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ELECTRANET REVENUE CAP REVIEW

Capital Projects Assessment Report

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EXECUTIVE SUMMARY

The South Australian Government requested AEMO to review ElectraNet's revenue proposal for the regulatory period 2013–14 to 2017–18. This report outlines AEMO's findings based on information provided by ElectraNet, the South Australian Electricity Transmission Code (ETC) [1] requirements, and the scope agreed with the South Australian Government.

This review cannot be considered a substitute for detailed planning assessments that will be conducted at the time of a Regulatory Investment Test for Transmission (RIT-T). For example, AEMO did not independently develop non-network solutions, such as demand side or generation support, which may defer the need for more costly network expenditure. Further, it did not independently verify ElectraNet's transmission unit costs or the connection point load forecasts supplied for this review.

AEMO expects that the AER will use the information supplied in this report to inform ElectraNet's revenue for the regulatory period 2013–14 to 2017–18 within the limitations of the current revenue setting framework. The AER will need to determine how to use the information supplied to establish an appropriate revenue allowance that incentivises ElectraNet to pursue the most efficient long term solutions.

The revenue proposal review

AEMO's revenue proposal review involved a review of network augmentations, based on the latest information received (as at 26 April 2012), including revisions made by ElectraNet following receipt of an updated connection point load forecast[2] and ElectraNet's interpretation of the ETC planning requirements. The conclusions from this review can change at any time if new information is supplied during the revenue reset process.

The review of network augmentations included the following:

- Shared transmission network augmentations.
- Connection asset augmentations.
- Asset management (including replacement) capex (but only when the proposed work program may impact on longer-term network developments). This was a limited review with the aim of identifying synergies between asset replacements and network augmentations.

Other parts of the review involved the South Australian transmission network's ability to meet the standards expressed in the ETC at the end of the regulatory period.

The parts of the revenue proposal AEMO did not review included:

- Operational expenditure.
- Asset management (including replacement) capex, other than in relation to longer-term network development impacts. In particular, asset condition was not reviewed.
- Any other aspects of the revenue proposal not associated with network projects.

Review of network augmentations

AEMO undertook a desktop review of ElectraNet's proposed network augmentations. AEMO did not develop an independent investment plan for South Australia. As a result, AEMO's support means the assessment confirmed that a need exists, the timing is appropriate, and the option being proposed appears reasonable (within the scope of a desktop review).

[1] ESCOSA, available http://www.escosa.sa.gov.au/library/120217-ElectricityTransmissionCode-TC07_0.pdf

[2] Referring to ETSA Utilities' 2012 connection point load forecast dated 18 April 2012 (provided to AEMO by ElectraNet on 24 April 2012).

The review of network augmentations included the following:

- Ensuring the needs assessment reflects the need to meet jurisdictional planning obligations as described in the ETC.
- The reasonableness of proposed options and other alternative options identified by ElectraNet.
- Proposed augmentation timings in relation to the load forecast information received as at 26 April 2012.
- Establishing whether ElectraNet's preferred option aligns with AEMO's National Transmission Development Plan (NTNDP).
- The reasonableness of a proposed contingent project (contingent on the need or trigger).

The parts of the network augmentation proposals AEMO did not review included:

- Cost estimates provided by ElectraNet.
- ElectraNet's and ETSA Utilities' connection point forecasts.

AEMO based this review on information provided, and while it discussed alternative options with ElectraNet, has not independently developed potentially more efficient options (for example non-network alternatives) to address the identified needs.

During the assessment process, AEMO worked closely with ElectraNet, reviewing information and seeking clarification, undertaking independent studies and sharing results with ElectraNet. ElectraNet's project list has evolved significantly through the review process.

Key findings from the revenue proposal review

Key findings from AEMO's review cover the following areas:

- Compliance with the South Australian Electricity Transmission Code (ETC).
- Proposed network development projects in the ex-ante proposal.
- Strategic land and easement acquisition projects.
- Contingent projects.
- Alignment with the NTNDP.

Compliance with South Australian Electricity Transmission Code

AEMO has analysed load-driven constraints for summer 2017–18 and is satisfied that taken together, the proposed network development projects address the network limitations that are reasonably expected to emerge over the regulatory period 2013–14 to 2017–18 for compliance with the South Australian ETC and the National Electricity Rules (NER).

Proposed network development projects in the ex-ante proposal

The ex-ante project list (as at 26 April 2012) contained 31 network development projects. Of these, AEMO and ElectraNet identified 25 projects that were relevant for AEMO's review. ElectraNet advises that the remaining 6 projects are, or are expected to be, work-in-progress with an advanced status and were considered out of scope for AEMO's assessment. For a list of the 25 capital network projects addressed in this report, as well as a list of the 6 projects that were not reviewed, see Appendix A.

AEMO's assessment confirms the existence and timing of potential future network limitations identified by ElectraNet. AEMO also considers that the proposed network solutions are reasonable. AEMO has qualified that in some cases, however, a non-network solution or an alternative network solution may be more economical, and would expect that ElectraNet fully investigate these alternative options during the RIT-T stage.

For a summary of the ex-ante proposal assessment's key findings, see the attachment to this Executive Summary. For more detailed information, see Section 5.1.

Strategic land and easement acquisition

In general, AEMO supports proposals to acquire the land parcels and easement rights in the coming regulatory period that meet one or more of the following:

- The land and easement is expected to be required over the next 10 years and is linked to an identified network project.
- The land and easement is expected to be required over the next 10 to 20 years or is of strategic value, and it can be reasonably substantiated via an economic assessment that a delayed purchase may result in a higher cost or a likelihood that the land will become unavailable at a later stage.

AEMO's assessment of ElectraNet's proposed 21 strategic land and easement acquisition projects included considering their need and timing.

Confining the assessment to the extent of the proposed locations, AEMO identified 7 land parcels and easements that can reasonably be expected to be required over the next 10 years to overcome potential network limitations. AEMO supports these projects as reasonable.

The optimal timing of the remaining 14 acquisitions is considered to be mainly driven by the risks associated with a higher cost of acquiring the land or easement, or the land becoming unavailable at a later stage, which should be subject to a probabilistic or economic assessment including the probability of future network development triggers, land-use planning and property development considerations. AEMO is not in a position to comment on these factors as they are beyond the scope of the current review.

For a complete list of ElectraNet's proposal and AEMO's assessment results, see Section 5.2.

Contingent projects

AEMO generally supports ElectraNet's contingent project proposal, involving contingent projects with trigger events that are probable within the relevant regulatory period. Based on the project descriptions:

- The proposed contingent projects are considered able to cover the range of probable future development scenarios.
- The proposed contingent projects (or their more economical alternative option, serving the same purpose) are expected to be required under specific development scenarios (for example, demand growth, generation growth, and identified market benefits).

AEMO also believes contingent projects should be limited to non-load driven augmentations or triggered by significant step changes in load (rather than driven by organic load growth), and that listing contingent projects is a prudent mechanism for managing uncertainty, particularly where it may result in high-cost augmentations.

ElectraNet specified the quantum of step load in megawatts (MW) to trigger some of the proposed contingent projects. AEMO did not (and has no plans to) carry out detailed studies to verify the accuracy of the trigger values ElectraNet nominated.

For a complete list of the contingent projects proposed by ElectraNet, see Appendix B.

Alignment with the National Transmission Network Development Plan

The 2010 and 2011 NTNDPs were focussed on the future needs of the high-capacity transmission backbone rather than the need for more local transmission capability. The majority of ElectraNet's ex-ante projects are for connection augmentations, regional transmission network reactive power compensation, and security and compliance, which were not considered in those NTNDPs. The ex-ante project proposal also does not include any major projects for transmission or sub-transmission line augmentation over the regulatory period 2013–14 to 2017–18.

The contingent projects, however, do include potential upgrades to the Victoria–South Australia (Heywood) and Victoria–South Australia (Murraylink) interconnectors, which were identified by the NTNDP. As a result, ElectraNet's proposal is considered to be consistent with the NTNDP.

Attachment – Findings from the ex-ante project proposal assessment

This attachment expands on the key findings from the ex-ante project proposal assessment, which are organised into three categories:

- Connection point asset and shared transmission network augmentations.
- Security and compliance projects.
- Asset replacement.

For more detailed information, see Section 5.1.

Connection point asset and shared transmission network augmentations

Eyre Peninsula region

A supply limitation begins to emerge at Port Lincoln towards summer 2017–18. However, the limitation is only marginal at the time (1.5 MW) and significant network augmentation is not expected to be required within the regulatory period 2013–14 to 2017–18.

ElectraNet does not have a proposed project in the ex-ante list. However, it has a non-network arrangement with Port Lincoln Power Station and a potential solution to this limitation may be to extend the capacity of the support in the agreement with Port Lincoln Power Station or some demand-side management.

Riverland region

Continued ETC compliance for the Riverland region depends on the outlook for the available capacity of Murraylink given load growth and network changes in Victoria and South Australia. ElectraNet and AEMO are currently carrying out joint planning studies to identify the available capacity of Murraylink and economical solutions to Riverland region and Regional Victorian network limitations.

ElectraNet's solution to ensure ETC compliance in the revenue cap proposal involves reliance on Murraylink to the extent available, further planned incremental network augmentation in South Australia and Victoria, and, if required, more substantial network augmentation as provided for via a contingent project.

Although the ex-ante project list does not include a solution to ensure compliance with the ETC in the Riverland region over the regulatory period 2013–14 to 2017–18, AEMO considers that the included contingent project is the prudent way of addressing this emerging limitation, given the uncertainty as to the need for network augmentations or the extent to which the limitations will be economically addressed in South Australia or Victoria.

ElectraNet also proposes to install a 132 kV 15 MVAr capacitor at Monash substation for voltage support during an outage of Murraylink. The need and timing of this project is considered reasonable.

Mid North region

The ETC changes taking effect from 1 July 2013 require two connection points in the Mid North region (Baroota and Dalrymple) to be upgraded from Category 1 to Category 2 supply reliability. To meet this requirement, ElectraNet proposes to augment the transformer capacity at both substations. AEMO considers the options proposed by ElectraNet appropriate.

Potential reactive power margin shortfalls and low voltages in the vicinity of Port Pirie/Bungama and on the Yorke Peninsula may emerge as early as summer 2014–15. ElectraNet proposes to install three 132 kV capacitors (at Kadina East, Dalrymple, Hummocks) and a second Bungama transformer over the regulatory period 2013–14 to 2017–18. The proposals are considered reasonable.

Potential low voltage issues may also emerge in the Barossa area early in the regulatory period 2018–19 to 2022–23. AEMO supports ElectraNet's proposal to carry out some preparatory works to ensure adequate reactive power support is available in time.

South East region

The South East 275/132 kV transformer and the Keith–Snuggery 132 kV line may be constrained under peak load conditions with high import into South Australia via the Victoria–South Australia (Heywood) interconnector. This is a market benefit issue, rather than reliability issue. The limitations will be captured in the Victoria–South Australia (Heywood) Interconnector Upgrade RIT-T[3] currently underway, which among other options will be assessing the market benefit of decommissioning the Keith–Snuggery line and installing a third South East 275/132 kV transformer. ElectraNet has listed a reinforcement of inter-regional power transfer capability as a contingent project, which AEMO considers appropriate.

Without augmentation, potential low voltages may appear at the Penola West or Mt Gambier connection points. AEMO supports ElectraNet's proposals to install two 132 kV capacitors each at Penola West and Blanche substations to provide adequate voltage support.

Upper North region

No connection asset or shared transmission network thermal limitation was observed in the Upper North region to meet the current load forecasts.

Eastern Hills region

Without augmentation, the two existing Mount Barker 132/66 kV transformers may be overloaded during an outage of the Mount Barker South 275/66 kV transformer at times of peak load.

AEMO supports ElectraNet's proposal to install the second 275/66 kV transformer in Mount Barker South and subsequently retire the aged Mount Barker 132 kV assets.

Adelaide Metro region

A potential limitation of the Torrens Island 275/66 kV transformers supplying the Western Suburbs Network may emerge at times of low generation from local generators connected to the 66 kV sub-transmission network. To address this limitation, ElectraNet proposes to replace the existing two 150 MVA transformers with two 225 MVA transformers.

AEMO supports the inclusion of ElectraNet's proposal in its revenue proposal, on the basis of ElectraNet's interpretation of its ETC requirements[4] and its confirmation that this proposed project is the most economic option at this point in time. AEMO expects that, during the RIT-T process, ElectraNet will consider an option of acquiring up to 80 MW of generation support to ensure the implementation of the most economic option.

An Adelaide CBD transformer capacity limitation may emerge toward end of the regulatory period 2013–14 to 2017–18, and AEMO supports ElectraNet's proposal to install a second East Terrace transformer.

In addition, early in the regulatory period 2018–19 to 2022–23 (around the summer of 2020–21), limitations may emerge involving the existing Northfield and Magill substation 275/66 kV transformers and the distribution network. ElectraNet proposes to establish a new 275/66 kV injection point at Yatala Vale North. AEMO considers this proposal reasonable.

Main Grid

Depending on the outcome of the Victoria–South Australia (Heywood) Interconnector Upgrade RIT-T currently underway, and any changes in the capacity of existing South Australian generating plant, there is a potential supply shortfall to meet South Australian peak demand (without new generation entry) later in the regulatory period 2013–14 to 2017–18. Potential new loads beyond those in the forecast (for example in the Eyre Peninsula region discussed in a current RIT-T[5]) will exacerbate the situation, which is a key area needing close attention.

[3] AEMO, available http://www.aemo.com.au/en/Electricity/Planning/Regulatory-Investment-Tests-for-Transmission-RITTs/Heywood-Interconnector-RIT-T.

[4] ElectraNet's interpretation of the ETC requires a network support contract with this generation in order to rely on its availability.

[5] ElectraNet, available http://www.electranet.com.au/assets/Uploads/EyrePeninsulaPSCRFinal23Feb-2012.pdf

In addition, ElectraNet proposes to install more weather stations to facilitate real-time rating of critical lines. AEMO supports the proposal in principle as this potentially represents a cost-effective approach to maximise the utilisation of existing transmission lines.

ElectraNet also proposes to install control equipment to automate the switching of 275 kV and 132 kV capacitors and reactors between the Heywood and Davenport substations. A properly designed and implemented control system is expected to be able to relieve or remove the existing voltage stability constraints that limit the level of the Victoria–South Australia (Heywood) interconnector power transfer into South Australia, minimizing the risk of the supply shortfall in South Australia. AEMO therefore supports the proposal, and encourages ElectraNet to carry out detailed studies to ensure the effectiveness of the proposed control scheme.

AEMO also supports the provision in ElectraNet's contingent project proposal to reinforce inter-regional transfer capability when the need arises.

Security and compliance projects

ElectraNet's capital project proposal includes installing integrated control schemes across the 275 kV and 132 kV networks to ensure compliance with the NER's 'next contingency' security requirements and to allow greater use of the network under system normal conditions, as well as providing the opportunity to undertake network maintenance as required.

AEMO considers it reasonable to implement integrated control schemes to ensure compliance with network security requirements and to minimise pre-contingency (second contingency) load shedding in line with ETC requirements. AEMO notes that issues confronting each region may vary and, as a result, the effectiveness of control schemes will depend on their proper design, based on detailed investigation of the limitation (for example, overloading and reactive power support deficiencies) that may appear under multiple outage conditions in the relevant regions. Specific control scheme design details were not available for AEMO's assessment, and are beyond the scope of this review.

In addition to the integrated control schemes, ElectraNet's ex-ante proposal includes several other projects for security and compliance purposes, such as control scheme implementation, the installation of additional circuit breakers, and various engineering solutions to secure maintenance windows and for reliability and security improvements. In the absence of detailed scheme designs, AEMO supports the proposals in principle.

Asset replacement

ElectraNet's ex-ante project proposal includes six network asset replacement projects, which also address augmentation needs, four of which were assessed by AEMO. The remaining two were not assessed due to their advanced work-in-progress status (advised by ElectraNet). The replacement program considers asset condition, and near-time and long-term transformer capacity requirements. AEMO considers the replacement proposals reasonable.

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CHAPTER 1 - BACKGROUND

AEMO was approached by ElectraNet in September 2011 to assist with the preparation of its Revenue Proposal for the regulatory period 2013–14 to 2017–18 due for submission to the Australian Energy Regulator (AER) by 31 May 2012. In November 2011, AEMO was formally requested by the Energy Division of the South Australian Government's Department for Transport Energy and Infrastructure to independently review ElectraNet's revenue proposal, with a focus on its augmentation plans.

AEMO's assessment process has involved a close engagement with ElectraNet involving progressively reviewing the information provided, seeking clarification where necessary, carrying out independent studies, and discussing the outcomes with ElectraNet. ElectraNet's project list has evolved significantly throughout the review process.

This assessment relates to the latest information received as at 26 April 2012, including revisions made by ElectraNet following receipt of an updated connection point load forecast.[6]

[6] Referring to ETSA Utilities' 2012 connection point load forecast dated 18 April 2012 (provided to AEMO by ElectraNet on 24 April 2012)

CHAPTER 2 - THE SCOPE OF THE REVIEW

AEMO's assessment consisted of a desktop review of ElectraNet's proposed network augmentations, not a development of its own investment plan. The assessment generally focussed on the following:

- The validity of the individual augmentation capex projects proposed by ElectraNet.
- Considering whether the South Australian transmission network meets the requirements set out in the ETC[7] for summer 2017–18 (the final year of the regulatory period 2013–14 to 2017–18).

The review of the validity of the individual augmentation projects proposed by ElectraNet included the following:

- Shared transmission network augmentations.
- Connection asset augmentations.
- Asset management (including replacement) capex (but only when the proposed work program may impact on longer-term network developments). This was a limited review with the aim of identifying synergies between asset replacements and network augmentations.

The parts of the revenue proposal AEMO did not review included:

- Operational expenditure.
- Asset management (including replacement) projects, other than in relation to longer-term network development impacts. In particular, asset condition was not reviewed.
- Cost estimates provided by ElectraNet.
- ElectraNet's and ETSA Utilities' connection point forecasts.
- Any other aspects of the revenue proposal not associated with network projects

With respect to the proposed network augmentations, AEMO has indicated support when it has assessed the need exists, the timing is appropriate, and the option being proposed appears reasonable within the scope of a desktop review.

AEMO based its review on information provided, and while it discussed alternative options with ElectraNet through the review, AEMO has not independently developed potentially more efficient options (for example non-network alternatives) that may eventually be available to address the identified needs.

[7] ESCOSA, available http://www.escosa.sa.gov.au/library/110628-ElectricityTransmissionCode_ETC07.pdf

CHAPTER 3 - GENERAL ASSUMPTIONS

This chapter provides information about the general assumptions underlying this review. Assumptions unique to a specific project or established for a particular purpose, however, may not be included here, but are detailed in conjunction with the project discussion in Chapter 5.

Ratings

Transmission line and transformer ratings are as per the rating advice provided by ElectraNet in the PSS/E load flow base cases, for the purpose of the revenue proposal review.[8]

Summer thermal ratings were used to identify thermal limitations because the South Australian electricity transmission network is highly loaded at times of peak summer demand. In line with ElectraNet's practice, for transmission lines, summer continuous ratings are used to identify thermal limitations. For single transformer substations, normal cyclic rating is used to identify thermal limitations. For substations with more than one transformer, the long-term emergency cyclic rating is used following an outage of a parallel transformer (where emergency cyclic rating is not available, normal cyclic rating will be used).

Demand level

In general, for connection point asset and regional network augmentation analysis, load(s) in the relevant connection point/region are set at the regional peak based on the connection point load forecast (undiversified). For Main Grid 275 kV network investigations, loads are modelled at levels consistent with the demand at the time of the state-wide summer peak demand in South Australia (diversified). Accordingly, load flow cases are modelled with the following load forecast information:

- Connection point load forecast under a medium growth scenario.[9]
- State-wide 10% probability of exceedence (POE) summer maximum demand in South Australia under a medium growth scenario (as per the 2011 South Australia Supply and Demand Outlook (SASDO)).[10]

Interconnector flow assumptions

- Victoria–South Australia (Heywood) – up to 460 MW import into South Australia.
- Murraylink – up to 40 MW import into South Australia.[11]

Wind farm availability

- Wind farm output at 0% or 3% of installed capacity.[12]
- Reactive power output as per the generation performance standards.

Network assumptions

Table 3-1 lists projects assumed to be proceeding within the current regulatory period ending in 2012–13 (as per discussions with ElectraNet).

8 ElectraNet advised that all ElectraNet's transformer ratings are defined at secondary terminal; The rating of existing Kanmantoo transformer provided in ElectraNet's base case is 5 MVA which was updated to the loadable winding capacity of 3 MVA based on the project summary subsequently provided by ElectraNet.

9 ElectraNet supplied to AEMO the revised connection point load forecast prepared by ETSA Utilities (dated 18 April 2012) on 24 April 2012. Prior to 24 April 2012, AEMO carried out all studies based on the connection point load forecast published in 2011 SAAPR. Subsequent to the receipt of ETSA utilities' 2012 connection point load forecast, the need and timing of those affected proposals were revisited based on the updated load forecast. The assessment results of this report are therefore consistent with the most recent load forecast information as at 26 April 2012.

10 http://www.aemo.com.au/planning/SASDO2011/documents/SASDO2011.pdf ; Table 2-6.

11 Transfer into South Australia required to avoid 132 kV circuit overloading in the Riverland region in summer 2017–18.

12 Output of wind farms located in the subject local area to be studied are set to zero, while wind farms external to the subject local area are set to 3%.

Table 3-1 — Projects assumed to be proceeding in the current regulatory period ending in 2012-13

Project	Commissioning date	Status
Tungkillo 275 kV 100 MVAr Capacitor Bank	2012	Committed.
Whyalla Terminal Substation Replacement	2013	Committed.
Ardrossan West 132 kV Substation Rebuild and 2 × 25 MVA Transformer Capacity Increase (including 1 × 15 MVAr capacitor)	2012	Committed.
Cultana 275/132 kV Augmentation	2014	Committed.
Wudinna 2 × 25 MVA 132/66 kV Transformer Reinforcement	2012	Committed.
Dorrien Third Transformer	2012	Committed.
Munno Para New 275/66 kV Connection Point	2014	Committed.
Davenport 275 kV 50MVAr Reactor Stage 2	2012	Committed.
Kincraig 132 kV 1 × 15 MVAr Capacitor	2012	Committed.
Hummocks 132/33 kV Transformer Upgrade	2013	Committed.

Generation assumptions

The 2011 SASDO generation information was used. As a result, AEMO's load flow studies assume all existing generation is available and no new generation is commissioned for the regulatory period 2013–14 to 2017–18. The possibility of existing generation not being in service, however, is considered from an operational perspective.

CHAPTER 4 - METHODOLOGY

AEMO's assessment process involved working with ElectraNet to progressively review information, seek clarification where necessary, carry out independent studies, and discuss the outcomes.

ElectraNet provided load flow base cases including the ratings of the relevant network elements to assist AEMO's assessment. AEMO reviewed and modified these load flow base cases where necessary to enable the modelling of appropriate scenarios to suit the load flow study purpose.

The load flow studies involved three stages:

- Load flow studies to identify limitations.
- Load flow studies to assess the adequacy of the projects ElectraNet proposed to overcome the limitations.
- Load flow studies to identify other likely alternative options for ElectraNet's consideration.

Two types of load flow studies were carried out for the purpose of assessing ElectraNet's proposal in line with the review scope:

- A contingency analysis (N-1) was carried out for the assessment of shared transmission network and connection asset supply adequacy, and voltage quality (magnitude).

  Transformer and transmission line loadings are to be maintained within the ratings discussed in Chapter 3, and the following voltage levels are to be maintained:

  - Voltages of 0.95 p.u to 1.05 p.u under system normal conditions.
  - Voltages of 0.90 p.u to 1.10 p.u under N-1 contingency conditions.
- Reactive Power-Voltage (QV) analysis was carried out to calculate the reactive margins at key 275 kV and 132 kV substations, and selective 33 kV connection points. Reactive power margins are to be maintained within NER requirements (1% of fault level in megavolt-amperes (MVA)). Fault levels reported in the 2011 South Australian Annual Planning report (SAAPR) are used as the basis for calculating the fault level margin requirement. As the proposed ex-ante projects' likely contribution to fault level increases is marginal, fault levels for the 2015 planning year are adopted to calculate reactive margin requirements for the 2016, 2017 and 2018 planning years.[13]

Adelaide (ADE) Metro region assessment load flow case set up

To assess the ADE Metro region's transmission network, the undiversified load flow base case provided by ElectraNet was modified in the following ways:

- Demand in the ADE Metro region is equivalent to the ADE Metro regional peak.
- Total demand in South Australia is equal to the South Australian 10% POE summer maximum demand (medium growth scenario).
- South Australia is importing approximately 460 MW via the Heywood interconnector and approximately 40 MW via the Murraylink interconnector (with the dummy generators modelled in ElectraNet's original base case removed).

Regional network and connection point assessment

In general, the undiversified load flow cases were used to assess the regional network. Dummy generators were installed at Torrens Island to model new entry generation and provide necessary additional generation capacity to achieve a supply-demand balance.

[13] AEMO assessed the likely impact of the proposed ex ante projects on the fault level at substations of concern prior to carrying out reactive margin review. It was found that no material fault level increase would expect to occur in years from 2016 to 2018 at the substations of interest, such that it would impact on the need or otherwise an augmentation for purpose of reactive margin improvement.

Reactive power compensation in the vicinity of Davenport

The undiversified load flow base case provided by ElectraNet was modified to assess the reactive power support requirement in the vicinity of Davenport in the following ways:

- The demand at both the Eyre Peninsula and the Upper North regions are set equal to the regional peak.
- Total demand in South Australia is equal to the South Australian 10% POE summer maximum demand (medium growth scenario).
- South Australia is importing approximately 460 MW via the Heywood interconnector and approximately 40 MW via the Murraylink interconnector (with the dummy generators modelled in ElectraNet's original base case removed).

CHAPTER 5 - NETWORK DEVELOPMENT

5.1 Network capital projects

The ex-ante project list (as at 26 April 2012) contained 31 network development projects. Of these, AEMO and ElectraNet identified 25 projects that were relevant for AEMO's review. ElectraNet advises that the remaining 6 projects are, or are expected to be, work-in-progress with an advanced status and were considered out of scope for AEMO's assessment. For a list of the 25 capital network projects addressed in this report, as well as a list of the 6 projects that were not reviewed, see Appendix A

5.1.1 Connection asset and shared transmission network augmentation

This section discusses connection asset and shared transmission network thermal limitations and the capital network projects proposed by ElectraNet to eliminate these limitations. Issues related to reactive power support, asset replacement and security and compliance are discussed in Section 5.1.2 and Section 5.1.3, respectively.

Eyre Peninsula region

A supply limitation begins to emerge at Port Lincoln towards summer 2017–18. However, the limitation is only marginal at the time (1.5 MW) and significant network augmentation is not expected to be required within the regulatory period 2013–14 to 2017–18.

ElectraNet does not have a proposed project in the ex-ante list. However, it has a non-network arrangement with Port Lincoln Power Station and a potential solution to this limitation may be to extend the capacity of the support in the agreement with Port Lincoln Power Station or some demand-side management.

Other observations include the following:

Potential Lower Eyre Peninsula 132 kV network thermal limitation.

- During peak load in the Eyre Peninsula region, the 132 kV line between Cultana (Whyalla) and Middleback may be overloaded under system normal conditions, without sufficient generation support from Port Lincoln generators and the wind farms on the Eyre Peninsula. This limitation needs to be managed by generation support from Port Lincoln, which has been the ongoing operational practice. The total generation support required to avoid overloading the Whyalla–Middleback line is approximately 40 MW in summer 2017–18.

Potential Cultana 275/132 kV transformer capacity limitations.

- The remaining Cultana 275/132 kV transformer may be overloaded during the outage of the parallel transformer, depending on the level of generation support available. The required generation support to avoid this overloading will grow to approximately 40 MW in summer 2017–18 (which is below the 49 MW maximum output level of the existing generation support contracted by ElectraNet). In the absence of generation support, the Cultana 275/132 kV transformer could be severely overloaded following an outage of the parallel transformer. AEMO notes that ElectraNet included contingent projects to overcome this potential limitation.

Potential Port Lincoln connection transformer capacity limitation.

- The N-1 supply capacity of the existing Port Lincoln transformers is approximately 60 MW. Based on the medium growth load forecast, the existing Port Lincoln transformer capacity will be sufficient for the regulatory period 2013–14 to 2017–18.

Port Lincoln support related issue.

- Load flow studies show that under peak load, two Port Lincoln units must be online, one of which must be Port Lincoln Unit 3. Otherwise, an unplanned outage of the step-up transformer connecting Port Lincoln Unit 1 and Unit 2 may lead to voltage collapse of the Eyre Peninsula 132 kV system.

  To manage this situation, ElectraNet will be implementing a control scheme as part of the proposed project to review the voltage control scheme for the Eyre Peninsula region network (see the proposed project in Section 5.1.3 – Reference A4-018).

Riverland region

AEMO's assessment shows that at times of peak demand in the Riverland region, South Australia needs to rely on import from Victoria via Murraylink to meet the ETC reliability requirement in the Riverland region of South Australia. Currently, the import requirement is approximately 30 MW, and is predicted to increase to approximately 40 MW in summer 2017–18 and to approximately 50 MW within the next 10 years. This is consistent with the import requirement reported in the 2011 SAAPR.[14]

AEMO's preliminary studies carried out in mid-2011 showed that at times of high summer demand in Victoria, the regional Victorian transmission network will experience limitations too, limiting exports to South Australia via Murraylink to zero and causing post-contingent load shedding in regional Victoria, though under favourable operating conditions, the Victorian transmission network may be able to provide the required support.

The need and timing for augmenting the Riverland region network depends on the support available via Murraylink at times of Riverland region peak demand. ElectraNet and AEMO are currently carrying out joint planning studies to identify the outlook for the available capacity of Murraylink at times of Riverland region peak demand given load growth and network changes in Victoria and South Australia. The joint planning studies will also identify economical solutions to Riverland region and regional Victoria network limitations.

AEMO notes that ElectraNet has included a contingent project for reinforcing the Riverland region network. Given the uncertainty as to the need for network augmentations or the extent to which the limitations will be economically addressed in South Australia or Victoria, AEMO considers that the included contingent project is the prudent way of addressing this emerging limitation.

Mid North region

Without augmentation, the 132 kV Snowtown–Hummocks line may be overloaded during the outage of the 132 kV Waterloo–Hummocks line by approximately 5% to 10%, and vice versa. The network overloading is expected to occur in summer 2015–16. Preliminary studies carried out by AEMO show that a load reduction of approximately 6 MW in the Yorke Peninsula will be able to eliminate the overloading observed during the regulatory period 2013–14 to 2017–18.

ElectraNet advises that the Hummocks transformer replacement project, due for completion in 2012, will remove this limitation by bringing the line to its design rating of 105 MVA. ElectraNet also proposed a contingent project (Yorke Peninsula Reinforcement) to address the line limitation that may appear again early in the regulatory period 2018–19 to 2022–23.

ElectraNet proposes two connection augmentation projects in the Mid North region:

- Install one new 25 MVA 132/33 kV transformer and reuse the existing 10 MVA 132/33 kV transformer (at Baroota) (2017).[15]
- Install a second 25 MVA 132/33 kV transformer (at Dalrymple) and complete the mesh bus (2016).

The Baroota transformer capacity needs to be upgraded from Category 1 to Category 2 by 1 December 2017 to meet ETC supply reliability requirements. Other options considered by ElectraNet are summarised in Appendix C (reference A4-001). The option proposed by ElectraNet is considered reasonable.

Currently there is only one transformer at the Dalrymple substation. To meet ETC supply reliability requirements, another transformer needs to be installed to upgrade the Dalrymple connection point from Category 1 to Category 2 by 1 December 2016.

[14] http://www.electranet.com.au/assets/Uploads/2011-Annual-Planning-Report.pdf

[15] This is an updated project scope confirmed with ElectraNet but different from the project description given in Appendix A (Project reference A4-001), which provides for the replacement of the existing transformer also. AEMO expects that ElectraNet will update the project description by the time it is issued in its revenue cap application.

South East Region

There are a number of potential constraints in the South East region:

The Snuggery Rural transformer.

- The Snuggery Rural 132/33 kV transformer capacity will be exceeded from summer 2018–19. While this is beyond the regulatory period 2013–14 to 2017–18, AEMO encourages ElectraNet to explore solutions to ensure the Snuggery Rural connection point supply will continue to meet ETC supply reliability requirements.

The Keith–Snuggery 132 kV line and South East 275/132 kV transformer.

- At times of South East region peak demand, with high import (up to 460 MW) via the Victoria–South Australia (Heywood) interconnector in the Victoria to South Australia direction, and:
  - High South East generation, particularly from the Ladbroke Grove Power Station, the Keith–Snuggery 132 kV line may be slightly overloaded (5%) during an outage of the Kincraig–Penola 132 kV line.
  - Low South East generation, the remaining South East 275/132 kV transformer may be overloaded during the outage of the other transformer. The level of overloading depends on both the South East generation level and the level of import into South Australia via the Victoria–South Australia (Heywood) interconnector.

Table 5-1 lists results demonstrating the dependence of the Keith–Snuggery line loading and the South East 275/132 kV transformer loading on the Heywood interconnector power flows and South East region generation.

Table 5-1 — Dependence of South East transformer and Keith–Snuggery line loading on system condition

South East generation assumption	Victoria to South Australia flow via the Heywood interconnector	Keith–Snuggery line loading (during the outage of Kincraig–Penola West line)	South East Transformer loading (during the outage of the other one)
Ladbroke : 2 × 35 MW Snuggery: 3 × 17 MW	460 MW (reduce to about 430 MW to eliminate Keith – Snuggery overloading)	105%	70%
Ladbroke : 1 × 35 MW Snuggery: 3 × 17 MW	460 MW	97%	85%
Ladbroke : 0 Snuggery: 3 × 17 MW	460 MW	88%	100%
Ladbroke : 0 Snuggery: 0	460 MW (reduce to about 180 MW to eliminate the South East transformer overloading)	71%	122%

From the load flow simulation results listed in Table 5-1, the South East 275/132 kV transformer and the Keith–Snuggery 132 kV line may be constrained under peak load condition with high import into South Australia via the Victoria–South Australia (Heywood) interconnector. This is a market benefit issue, rather than reliability issue. The limitations will be captured in the Victoria–South Australia (Heywood) Interconnector Upgrade RIT-T[16] currently underway, which among other options, will be assessing the market benefit from decommissioning the Keith–Snuggery line and installing a third South East 275/132 kV transformer.

Upper North region

No connection asset or shared transmission network thermal limitation was observed in the Upper North region.

[16] http://www.aemo.com.au/en/Electricity/Planning/Regulatory-Investment-Tests-for-Transmission-RITTs/Heywood-Interconnector-RIT-T

The capability of the existing Davenport–Olympic Dam 275 kV line for supporting load growth in the Olympic Dam area was not assessed in detail by AEMO, due to load growth uncertainties. However, high level load flow studies show that the network supplying the Olympic Dam area needs to be augmented before load supplied from the Davenport 275 kV bus exceeds 200 MW, starting with reactive support, preferably in the Olympic Dam area.

A question that arises generally when there is a step increase in load that would trigger network augmentation is whether the provision of these works should constitute a prescribed service funded by regulated customers or a negotiated service funded by the proponent of the load increase. AEMO believes that this should be considered when the augmentation trigger eventuates and, if it is to be a prescribed service, the case clearly set out in the RIT T process.

At this stage, AEMO supports the provision in ElectraNet's contingent project proposal to accommodate potential step increases in load in the Upper North, with ownership and funding issues to be considered at the RIT-T stage.

Eastern Hills region

The two existing Mount Barker 132/66 kV transformers may be overloaded during an outage of the Mount Barker South 275/66 kV transformer at times of peak load in the Eastern Hills region, without augmentation.

ElectraNet proposes one capital project to overcome this limitation:

- Install a second 225 MVA, 275/66 kV transformer at Mount Barker South, and retire the aged 132 KV assets at Mount Barker from service (in 2016).

The proposed option is considered reasonable. Other alternative options considered by ElectraNet are summarised in Appendix C (reference A4-002).

Adelaide Metro region

ElectraNet proposes three capital projects to overcome the potential limitations in the Adelaide Metro network. Table 5-2 summarises the relationship between each capital project and targeted limitation.

Table 5-2 — Summary of capital program network projects and targeted limitations in the Adelaide Metro region

Project description	Commissioning date	Targeted limitation
Replace the two 150 MVA 275/66 kV transformers at Torrens Island with two 225 MVA units	2015	Western Suburbs transformer capacity limitation
Install a second 225 MVA275/66 kV transformer at East Terrace substation supplying into ACR; change protection settings on the Magill to East Terrace 275 kV cable to 450 MVA	2017	Adelaide CBD supply capacity limitation
Establish a new 275/66 kV injection point at Yatala Vale North with a 1 × 225 MVA transformer	2021	Thermal limitations of the 275/66 kV transformers supplying Adelaide Metro East region; Thermal limitations in ETSA Utilities 66 kV network

ElectraNet considered a range of options which can be found in Appendix C (reference A4-003, reference A4-004, and reference A4-005). Each proposed project is considered adequate to remove the limitation it targets.

Details related to each limitation are as follows:

Western Suburbs transformer capacity limitation

- Load flow analysis shows that when the 66 kV generators (Osbourne, Quarantine and Dry Creek) in the Western Suburbs are not generating at times of peak load in the Adelaide Metro region, an outage of one of the existing 275/132 kV transformers (at Torrens Island A, Lefevre or Kilburn) may overload the remaining Torrens Island transformers from summer 2015–16.

- ElectraNet proposes replacing the two existing 150 MVA 275/66 kV transformers at Torrens Island Power Station with two 225 MVA transformers. Load flow studies showed that the proposed projects will provide adequate transformer capacity supplying the Western Suburbs, even if all the generation connected to the Western Suburbs 66 kV network is out of service at times of peak demand.
- It is worth noting that with up to approximately 80 MW of support from the Osborne Cogen or Quarantine Power Station (or both), this transformer overloading may not occur with the existing transformer capacity over the regulatory period 2013–14 to 2017–18. Given the installed generation capacity located within the 66 kV Western Suburbs network, there is a significant chance that this project could be deferred by a generation support solution. AEMO supports the inclusion of the proposed transformer project within ElectraNet's revenue proposal on the basis of ElectraNet's interpretation of its ETC requirements[17] and confirmation that the proposed project is the most economic option at this point of time.
- AEMO expects that, during the RIT-T process, ElectraNet will consider an option of acquiring up to approximately 80 MW of generation support to ensure the implementation of the most economic option.

Adelaide CBD supply limitation

- The existing East Terrace 275/66 kV transformer may be overloaded in summer 2017–18 during an outage of the Torrens Island Power Station–City West 275 kV cable or the CityWest 275/66 kV transformer supplying the Adelaide CBD. ElectraNet proposes installing a second East Terrace 275/66 kV transformer in 2017. AEMO understands that ElectraNet is exploring a non-network option to defer the timing of this project. As the outcome is unknown at this stage, it is considered reasonable to include the project as capital program project.

Eastern Suburbs supply limitation

- Load flow assessment shows that in summer 2021–22, outage of one of the 275/66 kV Northfield transformers may overload the remaining transformers and loss of one of the two Magill 275/66 kV transformers supplying the Eastern Suburbs may overload the other transformer. AEMO also noted the distribution network limitations in the same time frame reported in ETSA Utilities' study report provided by ElectraNet. ElectraNet proposes to establish a new 275/66 kV injection point at Yatala Vale North with one 225 MVA transformer. ElectraNet's proposal is considered appropriate.

Other findings

- At times of peak demand in the ADE Metro region, particularly in the Western Suburbs, one of the two existing Torrens Island Power Station New Osborne 66 kV lines may be overloaded during an outage of the other line, depending on the generation from the Quarantine and Osborne Power Stations. The 66 kV line overloading may arise due to a need to transfer power from the Torrens Island Power Station 66 kV bus to the New Osborne Power Station 66 kV bus. To avoid the overloading, a certain level of generation needs to be maintained at Osborne Power Station, which varies with the output level at Quarantine. Lower generation from Quarantine Power Station contributes to reducing the loading of the 66 kV line. This limitation, which can be managed by generation dispatch, is currently managed by National Electricity Market Dispatch Engine (NEMDE) constraint equations. ElectraNet also proposes to defer the network augmentation required to overcome this limitation by operational measures under certain operating conditions. The approach is considered appropriate.

Main Grid network

ElectraNet's capital program includes two ex-ante projects that can be included with the connection asset and shared transmission network augmentations category:

- Installing additional weather stations across the network, and operating circuits as required in real time (2013 - 2018; Reference A4-006).

[17] ElectraNet's interpretation of the ETC requires a network support contract with this generation in order to rely on its availability.

AEMO considers that the real time rating of transmission lines to harness increased thermal capacity and effective control schemes to avoid voltage collapse both represent an effective way to improve existing network capacity utilisation. AEMO supports the proposals in principle.

- Installing all control equipment necessary to automate the switching of both 132 kV and 275 kV connected capacitors and reactors at substations between Heywood and Davenport, creating a wide-area control scheme to ensure maximum available import and export is always available. Additionally, the operation of 275/132 kV inter-bus or connection point transformer on-load tap-changers (OLTC), critical to wide-area control, are also to be automated (2017; Reference A4-007).

  Depending on the outcome of the Victoria–South Australia (Heywood) Interconnector Upgrade RIT-T currently underway, and any changes in the capacity of existing South Australian generating plant, there is a potential supply shortfall in South Australia to meet South Australian peak demand (without new generation entry) later in the regulatory period 2013–14 to 2017–18. Potential new loads beyond those in the forecast, for example, potential load in the Eyre Peninsula region discussed in a current RIT-T[18], will exacerbate the situation. A properly designed control system is expected to be able to relieve or remove the existing voltage stability issues limiting the level of Victoria–South Australia (Heywood) interconnector power transfers in the Victoria to South Australia direction, minimising the risk of supply shortfall in South Australia. This control system is not a part of the options in the Victoria–South Australia (Heywood) Interconnector Upgrade RIT-T. However, the final outcome of this RIT-T may have some impact on the detailed scope of the control system, noting that the control system design details and project scope are not available for AEMO's assessment.

5.1.2 Reactive power compensation

Riverland region

ElectraNet proposes implementing the following project for reactive power support in the Riverland region:

- Install one 15 MVAr point-on-wave (POW) switched capacitor bank at the Monash substation (2017; Reference A4-008). The alternative options can be found in Appendix C.

AEMO's load flow studies confirmed the need for this capacitor to maintain the voltage at the Berri connection point to be above 0.9 p.u. for an unplanned outage of Murraylink. AEMO understood that this is the technical obligation placed on ElectraNet by the Connection Agreement with ETSA Utilities. AEMO also noted ElectraNet's advice that this capacitor will be able to contribute to increasing exports to Victoria via Murraylink during periods of non-peak demand in South Australia by approximately 10 MW, providing potential market benefits. AEMO considers the proposal appropriate.

Mid North region

Reactive power margin shortfalls and low voltages in the vicinity of Port Pirie/Bungama and on the Yorke Peninsula may emerge in the regulatory period 2013–14 to 2017–18. ElectraNet proposes the following ex-ante network projects for overcoming the observed limitations:

- Install one 15 MVAr 132 kV POW switched capacitor bank at Kadina East substation (2014; Reference A4-009).
- Install one 8 MVAr 132 kV POW switched capacitor bank at Dalrymple substation (2016; Reference A4-010).
- Install a second 200 MVA 275/132 kV transformer at Bungama Substation (2015; Reference A4-011).
- Install one 15 MVAr 132 kV POW switched capacitor bank at Hummocks (2016; Reference A4-012).

The alternative options can be found in Appendix C. The projects proposed by ElectraNet are adequate to provide the required reactive support.

[18] http://www.electranet.com.au/assets/Uploads/EyrePeninsulaPSCRFinal23Feb-2012.pdf

AEMO discussed with ElectraNet an alternative option to install two 15 MVAr capacitor banks at Bungama instead of installing a second Bungama 275/132 kV transformer. ElectraNet advised that the transformer option is the least-cost technically-compliant option.

AEMO also noted that in 2020–21, low voltage may appear in the Barossa Valley area during the outage of the existing Templers West transformer. ElectraNet includes one project in its capital program for overcoming this potential limitation:

- Install one 12 MVAr POW switched capacitor bank at Roseworthy substation (2020; Reference A4-013).

The alternative options can be found in Appendix C. AEMO noted that, rather than Roseworthy, the most effective reactive power support should be located in Dorrien. However, it was understood from ElectraNet that the capacitor cannot be installed at the Dorrien substation due to a site constraint. No study of the Dorrien substation's site condition was carried out by AEMO. AEMO also questioned the need to include this project in the regulatory period 2013–14 to 2017–18. ElectraNet advised that, based on project lead time requirements, some preliminary works need to be carried out toward the end of the regulatory period 2013–14 to 2017–18. AEMO considers ElectraNet's proposal reasonable.

South East region

Without augmentation, the Penola West connection points may experience low voltage during an unplanned outage of the South East–Penola West line, and the Mt Gambier and Blanche connection points may experience low voltages during an unplanned outage of the South East–Mt Gambier line. ElectraNet proposes two projects for voltage support:

- Install one 15 MVAr 132 kV POW switched capacitor at Penola West substation (2015; Reference A4-014).
- Install one 15 MVAr 132 kV POW switched capacitor at Blanche substation (2017; Reference A4-015).

The alternative options can be found in Appendix C. The proposed options are considered reasonable.

5.1.3 Security and compliance

ElectraNet's capital project proposal includes six projects for security and compliance purposes. These projects range from control scheme implementation, various engineering solutions to secure maintenance windows, and for reliability/security improvements. AEMO considers the following proposals supportable in principle:

Install an integrated control scheme in strategic network locations that will ensure compliance with the 'next contingency' security requirements of the NER, and allow a higher utilisation of the network under system normal conditions, as well as providing the opportunity to perform network maintenance as required (2017; Reference A4-016).

- AEMO carried out high-level load flow studies in some regions to assist the assessment of the proposed control schemes. Based on the assessment, it is considered reasonable to implement integrated control schemes to ensure compliance with the network security requirement and to minimise pre-contingency (second contingency) load shedding as required by the ETC.
- AEMO notes that issues confronting each region may vary. As a result, the effectiveness of control schemes depends on their proper design based on detailed investigation of the limitations (for example, network overloading and reactive power support deficiencies) that may appear under N-1-1 conditions in individual regions. Design details of the proposed control schemes are not available for AEMO's assessment, and do not form part of this review.

High-level load flow study observations

South East region

- Load flow studies show that under a prior outage of the South East 275/132 kV transformer, or a critical 132 kV line in the South East region, a second outage of a critical transmission element in the South East region may lead to significant overloading, low voltage or voltage collapse in the South East region's network.

- The proposal to implement properly designed under-voltage load shedding schemes and/or network server schemes is considered reasonable to ensure network security and to minimise a pre-contingency load shedding requirement.

Eastern Hills region

- Load flow studies carried out by AEMO showed that under the prior outage of a Para or Cherry Gardens 275/132 kV transformer, the outage of another transmission element (275/132 kV transformer or 132 kV line) in the Eastern Hills region or (at certain times) the South East region, may lead to significant overloading, low voltage and/or voltage collapse in the Eastern Hills region.
- The proposal to implement properly designed under-voltage load shedding schemes and/or network server schemes is considered reasonable to ensure network security and to minimise a pre-contingency load shedding requirement.

Adelaide Metro region

- Load flow studies carried out by AEMO show that a contingency during a prior outage (N-1-1 condition) of a critical element (275/66 kV transformer and/or 275 kV line) may result in significant overloading in both ElectraNet's and ETSA's network. Installation of an effective control system for load shedding, load transfer, or a distribution network configuration for maintaining network security and minimising pre-contingency load shedding is considered to be in line with good electricity industry practice.
- The load flow studies showed, however, that under a contingency during a prior outage (N-1-1), low voltage may occur at buses other than where the tripped or overloaded element (transformer or line) are connected. For example, studies show that a trip of a Parafield Gardens West 275/66 kV transformer, when the other Parafield Gardens West 275/132 kV transformer was on prior outage causes low voltages at some locations deeper in the 66 kV network (Virginia, Paralowie, Direk and HNA) but not at Parafield Gardens West or Para 66 kV buses. This essentially complicates the design of an effective load shedding/integrated control scheme, requiring the need for comprehensive simulation studies to ensure the effectiveness of any schemes to be implemented.

Riverland region

- The proposed control scheme includes a Murraylink run-forward scheme, the feasibility of which is still being investigated under the joint planning studies being carried out by AEMO and ElectraNet. It is expected that ElectraNet will take into consideration the joint planning study results when finalizing the control scheme for the Riverland region.

Implement a range of engineering solutions to improve supply reliability and to expand outage windows available to perform necessary network maintenance (2013-2018; Reference A4-017).

- ElectraNet advises that this project is proposed for securing maintenance outage windows for a number of radial supply networks and for improving the reliability of the radial supplies. The issue involves several regions.
- Part of the scope of this project is the purchase of three 2 MVA mobile generators (including step-up transformers and other auxiliaries), and a 3.3/19 kV transformer.
- Other scopes of work comprising the engineering solution vary from site-to-site. In some cases it will be the installation of a short stub bus to allow the connection of a portable generator or mobile transformer, in other cases it will involve installing additional disconnectors and/or circuit breakers to facilitate the maintenance of a site on a radial supply network without completely turning the supply off to customers.
- The targeted connection points include Dalrymple, Wudinna, Kadina East, Woomera, Leigh Creek South, and Florieton SWER, all being supplied via radial lines. It is expected that implementation of the proposed projects will help to improve the supply reliability to these connection points.
- AEMO noted the ETC requirement for ElectraNet to use best endeavours to minimise the duration of interruption. Therefore, AEMO considers the proposal supportable in principle. AEMO however notes the following:
  - The non-compliance with ETC reliability standards (without implementing the engineering solutions) is subject to interpretation.

- The implementation of the engineering solutions is subject to ETSA's agreement to also implement the necessary scope of works in ETSA Utilities' network.
- Details vary with solution design (for example, mobile generator size, step-up transformers, and the interfacing design).

Revise the voltage control scheme presently implemented on the Eyre Peninsula, review and update the line-drop compensation settings at Cultana and Whyalla, and introduce the automated switching of reactive plant at Port Lincoln and Yadnarie (2014; Reference A4-018).

- The existing control scheme needs to be reviewed after the Cultana reinforcement project, which among other things includes breaking the 132 kV mesh between the Eyre Peninsula region and the Upper North region. Design details of the proposed control schemes are not available for AEMO's assessment, and do not form part of this review.
- ElectraNet also advised that this project includes implementing a control scheme to prevent likely voltage collapse on the Eyre Peninsula in the event of an unplanned outage of the step-up transformer connecting Port Lincoln Unit 1 and Unit 2.

Revise the voltage control scheme presently implemented in the Upper North, review and update the line-drop compensation settings at Davenport, and introduce the automated switching of reactive plant at Leigh Creek Coalfield and at Woomera (2014; Reference A4-019).

- Similar to the Eyre Peninsula proposal, the existing control scheme needs to be reviewed and revised after the Cultana reinforcement project, which among other things includes breaking the 132 kV mesh between the Eyre Peninsula region and the Upper North region. Design details of the proposed control schemes are not available for AEMO's assessment, and do not form part of this review.

Complete Tailem Bend substation diameters to ensure compliance with ElectraNet policy (2015; Reference A4-020).

- The Tailem Bend 275 kV substation is one of the key nodal substations located on the Victoria–South Australia (Heywood) interconnector flow path. However, the substation only has two 275 kV diameters with a single circuit breaker between the two South East–Tailem Bend 275 kV circuits, which is not considered to be in line with good electricity industry practice. ElectraNet's proposal is considered reasonable, however, the project timing is considered to be subjective. AEMO's support also considers the potential benefit of the proposal with respect to minimizing the risks of supply shortfall in South Australia (discussed in 5.1.1).

Complete South East substation diameters to ensure compliance with the ElectraNet policy (2015; Reference A4-021).

- The South East 275 kV substation is one of the key nodal substations located on the Victoria–South Australia (Heywood) interconnector flow path. However, both the 275 kV South East–Heywood lines and the South East 275/132 kV transformers are single breaker switched, which is not considered to be in-line with good electricity industry practice. ElectraNet's proposal is considered reasonable, however the project timing is considered to be subjective. AEMO's support also considers the potential benefit of the proposal with respect to minimizing the risks of supply shortfall in South Australia (discussed in 5.1.1).

5.1.4 Asset replacement

ElectraNet's capital project proposal includes six network asset replacement projects, which also addresses the network augmentation with additional capacity. Among them four are assessed by AEMO. The remaining two were not assessed due to advanced work-in-progress status advised by ElectraNet.

AEMO assessed four replacement projects:

- Rebuild Kincraig as a breaker-and-half 132 kV substation with two new 60 MVA 132/33 kV transformers (2017; Reference A4-022).
- Rebuild the existing Kanmantoo substation on an adjacent site with 2 × 10 MVA 132/33 kV transformers (2015; Reference A4-023).

- Rebuild Keith as a 132 kV mesh bus substation with two new 60 MVA 132/33 kV transformers (2019; Reference A4-024).
- Rebuild Mount Gambier on a new site as a mesh bus 132 kV substation with two new 60 MVA 132/33 kV transformers (2020–21; Reference A4-025).

The alternative options can be found in Appendix C.

The replacement program considers asset condition and forecast transformer capacities to meet ETC requirements. The replacement proposals are considered reasonable.

Further details related to the Kanmantoo rebuild are as follows:

- Kanmantoo is currently a Category 1 connection point. AEMO noted the proposed project will provide Kanmantoo with Category 2 capability. ElectraNet advised that it has examined the incremental cost involved in the installation of the second transformer at this location in the course of the scheduled substation replacement works which amounts to $3 million. ElectraNet has undertaken a high level net present value analysis of the economic benefits of the additional capacity using the economic model and assumptions (adopted by AEMO in its advice to ESCOSA on the review of the ETC in 2010), and the analysis indicates the additional expenditure will realise lifetime benefits in excess of $11 million.

5.2 Strategic land and easement acquisition

ElectraNet's capital program includes 21 strategic land and easement acquisition projects. Confining assessment to the extent of the reasonableness of the proposed locations, AEMO carried out a high-level assessment based on the information provided by ElectraNet and the load forecast published in the 2011 SAAPR and 2011 SASDO. AEMO's assessment results are as follows:

- All land and easement acquisition projects proposed by ElectraNet are considered of strategic value.
- The need and timing of the proposed projects vary from project to project.

AEMO has categorised the land and easement acquisition projects proposed by ElectraNet into two categories:

- **Group 1** includes land parcels and easements that may be required over the next 10 years to overcome potential network limitations.
- **Group 2** includes land parcels and easements that are not expected to be required over the next 10 years to overcome potential network limitations.

Group 1 projects include the following:

- Fleurieu Peninsula Reinforcement Land and Easement Acquisition.
- Eyre Peninsula Reinforcement Land and Easement Acquisition.
- Yorke Peninsula Reinforcement Land and Easement Acquisition.
- Riverland Reinforcement Land and Easement Acquisition.
- Kadina East to Hummocks Land and Easement Acquisition.
- Angas Creek Substation Replacement Land Acquisition.
- South East to Mount Gambier to Snuggery Easement Expansion.

Group 2 projects include the following:

- Mount Barker South Triple Circuit Easement Expansion.
- Cultana to Stony Point Land and Easement Acquisition.
- Snuggery Substation Replacement Land Acquisition.
- Torrens Island C Switching Station Land and Easement Acquisition.
- Morphett Vale East/Cherry Gardens/Happy Valley Easement Expansion.
- Tepko Substation Land Acquisition.

- Wilmington Substation Land Acquisition.
- Lincoln Gap Land Acquisition.
- Fourth Northern Suburbs Substation Land Acquisition.
- Jamestown Substation Land Acquisition.
- Para to Tungkillo Easement Expansion.
- Mallala to Para Easement Expansion.
- Templers to Para Easement Expansion.
- Mallala to Templers West Land and Easement Acquisition.

AEMO considers the projects in Group 2 are of strategic value for long-term network development. However, at this stage their optimal timing is considered to be mainly driven by the risks associated with land and easements being unavailable and cost escalation, should the acquisition be deferred. AEMO notes ElectraNet's explanation that these land parcels and easement rights may become unavailable or more costly should the purchase be delayed beyond the regulatory period 2013–14 to 2017–18. AEMO is not in a position to comment on these projects without carrying out detailed land-use planning and real estate property market-type investigations, which is beyond the scope of AEMO's review.

AEMO supports the proposal to acquire the strategic land parcels and easement rights in the coming regulatory period that meet one or more of the following:

- The land and easement is expected to be required over the next 10 years and is linked to an identified network project.
- The land and easement is expected to be required over the next 10 to 20 years or is of strategic value, and it can be reasonably substantiated via an economic assessment that a delayed purchase may result in a higher cost or a likelihood that the land will become unavailability at a later stage.

In line with these criteria, AEMO considers the inclusion of projects in Group 1 in the revenue proposal for the regulatory period 2013–14 to 2017–18 to be reasonable. However, AEMO is not in a position to comment on the remaining projects as the economic and land availability analysis is beyond the scope of the current review.

5.3 Contingent projects

ElectraNet's contingent project proposal contains 29 projects. For a complete list of these projects, see Appendix B.

AEMO's review of contingent projects was different to the review of the ex-ante projects, with the ex-ante projects required to meet a higher standard, due to a revenue allowance being made at this stage. Contingent projects are subject to further justification. As a result, AEMO has limited its review to the question of whether there are sufficient projects identified to enable ElectraNet to respond to changing future conditions.

AEMO also discussed the specification of the trigger event with ElectraNet to ensure it is as clear and specific as possible. AEMO notes that ElectraNet specified the quantum of step load to trigger some of the proposed contingent projects. AEMO supports this approach but no detailed studies were carried out to verify the accuracy of these values.

Based on the project descriptions, these projects are considered able to cover the range of probable future development scenarios. The proposed projects (or more economical alternative options serving the same purpose) are also expected to be required under the specific development scenarios (demand growth, generation growth, and identified market benefits).

AEMO supports ElectraNet's contingent project proposal, and considers that listing contingent projects is a prudent mechanism for managing uncertainty, particularly where it may result in high-cost augmentations.

CHAPTER 6 - ALIGNMENT WITH THE NTNDP

The majority of ElectraNet's ex-ante projects are for connection augmentations, regional transmission network reactive power compensation, and security and compliance, which are outside the NTNDP's scope. The ex-ante project proposal also does not include any major projects for transmission or sub-transmission line augmentation over the regulatory period 2013–14 to 2017–18.

The contingent projects, however, do include potential upgrades to the Victoria–South Australia (Heywood) and Victoria–South Australia (Murraylink) interconnectors, which were identified by the NTNDP. As a result, ElectraNet's proposal is considered to be consistent with the NTNDP.

CHAPTER 7 - REVIEW LIMITATIONS

- AEMO's review only addressed a part of the projects constituting ElectraNet's revenue proposal (as described in the Executive Summary and Section 5.1).
- An assessment of ElectraNet's cost estimates is beyond the scope of AEMO's review. As a result, in assessing the option analysis by ElectraNet, AEMO limited its review to whether or not reasonable technically-compliant options have been looked into by ElectraNet. Of the options investigated at this point of time, AEMO assumes that ElectraNet has selected the most economic option.
- While AEMO may comment on the potential market benefit of a project proposed by ElectraNet, no market benefits analysis was carried out by AEMO for the purpose of this review.
- In assessing the replacement (with augmentation) projects addressed in this report, AEMO presumed the asset condition is as per ElectraNet's description. AEMO did not independently assess asset conditions.

CHAPTER 8 - CONCLUSIONS

In general, AEMO is satisfied that taken together, ElectraNet's proposed capital program (as at 26 April 2012) constitutes a reasonable development program to overcome the potential network limitations that are reasonably expected to emerge over the regulatory period 2013–14 to 2017–18, for compliance with the South Australian ETC.

AEMO notes the significant likelihood that the timings of some projects may be deferred by potential non-network solutions, though at this stage network solutions are the only known certain solutions that can ensure compliance with the ETC. AEMO would expect that ElectraNet will carry out a thorough investigation of these non-network solutions when carrying out RIT-Ts for these projects.

The strategic land and easement acquisitions proposed by ElectraNet are of strategic value. AEMO identified 7 land parcels and easements that can reasonably be expected to be required over the next 10 years to overcome potential network limitations. The optimal timing of the remaining 14 acquisitions is considered to be mainly driven by the risks associated with a higher cost or the land becoming unavailable from a delayed purchase, which should be subject to a probabilistic or economic assessment including the probability of future network development triggers, land-use planning and property development considerations. AEMO is not in a position to comment on these factors as they are beyond the scope of the current review.

Based on the project descriptions, the contingent projects proposed by ElectraNet are considered able to cover the range of probable future development scenarios. The proposed projects (or more economical alternative options serving the same purpose) are also expected to be required under the specific development scenarios (demand growth, generation growth, and identified market benefits). AEMO notes that ElectraNet specified the quantum of step load to trigger some of the proposed contingent projects. AEMO supports this approach but no detailed studies were carried out to verify the accuracy of these values.

APPENDIX A - NETWORK PROJECT LISTS

This appendix contains network project lists provided by ElectraNet (as at 26 April 2012) for the purposes of this review.

The lists are categorised according to the project type. For information about alternative options to the projects listed, see Appendix C (using the project reference numbers listed against each project).

The information obtained from ElectraNet evolved through the review process and even as at 26 April 2012 it was still a work in progress. The project and limitation descriptions in this appendix are directly quoted from ElectraNet's project list with table notes added by AEMO where necessary for clarification. AEMO expects that ElectraNet will continue to refine the descriptions up to their submission to the AER. As a result, some of the descriptions presented in this report may differ from those in ElectraNet's revenue cap proposal.

Table A 1 — Summary of capital network projects assessed by AEMO (augmentation)

Project Timing	Limitation (by ElectraNet)	Project description (by ElectraNet)	Project reference (by AEMO)
2014	Inadequate voltage at Kadina East for the loss of the 275/132 kV transformer at Bungama or the Hummocks to Waterloo 132 kV transmission line.	Install 1 × 15 Mvar PoW switched capacitor bank at Kadina East substation.	A4-009
2015	Inadequate voltage in the vicinity of Port Pirie for the loss of the Bungama 200 MV.A 275/132 kV transformer.	Install a second 200 MV.A 275/132 kV transformer at Bungama Substation.	A4-011
2017	Thermal overload of the Baroota transformer under N conditions; substation infrastructure is at the end of its technical life.[a]	Replace Baroota substation; install 2 × 25 MV.A 132/33 kV transformers at Baroota substation (ETC category change).[b]	A4-001
2017	Inadequate reactive margins at Monash/Berri substations for the loss of Murraylink interconnector.[c]	Install 1 × 15 Mvar PoW switched capacitor bank at Monash substation.	A4-008
2016	Inadequate reactive margin at Dalrymple for the loss of the 275/132 kV transformer at Bungama or the Hummocks to Waterloo 132 kV transmission line; ETC change requires Dalrymple to be raised to a Category 2 reliability level.	Install 1 × 8 Mvar PoW switched capacitor bank at Dalrymple substation; install a second 25 MV.A 132/33 kV transformer and complete the mesh bus.	A4-010
2015	An unplanned outage of 275/66 kV transformer at Kilburn, Torrens Island or Le Fevre results in thermal overload of remaining units.	Replace the two 150 MV.A 275/66 kV transformers at Torrens Island with two 225 MV.A units.[d]	A4-003
2017	This work is required to maximise the opportunity to import and export power efficiently in the NEM, optimising constraints and utilising the existing network topology whilst managing system voltages, by coordinating all available reactive plant and voltage control facilities.	Install all control equipment necessary to automate the switching of both 132 kV and 275 kV connected capacitors and reactors at substations between Heywood and Davenport, creating a wide area control scheme to ensure maximum available import and export is always available; Additionally, the operation of 275/132 kV inter-bus or connection point transformer OLTCs, critical to such wide area control, are also to be automated.[e]	A4-007
2013-2018	High penetration of wind generation in South Australia results in periods of constraint when utilising static line ratings.	Install additional weather stations across the network and operate circuits as required in real-time.	A4-006
2015	De-commissioning Keith to Snuggery and Tailem Bend to Keith #1 line will lead to low voltages following the loss of the South East to Penola West 132 kV circuit.[f]	Install 1 × 15 Mvar, PoW switched, 132 kV capacitor bank at Penola West substation.	A4-014
2016	Voltage constraints at Dalrymple and Kadina East on the Yorke Peninsula for the outage of the Bungama to Hummocks 132 kV circuit.	Install a 15 Mvar capacitor bank at Hummocks substation.	A4-012
2017	De-commissioning Keith to Snuggery and Tailem Bend to Keith #1 line will lead to low voltages following the loss of the South East to Penola West 132 kV circuit.[g]	Install 1 × 15 Mvar, PoW switched, 132 kV capacitor bank at Blanche substation.	A4-015
2020	Inadequate reactive margins at Dorrien and Roseworthy connection points after the loss of Templers 275/132 kV transformer.[h]	Install 1 × 12 Mvar PoW switched capacitor bank at Roseworthy substation.	A4-013

Project Timing	Limitation (by ElectraNet)	Project description (by ElectraNet)	Project reference (by AEMO)

AEMO Notes:

a. The main driver is to upgrate Baroota from Category 1 to Category 2 for compliance with ETC requirement

b. The correct scope is ' Install one new 25 MVA and reuse the existing 10 MVA until the time it is necessary to augment the site to 2 × 25 MVA transformers'

c. limitation is low voltage, not reactive margin shortfall

d. Generation support option may defer the timing of this project

e. The need is reasonable. Control scheme details are not available for AEMO's assessment. Neither is AEMO in the position to look into this level of details

f. The limitations are not related to the decommissioning projects

g. The limitations are not related to the decommissioning projects and the contingency is South East to Mt Gambier 132kV line

h. The potential limitation is low voltage, not reactive margin shortfall

Table A 2 — Summary of capital network projects assessed by AEMO (connection)

Project Timing	Limitation	Recommended solution	Project reference (by AEMO)
2016	Mount Barker 132/66 kV transformers unable to meet ETC service standards under the outage of 275/66 kV transformer.	Install a 2nd 225 MV.A, 275/66 kV transformer at Mount Barker South; retire aged 132 KV assets at Mount Barker from service.	A4-002
2017	Outage of the City West cable or outage of the ACR transformer at City West overloads the East Terrace transformer.	Install a 2nd 225 MV.A 275/66 kV transformer at East Terrace substation supplying into ACR; change protection settings on the Magill to East Terrace 275 kV cable to 450 MV.A.	A4-004
2021	Thermal and voltage limitations in the ETSA Utilities' 66 kV network supplying the North Eastern suburbs.	Establish a new 275/66 kV injection point at Yatala Vale North with a 1 × 225 MV.A transformer.	A4-005

Table A 3 — Summary of capital network projects assessed by AEMO (replacement)

Project Timing	Limitation	Recommended solution	Project reference (by AEMO)
2017	Kincraig substation at end of technical life; 132/33 kV transformer capacity limitation.	Rebuild Kincraig substation at an adjacent site; install 2 × 60 MV.A transformers.	A4-022
2013-2018 [a]	Kanmantoo 5 MV.A[a] 132/11 kV transformer exceeds its rating capacity.	Replace the substation; install 2 × 10 MV.A 132/33 kV transformers at the site; convert to a Category 2 connection point (subject to ETC change).	A4-023
2019	Keith substation at end of technical life; inadequate Keith 132/33 kV transformer capacity under N-1 conditions.	Rebuild Keith substation in a circuit breaker and a half configuration on an adjacent site; install 2 × 60 MV.A transformers.	A4-024
2018-2023 [b]	Mount Gambier substation at end of technical life; 132/33 kV transformer capacity limitation; unsatisfactory voltages under contingency.	Rebuild existing substation at a nearby site; install 2 × 60 MV.A 132/33 kV transformers and 2 × 15 MVar capacitor banks in addition to the existing capacitors.	A4-025

AEMO Notes:

a. As per ElectraNet's update, the loadable winding capacity is 3 MVA. The rebuild needs to be completed by 2015 for compliance with ETC.

b. The timing is mainly driven by asset condition (beyond AEMO's review scope).

Table A 4 — Summary of capital network projects assessed by AEMO (security/compliance)

Project timing	Limitation	Recommended solution	Project reference (by AEMO)
2014	After the Cultana and Whyalla projects have been completed the Eyre Peninsula Region will be split from Upper North Region (i.e. 275/132 kV transformers are no longer meshed). Once this is done the existing voltage control scheme will need to be revised to ensure that the operation of the plant is correctly co-ordinated and voltage collapse doesn't result from a routine plant outage.	Revise the voltage control scheme presently implemented in the Eyre Peninsula, review and update the line drop compensation settings at Cultana and Whyalla and introduce the automated switching of reactive plant at Port Lincoln and Yadnarie.[a]	A4-018
2017	Increased loading on the transmission network has made compliance with NER Ch. 4 security provisions difficult operationally and has reduced the opportunities to do critical network maintenance and construction work to very restrictive windows.	Install an integrated control scheme in the strategic locations in the network that will ensure compliance to the 'next contingency' security requirements of the NER and allow a higher utilisation of the network under system normal conditions as well as provide the opportunity to do network maintenance as required.[a]	A4-016
2013-2018	Increasing difficulties in securing maintenance outage windows and maintaining adequate quality of supply on radial networks.	Implement a range of engineering solutions to improve supply reliability and to expand outage windows available to performance necessary maintenance on the network.[b]	A4-017
2015	Substandard circuit breaker arrangement makes it difficult to obtain outages for maintenance and places network security at risk [at South East].	Install an extra circuit breaker in a third diameter to correct the layout.[c]	A4-020
2015	Tailem Bend substation layout doesn't comply with standards and impacts on operability and maintainability of the network, particularly on the SA-Vic interconnector.	Install additional circuit breakers to overcome operational and maintainability issues and bring site into compliance with the standards.[c]	A4-021
2014	After the Cultana and Whyalla projects have been completed the Eyre Peninsula Region will be split from Upper North Region (i.e. 275/132 kV transformers are no longer meshed). Once this is done the existing voltage control scheme will need to be revised to ensure that the operation of the plant is correctly co-ordinated and voltage collapse doesn't result from a routine plant outage	Revise the voltage control scheme presently implemented in the Upper North, review and update the line drop compensation settings at Davenport and introduce the automated switching of reactive plant at Leigh Creek Coalfield and at Woomera [a]	A4-019

AEMO Notes:

a. The need is reasonable. However, the control scheme details are not available for AEMO's assessment. Neither is AEMO in the position to look into this level of details

b. The need is reasonable. However, details which may affect the scope of work are not available for AEMO's assessment, neither is AEMO in the position to look into this level of details.

c. The proposal is considered in line with good utility practice. Timing however is not critical. ElectraNet is expected to update the project descriptions to better reflect the work scope.

Table A 5 — Summary of Capital Network Projects not assessed by AEMO due to advanced status advised by ElectraNet

Augmentation

Project timing	Limitation	Recommended Solution
2013	Unsatisfactory voltages and thermal issues on Davenport to Cultana/Whyalla terminal 132 kV lines under contingency conditions	Turn in both the Playford to Whyalla 132 kV lines into Cultana; supply Yadnarie radially from Cultana; break out 2nd Davenport to Cultana 275 kV circuit; install a 2nd 275/132 kV transformer at Cultana (also rebuild Whyalla Terminal substation with 2 × 120 MV.A 132/33 kV transformers; install 2 × 15 Mvar 132 kV capacitors banks (replacing the existing tertiary connected banks))
2013	Low voltage at Keith and Tailem Bend under loss of Tailem Bend 275/132 kV transformer	Install 1 × 30 Mvar capacitor bank at Tailem Bend substation

Connection

Project timing	Limitation	Recommended Solution
2014	An unplanned outage of Para 275/66 kV transformer results in thermal overload of remaining unit	Establish Munno Para substation and install a single 225 MV.A 275/66 kV transformer supplying into the Para system
2013	Thermal overload of the remaining transformer at Hummocks under N-1 conditions	Minimal asset replacement at Hummocks substation, install 2 × 25 MV.A 132/33 kV transformers (ex Playford)

Replacement

Project Timing	Limitation	Recommended Solution
2008-2013	Critical infrastructure at Whyalla terminal substation at end of technical life; change in ETC categorisation of Whyalla from category 3 to 4 (firm N-1 transformer capacity for AMD is required)	Replace Whyalla Terminal substation with 2 × 120 MV.A 132/33 kV transformers; install 2 × 15 Mvar 132 kV capacitors banks (replacing the existing tertiary connected banks) (also turn in both the Playford to Whyalla 132 kV lines into Cultana; supply Yadnarie radially from Cultana; break out 2nd Davenport to Cultana 275 kV circuit; install a 2nd 275/132 kV transformer at Cultana)
2013	Critical infrastructure at Waterloo substation at end of technical life; thermal rating of the transformers under N conditions	Rebuild Waterloo substation and install 2 × 25 MV.A 132/33 kV transformers

APPENDIX B - SUMMARY OF CONTINGENT PROJECTS PROPOSED BY ELECTRANET

Table B 1 — Summary of contingent projects proposed by ElectraNet

	Project Description	Trigger Events
Eastern Hills		
1	Establish a new distribution connection point in the Eastern Hills Region with 1 × 225 MVA 275/66 kV transformer and cut into the existing Cherry Gardens to Tungkillo 275 kV lines.	1. Formal request for a new regulated connection point from the DNSP 2. Successful completion of the RIT-T showing a new connection point in the region is justified
Eyre Peninsula		
2	Establishment of a 275/132 kV nodal substation north of Yadnarie with 2 × 200 MVA transformers (assuming the prior construction of a double circuit 275 kV line from Cultana to Port Lincoln)	1. Customer commitment to connect OR an increase of 5 MW in load forecast above the forecast published in the 2011 APR for 2018/19 on the transmission network south of Cultana[19] 2. Successful completion of the RIT-T showing a new connection point in the region is justified
3	Establishment of a 275/132 kV nodal substation south of Yadnarie with 2 × 200 MVA transformers (assuming the prior construction of a double circuit 275 kV line from Cultana to Port Lincoln)	1. Customer commitment to connect OR an increase of 5 MW in load forecast above the forecast published in the 2011 APR for 2018/19 on the transmission network south of Yadnarie[20] 2. Successful completion of the RIT-T showing a new connection point in the region is justified
Main Grid		
4	Reinforcement of the Eyre Peninsula network south of Cultana by constructing a double circuit 275 kV line from Cultana to Port Lincoln (also covers scope of works required to replace Port Lincoln 132 kV section, this project will also cover the installation of an SVC in the region should it be required)	1. Demand forecast at Port Lincoln exceeding 49 MW 2. Successful completion of the RIT-T showing transmission investment is justified
5	Construction of a new Davenport North switching station (near Yorkeys Crossing) and new double circuit 275 kV transmission line from Davenport North to Cultana along with associated line reconfiguration works in the upper north region of South Australia (this project will also cover the installation of an SVC in the region should it be required)	1. Customer commitment to connect increasing the total forecast demand supplied south of Cultana to above 590 MW 2. Successful completion of the RIT-T showing network development
6	Construction of double circuit 275 kV line from Robertstown to Monash, installation of 2 × 225 MVA 275/66 kV transformers and a refurbished 275/132 kV transformer at Monash and the removal of all high voltage ElectraNet assets from Berri.	1. An increase of 12.5 MW in load forecast above the forecast published in the 2011 APR for 2018/19 for the North West Bend and Berri connection points OR publication by AEMO of available Murraylink dispatch into South Australia that is insufficient to provide the necessary network support to meet ETC reliability standards in the Riverland region. 2. Successful completion of the RIT-T showing transmission investment is justified.

[19], [27] [AEMO notes] The alternative triggers based on 5 MW load forecast increase for these two nodal substations are exclusive.

	Project Description	Trigger Events
7	Construction of a double circuit 275 kV transmission line from Kanmantoo North to Currency Creek to extend the transmission network and establish a new distribution connection point on the Fleurieu Peninsula (if not established to supply the distribution network already, this project would also include the establishment of a 275 kV switching station at Kanmantoo North cut into the existing Cherry Gardens to Tungkillo 275 kV lines)	1. Formal request for a new regulated connection point from the DNSP 2. Successful completion of the Regulatory Test demonstrating a transmission solution is economically justified
8	Construction of a new double circuit 275 kV transmission line (cut into the existing Para to Bungama 275 kV circuit), installation of 1 × 200 MVA 275/132 kV transformer and 2 × 60 MVA 132/33 kv transformers and other associated substation works at Hummocks	1. Aggregate demand forecast for the Hummocks, Kadina East, Ardrossan West and Dalrymple connection points exceeding 90 MW 2. Successful completion of the RIT-T showing a new connection point in the region is justified
9	Uprating (or rebuilding) of the Para - Brinkworth - Davenport and/or the Para - Bungama - Davenport 275 kV transmission Lines	1. Successful completion of the RIT-T demonstrating positive net market benefits
10	Turn both Davenport to Robertstown 275 kV circuits into Belalie (or Mokota), construct a double circuit 275 kV connection between Belalie (or Mokota) to Brinkworth, turn the west circuit into Brinkworth to tie the four circuits together and aloow the flows on the circuits to be balanced.	1. Successful completion of the RIT-T demonstrating positive net market benefits
11	Install series compensation at Black Range, a 3rd 275/132 kV transformer at South East, decommission the Snuggery - Keith and the Keith - Tailem Bend 132 kV circuits and install 2 × 15 Mvar capacitors at Keith	1. Successful completion of the RIT-T demonstrating positive net market benefits
12	Establishment of a new high voltage (AC or DC) interconnector along either a northern (from Wilmington to Mount Piper) or southern (Tepko or Krongart to Heywood) route	1. Successful completion of the RIT-T demonstrating positive net market benefits
13	Construction of a new double circuit 275 kV transmission line from Davenport to Olympic Dam West and associated substation works (this assumes that the BHPB Olympic Dam mine will proceed prior to the Eyre Peninsula iron ore developments)	1. Customer commitment to connect increasing the total forecast demand supplied from Davenport to above 260 MW 2. Successful completion of the RIT-T showing network development in the region is justified
14	Construction of a new high voltage (AC or DC) transmission network from Wilmington to Innamincka to enable economic delivery of additional generation to major load centres and serve associated load	1. Successful completion of the RIT-T demonstrating positive net market benefits
15	Installation of reactive support plant at Davenport for voltage control such as an SVC or suitable alternative	1. Commitment to the retirement of the Playford Power Station 2. Successful completion of the RIT-T showing installation of additional reactive support at Davenport is justified
16	Construct a third 275 kV circuit between Para and Tungkillo; string the unstrung circuit on the Tailem Bend to Tungkillo line; complete the diameters at Tungkillo and at Tailem Bend	1. Successful completion of the RIT-T demonstrating positive net market benefits
17	Substation works required to facilitate the entry of the TIPS to Cherry Gardens 275 kV circuit into Parafield Gardens West substation and the TIPS to Cherry Gardens and TIPS to Magill 275 kV circuits into Para substation	1. Successful completion of the RIT-T demonstrating positive net market benefits

	Project Description	Trigger Events
Metropolitan		
18	Installation of 1 × 300 MVA 275/66 kV transformer at City West substation supplying into the western suburbs along with associated switchgear, establishment of a new distribution connection point at City West	1. Formal request for a new regulated connection point from the DNSP 2. Successful completion of the RIT-T showing a new connection point in the region is justified
19	Installation of 1 × 300 MVA 275/66 kV transformer at City West supplying into the southern suburbs along with associated switchgear. Splitting the 66 kV sub-transmission network between the Happy Valley and the Morphett Vale East bulk supply points. Installation of 1 × 225 MVA 275/66 kV transformer at MVE along with associated switchgear and 1 × 275 kV CB to complete the mesh bus arrangement.	1. An increase in demand exceeding the forecast load published in the 2011 APR for 2018/19 by 60 MW for the aggregate of the Southern Suburbs connection points 2. Successful completion of the RIT-T showing that modifying the existing connection points is justified
20	Establishment of a new Kingsford 275/66 kV connection point with 2 × 225 MVA transformers OR reinforcement of an existing connection point/substation in the region	1. Formal request for a new regulated connection point from the DNSP OR Formal request to modify an existing connection point from the DNSP 2. Successful completion of the RIT-T showing a new or modified connection point in the region is justified
21	Reconfiguration of the western suburbs transmission network through the establishment of Torrens Island C switchyard	1. Successful completion of the RIT-T demonstrating positive net market benefits
Mid North		
22	Establish a new distribution connection point in the Mid North region with 1 × 225 MVA 275/66 kV transformer and cut into the existing Robertstown to Davenport 275 kV lines.	1. Formal request for a new regulated connection point from the DNSP 2. Successful completion of the RIT-T showing a new connection point in the region is justified
23	Establish a new distribution connection point in the Barossa Valley region with 1 × 225 MVA 275/66 kV transformer and cut into the existing Para to Robertstown 275 kV lines	1. Formal request for a new regulated connection point from the DNSP OR an increase in forecast demand exceeding the forecast published in the 2011 APR for the Barossa Valley connection points 2018/19 by 25 MW 2. Successful completion of the RIT-T showing a new connection point in the region is justified
24	Reinforcement of the Port Pirie connection point by installing a second 60 MVA 132/33 kV transformer and the construction of a second 132 kV line between Bungama and Port Pirie	1. Formal request for a new regulated connection point from the DNSP 2. Successful completion of the RIT-T showing a new connection point in the region is justified
South East		
25	Establish a new 132/33 kV connection point in the South East region with 2 × 25 MVA 132/33 kV transformers and cut into the existing Tailem Bend to Keith #2 line (for Coonalpyn West) or the existing Keith to Penola West circuit (for Sugar Loaf Hill or Mount Benson)	1. Formal request for a new regulated connection point from the DNSP 2. Successful application of the RIT-T showing a new or modified connection point in the region is justified
26	Construct a second South East - Mount Gambier - Blanche - Snuggery 132 kV circuit on the same alignment as the existing circuit	1. An increase in the forecast demand exceeding the forecast published in the 2011 APR for 2018/19 by 30 MW for the aggregate of the Snuggery, Blanche and Mount Gambier connection points 2. Successful application of the RIT-T showing a network augmentation is justified

	Project Description	Trigger Events
27	Establish a new transmission connection point at Kincraig with 1 × 200 MVA 275/132 kV transformer and associated 132 kV network reconfiguration OR install dynamic reactive support at Keith.	1. An increase in the forecast demand exceeding the forecast published in the 2011 APR for 2018/19 by 4 MW at Keith, 3 MW at Kincraig or 3 MW at Penola West connection points 2. Successful application of the RIT-T showing a new or modified connection point is justified
28	Augmentation of 275/132 kV transformer capacity at South East or a new site at Kincraig and associated 132 kV line reconfiguration (if necessary)	1. An increase in the forecast demand exceeding the forecast published in the 2011 APR for 2018/19 by 25 MW for the aggregate of the Snuggery, Blanche and Mount Gambier connection points 2. Successful application of the RIT-T showing a new or modified connection point is justified
Upper North		
29	Rebuilding of the Leigh Creek and/or Pimba 132 kV lines and establishment of associated substation assets	1. Customer commitment to connect and / or an increase in forecast demand of 10 MW above the forecast published in the 2011 APR for 2018/19 at a distance of more than 10 km from Davenport 2. Successful application of the RIT-T showing a new connection point and line upgrade is justified

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APPENDIX C - ALTERNATIVE OPTIONS

This appendix provides details about alternative options to the proposed projects consolidated from various documents provided by ElectraNet.

Table C 2 — Alternative Options

Reference	Project Description	Alternative Options
A4-001	Install one new 25 MVA and reuse the existing 10 MVA at Baroota until the time it is necessary to augment the site to 2 × 25 MVA transformers.	Option 1 – the proposed project Option 2 – one new 10 MVA transformer and one refurbished 10 MVA transformer Option 3 – Install two new 25 MVA transformer
A4-002	Install a second 275/66 kV 225 MVA transformer at Mount Barker South.	Option 1 – the proposed project Option 2 – Install a third 132/66 kV 60 MVA transformer at Mount Barker and then replace the existing transformers Option 3 – Distribution solution Option 4 – Non-network solution: Generation Option 5 – Non-network solution: Demand Side Management
A4-003	Replace the two 150 MVA 275/66 kV transformers at Torrens Island with two 225 MVA units.	Option 1- the proposed project Option 2 – Install a second 225 MVA transformer at Kilburn along with associated land procurement and substation reconfiguration works Option 3 – Establish Royal Park substation with 1 × 300 MVA 275/66 kV transformer fed by 1 × 720 MVA 275 kV cable from City West Option 4 – Distribution solution Option 5 – Non-network solution: Generation support in the Metro West area Option 6 – Non-network solution: Demand side management
A4-004	Install a 2nd 225 MVA 275/66 kV transformer at East Terrace substation supplying into ACR; change protection settings on the Magill to East Terrace 275 kV cable to 450 MVA.	Option 1 – the proposed project Option 2 – construct a second 275 kV cable from TIPS to City West and install second 275/66 kV transformer supplying into ACR Option 3 – construct 275 kV cable from City West to East Terrace or Magill and install second 275/66 kV transformer at City West supplying into ACR Option 4 – replace the existing 225 MVA transformer at East Terrace substation with a 300 MVA transformer; Option 5 – Generation support Option 6 – Demand side management

Reference	Project Description	Alternative Options
A4-005	Establish a new 275/66 kV injection point at Yatala Vale North with a 1 × 225 MVA transformer.	Option 1 – the proposed option Option 2 – Defer Yatala Vale by replacing Northfield transformers with 300 MVA units and rearranging Magill transformers (note by ElectraNet: This option has been discounted because it will not address the distribution system limitations and high cost) Option 3 – Distribution solution Option 4 – Non-network solution: Generation support Option 5 – Non-network solution: Demand side management
A4-006	Install additional weather stations across the network and operate circuits as required in real-time.	Option 1 – the proposed option Option 2 – use of tension monitoring Option 3 – do nothing
A4-007	Install all control equipment necessary to automate the switching of both 132 kV and 275 kV connected capacitors and reactors at substations between Heywood and Davenport, creating a wide area control scheme to ensure maximum available import and export is always available; Additionally, the operation of 275/132 kV inter-bus or connection point transformer OLTCs, critical to such wide area control, are also to be automated.	Option 1 – the proposed option Option 2 – do nothing Option 3 – Network augmentation
A4-008	Install 1 × 15 MVAr POW switched capacitor bank at Monash substation.	Option 1- the proposed project Option 2 – Distribution solution Option 3 – Non-network solution: Generation support Option 4 – Non-network solution: Demand side management
A4-009	Install 1 × 15 MVAr PoW switched capacitor bank at Kadina East substation.	Option 1 – the proposed project Option 2 – Establish a 275/132 kV injection point at Hummocks Option 3 – Permanent or rapid automatic distribution load shift Option 4 – Demand Side Management Option 5 – Load side Power Factor improvement Option 6 – Generation support
A4-010	Install 1 × 8 MVAr PoW switched capacitor bank at Dalrymple substation.	Option 1 – the proposed project Option 2 – Permanent or rapid automatic distribution load shift Option 3 – Demand Side Management Option 4 – Load side Power Factor improvement Option 5 – Generation support

Reference	Project Description	Alternative Options
A4-011	Install a second 200 MVA 275/132 kV transformer at Bungama Substation.	Option 1 – the proposed project Option 2 – Install 132 kV and/or 33 kV switched capacitors at and near Bungama Option 3 – Install second 132/33 kV transformer at Port Pirie Option 4 – Distribution solution Option 5 – Non-network solution: Generation support Option 6 – Non-network solution: Demand Side Management
A4-012	Install 1 × 15 MVAr 132 kV capacitor at Hummocks substation.	Option 1 – the proposed project Option 2 – Major augmentation of the supply to the Yorke Peninsula system (Establish a 275/132 kV injection at Hummocks substation, supplied by turning the 275 kV Para to Bungama line in and out to Hummocks) Option 3 – Install 1 × 15 MVAr 132 kV capacitor at Waterloo substation Option 4 – Re-energize the Robertstown to Waterloo #1 132 kV line Option 5 – Distribution solution Option 6 – Non-network solution: Generation support Option 7 – Non-network solution: Demand side management
A4-013	Install 1 × 12 MVAr 132 kV PoW switched capacitor at Roseworthy substation.	Option 1 – the proposed option Option 2 – Install a second 275/132 kV transformer at Templers West and rebuild Templers 132 kV section at Templers West to create a Templers West to Waterloo 132 kV line Option 3 – Distribution solution Option 4 – Non-network solution: Generation support Option 5 – Non-network solution: Demand side management
A4-014	Install 1 × 15 MVAr 132 kV PoW switched capacitor at Penola West substation.	Option 1 – the proposed option Option 2 – Distribution solution: Install 1 × 5 MVAr 33 kV capacitor bank at Penola West substation Option 3 – Non-network solution: Generation support / Demand side management
A4-015	Install 1 × 15 MVAr 132 kV PoW switched capacitor at Blanche substation.	Option 1 – Install 1 × 15 MVAr 132 kV PoW switched capacitor at Blanche substation Option 2 – Distribution solution Option 3 – Non-network solution: Generation support / Demand side management

Reference	Project Description	Alternative Options
A4-016	Install an integrated control scheme in the strategic locations in the network that will ensure compliance to the 'next contingency' security requirements of the NER and allow a higher utilisation of the network under system normal conditions as well as provide the opportunity to do network maintenance as required.	Option 1 – the proposed option Option 2 – do nothing Option 3 – Demand side management
A4-017	Implement a range of engineering solutions to improve supply reliability and to expand outage windows available to perform necessary maintenance on the network.	Option 1 – the proposed option Option 2 – Purchase mobile transformers instead of mobile generators and do the same project as proposed in Option 1 Option 3 – do nothing
A4-018	Revise the voltage control scheme presently implemented in the Eyre Peninsula, review and update the line drop compensation settings at Cultana and Whyalla and introduce the automated switching of reactive plant at Port Lincoln and Yadnarie.	Option 1 – the proposed option Option 2 – Do nothing Option 3 – Network Augmentation
A4-019	Revise the voltage control scheme presently implemented in the Upper North, review and update the line drop compensation settings at Davenport and introduce the automated switching of reactive plant at Leigh Creek Coalfield and at Woomera.	Option 1 – the proposed option Option 2 – Do nothing Option 3 – Network Augmentation
A4-020	Complete Tailem Bend substation diameters to ensure compliance with the ElectraNet policy 1-02-OP05.	Option 1 – The proposed option Option 2 – Rebuild Tailem Bend substation on an adjacent block of land Option 3 – Do nothing
A4-021	Complete South East substation diameters to ensure compliance with the ElectraNet policy 1-02-OP05.	Option 1 – The proposed option Option 2 – Rebuild South East substation on an adjacent block of land to allow compliance with and ElectraNet policy 1-02-OP05 Option 3 – Do nothing
A4-022	Rebuild Kincraig as a breaker-and-half 132 kV substation with two new 60 MVA 132/33 kV transformers.	Option 1 – The proposed option Option 2 – Rebuild Kincraig as an ultimate breaker-and-half 132 kV substation with three new 25 MVA 132/33 kV transformers Option 3 – Rebuild Kincraig substation with existing capacity and distribution solution Option 4 – Rebuild Kincraig substation with existing capacity and non-network solution: Generation support / demand side management

Reference	Project Description	Alternative Options
A4-023	Kanmantoo Substation Upgrade.	Option 1 – Rebuild the existing substation on an adjacent site with 2 × 10 MVA 132/33 kV transformers Option 2 – Rebuild the existing substation in situ with 2 × 10 MVA 132/33 kV transformers Option 3 – Do nothing
A4-024	Keith Substation Replacement and Transformer Upgrade.	Option 1 – Rebuild Keith as a 132 kV mesh bus substation with two new 60 MVA 132/33 kV transformers Option 2 – Rebuild Keith as an ultimate breaker-and-half 132 kV substation with three new 25 MVA 132/33 kV transformers Option 3 – Distribution solution Option 4 – Rebuild Keith substation with existing capacity and generation support Option 5 – Rebuild Keith substation with existing capacity and demand side management
A4-025	Mount Gambier Substation Replacement and Transformer Upgrade.	Option 1 – Rebuild Mount Gambier on a new site as a mesh bus 132 kV substation with two new 60 MVA 132/33 kV transformers Option 2 – Rebuild Mt Gambier with as an ultimate breaker-and-half 132 kV substation with three new 25 MVA 132/33 kV transformers Option 3 – Distribution solution Option 4 – Rebuild Mount Gambier substation with existing capacity and Generation support / demand side management