Appendix G

Forecast Network Capital Projects
1 July 2008 to 30 June 2013

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31 May 2007

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1. Introduction

ElectraNet's capital expenditure forecast for the 1 July 2008 to 30 June 2013 regulatory period is presented in Chapter 5 of ElectraNet's Revenue Proposal, which also includes a description of the methodology and key inputs and assumptions used to develop the capital expenditure forecast.

The Submission Guideline templates accompanying the Revenue Proposal include a full list of the capital projects included in the capital expenditure forecast.

This document includes project summaries for augmentation, connection and replacement network projects with an estimated cost greater than $1 million.

The project summaries include:

- Details of the project requirement and timing including the Rules capital expenditure objective(s) that the capital project is required to meet;
- A description of the project; and
- Project selection – alternative options considered to address the limitation.

While the project summaries include a high level comparison of the selected project with alternative options considered, they are not intended to include a detailed present value analysis of the alternative options.

2. Whyalla Terminal

Project Title: Whyalla Terminal Rebuild and Transformer Capacity Increase

Project No: 10509 **Commissioning Date:** 2010

Category: Connection and Replacement **Estimated Cost:** $48.9m

2.1 Project Requirement and Timing

Connection

Whyalla Terminal supplies an ETSA Utilities distribution network.

The new ETC, which takes effect from 1 July 2008, classifies the Whyalla Terminal connection point as a Category 4 load.

The reliability standard that applies to Category 4 loads requires ElectraNet to have in place N-1 equivalent line and transformer capacity to meet 100% of the Agreed Maximum Demand (AMD). N-1 is defined as the ability to continue to supply without interruption should any one element of the transmission system fail (typically an outage of a transmission line or transformer).

This is a higher standard than applies to the Whyalla Terminal connection point under the current ETC, which allows the provision of N-1 transmission line and transformer capacity in an interrupted, non-continuous way.

The introduction of the new standard means that N-1 transformer capacity at this connection point will be exceeded from 1 July 2008 under all demand forecasts provided by ETSA Utilities.

Specifically, the loss of a single connection point transformer will result in the thermal overloading and tripping of the remaining unit disconnecting the entire load. The peak load currently exceeds the continuous N-1 transformer rating by more than 30 MV.A and is restored by disconnecting other industrial load and restoring supply utilising that load's transformer.

The new ETC standard from 1 July 2008 will trigger a requirement for ElectraNet to use its best endeavours to ensure that the equivalent line and transformer capacity meets the required standard within 12 months and in any case within 3 years.

The connection component of this project is required to meet the Rules capital expenditure objective to comply with all applicable regulatory obligations associated with the provision of prescribed transmission services.

Replacement

The Whyalla Terminal 132/33 kV substation was established in 1964 and provides a point of supply for significant loads at both Whyalla Terminal itself and the remainder of the Eyre Peninsula. These loads represent some 200 MW at times of peak demand. A detailed condition assessment shows that the substation is at the end of its useful life. In its current condition, the Whyalla Terminal represents an increasing reliability risk for the connected loads.

The replacement component of the project is required to meet the Rules capital expenditure objective to maintain the quality, reliability and security of supply of prescribed transmission services.

2.2 Project Description

The condition of the substation and the old standards to which it was designed are such that rebuilding the entire 132 kV switchyard, including the necessary protection and control equipment represents the most viable solution.

The scope of works is to rebuild the substation with 2x120 MV.A 132/33 kV transformers and to reconfigure the network, moving some of the existing functionality to Cultana substation.

This would allow for a simpler rebuilding of Whyalla Terminal without having to accommodate two additional line entries. It would also provide the opportunity to shift the entire radial Eyre Peninsula load from Whyalla Terminal to Cultana, away from a highly polluting environment. The proposed solution would, therefore, turn the Playford to Whyalla Terminal #1 132 kV transmission line into Cultana and create a direct Cultana-Middleback-Yadnarie line.

Another advantage of this proposed arrangement is that it will increase the reliability of the Eyre Peninsula network by connecting the radial line into a breaker-and-a-half arrangement rather than via a circuit breaker that relies on a transfer bus for operational requirements and will also assist with the rebuilding of Whyalla Terminal by placing less load at risk.

2.3 Project Selection

Alternative options considered were:

- Do nothing – This is not considered a viable alternative as it does not address either the ETC reliability standard or the asset condition.

- Permanent or rapid automatic distribution load shift – No alternative distribution system exists.

- Demand Side Management (DSM) – Any DSM schemes at the distribution level are incorporated into the ETSA Utilities AMD. ElectraNet is currently unaware of any suitably sized loads that could viably address the emerging limitation. This option does not address the asset condition.

- Load side power factor improvement – The load power factor is already compliant with the connection agreement and Rules thresholds and there is no additional benefit of further improvement. This alternative does not address the asset condition.

- Generation network support – This alternative does not address the asset condition and would require a new generator connection point in addition to a substation rebuild making this option more costly.

- Alternative Transmission - The condition of the existing transformers precludes them being reused with the installation of a third 50 MV.A transformer. Therefore, this option has not been considered further as it would require the more costly purchase of three new 50 MV.A transformers and additional works to make the 132 kV and 33 kV connections.

The selected option is considered to be the only viable cost effective option capable of addressing the emerging limitation.

3. Mount Barker

Project Title: Mount Barker 275/66 kV Injection

Project No: 11108 **Commissioning Date:** 2011

Category: Connection **Estimated Cost:** $28.3m

3.1 Project Requirement and Timing

Mount Barker substation supplies an ETSA Utilities distribution network.

The new ETC, which takes effect from 1 July 2008, classifies the Mount Barker connection point as a Category 4 load.

The reliability standard that applies to Category 4 loads requires ElectraNet to have in place N-1 equivalent line and transformer capacity to meet 100% of the Agreed Maximum Demand (AMD). N-1 is defined as the ability to continue to supply without interruption should any one element of the transmission system fail (typically an outage of a transmission line or transformer).

This is a higher standard than applies to Mount Barker under the current ETC, which allows the provision of N-1 transmission line and transformer capacity in an interrupted, non-continuous way.

The introduction of the new standard means that N-1 transformer capacity at this connection point will be exceeded from 1 July 2008 under all demand forecasts provided by ETSA Utilities.

Specifically, the loss of a single connection point transformer will result in the thermal overloading and tripping of the remaining unit, and the loss of the Cherry Gardens to Mount Barker 132 kV transmission line will result in voltages below the minimum standards specified in the Rules and probable voltage collapse; in both cases the entire load will be disconnected. The peak load currently exceeds the continuous N-1 transformer rating by more than 10 MV.A and is restored after dead-switching in the distribution network.

More detailed descriptions of these limitations are discussed in the report, “Projected Transmission Network Constraint: Electricity Supply to the Eastern Hills Region”, published jointly by ElectraNet and ETSA Utilities (RFI 001/07 / RFP 001/07) in March 2007.

An Application Notice is currently being prepared by ElectraNet, in conjunction with ETSA Utilities, in accordance with the Regulatory Test public consultation requirements in the Rules and is due for release later in 2007.

The new ETC standard from 1 July 2008 will trigger a requirement for ElectraNet to use its best endeavours to ensure that the equivalent line and transformer capacity meets the required standard within 12 months and in any case within 3 years.

This project is required to meet the Rules capital expenditure objective to comply with all applicable regulatory obligations associated with the provision of prescribed transmission services.

3.2 Project Description

This scope of works includes:

- establishment of a new 275/66 kV substation at a site close to the existing Mount Barker 132/66 kV substation and existing 275 kV transmission line infrastructure, off-loading the 132 kV network; and

- installation of a single 225 MV.A transformer, connected to the Tungkillo to Cherry Gardens 275 kV circuit, and run in parallel with the existing 132/66 kV substation (ETSA Utilities would construct and own the interconnecting 66 kV infrastructure between the new and existing sites).

This solution has the advantage of addressing both the equivalent transformer and the equivalent transmission line capacity issues in a single development. Additionally, apart from line terminations, no new transmission lines are required assuming that land adjacent to the existing 275 kV lines can be purchased and developed.

3.3 Project Selection

Alternative options considered were:

- Do nothing – This is not considered a viable alternative as it does not address the ETC or Rules reliability standards.

- Permanent or rapid automatic Distribution load shift – ElectraNet currently has a connection agreement with ETSA Utilities that allows the dead-shifting of load from the Mount Barker system to the Eastern suburbs at Uraidla, at times of high load, under emergency conditions. The current arrangement requires the entire load to be disconnected from Mount Barker as in the “do-nothing” option. Under such conditions, ETSA Utilities would have to shift the Uraidla load in a dead-changeover and the Mount Barker transformer and the remaining Mount Barker system load could then be restored via the remaining Mount Barker transformer. The new ETC standard requires continuous N-1 equivalent transmission line and transformer capacity for Mount Barker, which means that the existing manual, post-contingency, distribution switching will no longer be adequate from 1 July 2008. Additionally, ETSA Utilities’ capacity to shift the Uraidla load at times of high load is rapidly diminishing in the short to medium term and therefore this option is not considered further as a viable alternative.

- Demand Side Management (DSM) – Any DSM schemes at the distribution level are incorporated into the ETSA Utilities AMD. ElectraNet is currently unaware of any suitably sized loads that could viably address the emerging limitation.

- Load side power factor improvement – the load power factor is already compliant with the connection agreement and Rules thresholds and there is no additional benefit of further improvement.

- Generation – ElectraNet does not consider that generation of sufficient size (at least 50 MW required by 2015) would obtain the necessary development approvals in the Mount Barker area or would technically be able to connect to the ETSA Utilities 66 kV network in a way that could meet the ETC reliability standards.

- Alternative Transmission – an alternative transmission plan has been costed and assessed that involves the initially less costly installation of 132 kV reactive plant at Mount Barker and the installation of a third 60 MV.A 132/66 kV transformer. These works are then followed by the establishment of a new 275/132 kV substation at a site known as Kanmantoo North in about 2015. PV analysis has shown that even though the larger capital spend is delayed by some years, it does not represent the overall least cost solution.

The selected option has been assessed as having the lowest PV cost of the viable options considered capable of addressing the emerging limitation.

4. Templers

Project Title: Templers 275/132 kV Injection

Project No: 11204 **Commissioning Date:** 2010

Category: Augmentation **Estimated Cost:** $27.6m

4.1 Project Requirement and Timing

The Rules require ElectraNet to comply with the power system performance and quality of supply standards in schedule 5.1.

Additionally, the new ETC, which takes effect from 1 July 2008, classifies both the Dorrien and Templers connection points as Category 4 loads. Both Dorrien and Templers substations supply ETSA Utilities distribution networks with Dorrien providing the sole supply to the Barossa Valley. AMCOR, a direct connect customer is supplied through the Roseworthy connection point.

The reliability standard that applies to Category 4 loads requires ElectraNet to have in place N-1 equivalent line and transformer capacity to meet 100% of the Agreed Maximum Demand (AMD). N-1 is defined as the ability to continue to supply without interruption should any one element of the transmission system fail (typically an outage of a transmission line or transformer).

Under all demand forecasts provided by both ETSA Utilities and AMCOR, these standards cannot be met for transmission lines from 2009.

Specifically, loss of the Para-Roseworthy 132 kV transmission line will result in voltages below the minimum standards specified in the Rules and probable voltage collapse and disconnection of load at all the connection points.

This project is required to meet the Rules capital expenditure objectives to meet the expected demand for prescribed transmission services over the period, to comply with all applicable regulatory obligations associated with the provision of prescribed transmission services, and to maintain the quality, reliability and security of supply of prescribed transmission services.

4.2 Project Description

This scope of works includes:

- establishment of a new 275/132 kV substation at a site adjacent to the existing Templers 132/33 kV substation, off-loading the 132 kV network;
- installation of a single 200 MV.A 275/132 kV transformer connected to the Para to Brinkworth 275 kV circuit via a new, short, 275 kV double circuit line, and run directly into the Templers to Dorrien 132 kV line; and
- reconnection of the existing Templers 132 kV bus to Roseworthy.

This 275/132 kV injection addresses the equivalent transmission line capacity issue and defers the need to rebuild the Templers 132 kV bus. Additionally, only a short new transmission line is required.

4.3 Project Selection

Alternative options considered were:

- Do nothing – This is not considered a viable alternative as it does not address the Rules and ETC reliability standards.

- Permanent or rapid automatic Distribution load shift – There are currently no existing or planned distribution networks of sufficient capacity available to off-load the 132 kV network and therefore this option is not considered further as a viable alternative.

- Demand Side Management (DSM) – Any DSM schemes at the distribution level are incorporated into the ETSA Utilities AMD. ElectraNet is currently unaware of any suitably sized loads that could viably address the emerging limitation.

- Load side power factor improvement – the load power factors are already compliant with the connection agreement and Rules thresholds and there is no additional benefit of further improvement.

- Generation – Although embedded generation exists at Angaston, it cannot meet the ETC continuous N-1 reliability standard unless it is dispatched pre-contingency at times of high load. Given the inherently high impedance of the 132 kV network supplied from Waterloo system studies indicate that this generation may not reliably remain connected while operating in a radial configuration given the nature of the re-closing throughout the existing 132 kV network. Therefore ElectraNet does not consider that this represents a viable option for meeting the ETC reliability standard.

- Alternative Transmission – an alternative transmission plan has been costed and assessed that involves the rebuilding of the Templers 132 kV bus and the installation of 132 kV reactive plant at Templers. These works would only allow a minimal deferral of the proposed solution, which would then be needed in any case. PV analysis shows that the deferral is insufficient to make this option the overall least cost solution in any scenario.

The selected option has been assessed as having the lowest PV cost of the options considered capable of addressing the emerging limitation.

5. Cultana

Project Title: Cultana 275/132 kV Injection

Project No: 11101 **Commissioning Date:** 2013

Category: Augmentation **Estimated Cost:** $35.7m

5.1 Project Requirement and Timing

The Rules require ElectraNet to comply with the power system performance and quality of supply standards in schedule 5.1.

Under all demand forecasts provided by both ETSA Utilities and direct connect customers, these requirements cannot be met by the installed transmission infrastructure alone from 2009.

Specifically, power transfer at times of high load on the Eyre Peninsula, is becoming increasingly difficult to manage under single contingency operating conditions. The issue is one of maintaining adequate and stable voltages at the extremities of the network (Port Lincoln and Wudinna) when either the Cultana 275/132 kV transformer or the Davenport to Cultana 275 kV is out of service. An unplanned outage at times of high load would result in 132 kV voltages below the minimum standards specified in the Rules and the potential for voltage collapse and disconnection of the entire 132 kV network supplied from Playford (Davenport).

More detailed descriptions of the limitations are discussed in the report, “Projected Transmission Network Limitations: Lower Eyre Peninsula 132 kV Supply Region of South Australia”, published by ElectraNet in November 2005.

ElectraNet is currently negotiating a generation network support agreement at Port Lincoln. An Application Notice is currently being prepared by ElectraNet in accordance with the Regulatory Test public consultation requirements in the Rules and is due for release later in 2007. The voltage limitations identified can be deferred some years by a combination of reactive support (Port Lincoln 33 kV Capacitor Banks) and system normal dispatch of the contracted Port Lincoln generation at times of high load (generation that is contracted in any case to provide network support to meet the ETC reliability standards at Port Lincoln).

However, by the summer of 2012-13, when either the Cultana 275/132 kV transformer or the Davenport to Cultana 275 kV transmission line is out of service, the voltage fluctuations on the Whyalla Terminal 33 kV main bus connection point with ETSA Utilities and the Middleback 132 kV connection point with OneSteel will exceed the emission limits allowed in Table 7 of AS/NZS 61000.3.7.2001 and specified in the Rules. This represents a quality of supply issue.

This project is required to address this issue and thereby meet the Rules capital expenditure objective to meet the expected demand for prescribed transmission services over the period, comply with all applicable regulatory obligations associated with the provision of prescribed transmission services, and to maintain the quality, reliability and security of supply of prescribed transmission services.

5.2 Project Description

This following scope of works allows for the staged reinforcement of Cultana substation in conjunction with both the Playford relocation and Whyalla Terminal rebuild projects. The staging of the proposed elements is currently under detailed consideration:

- Undertake the 275 kV Cultana exit works at Davenport at the same time as the Playford relocation project;
- Develop the 132 kV section at Cultana; and,
- Reinforce Cultana with a second 160 MV.A 275/132 kV transformer and break out the second Davenport to Cultana 275 kV transmission line.

5.3 Project Selection

Alternative options considered were:

- Do nothing – This is not considered a viable alternative as it does not address the Rules quality of supply issue.
- Permanent or rapid automatic Distribution load shift – No alternative distribution systems exist.
- Demand Side Management (DSM) – Any DSM schemes at the distribution level are incorporated into the ETSA Utilities AMD. ElectraNet is currently unaware of any suitably sized loads that could off-load the network enough to prevent this quality of supply issue.
- Load side power factor improvement – the load power factors are already compliant with the connection agreement and Rules thresholds and there is no additional benefit of further improvement.
- Generation – The running of the existing generation connected at Port Lincoln Terminal to address the aforementioned voltage issue also assists in keeping the voltage fluctuations below the emission limits specified in AS/NZS 61000. However, post 2012-13, as the load increases, this solution does not prevent the emission limits from being exceeded.

The selected option is considered to be the only option capable of addressing the emerging limitations.

6. Adelaide CBD

Project Title: Adelaide Central Reinforcement

Project No: 10161 **Commissioning Date:** 2011

Category: Connection and Augmentation **Estimated Cost:** $138.1m

6.1 Project Requirement and Timing

The new ETC, which takes effect from 1 July 2008 categorises the Adelaide CBD (Adelaide Central) as a Category 6 load supplied from the existing East Terrace and a new City West substation, which must be commissioned and in service by 31 December 2011.

The ETC reliability standard that applies to Category 6 loads requires ElectraNet to have in place N-1 line and transformer capacity to meet 100% of the Agreed Maximum Demand (AMD). N-1 is defined as the ability to continue to supply without interruption should any one element of the transmission system fail (typically an outage of a transmission line or transformer).

In the case of the Category 6 load the required transmission line and transformer contingency capacity cannot be provided by any other alternative means.

More detailed descriptions of these requirements and emerging limitations are discussed in the report, “Projected Network Limitations: Adelaide Central Region South Australia”, published by ElectraNet and ETSA Utilities (RFP 002/06) in October 2006.

An Application Notice is currently being prepared by ElectraNet, in conjunction with ETSA Utilities, in accordance with the Regulatory Test public consultation requirements in the Rules and is due for release later in 2007.

This project is required to meet the Rules capital expenditure objective to comply with all applicable regulatory obligations associated with the provision of prescribed transmission services.

6.2 Project Description

The scope of works involves:

- establishment of a new 275/66 kV City West substation site at Keswick with a single 300 MV.A 275/66 kV transformer installed with associated 275 kV switchgear (ETSA Utilities will install and own all 66 kV equipment and connections to the existing Adelaide 66 kV network); and

- construction of a new transmission line (including a section of underground 275 kV cable) to the City West substation from Torrens Island.

This project has been commenced in the current regulatory period. A detailed process was followed to identify the optimal location for the substation site from available alternatives. This work was undertaken jointly with ETSA Utilities to ensure both transmission and distribution requirements were taken into account.

6.3 Project Selection

Given the ETC requirements and selection of an optimal substation site, alternative options were limited to considering different transmission line supply routes for the new City West substation.

The alternate supply routes including the substation were costed as follows:

- From Magill to City West: $173m;
- From Torrens Island to City West (with new infrastructure all the way back to Torrens Island): $202m; and,
- From Happy Valley to City West: $215m.

The selected option has been assessed as having the lowest PV cost of the options considered (taking into account both the transmission and associated distribution costs).

7. Southern Suburbs

Project Title: Southern Suburbs 275/66 kV injection (SIM 2)

Project No: 10336 **Commissioning Date:** 2011

Category: Connection **Estimated Cost:** $15.0m

7.1 Project Requirement and Timing

Electricity transmission supply to the Southern Suburbs is presently provided by the ElectraNet 275 kV transmission system at Happy Valley, Morphett Vale East and Magill substations, which are classified as a Category 4 group of connection points under the ETC.

The reliability standard that applies to Category 4 loads requires ElectraNet to have in place N-1 equivalent line and transformer capacity to meet 100% of the Agreed Maximum Demand (AMD). N-1 is defined as the ability to continue to supply without interruption should any one element of the transmission system fail (typically an outage of a transmission line or transformer).

The required N-1 transformer capacity will be exceeded from 2011 based on the demand forecasts provided by ETSA Utilities. ETSA Utilities also has emerging 66 kV distribution network limitations at this time.

Specifically, the loss of a single Happy Valley connection point transformer will result in thermal overloading of one of the two remaining units. Additionally, an unplanned outage of 66 kV distribution lines will result in the thermal overloading and tripping of remaining lines. This presents the possibility of a cascade failure of the entire region, representing the loss of some 800 MW of load.

Accepting the forecast AMD in 2011 will trigger a requirement for ElectraNet to use its best endeavours to ensure that the equivalent transformer capacity meets the required standard within 12 months and in any case within 3 years. However, the most efficient way to deliver this project is in conjunction with the Adelaide CBD reinforcement, which must be commissioned by December 2011 in accordance with the ETC.

More detailed descriptions of these requirements and emerging limitations are discussed in Appendix 1 in the report, “Projected Network Limitations: Adelaide Central Region South Australia”, published by ElectraNet and ETSA Utilities (RFP 002/06) in October 2006.

An Application Notice is currently being prepared by ElectraNet, in conjunction with ETSA Utilities, in accordance with the Regulatory Test public consultation requirements in the Rules and is due for release later in 2007.

This project is required to meet the Rules capital expenditure objectives to meet the expected demand for prescribed transmission services over the period and to comply with all applicable regulatory obligations associated with the provision of prescribed transmission services.

7.2 Project Description

The scope of works is to install a single 300 MV.A 275/66 kV transformer with associated 275 kV switchgear at the new City West substation. ETSA Utilities will install and own all 66 kV equipment and connections to the existing Southern Suburbs 66 kV network.

7.3 Project Selection

Alternative options considered were:

- Do nothing – This is not considered a viable alternative as it does not address the ETC reliability standards.

- Permanent or rapid automatic Distribution load shift – There are currently no existing or planned distribution networks capable of off-loading the 66 kV network.

- Demand Side Management (DSM) – Any DSM schemes at the distribution level are incorporated into the ETSA Utilities AMD. ElectraNet and ETSA Utilities are currently unaware of any suitably sized loads that could viably address the emerging limitation.

- Load side power factor improvement – the load power factors are already compliant with the connection agreement and Rules thresholds and there is no additional benefit of further improvement.

- Generation – ElectraNet does not consider that generation of sufficient size, (at least 100 MW would be required by 2015), would obtain the necessary development approvals in the Adelaide metropolitan area or would technically be able to connect to the ETSA Utilities 66 kV network in a way that could meet the ETC reliability standards.

- Alternative Transmission - Establish Panorama 275/66 kV substation supplied from Magill (assuming overhead line is achievable on existing Adelaide Hills face 66 kV distribution line route): $72m.

- Alternative Transmission - Establish Panorama 275/66 kV substation supplied from Happy Valley (assuming cable for the entire distance): $120m.

- Alternative Transmission - Install larger transformers at Happy Valley substation and upgrade the 66 kV distribution network to Panorama and Seacombe: $140m.

None of the transmission alternatives include costs required to address distribution limitations north of Panorama that are addressed by the proposed option.

The selected option has been assessed as having the lowest PV cost of the options considered that are capable of addressing the emerging limitation.

8. Port Lincoln

Project Title: Port Lincoln 33 kV Capacitor Banks

Project No: 10673 **Commissioning Date:** 2010

Category: Augmentation **Estimated Cost:** $5.2m

8.1 Project Requirement and Timing

The Rules require ElectraNet to comply with the power system performance and quality of supply standards in schedule 5.1. The Rules mandate system security requirements (operation allowing for next contingency) and reliability requirements (e.g. N-1 for meshed network).

Additionally, the new ETC, which takes effect from 1 July 2008 categorises Whyalla Terminal to a Category 4 load.

The reliability standard that applies to Category 4 loads requires ElectraNet to have in place N-1 equivalent line and transformer capacity to meet 100% of the Agreed Maximum Demand (AMD). N-1 is defined as the ability to continue to supply without interruption should any one element of the transmission system fail (typically an outage of a transmission line or transformer).

Under all demand forecasts provided by both ETSA Utilities and direct connect customers, these requirements cannot be met by the installed transmission infrastructure alone from 2009.

Specifically, power transfer at times of high load on the Eyre Peninsula, is becoming increasingly difficult to manage under single contingency operating conditions. The issue is one of maintaining adequate and stable voltages at the extremities of the network (Port Lincoln and Wudinna) when either the Cultana 275/132 kV transformer or the Davenport to Cultana 275 kV is out of service. An unplanned outage at times of high load would result in 132 kV voltages below the minimum standards specified in the Rules and the for potential voltage collapse and disconnection of the entire 132 kV network supplied from Playford (Davenport).

More detailed descriptions of the limitations are discussed in the report, “Projected Transmission Network Limitations: Lower Eyre Peninsula 132 kV Supply Region of South Australia”, published by ElectraNet in November 2005.

ElectraNet is currently in the process of negotiating a generation network support contract at Port Lincoln. An Application Notice is currently being prepared by ElectraNet in accordance with the Regulatory Test public consultation requirements in the Rules and is due for release later in 2007. The emerging limitations can be deferred some years by the combination of reactive support (Port Lincoln 33 kV Capacitor Banks) in conjunction with the system normal dispatch of the contracted Port Lincoln generation at times of high load, (generation that is contracted in any case to provide N-1 supply to Port Lincoln as per the ETC).

This project is required to meet the Rules capital expenditure objectives to meet the expected demand for prescribed transmission services over the period, comply with all applicable regulatory obligations associated with the provision of prescribed transmission services and to maintain the quality, reliability and security of supply of prescribed services.

8.2 Project Description

The scope of works involves the installation a 4x3.5 Mvar 33 kV static capacitor banks at the existing Port Lincoln substation. This in effect is a load-side power factor improvement solution. The installation of these capacitor banks allows the cost-effective deferral, given the known load forecasts, of capital expenditure at Cultana and also reduces the run-time of the contracted distillate fired gas turbines at Port Lincoln.

8.3 Project Selection

Alternative options considered were:

- Do nothing – This is not considered a viable alternative as it does not address the schedule 5.1 or ETC reliability standards.

- Permanent or rapid automatic distribution load shift – No alternative distribution systems exists.

- Demand Side Management (DSM) – Any DSM schemes at the distribution level are incorporated into the ETSA Utilities AMD. ElectraNet is currently unaware of any suitably sized loads that could viably address the emerging limitation.

- Generation – The existing generation connected at Port Lincoln Terminal could be run to prevent this limitation but this has been assessed as not being the most cost effective alternative.

The selected option has been assessed as having the lowest PV cost of the options considered that are capable of addressing the emerging limitations.

9. Kincraig

Project Title: Kincraig 132 kV Capacitor Bank

Project No: 11307 **Commissioning Date:** 2011

Category: Augmentation **Estimated Cost:** $1.8m

9.1 Project Requirement and Timing

The Rules require ElectraNet to comply with the power system performance and quality of supply standards in schedule 5.1.

Additionally, ElectraNet is required to comply with the Category 4 reliability standards laid down in the new ETC with respect to reliability of supply to connection points.

Under all demand forecasts provided by ETSA Utilities, these requirements cannot be met by the installed transmission infrastructure alone from 2011.

Power transfer at times of high load in the vicinity of Kincraig substation, (and in the near future, Penola West), is becoming difficult to maintain under single contingency operating conditions.

Specifically, the issue is one of maintaining adequate voltages at the Kincraig and Penola West connection points when either the Kincraig-Penola West or Penola West-South East 132 kV transmission lines are out of service. An unplanned transmission line outage at times of high load would result in 132 kV voltages below the minimum standards specified in the Rules and the potential for voltage collapse and disconnection of the South-East 132 kV network and the distribution systems connected to Kincraig and Penola West connection point substations. Under-voltage load shedding could be used to restore voltages, however, the ETC requires that the transmission system continue to supply the contracted agreed maximum demand connected to the transmission system without interruption should one element fail.

This project is required to address this issue and thereby meet the Rules capital expenditure objectives to meet the expected demand for prescribed transmission services over the period, comply with all applicable regulatory obligations associated with the provision of prescribed transmission services, and to maintain the quality, reliability and security of supply of prescribed transmission services.

9.2 Project Description

The scope of works involves the installation a 15 Mvar 132 kV static capacitor bank at the existing Kincraig substation. The installation of a capacitor bank allows the cost-effective deferral, given the known load forecasts, of significant capital expenditure otherwise required to establish new transmission lines and 275 kV injection into the area.

9.3 Project Selection

Alternative options considered were as follows:

- Do nothing – This is not considered a viable alternative as it does not address the ETC reliability standards.

- Permanent or rapid automatic Distribution load shift – There is only minimal opportunity for ETSA Utilities to permanently shift load from both Kincraig and Penola West substations via its existing 33 kV distribution network and this ability at times of high load is rapidly diminishing. No alternative distribution systems exist or are planned that are capable of addressing the emerging limitation.

- Demand Side Management (DSM) – Any DSM schemes at the distribution level are incorporated into the ETSA Utilities AMD. ElectraNet is currently unaware of any suitably sized loads that could viably address the emerging limitation.

- Load side power factor improvement – The load power factors are already compliant with the connection agreement and Rules thresholds and there is no additional benefit of further improvement.

- Install an SVC at Kincraig - While having superior voltage control capabilities this option is significantly more costly (greater than $10m) when compared to the static capacitor bank solution.

- Generation – The existing generation at Ladbroke Grove is not in a position to address this limitation (for a Kincraig – Penola West line outage). In any case, this option is not considered a cost effective alternative compared to the preferred option.

- 132 kV option – Construct a new 132 kV transmission line from South East to Kincraig. The construction of this line is obviously significantly more expensive than the preferred option and therefore is not considered further.

The selected option has been assessed as having the lowest PV cost of the options considered capable of addressing the emerging limitations.

10. Tungkillo

Project Title: Tungkillo 275 kV 100 Mvar Capacitor Bank

Project No: 10338 **Commissioning Date:** 2010

Category: Augmentation **Estimated Cost:** $3.0m

10.1 Project Requirement and Timing

The Rules require ElectraNet to comply with the power system performance and quality of supply standards in schedule 5.1.

Studies of future reactive requirements indicate that additional reactive power will be required by 2010 to preserve the reactive margin required for stable and secure system operation.

Therefore this project is required to meet the Rules capital expenditure objectives to meet the expected demand for prescribed transmission services over the period, comply with all applicable regulatory obligations associated with the provision of prescribed transmission services, maintain the quality ,reliability and security of supply of prescribed services and maintain the quality, safety and security of the transmission system.

10.2 Project Description

The scope of works involves the installation a 1x100 Mvar 275 kV static capacitor bank at the existing Tungkillo switching station.

10.3 Project Selection

Alternative options considered were as follows:

- Do nothing – This option does not meet the schedule 5.1 power system performance and quality of supply standards.

- The installation of the capacitor bank at Para was also considered but Para already has two capacitor banks and two SVC's connected to the 275 kV busses and does not represent as good a location electrically as Tungkillo.

- The installation of the capacitor bank at Morphett Vale East was also considered but Happy Valley and Cherry Gardens already have capacitor banks connected in the same area and because of this Morphett Vale East not represent as good a location electrically as Tungkillo.

All of the capacitor bank locations considered had virtually identical costs for such an installation and therefore preference has been given to the site that has the best electrical characteristics. Therefore the selected option is considered to be the best option capable of addressing the limitation.

11. Cherry Gardens – Morphett Vale East

Project Title: Cherry Gardens – Morphett Vale East 275 kV line up-rate

Project No: 10638 **Commissioning Date:** 2010

Category: Augmentation **Estimated Cost:** $3.6m

11.1 Project Requirement and Timing

The Cherry Gardens to Morphett Vale East 275 kV transmission line currently has a thermal rating limited by several spans on a section originally designed for a maximum operating temperature of 80°C.

An unplanned outage of the Cherry Gardens to Happy Valley 275 kV transmission line results in the thermal overloading of the Cherry Gardens to Morphett Vale East circuit at times of high load.

The Rules require ElectraNet to comply with the power system performance and quality of supply standards in schedule 5.1.

Additionally, ElectraNet is required to comply with the ETC Category 4 reliability standard at both Happy Valley and Morphett Vale East, which require N-1 equivalent line capacity to meet 100% of the AMD.

This limitation was identified and described in detail in ElectraNet's Final Report, *"New Large Network Asset supplying the Southern Suburbs and supporting the Eastern Suburbs of Metropolitan Adelaide and the Eastern Hills and Southern Rural Regions of South Australia"* published in October 2005.

This project is required to meet the Rules capital expenditure objective to comply with all applicable regulatory obligations associated with the provision of prescribed transmission services, and to maintain the quality, reliability and security of supply of prescribed transmission services.

11.2 Project Description

The Regulatory Test Final Report recommended up-rating of the Cherry Gardens to Morphett Vale East transmission line for 120°C operation by addressing the low spans identified.

11.3 Project Selection

The only alternative to the proposed option, given the magnitude of the load involved was the construction of a new line. This option wasn't costed on the basis that it would have far exceeded the cost of the proposed solution.

The selected option is considered to be the most cost effective option capable of addressing the limitation.

12. Kadina East

Project Title: Kadina East Transformer Reinforcement

Project No: 11401 **Commissioning Date:** 2010

Category: Connection **Estimated Cost:** $18.0m

12.1 Project Requirement and Timing

Kadina East 132/33 kV substation is supplied via a radial 132 kV network from Hummocks and supplies into a 33 kV distribution network owned by ETSA Utilities, ultimately supplying Kadina, Wallaroo, Moonta and Port Hughes on upper Yorke Peninsula.

The substation currently comprises a single 25 MV.A 132/33 kV transformer with minimal associated 132 kV and 33 kV infrastructure. It has no communications, no SCADA and no supervisory capability.

Kadina East substation is a Category 1 connection point in the current ETC. To date this reliability standard has only obliged ElectraNet to provide system normal transmission line and transformer capacity with no requirement for any redundancy.

In the new ETC which will come into effect on 1 July 2008, the Kadina East connection point reliability is upgraded to the new Category 2 standard. While this new standard still allows a radial transmission line connection, with no transmission line redundancy requirement, it does require N-1 equivalent transformer capacity to meet 100% of the Agreed Maximum Demand (AMD).

The introduction of the new standard means that this connection point will have inadequate transformer redundancy from 1 July 2008 under all demand forecasts provided by ETSA Utilities.

The new ETC standard from 1 July 2008 will trigger a requirement for ElectraNet to use its best endeavours to ensure that the equivalent line and transformer capacity meets the required standard within 12 months and in any case within 3 years.

This project is required to meet the Rules capital expenditure objective to comply with all applicable regulatory obligations associated with the provision of prescribed transmission services, and to maintain the quality, reliability and security of supply of prescribed transmission services.

12.2 Project Description

This scope of works involves the expansion of the existing Kadina East substation and the installation of two 60 MV.A 132/33 kV transformers (the next standard size greater than 25 MV.A), the establishment of a 132 kV bus and the installation of secondary systems with the provision for remote control, data collection and national grid metering.

12.3 Project Selection

Alternative options considered were as follows:

- Do nothing – This does not address the ETC reliability standard.
- Permanent or rapid automatic Distribution load shift – No alternative distribution system exists with adequate capacity to supply the AMD.
- DSM – The only DSM alternative that could meet the ETC requirements would require contracting the entire load to be disconnected in the event of a transformer failure. This is not a practical solution.
- Generation – The only Generation option that could meet the ETC reliability standard would have to be dispatched at all times to prevent any load from being disconnected in the event of a transformer failure. This is not a practical solution.

The selected option is considered to be the only viable option capable of addressing the emerging limitation.

13. Wudinna

Project Title: Wudinna Transformer Reinforcement

Project No: 11102 **Commissioning Date:** 2010

Category: Connection **Estimated Cost:** $9.2m

13.1 Project Requirement and Timing

Wudinna 132/66 kV substation is supplied via some 250 km of radial 132 kV network and supplies a further 200 km of 66 kV distribution network owned by ETSA Utilities, that supplies Streaky Bay and Ceduna on the far west coast of Eyre Peninsula.

The substation currently comprises a single 25 MV.A 132/66 kV transformer with minimal associated 132 kV and 66 kV infrastructure. It has no communications, other than leased Telstra lines, no SCADA and no supervisory capability.

Wudinna substation is a Category 1 connection point in the current ETC. To date this reliability standard has only obliged ElectraNet to provide system normal transmission line and transformer capacity with no requirement for any redundancy.

In the new ETC which will come into effect on 1 July 2008, the Wudinna connection point reliability is upgraded to the new Category 2 standard. While this still allows a radial transmission line connection with no transmission line redundancy requirement, it does require N-1 equivalent transformer capacity to meet 100% of the Agreed Maximum Demand (AMD).

The introduction of the new standard means that this connection point will have inadequate transformer redundancy from 1 July 2008 under all demand forecasts provided by ETSA Utilities.

The new ETC standard from 1 July 2008 will trigger a requirement for ElectraNet to use its best endeavours to ensure that the equivalent line and transformer capacity meets the required standard within 12 months and in any case within 3 years.

This project is required to meet the Rules capital expenditure objective to comply with all applicable regulatory obligations associated with the provision of prescribed transmission services, and to maintain the quality, reliability and security of supply of prescribed transmission services.

13.2 Project Description

This scope of works involves the expansion of the existing Wudinna substation and the installation of a second 25 MV.A 132/66 kV transformer, the establishment of a 132 kV bus and the installation of secondary systems with the provision for remote control, data collection and national grid metering.

This development presents the opportunity to provide for vastly improved radial reliability to a remote area of South Australia. The lack of fault discrimination between the 66 kV and the 132 kV networks in the recent past has been the cause of several extended outages.

13.3 Project Selection

Alternative options considered were as follows:

- Do nothing – This was not considered a viable alternative as it does not address the ETC reliability standard.

- Permanent or rapid automatic Distribution load shift – No alternative distribution system exists with adequate capacity to supply the AMD.

- DSM – The only DSM alternative that could meet the ETC requirements would require contracting the entire load to be disconnected in the event of a transformer failure. This is not a practical solution.

- Generation – The only Generation option that could meet the ETC reliability standard would have to be dispatched at all times to prevent any load from being disconnected in the event of a transformer failure. This is not a practical solution.

The selected option is considered to be the only viable option capable of addressing the emerging limitation.

14. Hummocks

Project Title: Hummocks Asset Replacement and Transformer Capacity Increase/ Hummocks 132 kV capacitor bank

Project No: 10508/ 10907 **Commissioning Date:** 2011

Category: Connection, Replacement and Augmentation **Estimated Cost:** $14.0m

14.1 Project Requirement and Timing

Hummocks 132/33 kV substation was established in 1951 and is supplied via two 132 kV transmission lines from Waterloo and Bungama and additionally supplies radial 132 kV transmission lines to Kadina East and Ardrossan West.

The substation currently comprises a meshed 132 kV bus and two 10 MV.A 132/33 kV fixed-tap transformers and two 10 MV.A 33 kV regulators supplying into a 33 kV distribution system owned by ETSA Utilities.

Connection

In the new ETC which will come into effect 1 July 2008, Hummocks is classified as a Category 4 connection point. This standard requires ElectraNet to have in place N-1 equivalent line and transformer capacity to meet 100% of the Agreed Maximum Demand (AMD). N-1 is defined as the ability to continue to supply without interruption should any one element of the transmission system fail (typically an outage of a transmission line or transformer).

Under both the High and the Medium load forecasts provided by ETSA Utilities the transformer capacity at this connection point will be exceeded by 2011 and 2012 respectively.

Specifically, the loss of a single connection point transformer will result in the thermal overloading and tripping of the remaining unit disconnecting the entire load.

The connection component of this project is required to meet the Rules capital expenditure objectives to meet the expected demand for prescribed transmission services over the period and to comply with all applicable regulatory obligations associated with the provision of prescribed transmission services.

Replacement

Some 132 kV and the 33 kV primary plant has been upgraded in the more recent past, however, the transformer, the regulators, some remaining primary plant and the entire secondary systems are at the end of their useful lives.

This replacement component of this project is required to address this issue and thereby meet the Rules capital expenditure objective to maintain the quality, reliability and security of supply of prescribed transmission services.

Augmentation

The Rules require ElectraNet to comply with the power system performance and quality of supply standards in schedule 5.1. .

Power transfer at times of high load in the vicinity of Hummocks substation is becoming difficult to maintain under single contingency operating conditions. The issue is one of maintaining adequate voltages at the Hummocks, Kadina East, Ardrossan West and Dalrymple connection points when the Hummocks-Waterloo 132 kV transmission line is out of service.

An unplanned transmission line outage at times of high load would result in 132 kV voltages below the minimum standards specified in the Rules and the potential voltage collapse and disconnection of the entire Yorke Peninsula if supplied only from Bungama.

As this limitation occurs with a very similar timing as the transformer capacity limitation, it is proposed to undertake all of this work at the same time.

This project is required to meet the Rules capital expenditure objectives to meet the expected demand for prescribed transmission services over the period, comply with all applicable regulatory obligations associated with the provision of prescribed transmission services, and to maintain the quality, reliability and security of supply of prescribed transmission services.

14.2 Project Description

This scope of works involves:

- the installation at Hummocks substation of two larger 25 MV.A 132/33 kV transformers;
- the replacement of some 132 kV primary plant and the entire secondary systems; and
- the installation of a 15 Mvar 132 kV capacitor bank installed on the Ardrossan West exit.

14.3 Project Selection

Alternative options considered were as follows:

- Do nothing – This was not considered a viable alternative as it does not address the Rules or ETC reliability standards and does not address the asset condition.
- Permanent or rapid automatic Distribution load shift – This was not considered a viable alternative as it does not address the asset condition.
- DSM – This was not considered a viable alternative as it does not address the asset condition.

- Load side Power Factor improvement – The load power factors are already compliant with connection agreement and NER thresholds and there is no additional benefit of improving them further. This was not therefore considered a viable alternative as it does not address the ETC reliability standards and does not address the asset condition.

- Generation – This alternative does not address the asset condition.

- Alternative Transmission - The condition of the existing transformers and regulators preclude their reuse in addition to the installation of a third 10 MV.A transformer. Therefore this option has not been costed as it would require the purchase of three new 10 MV.A transformers and additional works to make the 132 kV and 33 kV connections, which is clearly a more costly option.

- Other alternative transmission options such as installing an SVC or constructing new 132 kV transmission lines are also clearly more costly.

The selected option is considered to be the most cost effective option capable of addressing the emerging limitations.

15. Ardrossan West

Project Title: Ardrossan West Asset Replacement and Transformer Capacity Increase

Project No: 10615 **Commissioning Date:** 2011

Category: Connection and Replacement **Estimated Cost:** $17.3m

15.1 Project Requirement and Timing

Ardrossan West 132/33 kV substation was established in 1973 and is supplied via one 132 kV transmission line from Hummocks and additionally supplies a radial 132 kV transmission line to Dalrymple.

The substation currently comprises a minimalist 132 kV bus and two 10 MV.A 132/33 kV transformers supplying into a 33 kV distribution system owned by ETSA Utilities.

Connection

In the current ETC Ardrossan West substation is a Category 1 connection point. To date this reliability standard has only obliged ElectraNet to provide system normal transmission line and transformer capacity with no requirement for any redundancy.

In the new ETC which will come into effect 1 July 2008, Ardrossan West is classified as a Category 4 connection point. This standard requires ElectraNet to have in place N-1 equivalent line and transformer capacity to meet 100% of the Agreed Maximum Demand (AMD). N-1 is defined as the ability to continue to supply without interruption should any one element of the transmission system fail (typically an outage of a transmission line or transformer).

Under all load forecasts provided by ETSA Utilities (High, Medium or Low), the transformer capacity at this connection point will be exceeded by 2009, 2009 and 2011 respectively.

Specifically, the loss of a single connection point transformer will result in the thermal overloading and tripping of the remaining unit disconnecting the entire load.

The connection component of this project is required to meet the Rules capital expenditure objectives to meet the expected demand for prescribed transmission services over the period and to comply with all applicable regulatory obligations associated with the provision of prescribed transmission services.

Replacement

The current layout of the 132 KV bus is difficult to manage operationally and the transformers and the entire secondary systems are at the end of their useful lives.

This replacement component of this project is required to meet the Rules capital expenditure objective to maintain the quality, reliability and security of supply of prescribed transmission services.

15.2 Project Description

This scope of works involves the installation at Ardrossan West substation of two larger 25 MV.A 132/33 kV transformers, the meshing of the 132 kV bus and the replacement of the entire secondary systems.

15.3 Project Selection

Alternative options considered were as follows:

- Do nothing – this was not considered a viable alternative as it does not address the ETC reliability standard and does not address the inadequate 132 kV bus arrangement or the asset condition.

- Permanent or rapid automatic Distribution load shift – This was not considered a viable alternative as it does not address the inadequate 132 kV bus arrangement or the asset condition.

- DSM – This was not considered a viable alternative as it does not address the inadequate 132 kV bus arrangement or the asset condition.

- Load side Power Factor improvement – The load power factors are already compliant with connection agreement and NER thresholds and there is no additional benefit of improving them further. This was not therefore considered a viable alternative as it does not address the ETC reliability standards and does not address the inadequate 132 kV bus arrangement or the asset condition.

- Generation – This alternative does not address the inadequate 132 kV bus arrangement or the asset condition.

- Alternative Transmission - The condition of the existing transformers precludes their reuse in addition to the installation of a third 10 MV.A transformer. Therefore this option has not been costed as it would require the purchase of three new 10 MV.A transformers and additional works to make the 132 kV and 33 kV connections, which is clearly a more costly option.

The selected option is considered to be the most cost effective option capable of addressing the emerging limitations.

16. Waterloo

Project Title: Waterloo Rebuild and Transformer Capacity Increase

Project No: 10503 **Commissioning Date:** 2013

Category: Connection and Replacement **Estimated Cost:** $24.1m

16.1 Project Requirement and Timing

Waterloo 132/33 kV substation was established in 1953 and is connected to four 132 kV transmission lines from Robertstown, Mintaro, Hummocks and Templers. It therefore is a key 132 kV transmission node in the Mid-North region, being required to supply the entire Yorke Peninsula or Barossa areas and supporting the Riverland under single contingency operating conditions.

The substation currently comprises a meshed 132 kV bus and two 10 MV.A 132/33 kV fixed-tap transformers and two 10 MV.A 33 kV regulators supplying into a 33 kV distribution system owned by ETSA Utilities.

Connection

Waterloo substation is a Category 1 connection point in the current ETC. To date this reliability standard has only obliged ElectraNet to provide system normal transmission line and transformer capacity with no requirement for any redundancy.

In the new ETC which will come into effect 1 July 2008, the Waterloo connection point reliability is upgraded to Category 4 standard from 1 January 2010. This standard requires ElectraNet to have in place N-1 equivalent line and transformer capacity to meet 100% of the Agreed Maximum Demand (AMD). N-1 is defined as the ability to continue to supply without interruption should any one element of the transmission system fail (typically an outage of a transmission line or transformer).

Currently under all load forecasts provided by ETSA Utilities, the system normal transformer capacity at this connection point will be exceeded by the commencement of the period covered by this revenue submission. As a result ElectraNet and ETSA Utilities recognise that the establishment of New Clare, as soon as practicable, will have the dual benefit of off-loading plant and equipment at Waterloo substation enough to comply with the ETC reliability standards, and of addressing an emerging distribution limitation.

However, by the summer of 2012-13, the condition of the then 60 year old transformers and regulators will necessitate a reduced thermal rating such that the transformer capacity will no longer comply with the ETC reliability standards. Specifically, the loss of a single connection point transformer or regulator will result in the thermal overloading and tripping of the remaining units disconnecting the entire load.

The connection component of this project is required to meet the Rules capital expenditure objectives to meet the expected demand for prescribed transmission services over the period and to comply with all applicable regulatory obligations associated with the provision of prescribed transmission services.

Replacement

Condition assessment of Waterloo substation has identified that the entire substation is in need of replacement. Therefore, even though the Clare North off-load will remove some load at risk, Waterloo still needs to be replaced in the latter part of the period covered by this revenue submission.

The replacement component of this project is required to meet the Rules capital expenditure objective to maintain the quality, reliability and security of supply of prescribed transmission services.

16.2 Project Description

This scope of works involves the complete rebuilding of Waterloo substation. It also involves upgrading of the existing connection point transformer capacity by installing two 25 MV.A 132/33 kV transformers.

16.3 Project Selection

Alternative options considered were as follows:

- Do nothing – This was not considered a viable alternative as it does not address the ETC reliability standards and does not address the asset condition.

- Permanent or rapid automatic Distribution load shift – This was not considered a viable alternative as it does not address the asset condition.

- DSM – This was not considered a viable alternative as it does not address the asset condition.

- Load side Power Factor improvement – The load power factors are already compliant with connection agreement and NER thresholds and there is no additional benefit of improving them further. This was not therefore considered a viable alternative as it does not address the ETC reliability standards and does not address the asset condition.

- Generation – This alternative does not address the asset condition.

- Alternative Transmission - The condition of the existing transformers and regulators preclude their reuse in addition to the installation of a third 10 MV.A transformer. Therefore this option has not been costed as it would require the purchase of three new 10 MV.A transformers and additional works to make the 132 kV and 33 kV connections, which is clearly a more costly option.

The selected option is considered to be the most cost effective option capable of addressing the emerging limitations.

17. Penola West

Project Title: Penola West 132/33 kV connection

Project No: 10408 **Commissioning Date:** 2008

Category: Connection **Estimated Cost:** $5.9m

17.1 Project Requirement and Timing

ETSA Utilities has made an application to connect in accordance with Chapter 5 of the National Electricity Rules following successful completion of a Regulatory Test assessment of alternative options.

The existing ETSA Utilities loads at Penola through to the Coonawarra are currently supplied via a radial 33 kV network supplied from ElectraNet's 132/33 kV Mount Gambier substation – ETSA Utilities has advised that the capacity of this distribution system is expected to run out by 2008.

ETSA Utilities published its Evaluation Report RFP-ER 003/05 in January 2006 that identified this proposal is the preferred least cost option to addressing the distribution system limitation.

ETSA Utilities has also formally requested that this work be completed prior to the summer of 2008-09 to avoid potential distribution network overloads and load shedding.

This project is required to meet the Rules capital expenditure objectives to meet the expected demand for prescribed transmission services over the period and to comply with all applicable regulatory obligations associated with the provision of prescribed transmission services.

17.2 Project Description

This scope of works allows for the construction of a new Category 4 132/33 kV connection point with 2x25 MV.A transformers by expanding the existing Penola West 132 kV substation.

17.3 Project Selection

ETSA Utilities has made an application to connect in accordance with Chapter 5 of the National Electricity Rules following successful completion of a Regulatory Test assessment of alternative options.

18. Clare North

Project Title: Clare North 132/33 kV substation establishment

Project No: 10370 **Commissioning Date:** 2010

Category: Connection **Estimated Cost:** $18.2m

18.1 Project Requirement and Timing

ETSA Utilities has made an application to connect in accordance with Chapter 5 of the National Electricity Rules following successful completion of a preliminary Regulatory Test assessment of alternative options by ETSA Utilities.

The existing ETSA Utilities loads at Clare and Burra are currently supplied via a radial 33 kV network supplied from ElectraNet's 132/33 kV Waterloo substation – ETSA Utilities has advised that the capacity of this distribution system is expected to run out by 2010.

ETSA Utilities did not receive any submissions proposing a non-network solution in response to its RFP 007/06 (ElectraNet RFI 003/06) in December 2006 and is planning to issue a final recommendation Evaluation Report supporting this project in September 2007.

This project is required to meet the Rules capital expenditure objectives to meet the expected demand for prescribed transmission services over the period and to comply with all applicable regulatory obligations associated with the provision of prescribed transmission services.

18.2 Project Description

This scope of works involves the construction of a new Category 4 132/33 kV connection point substation with 2x25 MV.A transformers connected to the existing Mintaro-Brinkworth 132 kV transmission line.

18.3 Project Selection

ETSA Utilities has made an application to connect in accordance with Chapter 5 of the National Electricity Rules following successful completion of a preliminary Regulatory Test assessment of alternative options.

19. Coonalpyn West

Project Title: Coonalpyn West 132/33 kV substation establishment

Project No: 10371 **Commissioning Date:** 2012

Category: Connection **Estimated Cost:** $19.6m

19.1 Project Requirement and Timing

ETSA Utilities has made an application to connect in accordance with Chapter 5 of the National Electricity Rules following successful of a preliminary Regulatory Test assessment of alternative options by ETSA Utilities.

The existing ETSA Utilities loads at Coonalpyn through to Narrung are currently supplied via a radial 33 kV network supplied from ElectraNet's 132/33 kV Tailem Bend substation – ETSA Utilities has advised that the capacity of this distribution system is expected to run out by 2012.

ETSA Utilities did not receive any submissions proposing non-network solutions in response to its RFP 003/06 in October 2006 and are planning to issue a final recommendation Evaluation Report supporting this project in July 2007.

This project is required to meet the Rules capital expenditure objectives to meet the expected demand for prescribed transmission services over the period and to comply with all applicable regulatory obligations associated with the provision of prescribed transmission services.

19.2 Project Description

This scope of works allows for the construction of a new Category 4 132/33 kV connection point substation with 2x25 MV.A transformers connected to the existing Tailem Bend-Keith #2 132 kV transmission line.

19.3 Project Selection

ETSA Utilities has made an application to connect in accordance with Chapter 5 of the National Electricity Rules following successful completion of a preliminary Regulatory Test assessment of alternative options.

20. Playford

Project Title: 132 kV Playford Replacement – Relocation to Davenport / Playford Transformer Capacity Increase

Project No: 85007/ 10283 **Commissioning Date:** 2011

Category: Replacement and Connection **Estimated Cost:** $49.8m

20.1 Project Requirement and Timing

Playford A switchyard is located adjacent to Playford Power Station near the city of Port Augusta. It is central to ElectraNet's northern 132 kV transmission network providing the sole point of supply to loads at Port Augusta, Leigh Creek and Woomera and back–up supply to the entire Eyre Peninsula.

Replacement

Playford A switchyard was built in 1953 to connect Playford A Power Station and has now reached the end of its useful life. The location of this switchyard compounds the problems presented by condition due to the impact of coastal salinity and effects of proximity to coal-fired generation on insulation.

In its current state, the Playford A switchyard represents an increasing risk to supply for ElectraNet's transmission network. Over the years there has been increasing numbers of substation events at Playford, including operations of protection and insulator flashovers on plant due to pollution and deteriorated insulation. Special protection arrangements that are put in place whenever work is carried out in the A switchyard further inhibit the level of system reliability. Other related issues include the state of ancillary equipment such as air compressors, substation clearances, the condition of the earthing system and the deteriorating vulcanised rubber insulation on control and communication cabling.

The replacement component of this project is required to meet the Rules capital expenditure objective to maintain the quality, reliability and security of supply of prescribed transmission services.

Connection

The ETSA Utilities electricity supply to the Port Augusta, Quorn and an extensive surrounding area is solely obtained from the ElectraNet 132 kV transmission system via the two 132/33 kV transformers in Playford A substation.

The new ETC, which takes effect from 1 July 2008, classifies the Playford connection point as a Category 4 load.

The reliability standard that applies to Category 4 loads requires ElectraNet to have in place N-1 equivalent line and transformer capacity to meet 100% of the Agreed Maximum Demand (AMD). N-1 is defined as the ability to continue to supply without interruption should any one element of the transmission system fail (typically an outage of a transmission line or transformer).

Specifically, the loss of a single connection point transformer will result in the thermal overloading and tripping of the remaining unit disconnecting the entire load. The Agreed Maximum Demand (AMD) supplied by this connection point already exceeds capability of the existing 25 MV.A transformers.

The connection component of this project is required to meet the Rules capital expenditure objectives to meet the expected demand for prescribed transmission services over the period and to comply with all applicable regulatory obligations associated with the provision of prescribed transmission services.

20.2 Project Description

The condition of the aged plant and the standards to which they were designed are such that rebuilding the entire 132 kV switchyard including the necessary protection and control equipment represents the most viable solution.

Due to the pollution and salinity problems and the lack of suitable adjacent land the scope of works involves rebuilding the Playford A Switchyard at the nearby Davenport substation including::

- Rebuilding the Playford A 132 kV switchyard at nearby Davenport substation including necessary control and protection equipment;
- Refurbishing and relocating one of the 160 MV.A 275/132 kV Playford "tie" transformers to Davenport substation;
- Installation of one new 160 MV.A 275/132 kV transformer;
- Making necessary changes to the 132 kV transmission lines linking Playford A switchyard to the new Davenport 132 kV switchyard;
- Decommissioning the existing 132 kV Playford A switchyard, whilst retaining assets necessary to maintain house supplies to both Northern and Playford Power Stations;
- Decommissioning transmission line structures no longer required following the transmission line changes; and,
- Replacing the two existing 25 MV.A transformers at Playford substation with two new 60 MV.A transformers at Davenport substation.

All of the work is planned to be completed by 2011, however, as the connection point transformer capacity is already exceeded, ElectraNet plans to establish and commission the connection point infrastructure by 2009 to meet the "within 3 years" requirement of the ETC.

20.3 Project Selection

Alternative options considered were as follows:

- Do nothing – This was not considered a viable alternative as it does not address the asset condition.

- Permanent or rapid automatic Distribution load shift – there is no alternative distribution system to shift load to and this does not address the asset condition.

- New Distribution - this does not address how to supply the loads currently supplied via long radial 132 kV transmission lines. Supply to the distribution system would have to come from the transmission system in any case and it is physically impossible for a new lower voltage distribution network supply such distant loads.

- DSM – unless the diverse loads currently supplied from Playford can be permanently managed by disconnecting them to allow the retirement of the entire substation then this option is not considered viable.

- Generation – it is not considered feasible to retire the entire substation and disconnect the loads, leaving them to be supplied by independent, reliable and diverse generation sources on a continuous basis.

The selected option is considered to be the only viable option capable of addressing the limitations.

21. Davenport

Project Title: Davenport 275 kV reactor replacement

Project No: 11355/ 10394 **Commissioning Date:** 2013

Category: Replacement **Estimated Cost:** $10.3m

21.1 Project Requirement and Timing

The three existing 30 Mvar 275 kV line reactors at Davenport substation were installed when the third and fourth 275 kV circuits to Port Augusta were constructed in 1985.

These reactors are required to keep transmission voltages below the 110% design maximum at times of light load with minimal northern area generation and maximum reactive contribution from unloaded transmission lines.

Condition assessment of each reactor indicates that they are at the end of their technical and economic life and need to be retired to avoid catastrophic failure in service.

Additionally, the reactors are connected to the lines via motorised disconnectors and cannot, therefore, be readily disconnected without temporarily removing the transmission lines from service. This is especially problematic at times of high load.

This project is required to meet the Rules capital expenditure objective to maintain the quality, reliability and security of supply of prescribed transmission services.

21.2 Project Description

It is proposed to replace all three 30 Mvar reactors with two switched 50 Mvar units. This project is to be staged; the first reactor order has already been placed and the reactor is programmed to be installed in 2009. This will allow the disconnection of one reactor, making it available as a spare should one of the two remaining units fail in service. The second reactor is programmed to be installed in the latter part of the revenue reset period, but this will rely on the condition of the remaining units. By the end of the period all three units will be disconnected and retired.

21.3 Project Selection

Alternative options considered were as follows:

- Do nothing – This was not considered a viable alternative as it does not address the asset condition.

- This alternative involved replacing all three 30 Mvar reactors by three switched 30 Mvar units and estimated to cost $16m.

The selected option has been assessed as having the lowest PV cost of the options considered that are capable of addressing the limitation.

22. Torrens Island

Project Title: Torrens Island secondary systems and primary plant replacement

Project No: 11109/ 11303/ 11304 **Commissioning Date:** 2013

Category: Replacement **Estimated Cost:** $36.7m

22.1 Project Requirement and Timing

Torrens Island substation was commissioned in 1967 and supplies loads in all four metropolitan regions. The substation still has for the most part the original secondary systems in service.

These systems, in addition to some remaining items of original primary plant, have been assessed as having exceeded their useful lives and therefore require replacement.

It is therefore proposed to replace the entire secondary systems and identified primary plant. This replacement would have the additional benefit of providing improved functionality.

This project is required to meet the Rules capital expenditure objective to maintain the quality, reliability and security of supply of prescribed transmission services.

22.2 Project Description

Replace the entire secondary system at Torrens Island substation, and additionally replace four 275 kV circuit breakers and ten sets of 275 kV CVT's, representing the remaining primary plant identified as requiring replacement.

22.3 Project Selection

Alternative options considered were as follows:

- Do nothing – This was not considered a viable alternative as it does not address the asset condition or functionality.

- The alternative of rebuilding the entire substation was not estimated after an estimate for just replacing the 66 kV section was in the order of $40m, which would clearly make a full replacement a much more costly option.

The selected option is considered to be the most cost effective option capable of addressing the emerging limitation.

23. Para Replacement

Project Title: Para secondary systems and minor primary plant replacement

Project No: 11302 **Commissioning Date:** 2013

Category: Replacement **Estimated Cost:** $24.5m

23.1 Project Requirement and Timing

Para substation was commissioned in 1967 and still has for the most part the original secondary systems in service. The building that houses these systems is also in an advanced state of disrepair.

The secondary systems, in addition to some remaining items of original primary plant, have been assessed as having exceeded their useful lives and therefore require replacement.

It is therefore proposed to replace the entire secondary systems and identified primary plant. This replacement would have the additional benefit of providing improved functionality.

This project is required to meet the Rules capital expenditure objective to maintain the quality, reliability and security of supply of prescribed transmission services.

23.2 Project Description

Replace the entire secondary system at Para substation, and additionally replace a 275 kV and a 132 kV CVT, representing the remaining primary plant identified as requiring replacement.

23.3 Project Selection

Alternative options considered were as follows:

- Do nothing – This was not considered a viable alternative as it does not address the asset condition or functionality.
- The alternative of rebuilding the entire substation was estimated to cost in excess of $60m, which is clearly a more costly option.

The selected option is considered to be the most cost effective option capable of addressing the emerging limitation.

24. RTU Replacement

Project Title: RTU Replacement Program

Project No: 10519 **Commissioning Date:** 2011

Category: Replacement **Estimated Cost:** $4.2m

24.1 Project Requirement and Timing

The "Giant" type RTU's used extensively in the ElectraNet transmission network to facilitate remote monitoring and control for efficient load restoration, are technically obsolete and no longer supported by the manufacturer; they therefore have reached the end of their technical and economic life and need to be replaced.

This project is required to meet the Rules capital expenditure objective to maintain the quality, reliability and security of supply of prescribed transmission services.

24.2 Project Description

Replace all remaining Giant RTU's that are not replaced in other projects.

24.3 Project Selection

Alternative options considered were as follows:

- Do nothing – this is not considered a viable alternative as the ElectraNet transmission system will be not be operable remotely and the loss of system data will prevent the use of, for example, the state-estimators used by both ElectraNet and NEMMCO and also impact on restoration times after system events.

The selected option is considered to be the only viable option capable of addressing the limitation.

25. Weather Stations

Project Title: Weather Stations

Project No: 10320 **Commissioning Date:** 2013

Category: Augmentation **Estimated Cost:** $4.1m

25.1 Project Requirement and Timing

In line with the practices of other TNSP's in Australia, ElectraNet has commissioned several weather stations at strategic locations across the State during the current Regulatory Period to allow the real-time thermal rating of critical transmission lines.

These weather stations collect data measurements of real-time environmental conditions such as ambient temperature, solar radiation and wind speed and direction. This data is then used to calculate the real-time thermal rating of transmission lines.

Real-time thermal rating maximises the available rating of (especially) the 132 kV networks which tend to limit and constrain the overall transmission network and allows operation while maintaining statutory conductor to ground clearances.

Additional substation and intermediate based sites have been identified that will allow the further utilisation of the existing transmission line assets, minimising currently constrained generation and interconnection operation and potentially deferring the need for additional lines. Application of these systems will also minimise the potential for network constraints associated with new entrant generation plant.

These systems will be particularly beneficial under contingency operating conditions, minimising constraints when transmission line elements and substation plant and equipment are disconnected due to routine maintenance or construction activities.

In summary, the application of real-time rating systems represents a cost effective way of increasing network transfer capacity, will support the secure connection of additional generation capacity, provide for increased asset utilisation and reduce network constraints and support the management of system security during planned outage conditions.

This project is required to meet the Rules capital expenditure objectives to meet the forecast demand for prescribed transmission service over the period and to maintain the quality, reliability and security of supply of prescribed transmission services.

25.2 Project Description

This scope of works allows for the construction of new substation based weather stations and stations at intermediate sites on long lines, to allow the more accurate and precise rating of transmission lines.

25.3 Project Selection

Alternative options considered were as follows:

- Do nothing and continue to and potentially constrain the transmission network under both system normal, contingency and especially under planned outage conditions.

- Construct additional transmission line infrastructure at significantly higher capital cost.

The selected option has been assessed as having the lowest PV cost of the options considered that are capable of addressing the limitation.