Winding and Core	Failure	0%	0%	0%	0%	0%	0%	

Event: **Complete Loss of Canberra Sub**

Likelihood of Consequence for each Consequence

Consequence	Measure Name	Measure Value	Comment	LoC OverWrite	LoC	CoF ($)	LoC x CoF ($)
Repair Cost						$49,400,000	$49,400,000
Service						$0	$0
Other						$0	$0
Environmental	Control Mechanisms (Containment)	Full			1.00%	$1,730,000	$17,300
Service Interruption (Electricity)	Load Restoration (Network Design Redundancy)	No Backup (N)			100.00%	$101,203,878,000	$101,203,878,000
						$101,255,008,000	$101,253,295,300

Consequence of Failure

Select	Consequence	Measure	Component #1	Component #2	Component #3	CoF - Overwrite	Comment	CoF ($)
☐	Repair Cost	Repair to TransGrid Assets	Total Costs ($) 49400000				Based on Cooma Substation $38.6M escalated at 2.5%pa for 10 years to 2023/2024	$49,400,000
☐	Repair Cost	3rd Party Damage	Total Costs ($) 0					$0
☐	Repair Cost	Criminal Damage	Total Costs ($) 0					$0
☐	Service	Incentive Scheme	Total Costs ($) Excluded					$0
☐	Other	Other	Total Costs ($) 0					$0
☐	Environmental	Media Coverage (Environmental)	Media Coverage Level Local Media	Duration of Coverage (Days) 30				$900,000
☐	Environmental	Litigation Initiated (Environmental)	Litigation Type Insignificant - No court action					$10,000
☐	Environmental	Legislation Breach (Env. Fines)	Legislation Breach Severity Minor Breach					$20,000
☐	Environmental	Land OR Water (Cleanup / Impact / Comp.)	Site Sensitivity High	Impacted Region Size Localised Impacts <5 Ha.	Volume of Oil Released 10,000 - 50,000L			$750,000
☐	Environmental	Investigation Cost (Environmental)	Investigation Medium					$50,000
☐	Service Interruption (Electricity)	Reliability (Elec Service Interruption)	Customer Type Mixed / Unknown	Load (MW) 1832	Asset Repair Duration (Hours) 2 Months		Complete loss of 600 MW load for 48 hours with 0.6 diversity factor. THEN loss of 250 MW for 2	$101,170,368,000
☐	Service Interruption (Electricity)	ENS Penalty (Elec Service Interruption)	ENS Penalty (Elec Service Interruptio System Minutes (>0.25)					$2,200,000
☐	Service Interruption (Electricity)	Media Coverage (Elec Service Interruption)	Media Coverage Level National Media	Duration of Coverage (Days) 180				$27,000,000
☐	Service Interruption (Electricity)	Litigation (Elec Service Interruption)	Litigation Type Insignificant - No court action					$10,000
☐	Service Interruption (Electricity)	Customer Consultation (Elec Service Interruption)	Consultation Level Moderate Consultation eg. Letterdro	Duration (Days) 270				$2,700,000
☐	Service Interruption (Electricity)	Customer Contacts (Elec Service Interruption)	Increase in Contacts 50% to 100% Increase	Duration (Days) 180				$1,350,000
☐	Service Interruption (Electricity)	Investigation Cost (Elec Service Interruption)	Investigation Large					$250,000
								$101,255,008,000