South Australian Energy Transformation

RIT-T: Project Specification Consultation Report

7 November 2016

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Executive Summary

Australia's energy markets are in transition

Australian energy markets are experiencing a time of significant change, driven by the transition to lower carbon emissions, rapidly evolving technologies and changing customer needs.

South Australia has reached significant levels of renewable energy penetration through large scale wind generation developments and rooftop solar photovoltaic (PV) installation. Around 45 per cent of South Australia's power generation now comes from renewable energy resources.

Successfully integrating this changing supply mix, while maintaining affordability, reliability and security of supply for customers is a key priority for the energy sector.

Electricity transmission networks have a key role to play in supporting the efficient development of energy markets during this transition, as highlighted recently by the Council of Australian Governments (COAG) Energy Council[1].

Additional interconnection between National Electricity Market (NEM) regions can result in greater competition between generation sources, thereby delivering lower overall energy prices for customers, in addition to facilitating an increase in renewable generation and addressing security of supply concerns associated with energy market transition.

Non-network options can also provide benefits to the market to help with energy market transition. These options could include demand response, generation options, battery storage and other solutions.

Exploring options to facilitate energy market transition

ElectraNet, in consultation with other transmission network service providers (TNSPs), has commenced an economic cost benefit assessment to explore options that can help to facilitate South Australia's energy transition. The Regulatory Investment Test for Transmission (RIT-T)[2] will be applied to this assessment. This report begins the formal consultation part of the RIT-T process.

The identified need for this RIT-T is driven by allowing greater competition between generators in different regions …

A number of South Australian generators have permanently, or partially, withdrawn from the market in the recent past, including the Northern Power Station (NPS) which closed in May 2016.

The closure of these generators has resulted in sharply increasing spot and futures prices in South Australia that have not been replicated in the eastern states. For example, South Australian electricity base futures prices are around $100/MWh for the next three years, while prices in New South Wales and Victoria range from $55 to $65/ MWh over that same time horizon[3].

1 COAG Energy Council, *Communique*, August 2016

2 The RIT-T is the regulatory cost benefit test administered by the Australian Energy Regulator (AER)

3 ASX Energy website, available at: https://www.asxenergy.com.au/, accessed 19 October 2016

A new interconnector or non-network alternatives would put downward pressure on energy prices in South Australia. Specifically, new interconnector options would enable demand in South Australia to be met through using surplus low cost generating capacity that currently exists elsewhere in the NEM. This will lower the overall costs of electricity supply across the market as a whole.

The reduction in electricity prices in South Australia can also be expected to lead to further benefits to customers through the value they derive from increased electricity use.

… as well as improving security of electricity supply in South Australia…

While new, low carbon emission generation technologies contribute significantly to Australia meeting carbon emission and renewable energy targets, they generally do not provide the same system services as those delivered by traditional coal or gas-fired generators. Consequently, the change in the generation mix is changing the nature and level of services required to maintain security of supply.

Security of supply concerns arise in particular in relation to the operation of the South Australian network during non-credible ‘separation events’. The loss of the existing Heywood Interconnector between South Australia and Victoria has the effect of ‘islanding’ the operation of the electricity network in South Australia from the rest of the NEM – this is referred to as a ‘separation event.’ Historically, separation events have occurred on average once every four years.

During a separation event, it is important that the electricity system in South Australia remains secure. This includes maintaining a Rate of Change of Frequency (RoCoF) within certain bounds, in order to avoid widespread supply disruptions. The retirement of conventional generation, which previously provided services to assist with managing frequency, means that new ways of managing the system security are needed.

To address security of supply concerns, the South Australian Government has enacted a new requirement that requires RoCoF to be limited within 3 Hz/s for the coincident loss of both circuits of the Heywood Interconnector, when the system is in a secure operating state as defined in the National Electricity Rules (NER). ElectraNet has consequently provided limit information to the Australian Energy Market Operator (AEMO) to assist in limiting flows on the Heywood Interconnector when necessary to achieve this RoCoF standard.

Against this background, the options considered in this RIT-T may provide system security benefits to consumers and producers of electricity through:

- allowing the RoCoF standard to be met without constraining flows over the Heywood Interconnector;
- further reducing the risk and/or consequences of supply disruption following a separation or other event, through reducing RoCoF below the mandated standard;
- managing the challenges of declining system strength (fault levels)4; and/or

[4] System strength (fault levels) declines where the quantity of synchronous generators operating declines and the quantity of power electronic convertor-connected generation such as wind and solar increases. This can lead to increased risk of protection systems not operating as designed and therefore an increased risk to system security, public safety and plant and equipment.

- allowing greater sharing of ancillary services across regions, resulting in an overall lower cost of providing system stability.

… and facilitating the transition to lower carbon emissions and the adoption of new technologies

Australia has in-place a number of carbon emission and renewable energy targets. Meeting these commitments, will lead to the replacement of emissions intensive generators with lower emission alternatives. New technologies, including distributed generation and energy storage, can be expected to assist with this transition.

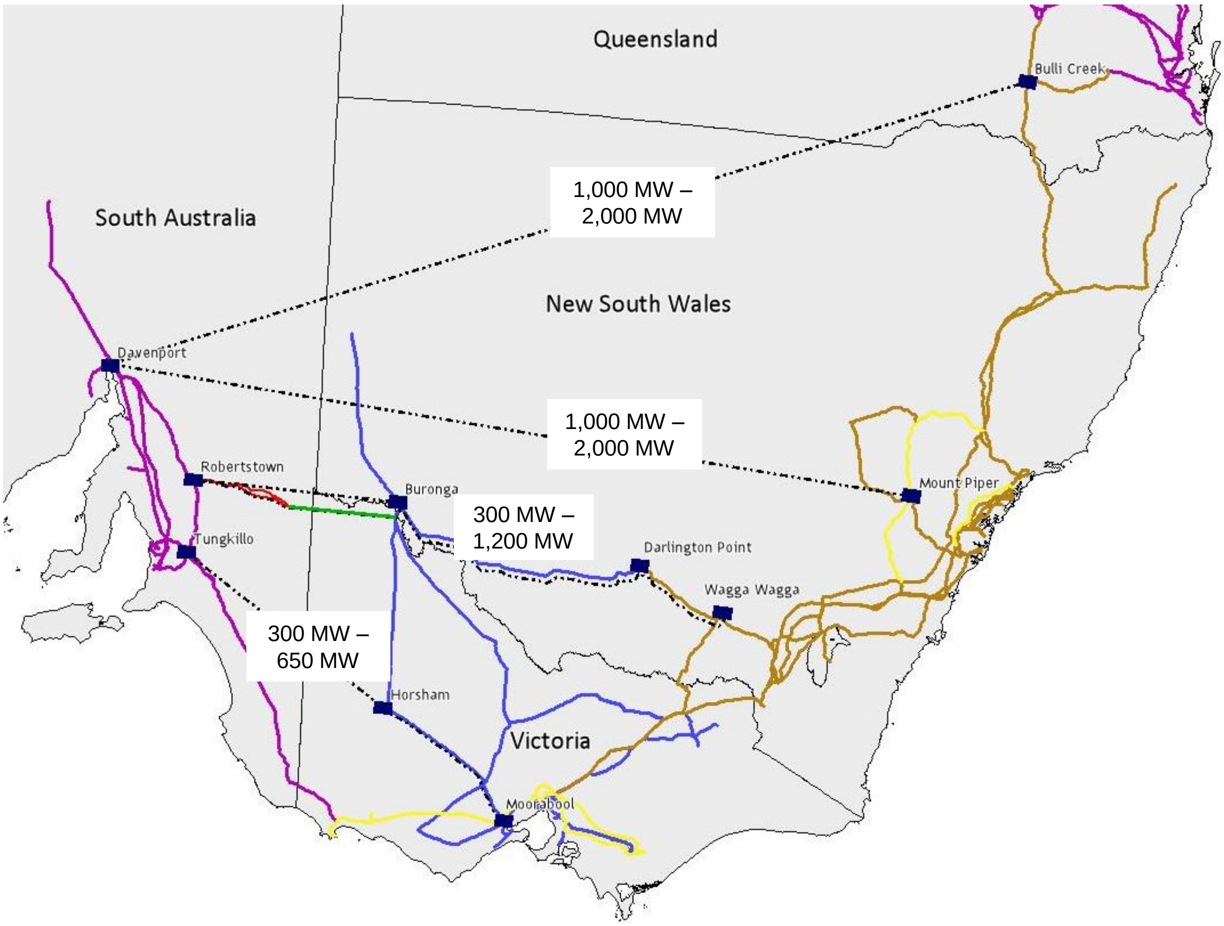
South Australia has abundant and high quality renewable energy resources that exceed its combined minimum demand and export capability. Greater interconnection would allow renewable energy from South Australia to assist the nation to meet carbon emission and renewable energy targets at lowest long-run cost.

Greater interconnection between South Australia and the rest of the NEM would also enable renewable energy resources in Queensland, New South Wales, or Victoria to be unlocked by developing transmission corridors through weakly or otherwise unconnected renewable regions, thereby, contributing further to the overall market transition.

Four interconnector options proposed to be assessed

ElectraNet has identified four credible network options, all of which involve constructing a new interconnector between South Australia and a neighbouring state. The map below shows the four routes that are being investigated, along with an indicative range of interconnector capacity (both ways).

Figure 1 Four new interconnector options are proposed to be investigated as part of this RIT-T (line corridors are indicative only)



None of the network options being investigated were considered in AEMO's 2015 National Transmission Network Development Plan (NTNDP). However, AEMO's 2016 NTNDP is expected to include high level consideration of additional interconnection options in the NEM, including from South Australia to neighbouring states.

Non-network options will also be evaluated

Non-network options can also provide benefits to the market and help with energy market transition, particularly in relation to system security.

Non-network options could provide inertia, fast frequency response and/or voltage response capabilities to increase interconnector capacity and so that supply disruptions could either be avoided or substantially reduced.

Technological advances with respect to controllable demand and storage mean that there may be a broader range of potential non-network options than previously was the case.

ElectraNet is interested to hear from non-network proponents

ElectraNet is interested to hear from potential proponents of non-network options. The information that non-network proponents need to provide is set out in section 4 of this report.

ElectraNet will use the information provided in submissions to further develop non-network options for inclusion in the next stage of the RIT-T assessment process.

Next steps

ElectraNet welcomes written submissions on this PSCR. Submissions are due on or before Monday 6 February 2017. Submissions are particularly sought on the investment options presented and from proponents of potential non-network options.

Submissions should be emailed to consultation@electranet.com.au.

Submissions will be published on the ElectraNet website. If you do not want your submission to be made publicly available, please clearly specify this at the time of lodging your submission.

ElectraNet will publish a separate consultation report on the economic modelling to be undertaken to assess the credible options. The Economic Modelling Assumptions report will be published before the end of 2016. This report will provide details of the modelling approach and assumptions that ElectraNet intends to adopt in the economic assessment, including the future scenarios against which credible options will be assessed.

A Project Assessment Draft Report (PADR), including a full quantitative assessment of the costs and benefits of each of the options being considered, is expected to be published mid-2017.

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Contents

Glossary of Terms

Term	Description
AC	Alternating Current
ACST	Australian Central Standard Time
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
COAG	Council of Australian Governments
ETC	Electricity Transmission Code
FOS	Frequency Operating Standard
HVDC	High Voltage Direct Current
LRET	Large-scale Renewable Energy Target
LNG	Liquefied Natural Gas
NPV	Net Present Value
NEFR	National Electricity Forecasting Report
NER	National Electricity Rules
NEM	National Electricity Market
NPS	Northern Power Station
NTNDP	National Transmission Network Development Plan
PACR	Project Assessment Conclusions Report
PADR	Project Assessment Draft Report
PSCR	Project Specification Consultation Report
PV	Photovoltaic
RET	Renewable Energy Target
RIT-T	Regulatory Investment Test for Transmission
RoCoF	Rate of Change of Frequency
Rules	National Electricity Rules
SPS	Special Protection Scheme
STTM	Short Term Trading Market
TNSP	Transmission Network Service Provider
UFLS	Under Frequency Load Shedding
USE	Unserved Energy
VCR	Value of Customer Reliability

1. Introduction

Australian energy markets are experiencing a time of significant change, driven by the transition to lower carbon emissions, rapidly evolving technologies and changing customer needs.

South Australia has reached significant levels of renewable energy penetration through large scale wind generation developments and rooftop solar photovoltaic (PV) installation. Around 45 per cent of South Australia's power generation now comes from renewable energy resources.

Successfully integrating this changing supply mix, while maintaining affordability, reliability and security of supply for customers is a key priority for the energy sector.

Electricity transmission networks have a key role to play in supporting the efficient development of the energy markets during this transition, as recently highlighted by the Council of Australian Governments (COAG) Energy Council[5].

Additional interconnection between National Electricity Market (NEM) regions can facilitate greater competition between generation sources, thereby delivering lower overall energy prices for customers, in addition to facilitating an increase in renewable generation and addressing security of supply concerns associated with energy market transition.

Non-network options can also provide benefits to the market to help with energy market transition. These options could include demand response, generation options, battery storage and other solutions.

1.1 Role of this report

This Project Specification Consultation Report (PSCR) represents the first step in the application of the Regulatory Investment Test for Transmission (RIT-T) to network and non-network options for meeting the identified need.

The purpose of this first step is to:

- set out the reasons why ElectraNet proposes that action be undertaken (i.e. the 'identified need');
- provide details as to what non-network solutions would need to provide in order to address the identified need, and invite submissions from proponents of potential non-network options to be included in the RIT-T assessment;
- present a number of options that ElectraNet currently considers address the identified need that would result in an overall net market benefit, including various network options and non-network alternatives; and
- allow interested parties to make submissions and provide input to the RIT-T assessment.

[5] COAG Energy Council, *Communique*, August 2016

The next stage of this RIT-T is the quantitative assessment of the net benefit to the NEM associated with different investment options.

The entire RIT-T process is summarised in Appendix C. The next steps for this particular RIT-T assessment are discussed further below.

1.2 Structure of this report

This PSCR provides information on various matters, as required under the NER. In particular, it:

- describes the drivers for investment under this RIT-T (the 'identified need') in more detail – section 2;
- provides information on the assumptions that underpin this identified need – section 3;
- sets out the technical characteristics that non-network options would need to have in order to provide similar market benefits, and requests submissions from potential proponents of non-network options – section 4;
- describes the credible options that ElectraNet currently considers may address the identified need – section 5;
- confirms that at this stage in the process all of the benefit categories in the RIT-T are potentially material – section 6.

Appendices to this PSCR provide a checklist of compliance of this report against the NER requirements, a list of definitions, a summary of the overall RIT-T process and additional detail on the background and assumptions underlying the identified need.

1.3 Requirement to apply the RIT-T

ElectraNet is required to apply the RIT-T to this economic assessment, as none of the exemptions listed in NER clause 5.16.3(a) apply.

This RIT-T is focused on options that maximise net benefits to the market. That is, an option that satisfies this RIT-T would have a positive overall net market benefit, compared with the option of taking no action.

ElectraNet has not classified this project as a reliability corrective action. While the South Australian Government has implemented a new Rate of Change of Frequency (RoCoF) standard to protect against the non-credible outage of the Heywood Interconnector[6], the scope of the identified need extends beyond this requirement.

[6] The RoCoF standard recently introduced by the South Australian government is discussed in section 2.2.2 .

1.4 Submissions and next steps

ElectraNet welcomes written submissions on this PSCR. Submissions are due on or before Monday, 6 February 2017. Submissions are particularly sought on the credible options presented and from proponents of non-network options that can meet the technical characteristics set out in section 4 of this PSCR.

Submissions should be emailed to consultation@electranet.com.au.

Submissions will be published on the ElectraNet website. If you do not want your submission to be made publicly available, please clearly specify this at the time of lodging your submission.

The next formal stage of this RIT-T is the Project Assessment Draft Report (PADR). The PADR will include the full quantitative analysis of both network and non-network options, and is expected to be published in mid-2017.

ElectraNet intends to publish an additional report, ahead of the PADR, that provides more detail in relation to the modelling approach and parameters it intends to adopt in the quantitative analysis. This separate Economic Modelling Assumptions report is not required under the NER, but will provide greater transparency and an opportunity to obtain earlier stakeholder feedback on the quantitative modelling, ahead of the PADR. ElectraNet intends to publish this report before the end of 2016.

Since the interconnector options considered in this report are all expected to have a material inter-network impact, ElectraNet will provide AEMO with a written request for an augmentation technical report.[7]

Further details in relation to this economic assessment can be obtained from:

Hugo Klingenberg
Senior Manager Network Development
consultation@electranet.com.au

[7] In accordance with NER clause 5.21(d).

2. Identified need

This section discusses the drivers for potential investment under this RIT-T (‘the identified need’), and why ElectraNet considers that material market benefits will arise as a result of this potential investment.[8]

2.1 Background

Australia’s energy markets are currently undergoing rapid change as the sector transitions to a world with lower carbon emissions and greater uptake of emerging technologies.

Renewable energy is making up an increasing proportion of the national energy mix. South Australia has abundant and high quality renewable energy resources that exceed its combined minimum demand and export capability with wind and rooftop solar PV already making up over 45 per cent of South Australia’s energy supply. Renewable penetration is also rapidly increasing in other jurisdictions.

Going forward, even more of Australia’s existing electricity generation fleet is likely to be replaced by lower emission alternatives to meet policy commitments, including the nation’s COP21 pledge to reduce carbon emissions by 26-28 per cent below 2005 levels by 2030[9].

At the same time there have been fundamental shifts in both underlying fuel markets (in particular the gas market), and generation technologies, with an increase in distributed generation and anticipation of widespread deployment of battery technologies. The changing generation mix and a shift to more distributed supply sources present new challenges for the security of energy supply.

The COAG Energy Council has noted that interconnectors provide a range of benefits that are particularly important in facilitating this energy transition, in particular:[10]

- enabling the lowest cost generation in the NEM to reach more consumers, lowering the overall cost of electricity for consumers;
- sharing of network support services, such as the transfer of services which support frequency stability between regions; and
- mitigating the risk of supply shortfall in a region through the ability to raise capacity quickly through imports from other regions.

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8 As required by NER clause 5.16.4(b)(2).

9 The 2015 United Nations Climate Change Conference (also known as ‘COP 21’ or ‘CMP 11’) was held in Paris, France, from 30 November to 12 December 2015.

10 COAG Energy Council, *Review of the Regulatory Investment Test for Transmission*, Consultation Paper, Energy Project Team, 30 September 2016, p.13.

2.2 Description of the identified need

The identified need for this RIT-T is to create a net benefit to consumers and producers of electricity and support energy market transition in South Australia through:

- facilitating greater competition between generators in different regions, leading to lower dispatch costs and consequently lower wholesale prices, particularly in South Australia; and
- providing appropriate security of electricity supply, including management of inertia, frequency response and system strength, in South Australia; and
- facilitating the transition to lower carbon emissions and the adoption of new technologies

The drivers for market benefits in each of these three areas is discussed further below. Section 2.2.3 outlines key assumptions in relation to these key sources of market benefit.

2.2.1 Benefits attributable from lower dispatch costs and lower electricity prices in South Australia

A number of South Australian generators have permanently, or partially, withdrawn from the market in the recent past, including Northern Power Station (NPS) which closed in May 2016. The substantial investment in new wind and rooftop solar photovoltaic (PV) generation in South Australia has been a contributing factor to this withdrawal.

Gas in the interconnected eastern seaboard markets has also experienced a rapid increase in demand and subsequently price. With the closure of NPS, South Australia has become more reliant on the gas markets for firm electricity supply. Since the announced closure of NPS, spot and futures prices in South Australia have experienced a sharp increase that have not been replicated in the eastern states. For example, South Australia electricity base futures prices are around $100/MWh for the next three years, while prices in New South Wales and Victoria range from $55 to $65/ MWh over that same time horizon[11].

ElectraNet considers that the effect of this increase in future prices could see South Australian customers pay around $500 million more, per annum, than equivalent customers inter-state.

A new interconnector or non-network alternatives would put downward pressure on energy prices in South Australia. Specifically, new interconnector options would enable demand in South Australia to be met through using surplus low cost generating capacity that currently exists elsewhere in the NEM. This would have a substantive impact in reducing the current wholesale price differentials in futures contracts observed between South Australia and the eastern states.

Increased utilisation of lower cost generation sources across the NEM would result in lower overall costs of electricity supply across the market as a whole – providing an overall market benefit.

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[11] ASX Energy website, available at: https://www.asxenergy.com.au/, accessed 19 October 2016

The reduction in electricity prices in South Australia can also be expected to lead to further benefits to customers through the value they derive from increased electricity use.[12]

2.2.2 Benefits from providing appropriate security of electricity supply in South Australia

The transition of the energy sector and the adoption of new technologies is also changing the nature and level of services required to maintain system security.

Additional interconnection can provide a benefit through enabling any one region to draw on ancillary services provided via another region in order to maintain system security more cost effectively. Non-network options may also be able to assist in maintaining system security more cost effectively.

While new, low carbon emissions generation technologies contribute significantly to Australia meeting carbon emission and renewable energy targets, they generally do not provide the same system services as those delivered by traditional coal or gas-fired generators. The uptake of new technologies (such as solar PV) also has an impact on the operation of the power system. This presents challenges to the ability to maintain power system security.

In particular, displacement of conventional generation assets that provided power system security services (such as frequency and voltage control services) by non-synchronous generation such as wind and solar PV is creating system security concerns by not providing a comparable level of services.

There are a number of current initiatives which are aimed, at least in part, at addressing the above system security concerns, such as:

- the Australian Energy Market Commission (AEMC)'s System Security Market Frameworks Review;
- the Australian Energy Market Operator (AEMO)'s Future Power System Security Program; and
- a number of proposed Rule changes relating to issues of system security.[13]

Security of supply concerns arise in particular in relation to the operation of the South Australian network during non-credible 'separation events'. The loss of the existing Heywood Interconnector has the effect of 'islanding' the operation of the electricity network in South Australia from the rest of the NEM – this is referred to as a 'separation event.'[14] Historically, separation events have occurred on average once every four years. Most recently, on Wednesday 28 September 2016 at 3:48 pm (ACST) the South Australian electricity market disconnected from Victoria and subsequently experienced a state-wide power outage, as a result of a severe storm.[15]

[12] This benefit is discussed further in section 6.

[13] In particular the South Australian Energy Minister's Rule change proposal for managing the rate of change of power system frequency and AGL's proposal for an inertia ancillary services market.

[14] Appendix D provides more detail on separation events and their history since the NEM started.

[15] Previously, separation events had only ever led to limited supply outages in South Australia.

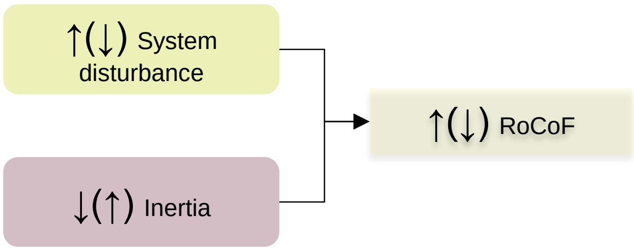
When a separation event occurs, sufficient inertia[16] or fast frequency response is required to be provided by facilities within South Australia in order to enable the system to not breach rate of change of frequency (RoCoF) requirements and operate in an islanded mode, within the required Frequency Operating Standards.[17] If there is insufficient inertia or fast frequency response available, then the South Australian network may suffer a total collapse, which would result in prolonged electricity outages to customers across all of South Australia while the system is restarted.

There are two key factors that go to controlling the RoCoF and, consequently, reducing the risk of wide-spread supply disruption – namely:

- increasing the amount of inertia that is provided by generators (or other facilities) in South Australia; and/or
- minimising the size of the system disturbance (via limiting power flow on the Heywood Interconnector at certain times)[18].

The relationship between the RoCoF, system inertia and the size of system disturbance is depicted in the figure below.

Figure 2 Relationship between inertia, the system disturbance and the RoCoF



Historically, conventional generation in South Australia has provided sufficient inertia to enable South Australia to withstand separation events without a state-wide supply disruption.

However, the closure of some conventional generating units and reduced availability for dispatch of others, means that there are now fewer resources available within South Australia to provide the required inertia to limit RoCoF, if a separation event occurs.

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16 Inertia is the stored kinetic energy in rotating masses of generators and motor loads which impacts the rate of change of system frequency during perturbations

17 Under normal operations fast frequency response and system strength are available to South Australia via the Heywood Interconnector and on-line conventional generators. However, these services are unavailable from the Heywood Interconnector during a separation event. The Murraylink Interconnector is not designed for providing frequency control services. The Frequency Operating Standards that are required to be met during a separation event are determined by the Jurisdictional System Security Coordinator. More detail on the Frequency Operating Standards can be found in Appendix D.

18 The system disruption can also potentially be reduced by the provision of fast frequency response, which would consequently reduce the RoCoF

To address these concerns, the South Australian Government has enacted a new requirement that requires RoCoF to be limited to 3 Hz/s[19] for the coincident loss of both circuits of the Heywood Interconnector, when the system is in a secure operating state as defined in the NER. ElectraNet has consequently provided limit information to AEMO to assist in limiting flows on the Heywood Interconnector when necessary to achieve the RoCoF standard.

Against this background, the options considered in this RIT-T may provide benefits through:

- allowing the RoCoF standard to be met without constraining flows over the Heywood Interconnector;
- further reducing the risk and/or consequences of supply disruption following a separation or other event, through reducing RoCoF below the mandated standard;
- managing the challenges of declining system strength (fault levels)[20]; and/or
- allowing greater sharing of ancillary services across regions, resulting in an overall lower cost of providing system stability.

2.2.3 Benefits attributable to the transition to lower carbon emissions

South Australia has among the most abundant and high quality renewable energy resources in Australia and has seen an unprecedented, and highly publicised, uptake of renewable generation over the last decade, in particular wind and rooftop solar PV installations on residential and commercial properties. Total renewable energy resources in South Australia exceed its combined minimum demand and export capability.

Australia's COP21[21] commitment to reduce carbon emissions by 26 to 28 per cent below 2005 levels by 2030 has significant implications for the future operation of the NEM. Meeting this commitment, will lead to further replacement of some of Australia’s emissions intensive generators with lower emission alternatives, such as renewable energy.[22]

Greater interconnection within the NEM would allow renewable energy from South Australia to assist the nation meet carbon emission and renewable energy targets at lowest long run cost.

[19] The South Australian Government Gazette, 12 October 2016.

[20] System strength (fault levels) declines where the quantity of synchronous generators operating declines and the quantity of power electronic convertor-connected generation such as wind and solar increases. This can lead to increased risk of protection systems not operating as designed and therefore an increased risk to system security, public safety and plant and equipment.

[21] The 2015 United Nations Climate Change Conference (also known as ‘COP 21’ or ‘CMP 11’) was held in Paris, France, from 30 November to 12 December 2015.

[22] COAG Energy Council, *Review of the Regulatory Investment Test for Transmission*, Consultation Paper, Energy Project Team, 30 September 2016, p. 13.

Greater interconnection would also enable renewable energy resources in Queensland, New South Wales, and/or Victoria to be unlocked, contributing further to the overall market transition. Opening up additional geographical areas of the NEM for renewable investment will drive diversification of renewable energy and lead to less volatility in output as a result of local weather effects.

Within the context of the RIT-T assessment, greater output from renewable generation can be expected to primarily deliver the following classes of market benefit:

- further reductions in total dispatch costs (including fuel and emissions costs), by enabling low cost renewable generation to displace higher cost conventional generation;
- reduced generation investment costs, resulting from more efficient investment and retirement decisions, due to higher wind generation capacity factors in South Australia compared to other locations.

3. Assumptions made in relation to the identified need

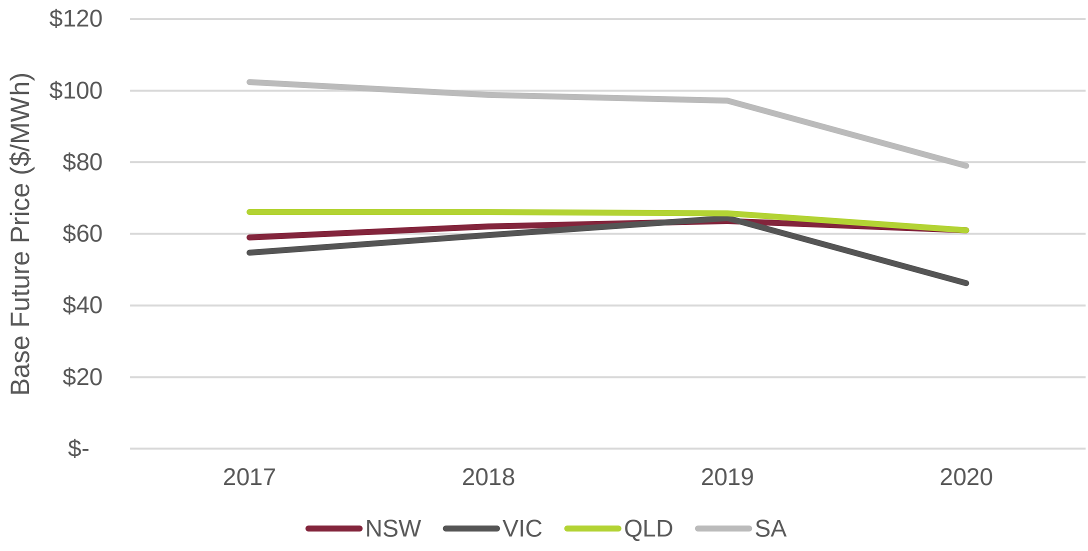
This section describes the key assumptions and data underpinning ElectraNet's assessment to date that the investment options being considered in this RIT-T are expected to provide a net market benefit.[23] More detail regarding the key assumptions and data that will underpin the NPV assessment for this RIT-T will be set out in a separate Economic Modelling Assumptions report, which ElectraNet intends to release before the end of 2016.

3.1 Price differentials in forward contracts

The reduced operation of conventional generators in South Australia has resulted in substantially higher futures electricity prices in South Australia that have not been replicated in the eastern states. For example, South Australia electricity base futures prices are currently around $100/MWh for the next three years, while prices in New South Wales and Victoria range from $55 to $65/ MWh over that same time horizon – as illustrated in Figure 3.

[23] This is in accordance with NER clause 5.16.4(b)(2).

Figure 3 Electricity futures in the NEM



Source: ASX Energy website, available at: https://www.asxenergy.com.au/, accessed 19 October 2016.

Increasing supply through a new interconnector will put downward pressure on energy prices in South Australia since it will allow South Australia to draw on surplus low cost generating capacity that currently exists elsewhere in the NEM. ElectraNet will estimate this benefit using a model of NEM dispatch and will make assumptions regarding generator fuel costs in the NEM. The Economic Modelling Assumptions report will discuss the proposed sources for generator fuel costs in more detail.

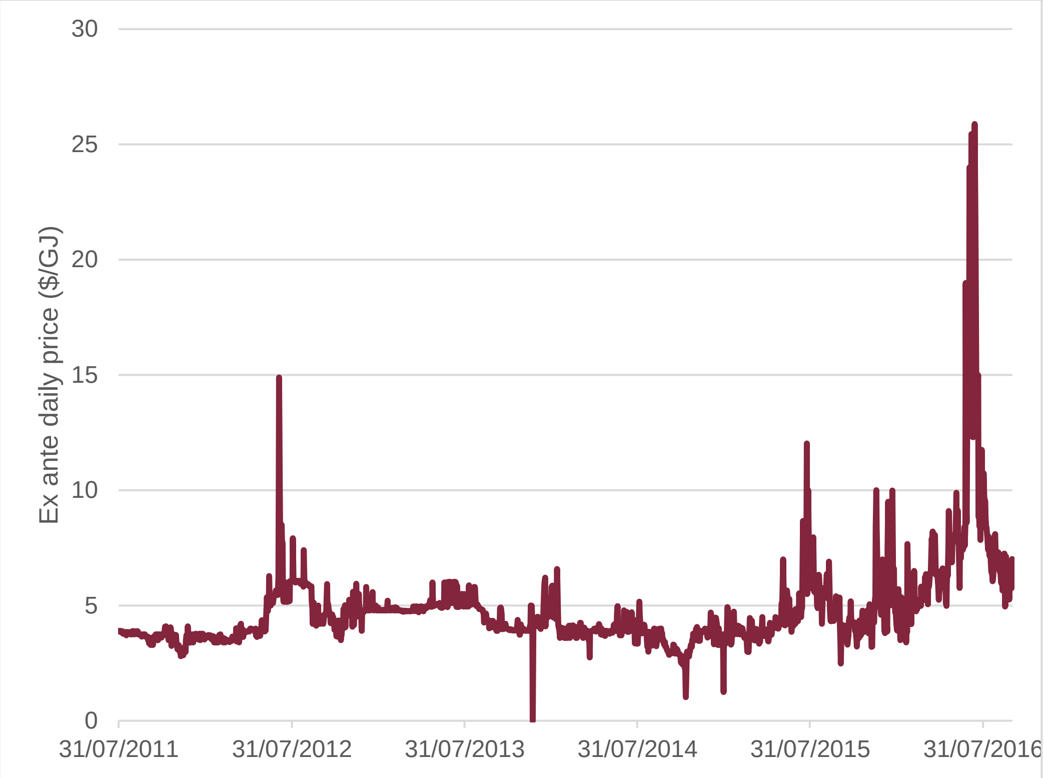
3.2 Increasing wholesale natural gas prices

The gas industry on the east coast of Australia is undergoing a structural change driven primarily by the Queensland-based liquefied natural gas (LNG) export industry. Specifically, these LNG export operations are anticipated to treble gas demand, from 694 PJ in 2014 to an expected 1,961 PJ in 2020, with consequential impacts on the level and variability of wholesale gas prices.[24]

Figure 4 illustrates this upswing in wholesale gas prices in South Australia over the last year by charting daily ex-ante prices at the Adelaide short-term trading market (STTM). Wholesale gas prices in South Australia increased substantially in May to July of this year, which can be considered the outworking of increased demand for gas for the three export LNG plants in Queensland, which are now running at two thirds of full capacity.

[24] Australian Energy Market Commission, *East Coast Wholesale Gas Markets and Pipeline Frameworks Review*, Stage 2 – Final Report, 23 May 2016, p.2.

Figure 4 Daily ex-ante gas prices at the Adelaide STTM



Source: AEMO STTM price and withdrawals data, available at: https://www.aemo.com.au/Gas/Short-Term-Trading-Market-STTM/Data

The increase in gas prices is one of the key drivers of the current increase in wholesale futures electricity prices in South Australia. The ability to utilise more low-cost generation sources elsewhere in the NEM as an alternative to South Australian gas generation, leading to lower costs of electricity supply overall, is a key benefit anticipated from options that involve additional interconnection.

3.3 Reduction in carbon emissions

Implicit in the various Australian carbon emission and renewable energy targets is a value on carbon reductions. This implicit value on carbon emissions can be considered independently of the particular mechanism used to achieve carbon reductions.

To reflect this, and the benefits associated with the ability of various options to reduce carbon emissions, ElectraNet intends to investigate various implicit values for carbon emissions as part of the assessment underpinning this RIT-T (and to be detailed in the PADR and PACR).

ElectraNet notes that AEMO takes a similar approach and incorporates assumptions in relation to carbon emissions targets as part of its NTNDP plans, and provides projections of implicit carbon prices.[25]

More detail on the specific approach to be adopted in reflecting government carbon policy commitments in the benefits modelling for this RIT-T will be provided in the forthcoming Economic Modelling Assumptions report.

3.4 Reduction in conventional generation affects system security

The significant uptake in large and small scale renewable generation in South Australia - combined with increases in gas prices and additional competition with other generators across the expanded Heywood Interconnector[26] - has contributed to a number of South Australian conventional generators reducing operations (in full or in-part).

For example:

- the 485 MW Pelican Point gas-fired power station was temporarily mothballed in 2015, with only half its capacity currently available[27];
- the 240 MW Playford brown coal power station was formally decommissioned in 2016[28];
- the 540 MW Northern brown coal power station was decommissioned in May 2016, which represented the last coal-fired power station in South Australia[29]; and
- the 480 MW Torrens Island A gas-fired power station announced in December 2014 indefinite mothballing, albeit that this was rescinded in June 201630.

Overall, the generation mix has changed substantially in South Australia with 45% of energy generated in South Australia since the closure of Northern Power Station coming from wind and solar – the figure below illustrates this changing generation mix since 2010-11.

[25] Both of the scenarios adopted by AEMO in its 2015 NTNDP included an implicit cost on carbon for the majority of the 20-year assessment period. AEMO, *National Transmission Network Development Plan, November 2015*, pp. 32-33. AEMO's assumptions for the 2016 NTNDP also include an implicit carbon price. AEMO, *Consultation Paper, Material Issues and Proposed Inputs for the 2016 National Transmission Network Development Plan*, January 2016 p.11 and p.13.

[26] The Heywood Interconnector has recently seen an expansion of its capacity, which included a RIT-T undertaken during 2011 to 2013. More information of the increased capacity across the Heywood Interconnector can be found in Appendix D.

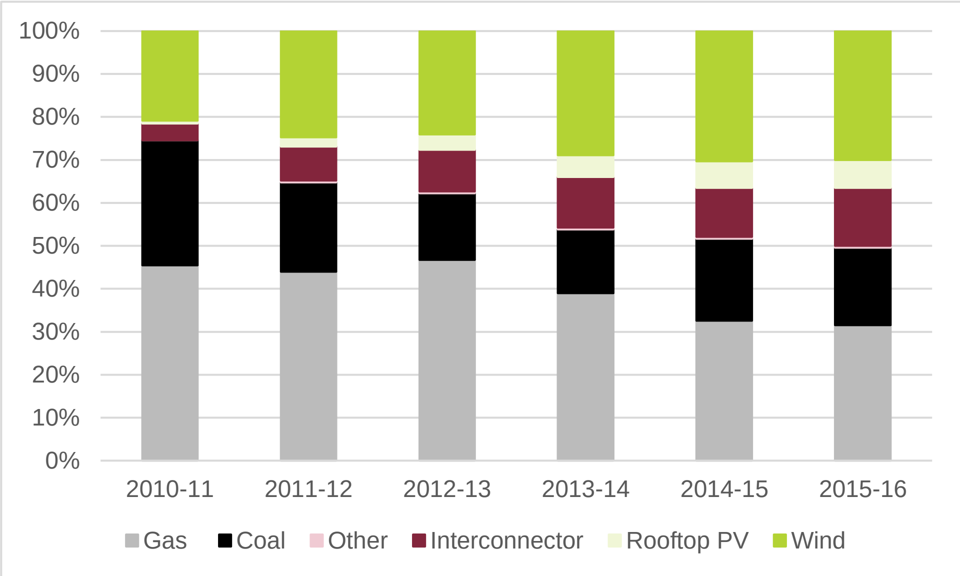
[27] AEMO, *ESOO*, August 2015

[28] AEMO, *ESOO*, August 2015

[29] AEMO, *ESOO Update*, October 2015

[30] AGL, *Media Release*, June 2016

Figure 5 Changing generation mix in South Australia since 2010-11



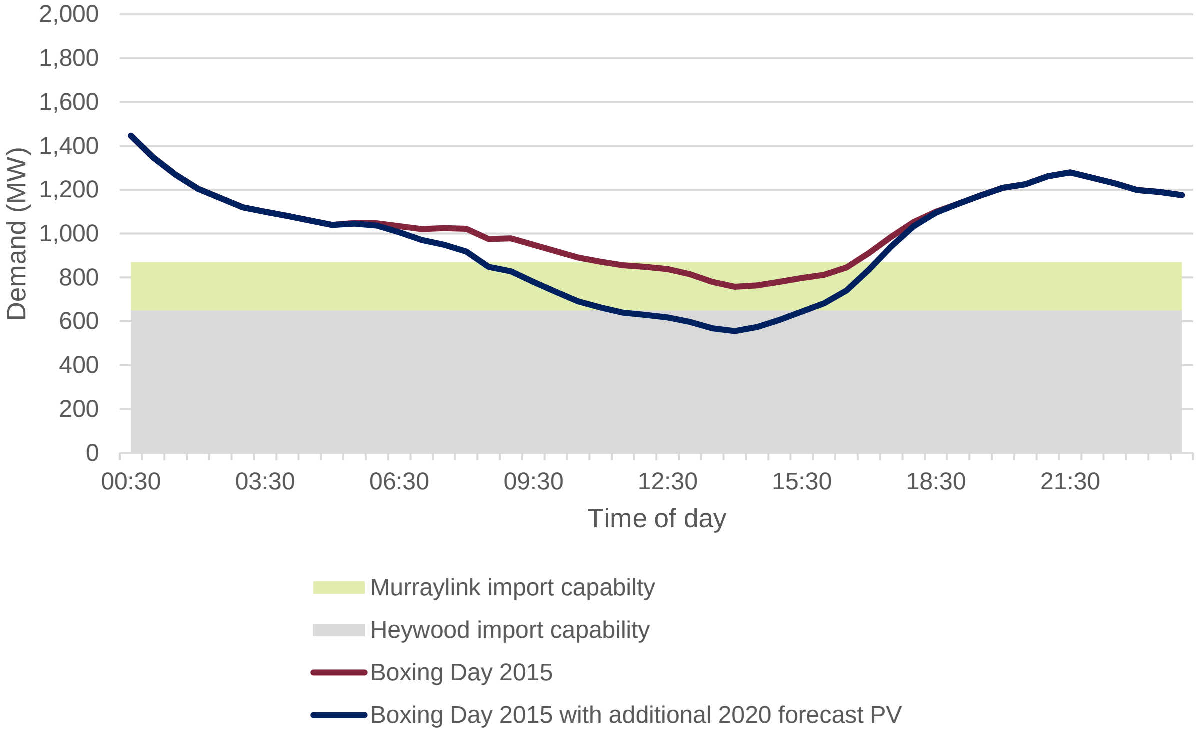
Source: AEMO. Note: The proportion attributable to renewables will increase in 2016-17 as a result of the Hornsdale Wind Farm being commissioned and the Northern Power Station shutting down.

The displacement of conventional generation will be exacerbated by additional wind generation capacity which is committed and will be added over the next 12 months. Displacement of conventional generation assets raises system security concerns. Conventional generation has traditionally provided power system security services (such as frequency and voltage control services), which are not currently provided by non-synchronous and inherently intermittent generation such as wind and solar PV.

3.5 New technologies also affect system security

Forecast reductions in South Australian minimum demand are also expected to increase the risk of severe disruption going forward during a separation event. Forecast reductions in South Australian minimum demand are being driven by the increase in behind-the-meter solar PV systems – Figure 6 depicts this by illustrating Boxing Day 2015, which was the day of lowest grid demand in the last 12 months, and how the further growth in PV may impact days like this in 2020 based on current forecasts.

Figure 6: Comparison of the 2015 minimum demand day with forecast additional PV in 2020



Source: ElectraNet 2016

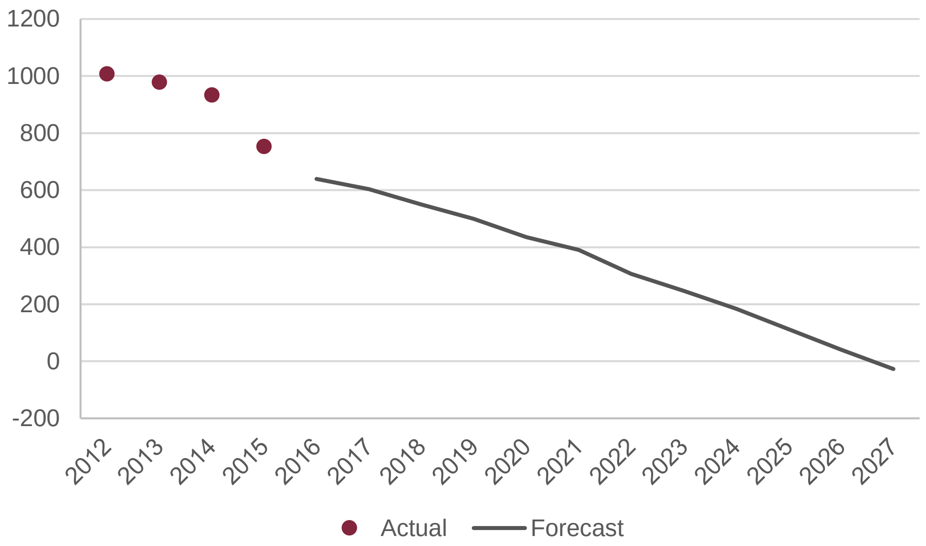
Even greater numbers of customers are likely to install solar PV and storage over the next 10-20 years as the economics of doing so become more favourable. In the next 10 years, battery storage costs are expected to fall by around 60 per cent and solar panel costs by around 35 per cent,[31] meaning that there is likely to be greater numbers of customers accessing their electricity from alternative sources and more decentralised energy resources.

If a separation event were to occur at a time during high interconnector transfers and when demand is at or close to its minimum level in South Australia, then this increases the likelihood that there will be insufficient inertia available (i.e. there will be less conventional generation on-line). The latest AEMO National Electricity Forecasting Report (NEFR) forecasts that the declining minimum demand trend in South Australia will continue and reach zero, possibly as soon as 2027 – as illustrated in the Figure 7.[32]

[31] COAG Energy Council, *Review of the Regulatory Investment Test for Transmission*, Consultation Paper, Energy Project Team, 30 September 2016, p. 13.

[32] AEMO 2016 National Electricity Forecasting Report

Figure 7 Actual and forecast minimum demand levels in South Australia



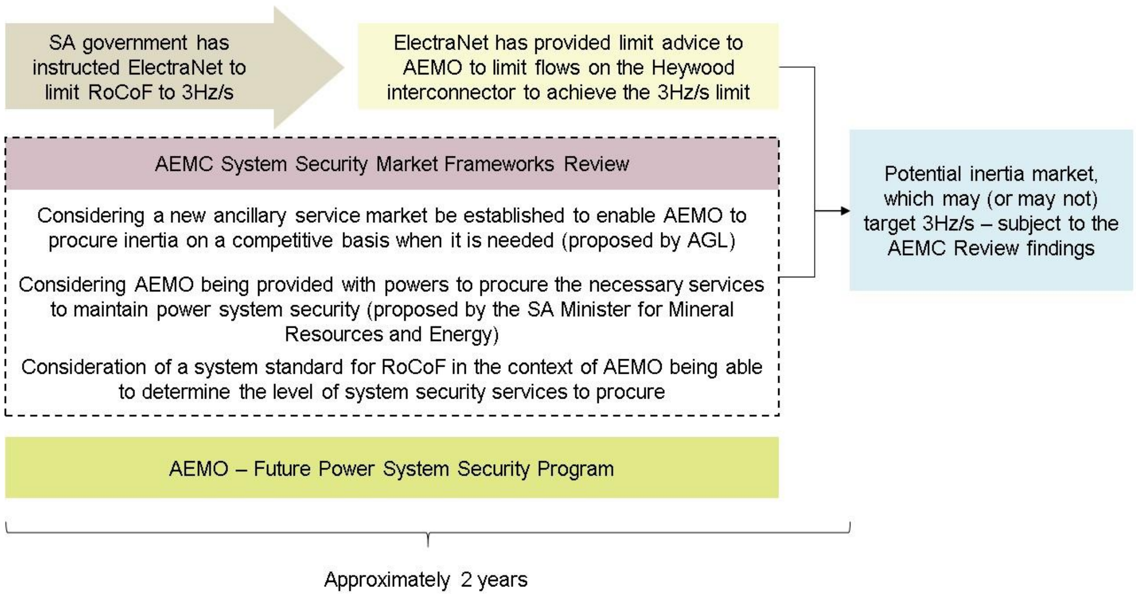
Source: AEMO 2016 NEFR.

3.6 Coincident reviews of system security arrangements

As discussed earlier, there are a number of current initiatives which are aimed, at least in part, at addressing system security concerns.

The interrelationships and timings of these coincident initiatives is illustrated in Figure 8.

Figure 8 Interaction between various system security initiatives currently underway



As part of its System Security Market Frameworks Review, the AEMC is currently considering a system standard for RoCoF.[33] The AEMC is to provide recommendations to the COAG Energy Council with an interim report by the end of 2016.[34]

ElectraNet will continue to monitor these developments as they affect the application of this RIT-T. The 'base case' for this RIT-T will need to reflect the new RoCoF obligation.

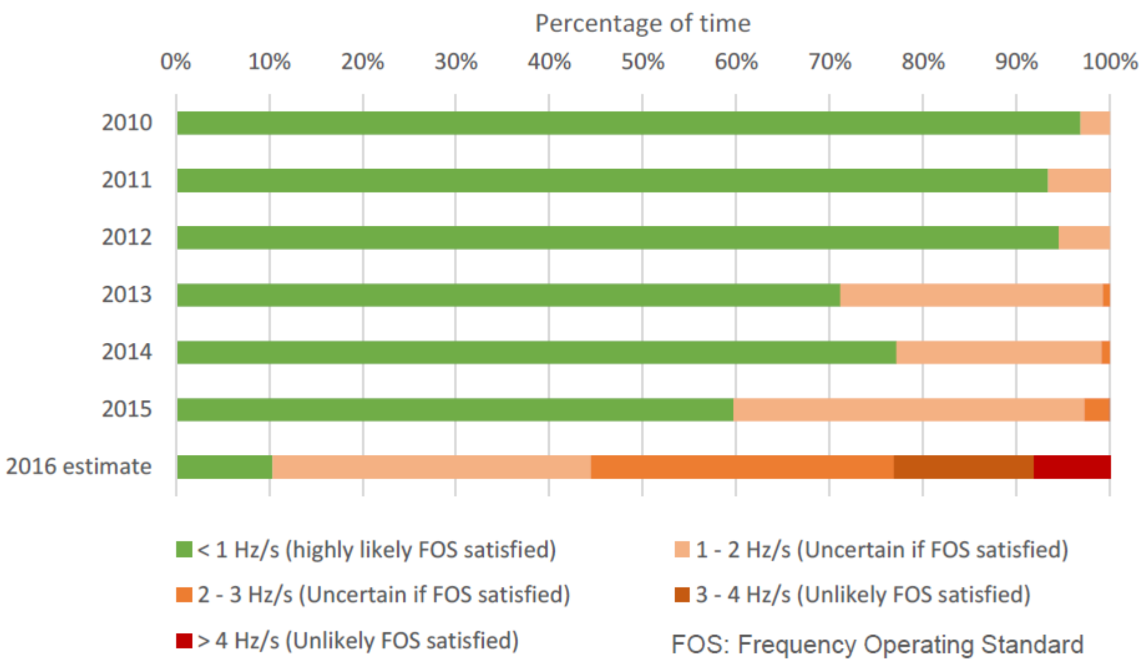
ElectraNet is currently considering the issue of how to define the base case and intends to provide further detail in the separate Economic Modelling Assumptions report.

3.7 Additional system security benefits from reducing RoCoF

As outlined in section 0, a key determinant of whether there is supply disruption following a separation event is the RoCoF, which is proportional to the size of the supply disruption and the level of system inertia at the time that the contingency occurs.

Figure 9 shows the percentage duration for different levels of RoCoF in South Australia for the coincident loss of both circuits of the Heywood interconnector, for each year since 2010, as reported by AEMO. In particular, it shows the estimated probability of occurrence with which the Frequency Operating Standard (FOS) would have been met for the potential non-credible loss of the interconnector.

Figure 9 Increasing exposure to RoCoF in South Australia for separation



Source: AEMO Future Power System Security Program, Progress Report, August 2016

33 AEMC, *System Security Market Frameworks Review*, 8 September 2016, p. 32.

34 AEMC, *System Security Market Frameworks Review*, 8 September 2016, p. 5.

Where the RoCoF exceeds 3 Hz/s, it becomes highly unlikely that the FOS will be met, with a consequent high risk of a 'system black' event. As discussed earlier, ElectraNet now faces a mandatory requirement to ensure that RoCoF remains below 3 Hz/s for the coincident trip of both circuits of the Heywood Interconnector, when the system is in a secure operating state as defined in the National Electricity Rules.

Figure 9 shows that where RoCoF remains below 1 Hz/s, it is highly likely that the FOS will be met. However, it also shows that where RoCoF is between 1 Hz/s and 3 Hz/s, it is uncertain if the FOS will be met, resulting in a residual risk of widespread supply disruptions.

Interconnector and non-network options may therefore provide a benefit to the market by reducing the risk and/or consequence of supply disruptions that may otherwise occur by improving the ability to manage RoCoF. ElectraNet intends to investigate this as part of this RIT-T.

3.8 Additional system security benefits, by increasing System Strength

With the reduction in conventional rotating generation plant and the increase in renewable power generation from wind farms and solar photovoltaic (PV) within South Australia, a reduction in system strength (fault levels) is occurring and expected to continue. Further reductions in system strength will result in greater volatility of voltage levels, reduced ability of protection systems to discriminate between fault and load currents and may reduce the ability of generators to remain connected following system disturbances[35].

Increased voltage volatility increases the risk of voltage instability following network disturbances that could lead to system collapse.

3.9 Discussion of the identified need in the 2015 NTNDP

The NER require ElectraNet to identify whether any of the options subject to this RIT-T have been identified in a previous AEMO NTNDP.

The 2015 NTNDP discusses part of the identified need for this RIT-T in identifying emerging challenges to network security and reliability arising from fundamental differences in the physical generating equipment between synchronous and certain renewable generation technologies.

Specifically, the 2015 NTNDP stated that South Australia is most exposed to these challenges, due to its high levels of wind and rooftop PV generation, and the region having only one AC interconnector (comprising two circuits) to other regions.

[35] System disturbances here covers a range of events and is not limited to a separation event.

The 2015 NTNDP noted that, within this context, an increasing reliance on the Heywood Interconnector presents a system security risk for South Australia and that an intended focus area for the 2016 NTNDP will be to identify possible network and non-network solutions to manage system security across the national transmission network, addressing these emerging challenges.[36]

AEMO's recent Future Power System Security Program – Progress Report has continued to highlight the challenges for system security posed by the energy transition in South Australia.[37]

The 2015 NTNDP has not explicitly discussed additional interconnector options for South Australia. However, it is anticipated that additional interconnection options will be considered, at a high level, in the 2016 NTNDP.[38]

4. Required technical characteristics of non-network options

This section describes the technical characteristics that a non-network option would be required to deliver in order to address the identified need.[39]

AEMO has recently identified a range of potential non-network options that may help meet the identified need, as part of its Future Power System Security Program, including:[40]

- inertia or fast-response ramping provided by new or existing conventional, synchronous generation (that may otherwise exit the market, or choose to not operate across part of the day);
- inertia provided by synchronous condensers with or without flywheels (new or retro-fitted to existing or retiring plant);
- fast frequency response from batteries or other inverter-connected energy storage options;
- wind generation providing synthetic inertia and/or fast frequency response; and
- demand management providing fast frequency response.

To meet the identified need, non-network options would need to provide a minimum amount of inertia, active power (MW) and energy (MWh) and provide a response within the first 0.5 seconds of a system disturbance event, and as close to time-zero as possible.

The minimum response time of any particular non-network option may depend on the interaction with other network and non-network response times. This means that the non-network options may not need to be in operation continuously in anticipation of a separation event, but would need to have automatic detection systems, and actuation times of less than one second.

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[36] AEMO, *National Transmission Network Development Plan*, November 2015, pp. 23-24.

[37] AEMO, *Future Power System Security Program, Progress Report*, August 2016.

[38] AEMO, *2016 National Transmission Network Development Plan*, Response to 2016 Consultation Paper Submissions, August 2016, p. 7.

[39] In accordance with NER clause 5.16.4(b)(3).

[40] AEMO, *Future Power System Security Program*, Progress Report, August 2016, p. 48.

Non-network solutions may be coupled with a fast acting Special Protection Scheme (SPS) to quickly reduce generation or demand as needed. The anticipated requirements of the SPS are outlined in more detail in section 5.7. ElectraNet considers that combining an appropriate SPS with a non-network option may increase the range of non-network options that could be technically and economically capable of meeting the identified need for this RIT-T.

Given the nature of the identified need including the:

- wide range of potential non-network options that could help meet the identified need;
- potential to combine non-network and network options;
- absence of reliability corrective action; and
- desire to be less prescriptive to non-network options at this early stage of the RIT-T process;

it is difficult to specify minimum levels of inertia, active power (MW) and energy (MWh) required in this report.

However, ElectraNet would be interested to hear from parties regarding the potential for non-network options to satisfy, or contribute to satisfying, the identified need, and from potential proponents of such non-network options.

Table 1 sets out the indicative parameters that ElectraNet requests parties nominate in any response.

Table 1: Indicative parameters that non-network proponents should provide

	Parameter
1	Detection method and time: • Method and time to detect the event from inception. • Local frequency reference may not always be available to detect an event. Therefore, detection method with and without local frequency reference to be provided. • If remote communication is used for detection, the communication method and communication time needs to be provided.
2	Actuation time: • Time from detection of an event to delivery of the appropriate services.
3	Characteristics of the response • Capability of response to ramp up and ramp down (MW or MVAR/second) • Sustained duration of response at nominal capacity and other capacities (if applicable) • Sustainable Stable Operation under weak system (low inertia and system strength) conditions
4	Inertia Capability (if applicable) in MW-s
5	Scalability - Minimum and maximum capability including block sizes

	Parameter
6	Cost: • Capital cost per unit ($million) • Operating costs per annum ($/year) • If offered as a service, annual cost in $/year and minimum duration of service in years
7	Demonstration of ability to deliver utility scale solution in a reasonable time frame
8	Specific locations in the system (if applicable)

ElectraNet notes that it is not initiating a formal tender for non-network solutions at this stage. However, ElectraNet strongly encourages proponents of potential non-network solutions to make a submission to this PSCR and/or to get in contact, as any non-network solutions considered potential options under this RIT-T will require indicative costs and timings to be evaluated alongside the other options in the next stage of this RIT-T assessment (the PADR).

Should the RIT-T assessment identify a non-network solution(s) as the preferred option then ElectraNet would seek binding offers from the proponent(s) prior to completing the PADR.

5. Potential credible options to address the Identified Need

This section provides a description of the five credible options ElectraNet has identified to-date.[41] The NER defines a 'credible option' as an option that: (1) addresses the identified need; (2) is (or are) commercially and technically feasible; and (3) can be implemented in sufficient time to meet the identified need.[42]

A summary of these five options is provided in Table 2. The four credible network options involve constructing a new interconnector between South Australia and a neighbouring state.

The fifth option is a non-network option. As discussed in Section 4, ElectraNet welcomes submissions from potential non-network proponents, and intends to further refine this option (including its cost and timing) in the light of responses received, for the purposes of the PADR analysis.

41 As required by NER clause 5.16.4(b)(5).

42 NER clause 5.6.5D(a).

Table 2 Summary of potential credible options

	Option	Overview of option(s)	Length (km)	Indicative capex ($m)	Indicative increase in capacity (MW)
1	Central SA to Victoria interconnector (nominally Tungkillo to Horsham, and beyond)	Construction of a new line and associated works. Consideration will be given (without limitation) to HVAC, HVDC, single circuit and double circuit options, including staging of development.[43]	350 – 600	500 - 1,000	300 - 650
2	Mid North SA to NSW interconnector (nominally Robertstown to Buronga, and beyond)	Construction of a new line and associated works. Consideration will be given (without limitation) to 275 kV HVAC, 330 kV HVAC, HVDC, single circuit and double circuit options, including staging of development.	300 – 800	500 - 1,500	300 – 1,200
3	Northern SA to NSW interconnector (nominally Davenport to Mt Piper)	Construction of a new high capacity line(s) and associated works. Consideration will be given (without limitation) to HVAC and HVDC options, including staging of development.	1,100 – 1,300	About 1,500 – 2,000	1,000 – 2,000
4	Northern SA to Queensland interconnector (nominally Davenport to Bulli Creek)	Construction of a new high capacity line(s) and associated works. Consideration will be given (without limitation) to HVAC and HVDC options, including staging of development.	1,450 to 1,600	About 2,000 - 2,500	1,000 – 2,000
5	Non-network solutions	A variety of non-network capabilities to provide fast frequency response, Inertia and system strength; e.g. large-scale batteries, demand management, generation.	-	To be informed via submissions to this PSCR.	Subject to non-network options proposed and how they may be combined with network options.

Note that ranges reflect the dependency of capacity, indicative cost and length on the details of options developed.

[43] Staging of investment will be considered as required and can include, for example, partial build of HVAC transmission lines (string one side of double circuit line) and HVDC transmission systems built as a monopole initially and augmented to a bipole in the future.

Each of these options is likely to also require a SPS, which is likely to vary between the options. This is discussed further in section 5.7 below.

Each of the credible options are expected to be both technically and commercially feasible and able to be implemented in a reasonable time to meet the identified need.[44] Possible commissioning dates listed in this section are subject to obtaining relevant State and Commonwealth development and environmental approvals.

5.1 Consideration of HVAC and HVDC interconnector technologies

In developing the options considered in relation to the four indicative interconnector routes, ElectraNet will take into account the potential for the interconnection to be either HVAC or HVDC. These two technologies have strengths and weaknesses that will be common to the options considered.

The HVDC configurations will tend to have considerably higher terminal costs than the HVAC alternative. However, HVDC tends to have lower incremental costs per kilometre and losses also tend to be lower. For these reasons, HVDC will tend to be the cheaper option when considering longer routes such as options 3 and 4.

The termination costs will also likely reduce the benefits of HVDC for the connection of additional renewables along the path of the interconnector. Renewable hubs may need to be determined in advance to facilitate connections, but nonetheless, connection costs for new entrants can be expected to be higher and also more challenging for a HVDC path (due to limited advances in multi-terminal HVDC technologies around the world). Similarly, some AC technologies (such as series capacitors) may also restrict the capability of the path to connect new entrants.[45]

An advantage of a HVDC interconnector is that it can be dispatched as if it were a power station. A HVAC alternative cannot be controlled in the same manner although there is a growing range of technologies that can be incorporated to give some of this control (such as phase angle regulators). The potential benefits of controllability may be considerable and will be taken into account in further developing the interconnector options for the PADR.

An advantage of a HVAC interconnector is its ability to provide some system strength and increase the fault levels within the South Australian Transmission system. However, this depends on the connection location in the system. A HVDC VSC[46] transmission system can also provide fault current, but only up to its maximum capacity, whereas HVDC LCC[47] technologies do not provide any contribution to fault current.

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44 In accordance with the requirements of NER clause 5.15.2(a).

45 This technology will reduce the impedance of the circuits and subsequently reduce the effects of some voltage limits and increase line flows. Series capacitors are installed along a path near the mid-point of long lines. Adding generators along the path after the installation of the series capacitors would reduce the effectiveness of the series capacitors.

46 Voltage Source Converter

47 Line Commutated Converter

5.2 Option 1 – interconnector from central SA to Victoria

This interconnector route would utilise the capacity around Horsham in Victoria to strengthen South Australia's connection to the east coast by providing an increase in export and import capability.

ElectraNet is considering several configurations for this particular route including but not limited to:

- construction of a new AC 275 kV connection between Tungkillo in South Australia and Horsham in Victoria;
- single or double circuit operation of the new connection; and
- AC or HVDC operation.

The notional capability of the interconnector is likely to be reduced at times due to deep network limitations and outages. Further, a single circuit line would be restricted to operating at 300 MW, currently the largest credible contingency that South Australia can withstand without the need for load shedding or restrictions on the operation of the Heywood Interconnector.

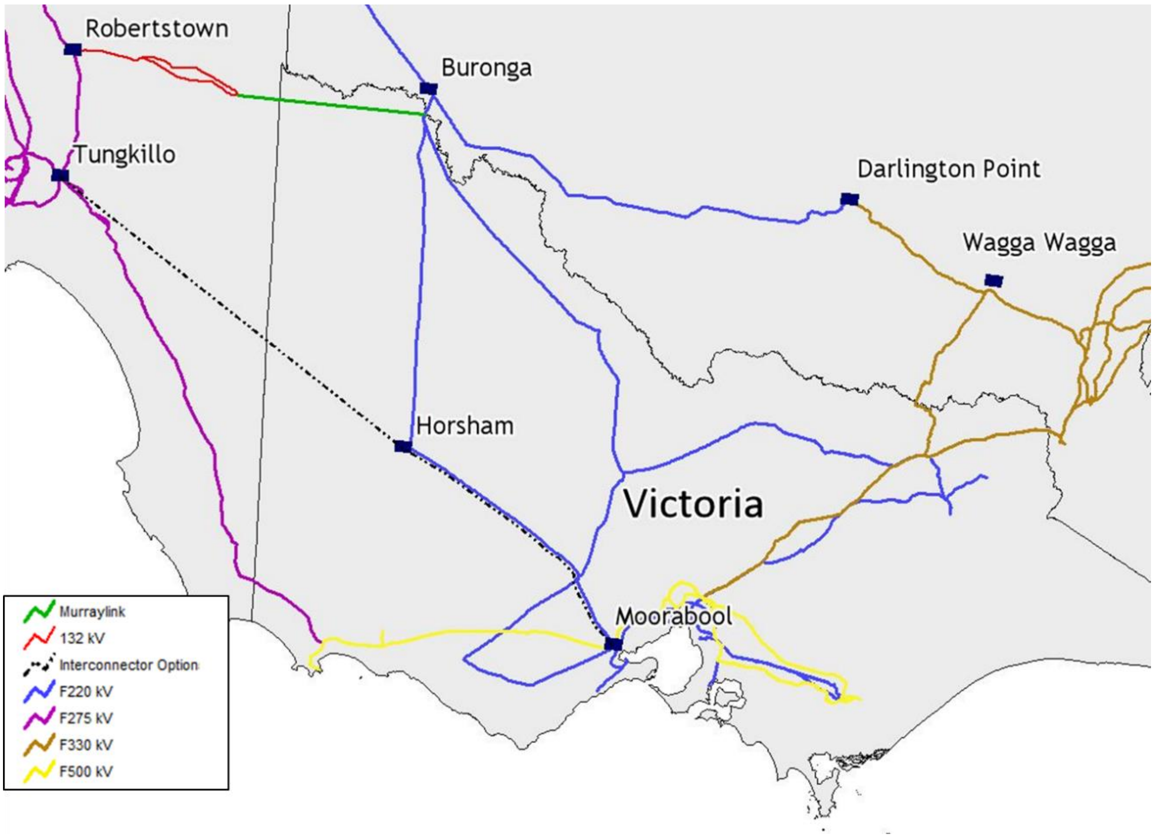
The capability of a double circuit interconnector would frequently be limited below 650 MW due to the capability of the Victorian network. AEMO has announced that it will be undertaking a RIT-T in relation to the augmentation of the north western Victoria network in 2016.[48] The benefits of building a high capacity interconnector between Tungkillo and Horsham would be enhanced with a stronger network between Melbourne and Horsham. This option may benefit from staging of investment such as the flexibility of a double circuit path initially operated as a single circuit until the potential outcomes of the AEMO north western Victoria RIT-T are delivered.

While this option would substantially reduce the risk of separation of the South Australian network from the eastern states, the Tungkillo substation would represent a potential single source of failure for this option and the existing Heywood interconnector. For example, were a bush fire to damage the substation, South Australia would be isolated for an extended period.

Figure 10 presents a representation of Option 1.

[48] AEMO 2016 Victorian Annual Transmission Planning Report

Figure 10 Network diagram for Option 1 – a new interconnector between central SA and Victoria



This option will likely require a number of supporting projects to deliver maximum benefit to customers and market participants in the NEM. ElectraNet is currently examining the optimal combination of such projects, which may include deeper network augmentation. The indicative costs in this report make some allowance for these projects. .

Capital costs for this option are estimated to be in the order of $500 to $1,000 million. The scope and estimate are currently being refined and will be updated in the PADR. Annual operating and maintenance costs are estimated to be about 2% of the capital cost. Construction is expected to take 1-2 years, with commissioning possible by 2021, subject to land/easement acquisition and obtaining necessary environmental and development approvals.

5.3 Option 2 – interconnector from mid-north SA to NSW

This interconnector route would utilise the spare capacity around Buronga in New South Wales to strengthen South Australia's connection to the east coast by providing an increase in export and import capability.

ElectraNet is considering several configurations for this particular route including but not limited to:

- New 275 kV or 330 kV AC transmission lines in single circuit, double circuit or staged configuration between Robertstown and Buronga and potentially new or upgraded lines to Wagga Wagga in New South Wales;

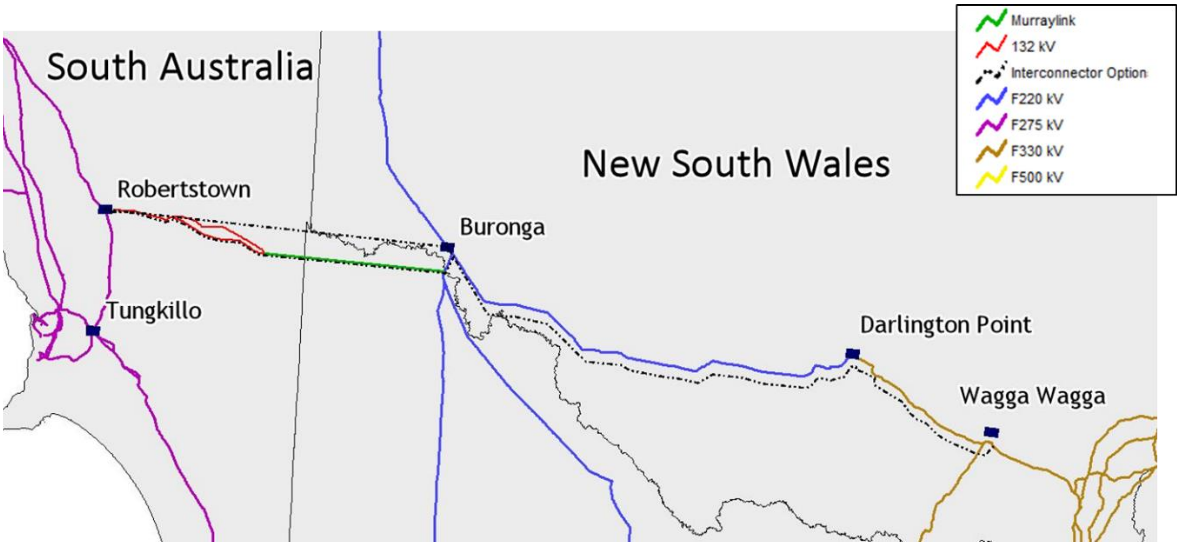
- New HVDC link from Robertstown as far as Wagga Wagga.
- Augment existing Murraylink capacity (e.g. by adding a parallel HVDC link) and upgrade control systems to provide fast frequency response

The notional capability of the interconnector is likely to be reduced at times due to deep network limitations and outages. Capability will be influenced by conditions in Victoria, in addition to conditions in South Australia and New South Wales. The potential export capability of this path is between 300 MW – 1200 MW with deeper network augmentation. This option will consider staging of investment, as required.

ElectraNet has had initial discussions with APA, owner of Murraylink, in relation to its augmentation plans. ElectraNet will continue to engage with APA on its plans, together with indicative cost and timings, in order to assess this as part of this or other options in the PADR analysis.

Figure 11 presents a representation of Option 2.

Figure 11 Network diagram for Option 2 – interconnector between mid-north SA and NSW



The exact path may require a deviation around national parks north of the Murray River. This may add as much as 100 km to the length of the path. However, this deviation may also enable access to the transmission network for development of high quality solar and wind resources in those areas.

This option will likely require a number of supporting projects to deliver maximum benefit to customers and market participants in the NEM. ElectraNet is currently examining the optimal combination of such projects, which may include deeper network augmentation. The indicative costs in this report make some allowance for these projects.

Capital costs for this option are estimated to be in the order of $500-1,500 million. This scope and estimate are currently being refined and will be updated in the PADR. Annual operating and maintenance costs are estimated to be about 2% of the capital cost.

Construction is expected to take 1-2 years, with commissioning possible by 2021, subject to land/easement acquisition and obtaining necessary environmental and development approvals.

5.4 Option 3 – interconnector from northern SA to NSW

This option considers a high capacity HVAC or HVDC interconnector between South Australia and New South Wales.

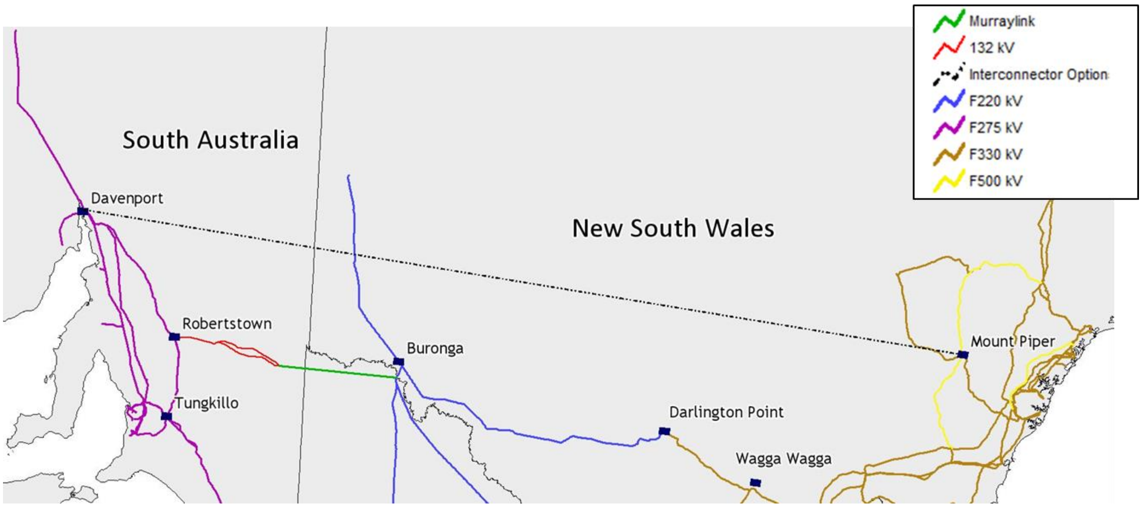
The path would extend from Davenport in South Australia and could pass by Broken Hill before terminating at Mount Piper, both of which are in New South Wales. This path would be around 1,200 km in length. ElectraNet notes that other connection points into the 500 kV ring in NSW would also be possible, other than at Mt Piper.

ElectraNet is considering several configurations for this particular route including, but not limited to:

- construction of a new HVAC connection, with possibility of staging of investment; and
- construction of a new HVDC connection, with staging of investment as required.

Strong connection nodes at both ends means that there will be reduced risks of constraints. Figure 12 presents a representation of Option 3.

Figure 12 Network diagram for Option 3 – high capacity interconnector between northern SA and NSW



This option will likely require a number of supporting projects to deliver maximum benefit to customers and market participants in the NEM. ElectraNet is currently examining the optimal combination of such projects, which may include deeper network augmentation. The indicative costs in this report make some allowance for these projects.

Capital costs for this option are estimated to be in the order of $1,500-$2,000million. The scope and estimate are currently being refined and will be updated in the PADR. Annual operating and maintenance costs are estimated to be about 2% of the capital cost.

ElectraNet estimates that the construction timetable for Option 3 is approximately 2 to 3 years, with commissioning possible by 2022, subject to land/easement acquisition and obtaining necessary environmental and development approvals.

The existing Electricity Transmission Code (ETC) requires that a transmission entity must use its best endeavours to plan, develop and operate the transmission network to meet the standards imposed by the NER in relation to the quality of transmission services such that there will be **no** requirement to shed load to achieve these standards under normal and reasonably foreseeable operating conditions.[49]

Given that improving security of electricity supply in South Australia is one of the identified needs, any new interconnector transfer capacity significantly higher than the Heywood Interconnector capacity will have to be considered carefully. This is especially the case in planning for the electricity system in South Australia to remain secure for a non-credible loss of a new high capacity interconnector.

5.5 Option 4 – interconnector from northern SA to Queensland

This option is a high capacity HVDC interconnector between South Australia and Queensland. The notional import capability of this path would be around 1000 to 2000 MW.

The indicative path would be between Davenport in South Australia, crossing into New South Wales and connecting with the Queensland network around Bulli Creek. This path would be around 1,400 km in length.

ElectraNet is considering several configurations for this particular route including but not limited to:

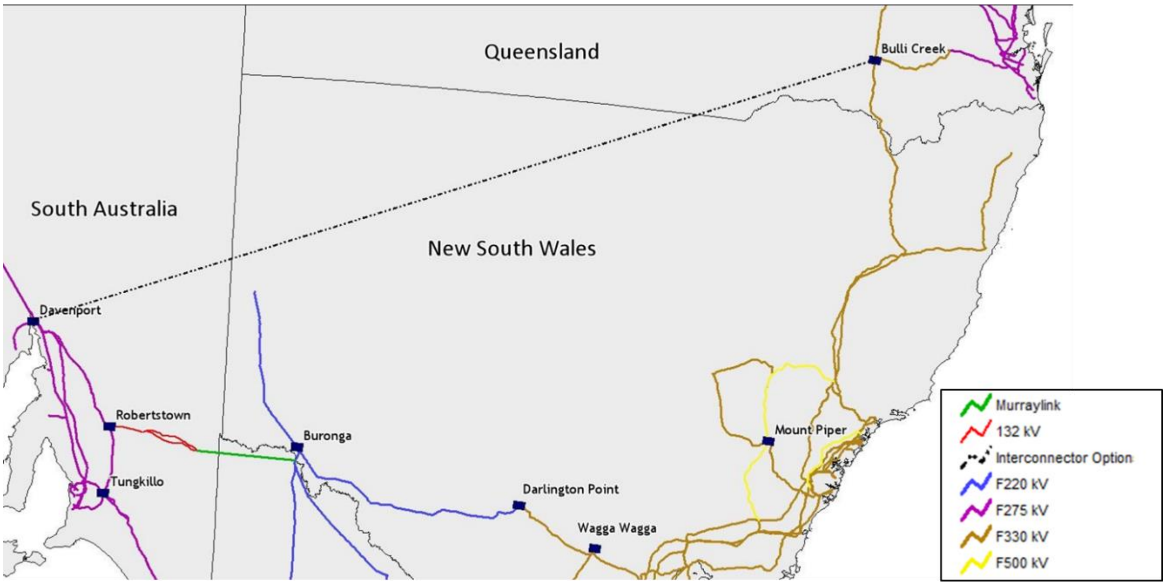
- construction of a new AC connection, with possibility of staging of investment; and
- construction of a new HVDC connection, with staging of investment.

Strong connection nodes at both ends means that there will be reduced risks of constraints.

Figure 13 presents a representation of Option 4.

[49] ETC clause 2.2.1

Figure 13 Network diagram for Option 4 – high capacity interconnector between northern SA and Queensland



This option will likely require a number of supporting projects to deliver maximum benefit to customers and market participants in the NEM. ElectraNet is currently examining the optimal combination of such projects, which may include deeper network augmentation. The indicative costs in this report make some allowance for these projects.

Capital costs for this option are estimated to be in the order of $2,000 - $2,500 million. The scope and estimate are currently being refined and will be updated in the PADR. Annual operating and maintenance costs are estimated to be about 2% of the capital cost.

ElectraNet estimates that the construction timetable for Option 4 is approximately 2-3 years, with commissioning possible by 2022, subject to land/easement acquisition and obtaining necessary environmental and development approvals.

The existing Electricity Transmission Code (ETC) requires that a transmission entity must use its best endeavours to plan, develop and operate the transmission network to meet the standards imposed by the NER in relation to the quality of transmission services such that there will be no requirement to shed load to achieve these standards under normal and reasonably foreseeable operating conditions.

Given that improving security of electricity supply in South Australia is one of the identified needs, any new interconnector transfer capacity significantly higher than the Heywood Interconnector capacity will have to be considered carefully. This is especially the case in planning for the electricity system in South Australia to remain secure for a non-credible loss of a new high capacity interconnector.

5.6 Option 5 – Non-network option

Section 4 sets out the technical characteristics that a non-network option would be required to deliver to address the identified need for this RIT-T.

ElectraNet would be interested to hear from any parties that can provide non-network options. The type/costs and timing of non-network options to be included in the PADR assessment will be informed by submissions.

As with the interconnector options, non-network options are likely to need to be combined with a SPS, in order to be effective. Inclusion of a SPS is expected to reduce the effective capability that a non-network option would need to provide, increasing the potential for such an option to be technically feasible and reducing its expected cost.

5.7 Anticipated requirement for a Special Protection Scheme

A SPS is likely to be required as part of both the interconnector and non-network options discussed above. The size and nature of the SPS will be dependent on the particular network and/or non-network option.

The SPS will be required to take appropriate actions to ensure the Frequency Operating Standard (FOS) is met in South Australia in the event of the loss of an interconnector – including the non-credible loss of Heywood or a new interconnector. The role of the SPS will be to very rapidly address the imbalance between supply and demand following a major event.

A new AC or HVDC interconnector may also require such a scheme, to manage the non-credible loss of the new interconnector at times of high transfer, to ensure the economic benefits of a new path can best be realised while still providing an essential role in maintaining synchronism with the eastern states.

Some of the functions of the SPS will be similar to the existing Under Frequency Load Shedding Scheme (UFLS).[50] The existing UFLS has been an effective tool in managing these events in the past, however, South Australia's energy transformation is testing some of the essential elements of the load shedding scheme. For example, the UFLS has no knowledge of the direction of flows on the network and the magnitude of PV generation that would also be tripped by the activation of the UFLS. UFLS may actually trip a feeder that has been acting as a net generator to try and redress a deficit of generation. This will exacerbate a loss of supply event.

This short-coming of the UFLS scheme leads to a requirement for a SPS for all options.

50 The existing UFLS is not expected to be capable of providing this service in its current form. However, ElectraNet notes that AEMO is considering changes to the current UFLS scheme as part of its Future Power System Security Program, and ElectraNet will take into account developments in relation to the current UFLS scheme as this RIT-T progresses.

ElectraNet notes that AEMO is considering changes to the current UFLS scheme. This ElectraNet will take into account developments in relation to the current UFLS scheme as this RIT-T progresses, and in particular how this may affect the need for and design of an appropriate SPS.

In particular, with two AC paths connecting South Australia to the east coast, following the loss of one interconnector, the South Australian frequency would remain unchanged and remain the same as the NEM system frequency. This means non-credible interconnector contingencies would not trigger UFLS and potentially lead to an overload of the remaining interconnector, and subsequent tripping.

Some of the key characteristics of a SPS being considered by ElectraNet are that it is capable of:

- monitoring all critical and relevant power system operating parameters in real time, in particular to detect the loss of an interconnector;
- determining the required amount of effective load (e.g. account for embedded solar PV generation at any time) or generation to be tripped, to maintain load-generation balance in the system;
- rapidly send signals (if required) to necessary elements in the system and trip the required generation or load, noting that if the action is not timely, the system may collapse;
- being co-ordinated with other control and under frequency load shedding schemes; and
- including high speed dual redundant communication paths, where signals need to be carried over a distance.

5.8 Options considered but not progressed

This section discusses additional options that ElectraNet has considered but does not consider technically and/ or economically feasible, and therefore which are not considered to be credible options for this RIT-T analysis.

Further increases to the Heywood Interconnector capacity

ElectraNet has investigated the ability of expanding the Heywood Interconnector capacity in order to meet the identified need. Two options have been considered, the “Krongart Option” from the earlier Heywood augmentation RIT-T and a further incremental option of adding further reactive support along the existing Heywood Interconnector corridor.

Neither of these options mitigate the risk of a separation event occurring, or the magnitude of the impact of that event in terms of unserved energy. Specifically, these options are:

- susceptible to the same drivers for separation events considered as part of this RIT-T (eg, bush-fires, storms, etc.);

- anticipated to worsen the expected unserved energy due to the relationship between interconnector flows and the risk of severe disruption in South Australia during a separation event.

ElectraNet therefore considers this option is unable to meet the system security component of the identified need for this RIT-T.

Connection to other jurisdictions

Connections to other jurisdictions such as Tasmania and Western Australia have not been considered as credible due to the large relative distances when compared to other alternatives.

5.9 Material inter-network impact

ElectraNet has considered whether the credible options above are expected to have a material inter-network impact.[51] A 'material inter-network impact' is defined in the NER as:

> *"A material impact on another Transmission Network Service Provider's network, which may include (without limitation): (a) the imposition of power transfer constraints within another Transmission Network Service Provider's network; or (b) an adverse impact on the quality of supply in another Transmission Network Service Provider's network."*

Options 1 to 4 are all interconnectors and will therefore have a material inter-network impact. These options do not meet AEMO's screening criteria for investments that do not have a material inter-network impact.[52]

ElectraNet will request AEMO to produce an augmentation technical report in relation to the options being considered in this RIT-T.[53] As part of the augmentation technical report, AEMO will: [54]

- consult with, and take into account the recommendations of, the jurisdictional planning representatives in relation to the proposed augmentation; and
- make a determination as to: (i) the performance requirements for the equipment to be connected; and (ii) the extent and cost of augmentations and changes to all affected transmission networks; and (iii) the possible material effect of the new connection on the network power transfer capability including that of other transmission networks.

ElectraNet will publish the augmentation technical report with the PACR.[55]

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51 NER clause 5.16.4(b)(6)(ii).

52 The screening test is set out in Appendix 3 of the Inter-Regional Planning Committee's Final Determination: Criteria for Assessing Material Inter-network Impact of Transmission Augmentations, Version 1.3, October 2004.

53 NER clause 5.21(d)(1)-(3).

54 NER 5.16.4 (k)(9)(iii).

55 As required by NER 5.16.4 (k)(9)(iii).

6. Materiality of market benefits for this RIT-T assessment

The NER requires that all categories of market benefit identified in relation to the RIT-T are included in the RIT-T assessment, unless the TNSP can demonstrate that a specific category (or categories) is unlikely to be material in relation to the RIT-T assessment for a specific option.[56]

The PSCR is required to set out the classes of market benefit that the TNSP considers are not likely to be material for a particular RIT-T assessment.[57]

At this stage, ElectraNet considers that all of the categories of market benefit identified in the RIT-T have the potential to be material. The RIT-T assessment will be presented in the next stage of this RIT-T process, i.e. the PADR.

Table 3 maps how ElectraNet considers each category of market benefit outlined in the NER most directly corresponds to the three components of the identified need for this RIT-T, and the other consequential market benefits that may be material for this RIT-T assessment.

Table 3 Mapping of RIT-T prescribed market benefits to the identified need

Component of the Identified Need	NER prescribed market benefit – 5.16.1(c)(4)
Lower prices in South Australia and an overall reduction in dispatch costs through greater competition between generation	(i) changes in fuel consumption arising through different patterns of generation dispatch (ii) changes in voluntary load curtailment (viii) competition benefits
Providing appropriate security of electricity supply in South Australia	(iii) changes in involuntary load shedding, with the market benefit to be considered using a reasonable forecast of the value of electricity to consumers (vii) changes in ancillary services costs
Facilitating the transition to lower carbon emissions and the adoption of new technologies	(iv) changes in costs for parties, other than the RIT-T proponent (ix) option value
Consequential market benefits	(vi) changes in network losses (v) differences in the timing of expenditure

In light of the particular circumstances and nature of the potential interconnector investments in this RIT-T, the approach to quantifying some of the benefit categories may warrant further consideration. ElectraNet will be publishing an Economic Modelling Assumptions report before the end of 2016 to further explore this. Below we highlight some of our initial views on these issues.

[56] NER clause 5.16.1(c)(6).

[57] NER clause 5.16.4(b)(6)(iii).

6.1 Quantification of benefit from reduction in unserved energy

ElectraNet considers that a key benefit for this RIT-T will be a reduction in the amount of load that would need to be shed in South Australia in the event of separation events occurring. ElectraNet intends to measure the change in the expected reduction in unserved energy as a result of the loss of the Heywood Interconnector. This will be measured by how the risk of an event (probability), and magnitude of that event (unserved energy) are influenced by the option.

ElectraNet will take into account the impact of the new RoCoF constraint on the operation of the Heywood Interconnector in making this assessment. For example, the addition of another interconnector may not reduce the risk that the Heywood Interconnector experiences a non-credible contingency event, but it may reduce the consequences of the event by reducing the need for involuntary load shedding.

ElectraNet considers it important that Value of Customer Reliability (VCR) values applied to estimating benefits associated with reductions in unserved energy are fit for purpose and accurately reflect the costs that electricity supply interruptions impose on the end-use customers in question. In the case of this RIT-T, ElectraNet does not consider that the application of AEMO's standard VCR estimates,[58] without modification, would be adequate, since they do not capture the full impact of widespread and prolonged outages that might arise following a separation event.

The inappropriateness of applying AEMO's standard VCR estimates to assessing the cost to customers of events that cause wide-spread, severe or prolonged supply shortages is noted by AEMO in its VCR Application Guide. Specifically, the AEMO guide notes that, because the VCR may not accurately estimate the impacts of widespread and/or prolonged outages, additional offsets to the VCR might be appropriate to estimate effects not captured through customer surveys.[59]

The guide notes that VCR survey respondents are not expected to have a good understanding of the social and safety impacts related to widespread and/or prolonged outages and so extrapolating survey results to cater for this kind of event might necessitate additional offsets due to the non-linear nature of VCR over time and space.

ElectraNet is currently giving consideration to what offsets may be appropriate in deriving a VCR estimate to apply to this RIT-T. The approach to valuing this benefit will be discussed in the Economic Modelling Assumptions report to be released in 2016 as well as the PADR.

[58] AEMO produces VCR estimates for each jurisdiction in the National Electricity Market, across four customer classifications, as well as a state-wide average. The customer classifications include residential and different sizes of commercial customer.

[59] AEMO, *Value of Customer Reliability – Application Guide*, Final Report, December 2014, p. 20.

6.2 Market benefits from renewable generation

Additional interconnection between South Australia and other NEM regions would facilitate an increase in renewable generation, as well as facilitating market competition between generation sources.

Within the context of the RIT-T assessment, increased transfer capacity between regions leading to greater output from renewable generation can be expected to result in lower generation dispatch costs, and to enable existing surplus generation in some regions to be more efficiently utilised. This can be expected to result in benefits arising through more efficient generation investment, operation and retirement decisions across the NEM.

ElectraNet will estimate this benefit using a model of NEM dispatch. ElectraNet will also estimate the benefits associated with a reduction in carbon emissions.

6.3 Competition benefits

Interconnection facilitates market competition between generation sources across the broader NEM, and can be expected to lower prices in previously constrained regions.

The interconnector options would have a substantive impact in reducing the current wholesale price differentials observed in forecast futures prices between South Australia and the other eastern states. The reduction in price differentials can be expected to have an overall positive impact on the net market benefit, through the additional consumer and producer surplus gained from the net increase in the consumption of electricity.

This ‘demand-response benefit’ forms part of the ‘competition benefits’ market benefits category.[60] [61] The market benefit is derived from consumers in the constraint-affected region being able to consume more electricity at lower prices and therefore deriving additional welfare from their consumption of that electricity. In addition, low cost producers outside of the constraint-affected region are able to dispatch more electricity and derive additional profit from it. For there to be an overall net benefit, the total impact in both South Australia and the rest of the NEM needs to be considered.

The separate modelling report that ElectraNet will publish by the end of 2016 will provide more detail on the proposed approach to quantifying this aspect of competition benefits.

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[60] See Frontier Economics, *Evaluating Interconnection Competition Benefits (Final Report)*, September 2004, and TransGrid and Powerlink *Methodology for Assessing Competition Benefits' for the Queensland-NSW interconnector*, 2013.

[61] Should the AER subsequently determine that this specific benefit type falls into another market benefit category, ElectraNet will assess this benefit under that category

6.4 Wider economic benefits

ElectraNet notes that the current RIT-T framework does not allow for the inclusion of wider economic benefits that might be expected to flow from investments that substantially affect electricity prices. For example, lower electricity prices in South Australia may be expected to lead to additional mining activity, employment and exports and therefore make a substantive contribution to overall Gross State Product.

ElectraNet does not propose to incorporate these benefits in the RIT-T assessment, in line with the current NER requirements. However, we note that the COAG Energy Council is currently undertaking a review of the RIT-T arrangements, and in particularly whether they are 'fit for purpose' in the case of interconnector investments and adequately capture all of the benefits associated with interconnector assessments. This review is expected to report before the end of 2016, and ElectraNet will take the findings of the review into account in progressing this RIT-T application.

Another advantage of a HVAC interconnector is its ability to attract further economic benefits to each state the interconnector traverses, due to the substantially cheaper connection costs (when compared to connecting to a HVDC link). Many of the routes will traverse renewable power generation areas capable of connecting Wind, PV, Solar Thermal & Gas power generation hubs. On top of the increased power generation availability, it would also provide a market benefit. This market benefit would provide the interconnected network with a geographically spread of renewable power generation, which would result in a higher base load of renewable generation being available to the interconnected power system, and the additional economic benefit resulting from the investment and construction of these power generation hubs.

South Australian Energy Transformation

Appendices

Appendix A Checklist of compliance clauses

This section sets out a compliance checklist which demonstrates the compliance of this PSCR with the requirements of clause 5.16.4(b) of the Rules version 82.

Rules clause	Summary of requirements	Relevant section(s) in PSCR
5.16.4 (b)	A RIT-T proponent must prepare a report (the project specification consultation report), which must include:	-
	(1) a description of the identified need;	2
	(2) the assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, why the RIT-T proponent considers reliability corrective action is necessary);	3
	(3) the technical characteristics of the identified need that a non- network option would be required to deliver, such as: (i) the size of load reduction of additional supply; (ii) location; and (iii) operating profile.	4
	(4) if applicable, reference to any discussion on the description of the identified need or the credible options in respect of that identified need in the most recent National Transmission Network Development Plan;	3.8
	(5) a description of all credible options of which the RIT-T proponent is aware that address the identified need, which may include, without limitation, alterative transmission options, interconnectors, generation, demand side management, market network services or other network options;	5
	(6) for each credible option identified in accordance with subparagraph (5), information about: (i) the technical characteristics of the credible option; (ii) whether the credible option is reasonably likely to have a material interregional impact; (iii) the classes of market benefits that the RIT-T proponent considers are likely not to be material in accordance with clause 5.16.1(c)(6), together with reasons of why the RIT-T proponent considers that these classes of market benefit are not likely to be material; (iv) the estimated construction timetable and commissioning date; and (v) to the extent practicable, the total indicative capital and operating and maintenance costs.	5 & 6

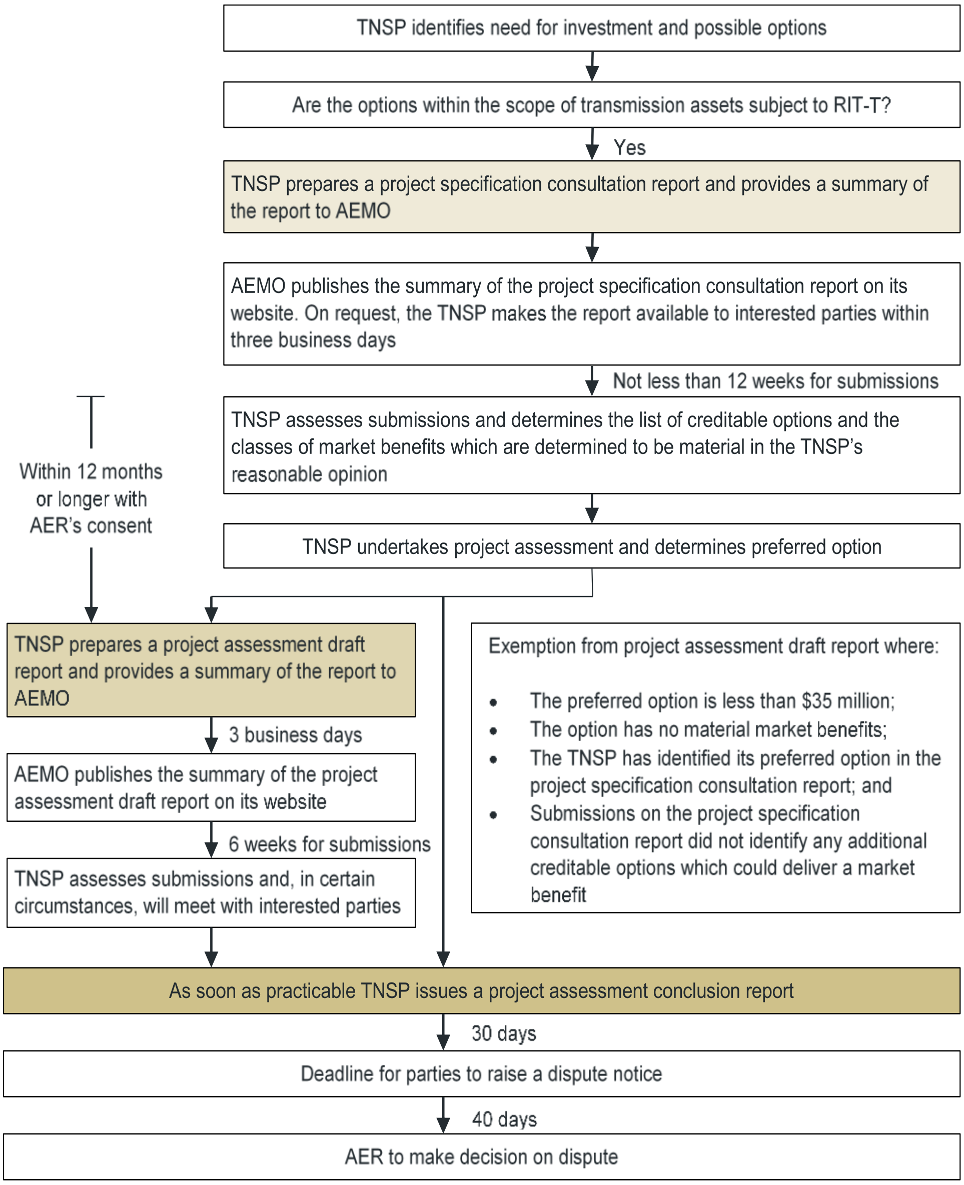
Appendix B Definitions

AEMO	Australian Energy Market Operator
Applicable regulatory instruments	All laws, regulations, orders, licences, codes, determinations and other regulatory instruments (other than the Rules) which apply to Registered Participants from time to time, including those applicable in each participating jurisdiction as listed below, to the extent that they regulate or contain terms and conditions relating to access to a network, connection to a network, the provision of network services, network service price or augmentation of a network. A comprehensive list of applicable regulatory instruments is provided in the Rules.
Base case	A situation in which no option is implemented by, or on behalf of the transmission network service provider.
Commercially feasible	An option is commercially feasible if a reasonable and objective operator, acting rationally in accordance with the requirements of the RIT-T, would be prepared to develop or provide the option in isolation of any substitute options. This is taken to be synonymous with 'economically feasible'.
Costs	Costs are the present value of the direct costs of a credible option.
Credible option	A credible option is an option (or group of options) that: 1. address the identified need; 2. is (or are) commercially and technically feasible; and 3. can be implemented in sufficient time to meet the identified need.
Economically feasible	An option is likely to be economically feasible where its estimated costs are comparable to other credible options which address the identified need. One important exception to this Rule's guidance applies where it is expected that a credible option or options are likely to deliver materially higher market benefits. In these circumstances the option may be "economically feasible" despite the higher expected cost. This is taken to be synonymous with 'commercially feasible'.
Identified need	The reason why the Transmission Network Service Provider proposes that a particular investment be undertaken in respect of its transmission network.
Market benefit	Market benefit must be: a) the present value of the benefits of a credible option calculated by: i. comparing, for each relevant reasonable scenario: A. the state of the world with the credible option in place to B. the state of the world in the base case, **And** ii. weighting the benefits derived in sub-paragraph (i) by the probability of each relevant reasonable scenario occurring. b) a benefit to those who consume, produce and transport electricity in the market, that is, the change in producer plus consumer surplus.
Net market benefit	Net market benefit equals the market benefit less costs.
Preferred option	The preferred option is the credible option that maximises the net economic benefit to all those who produce, consume and transport electricity in the market compared to all other credible options. Where the identified need is for reliability corrective action, a preferred option may have a negative net economic benefit (that is, a net economic cost).
Reasonable Scenario	Reasonable scenario means a set of variables or parameters that are not expected to change across each of the credible options or the base case.

Appendix C Process for implementing the RIT-T

For the purposes of applying the RIT-T, the NER establishes a three stage process: (1) the PSCR; (2) the PADR; and (3) the PACR. This process is summarised in the figure below.

Figure 14 The RIT-T assessment and consultation process



Source: AER, Final Regulatory investment test for transmission application guidelines, June 2010, p.43

As part of this RIT-T, ElectraNet will be publishing a separate consultation report on the economic modelling to be undertaken to assess the credible options. This is an additional step in the RIT-T process, not required under the NER.

Appendix D Additional detail underlying the identified need

This appendix provides additional detail regarding the background and assumptions underlying the identified need. In particular, it provides a definition and the history of 'separation events', outlines the Frequency Operating Standard applying in South Australia and describes how the capacity across the Heywood Interconnector has recently increased.

Definition and history of 'separation events'

A 'separation event' can occur (HVDC Murraylink normally stays connected) as the result of both non-credible and credible contingencies occurring – namely:

- non-credible contingencies – in the event of a loss of (i) *both* of the 500 kV lines/circuits between Sydenham and Heywood in Victoria, or (ii) the loss of *both* of the 275 kV lines/circuits between Heywood in Victoria and Tungkillo in South Australia;

- credible contingencies – (i) the loss of the *second* 500 kV line/circuit between Sydenham and Heywood in Victoria, during a prior outage of the other 500 kV line/circuit; or (ii) the loss of a *second* 275 kV line/circuit between Heywood in Victoria and Tungkillo in South Australia, during a prior outage of the parallel 275 kV line/circuit.

South Australia has experienced 10 separation events since the start of the NEM in December 1998. Such separation events due to non-credible contingencies have been observed on average once every four years, as shown in Table 4 below.

Table 4: Observed separation events since NEM market start

Date and time	Duration	Load shed in SA (MW)	Credible/ Non-credible
30/10/1999 0602 hrs	10 minutes	0	Not known
02/12/1999 1311 hrs	26 minutes	1,130	Non-credible
25/05/2003 1702 hrs	56 minutes	0	Credible
08/03/2004 1128 hrs	43 minutes	650	Non-credible
14/03/2005 0639 hrs	22 minutes	580	Non-credible
16/01/2007 1502 hrs	40 minutes	100	Non-credible
19/10/2011 0618 hrs	35 minutes	0	Credible
13/12/2012 0707 hrs	14 minutes	0	Credible
01/11/2015 2151 hrs	35 minutes	160	Credible
28/09/2016 1618 hrs	65 minutes	1895	Non-credible

There have been five non-credible contingency events. These non-credible contingency events have all been associated with load shedding. The most recent lead to a state-wide blackout.

There have also been four credible contingency events (and one unclassified event), including the most recent credible event in November 2015. At the time of this event, it was known that the next contingency would lead to separation. AEMO had subsequently re-dispatched the market to ensure a secure and satisfactory operating state. It is worth noting that when the credible separation event

occurred it also resulted in UFLS, which operated as designed. During previous credible contingency events, the loss of the interconnector could be managed without loss of load.

Frequency Operating Standard applying in South Australia

The Frequency Operating Standard (FOS) in South Australia is determined by Reliability Panel and published by the AEMC. The FOS defines a range of standards depending on the situation. Of relevance to this RIT-T is the NEM mainland FOS for an islanded system.

Table 5 NEM Mainland Frequency Operating Standard – islanded system

Condition	Containment	Stabilisation	Recovery
No contingency event, or load event	49.5 to 50.5 Hz		
Generation event, load event or network event	49 to 51 Hz	49.5 to 50.5 Hz within 5 minutes	
The separation event that formed the island	49 to 51 Hz or a wider band notified to AEMO by a relevant Jurisdictional Coordinator (see below)	49 to 51 Hz within 2 minutes	49.5 to 50.5 Hz within 10 minutes
Multiple contingency event including a further separation event	47 to 52 Hz	49 to 51 Hz within 2 minutes	49.5 to 50.5 Hz within 10 minutes

For a separation event that forms an island, the South Australian Frequency Operating standard during a separation event has been set at between 47 Hz and 52 Hz[62].

A sharp fall in the system frequency is managed with under frequency load shedding, combined with automatic governor action (to increase generation) from synchronous generators. The generation support will not be available if generators are offline. Sustained stable islanded operation requires some amount of synchronous generation to be on-line. Stable operation of islands without any synchronous generation may be challenging and will be subject to detailed investigation.

UFLS is designed to respond to a frequency drop and balance demand with supply, to restore frequency within operationally acceptable limits. However, UFLS may not be capable of preventing this for high RoCoF events.

[62] Letter from the Electricity Supply Industry Planning Council (ESIPC), 17 September 2001.

Increased capacity across the Heywood Interconnector

ElectraNet and AEMO undertook a RIT-T during 2011 to 2013 to investigate the market benefits possible from increasing the transfer capacity between South Australia and the rest of the NEM across the Heywood Interconnector.[63] The outcome of the RIT-T identified that the preferred option was to:

- install a third transformer and 500 kV bus tie at Heywood in Victoria;
- install series compensation on 275 kV transmission lines in South Australia; and
- undertake 132 kV network reconfiguration works in South Australia.

These investments were expected to increase interconnector capability by about 40 per cent in both directions (to bring the notional limit to 650 MW), and to enable increased wind energy exports from South Australia and also increased imports of lower cost generation into South Australia, particularly at times of peak demand.

Further incremental upgrades to the thermal capability of the existing Heywood Interconnector have increased the frequency with which the interconnector will be capable of operating at its nominal 650 MW capability. Subject to testing, these upgrades may also allow the interconnector to be operated as high as 750 MW under favourable operating conditions.

The operational capacity of the interconnector immediately preceding any failure that leads to a separation event has important ramifications for the risk of severe supply disruptions in South Australia. Specifically, the higher the interconnector operating capacity at the time of a separation event, the greater the risk of severe disruption from the supply disruption following the event.

This risk has grown much faster than forecast during the Heywood RIT-T as a result of the removal of conventional generation.

As outlined in the body of the PSCR, to address the concerns regarding insufficient inertia during a separation event going forward, the South Australian government has gazetted a new requirement on ElectraNet which effectively requires ElectraNet to meet an inertia target in South Australia in order to limit RoCoF to 3 Hz/s.[64] A new interconnector may relieve this constraint and allow the market benefits from the recent Heywood expansion to be fully realised.

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[63] All relevant RIT-T documents are available on both the AEMO and ElectraNet websites – https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Victorian-transmission-network-service-provider-role/Regulatory-investment-tests-for-transmission & https://www.electranet.com.au/projects/sa-vic-heywood-interconnector-upgrade/

[64] The South Australian Government Gazette, 12 October 2016.