Australian Energy Market Commission

AEMC Reliability Panel

Towards a Nationally Consistent Framework for Transmission Reliability Standards

Review - Final Report

31 August 2008

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About the AEMC

The Council of Australian Governments, through its Ministerial Council on Energy, established the Australian Energy Market Commission (AEMC) in July 2005 to be the Rule maker for national energy markets. The AEMC is currently responsible for Rules and policy advice covering the National Electricity Market. It is a statutory authority. Our key responsibilities are to consider Rule change proposals, conduct energy market reviews and provide policy advice to the Ministerial Council as requested, or on AEMC initiative.

About the AEMC Reliability Panel

The Panel is a specialist body within the AEMC and comprises industry and consumer representatives. It is responsible for monitoring, reviewing and reporting on the safety, security and reliability of the national electricity system and advising the AEMC in respect of such matters. The Panel's responsibilities are specified in section 38 of the NEL.

Disclaimer

The views and recommendations set out in this document are those of the Reliability Panel and are not necessarily those of the Australian Energy Market Commission.

Foreword

This Final Report is the fourth and final stage in the Reliability Panel's (the Panel's) review of transmission reliability standards in the National Electricity Market (NEM).

The Panel was asked by the Australian Energy Market Commission (AEMC) to undertake a review of the jurisdictional transmission reliability standards and provide advice to the AEMC. The Panel's views will be considered by the AEMC in formulating its advice to the Ministerial Council for Energy (MCE) on the development of a nationally consistent framework for transmission reliability standards. The AEMC will consider the Panel's advice in the context of the AEMC's other recommendations to the MCE concerning: the role and functions of a National Transmission Planner (NTP); and a new Regulatory Investment Test for Transmission(RIT-T).

The first stage of the Panel's consultation process was the publication of an Issues Paper on 21 December 2007. This paper discussed the size and scope of the problem that a framework for nationally consistent transmission standards is trying to solve, considered the motivations for changing current jurisdictional standards, and presented three potential frameworks that could be used to improve the consistency of transmission reliability standards across the NEM. .

The publication of the Draft Report on 24 April 2008 was that second stage of the Panel's consultation process. On 30 April 2008, the Panel held a public forum in Melbourne on its Draft Report. The Draft Report set out areas of consensus which had emerged from submissions on the Issues Paper, defined a series of high level principles for a national framework, and detailed a range of specific options for a framework of nationally consistent transmission reliability standards..

The Interim Report was published on 5 August 2008. This report presented the Panel's intended final principles for a nationally consistent framework, and set out the Panel's preferred option for a nationally consistent framework for transmission reliability standards. The purpose of this report was to allow stakeholders to comment on the Panel's likely preferred position before it was finalised.

Following publication of the Interim Report, the Panel held a stakeholder workshop for interested parties. The stakeholder workshop was attended by representatives from Grid Australia, VENCorp, The Group[*], and the Australian Energy Regulator. Each of these organisations broadly supported both the principles and the preferred option for a nationally consistent framework for transmission reliability standards as presented in the Interim Report.

The options for delivering a nationally consistent framework for transmission reliability standards would all involve significant change. The implementation

[*] The Group includes Loy Yang Marketing Management Company Pty Ltd, AGL Hydro Partnership, International Power Australia, TRUenergy Pty Ltd, and Flinders Power.

process for each of the options would require existing jurisdictional arrangements to be changed in a coordinated manner and to a timetable agreed to by jurisdictions.

The Panel is of the view that its recommended framework for nationally consistent transmission reliability standards is a major market reform that is implementable, and would promote national consistency and transparency for transmission standards, benefiting both market participants and consumers.

The Panel extends its appreciation to the various stakeholders who have engaged in this process.

Ian C Woodward

Chairman, Reliability Panel
Commissioner, Australian Energy Market Commission

Other AEMC Reliability Panel Members

Kerry Connors, Executive Officer, Consumer Utilities Advocacy Centre

Jeff Dimery, Group General Manager, Merchant Energy, AGL Energy

Mark Grenning, Chief Advisor Energy, Rio Tinto

Les Hosking, Managing Director and CEO, NEMMCO

Gordon Jardine, Chief Executive, Powerlink

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Stephen Orr, Commercial Director, International Power Australia

David Swift, Chief Executive, Electricity Supply Industry Planning Council

Geoff Willis, former CEO, Hydro Tasmania

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Abbreviations

ACCC	Australian Competition and Consumer Commission
AEMC	Australian Energy Market Commission
AER	Australian Energy Regulator
capex	Capital Expenditure
CBD	Central Business District
COAG	Council of Australian Governments
Commission	see AEMC
CRR	Comprehensive Reliability Review
CVR	Customer Value of Reliability (CVR = VCR)
DNSP	Distribution Network Service Providers
DSC	Distribution System Code
ERIG	Energy Reform Implementation Group
ESC	Essential Services Commission (Victoria)
ESCOSA	Essential Services Commission of South Australia
ESIPC	Electricity Supply Industry Planning Council
ETC	Electricity Transmission Code
ETNOF	Electricity Transmission Network Owners Forum
ETSA	ETSA Utilities
FCAS	Frequency Control Ancillary Services
FERC	Federal Energy Regulatory Commission (USA)
GA	Grid Australia (formerly ETNOF)
IEC	International Electrotechnical Commission
ISO	Independent Systems Operator
JPB	Jurisdictional Planning Body
kV	Kilovolt
MCE	Ministerial Council on Energy
MNSP	Market Network Service Provider
MW	Megawatt
NCAS	Network Control Ancillary Services
NCF	Nationally Consistent Framework
NECA	National Electricity Code Administrator

NEL	National Electricity Law
NEM	National Electricity Market
NEMMCO	National Electricity Market Management Company
NER	National Electricity Rules
NERC	North American Electricity Reliability Corporation
NGF	National Generators Forum
NLCAS	Network Loading Control Ancillary Services
NSCS	Network Support and Control Services
NTNDP	National Transmission Network Development Plan
NTP	National Transmission Planner
opex	Operating Expenditure
PASA	Projected Assessment of System Adequacy
PJM	Pennsylvania-Jersey-Maryland
QCA	Queensland Competition Authority
RIT-T	Regulatory Test for Transmission
RNPP	Tasmanian Reliability and Network Planning Panel
Rules	National Electricity Rules
SCO	Standing Committee of Officials
SVC	Static VAR Compensators
SOO ANTS	Statement of Opportunities Annual National Transmission Statement
TNSP	Transmission Network Service Provider
TO	Transmission Operator
TUoS	Transmission User of Service
USE	Unserved energy
VCR	Value of Customer Reliability
VESC	Victorian Electricity System Code
VoLL	Value of Lost Load
WACC	Weighted Average Cost of Capital

Executive Summary

This report provides the Reliability Panel's (the Panel's) final recommendations to the Australian Energy Market Commission (AEMC) for delivering a nationally consistent framework for transmission reliability standards.

Principles

The Panel recommends the following set of principles for developing and assessing the range of competing frameworks for nationally consistent transmission reliability standards.

1. Transparency – The processes used for setting standards should be transparent and open, with ample opportunity for stakeholder input. The degree of transparency should be similar to that specified in the National Electricity Law (NEL) for the AEMC when it investigates whether to make a change to the National Electricity Rules (Rules).

The transmission reliability standards and process should be published and consistently applied by transmission operators in evaluating the transmission system and evaluating expansion plans.

The consequences of not following the transmission reliability standards must be clearly defined along with the processes for enforcing the standards and reviewing or appealing any enforcement action.

2. Governance – Standards should be set by a body that is separate from the body that must apply the standard. That is, separate from the transmission asset owner.

3. Economic efficiency – The framework should result in reliability standards being derived from economic considerations that strike a reasonable balance between transmission system cost and customer reliability.

4. Specificity of standards – Transmission reliability standards should be clearly specified on a connection point basis or on some other readily understandable basis (e.g. by geographic area, such as CBD, large regional city, etc.).

The transmission reliability standards should be clearly specified on a readily-understandable basis that:

- identifies the starting condition for the transmission studies:
- defines the test that will be performed on the system; and
- states what constitutes acceptable system performance.

5. Fit for purpose – The framework should not be a "one size fits all" approach. Rather it should allow for reliability standards to differ according to, say, the significance or criticality of the load centre — e.g. between CBD, metro and rural areas of a jurisdiction — or according to explicit customer valuation of reliability at each connection point.

6. Amendable – The specific requirements and many of the processes should be able to be amended without requiring legislative approval; either through approval by the various regulatory bodies involved or through an open consultation process.

7. Accountability – Transmission Network Service Providers (TNSPs) should be accountable to the appropriate authority for meeting the transmission standards, as well as to the AER for meeting the resultant service standards, as this is an integral part of regulatory incentive regime. If standards were set by a jurisdictional authority, it would most likely follow that the TNSPs would be accountable to that jurisdictional authority.

8. Technology neutral – Standards should be technologically neutral, and not be biased towards network solutions where other non-network options can provide a comparable level of reliability

9. Maintains the ability to achieve consistency between transmission and sub-transmission standards – The ability to achieve consistency between the standards and associated planning methodologies at the transmission and sub-transmission level is one important element in least-cost joint planning of transmission and sub-transmission networks to deliver the appropriate level of reliability at each connection point.

Other important elements that contribute to economically efficient network design—which are beyond the scope of the Panel's mandate include:

- the consistency of the different regulatory tests for transmission and distribution networks;
- the effectiveness of any joint-planning arrangements; and
- the regulatory incentive regime for transmission and distribution networks.

10. Effectiveness – The framework should enable investment to proceed in a timely manner to meet customers' expectations for reliability and minimise the potential for disputes.

The framework should recognise customers who have made long term investments in the expectation that the standard of reliability would be at least maintained into the future.

The framework should allow for national and international comparison of standards in consistent formats.

The Panel's Recommendation for a Nationally Consistent Framework for Transmission Reliability Standards

The Panel developed a number of options for a nationally consistent framework for transmission reliability standards. The performance of each of these options was assessed against the principles outlined above. The option that performed best against these principles (known as Option F) is recommended by the Panel to the AEMC. Some of the key features of this option include:

1. Form of standard – The form of the standard would be a hybrid that is economically derived using a customer value of reliability (CVR) or similar measure, and capable of being expressed in a deterministic manner.

2. Scope and level of standard – This would be applied on a jurisdictional basis and would make allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction, depending on criticality of load or an explicit valuation of customer reliability.

3. National mechanisms – Introduction of a national 'reference standard' on a 'for information basis', against which high level standards for broad types of connection points (e.g. CBD, metro, rural) can be compared. The amendments would operate in conjunction with the new Regulatory Test for Transmission (RIT-T).

4. Specifying the standards – The framework would be expressed in the National Electricity Rules (Rules) with the standards specified in jurisdictional instruments.

5. Process for setting standards – The process for setting standards would be clear and transparent, including consultation.

6. Who sets the level of standards and publishes information? – The levels would be determined by a jurisdictional authority separate from the TNSP. Under the framework, each jurisdiction would have the option of appointing an independent national body to set the jurisdiction's reliability standards. The National Electricity Planner (NTP) would establish an information base of standards in the NEM.

7. Development, review and application of standards – Each jurisdiction would have pre-set standards, where the jurisdiction standard setting body uses economic analysis to set standards, which are capable of being expressed in a deterministic form. In addition, a jurisdiction may apply a flexible application, where the jurisdictional standard setting body could, at its option, allow for a TNSP to defer or advance an investment that would otherwise be needed to meet that standard if the TNSP could demonstrate that, under the prevailing circumstances, it would be economic to do so.

8. Accountability of the standard setting body – The body that sets the levels of jurisdictional standards would be accountable to the jurisdictional government. The body that sets the national reference standards would be accountable through the Rules to a body yet to be considered by the AEMC.

9. Accountability of TNSPs – TNSPs would be accountable to the jurisdictional authority and to the AER.

10. Retains capability for consistency between transmission and DNSP sub-transmission standards – Consistency could be maintained because all jurisdictions would have hybrid standards that are capable of being expressed in a deterministic equivalent manner. Each jurisdiction could then apply these hybrid standards to the joint planning of transmission and sub-transmission networks, regardless of whether a deterministic or probabilistic planning methodology is applied when applying the new RIT-T.

11. Likely changes – There would be significant changes, including to the NER, the NEL, State legislation, regulations and licences.

Implementation

Given the existing arrangements in the NEM, the implementation of any framework for nationally consistent transmission standards will require significant changes to jurisdictional and national laws, regulations, and codes. Such changes would need to be transitioned, in a co-ordinated manner across the NEM.

The Panel recommends the establishment of a new work-stream to develop an implementation plan following MCE endorsement of a framework design.

An implementation plan should have regard to the emerging governance arrangements of the Australian Energy Market Operator (AEMO) and the NTP, and the MCE's response to the AEMC's recommendations on the RIT-T. The implementation plan should also have regard to the current regulatory regime, including the planning, investment decisions, and revenue decisions made under that regime.

Recommendations

The Panel makes the following recommendations for the AEMC's consideration, in the wider context of its NTP review. That:

1. the principles for a nationally consistent framework presented in Table 3 of Chapter 3 be recommended by the AEMC to the MCE;

2. Option F, as presented in Table 2 of Chapter 6, be recommended by the AEMC to the MCE as the framework for nationally consistent transmission reliability standards;

3. the AEMC consider the appropriate institutions to:
    - i. determine the national "information" reference standard;
    - ii. set the level of the standards if the standard setting is referred to the national level by a jurisdiction; and
    - iii. be the institution to which national reference standard setting body is accountable to,

taking into consideration consistency with the governance arrangements which apply to the various NEM institutions; and

4. the AEMC develop a comprehensive implementation and transition plan for the nationally consistent framework which it recommends to the MCE.

Next Steps

The Panel believes that the introduction of a nationally consistent framework for transmission reliability standards will be a significant reform in the NEM. Whilst acknowledging that substantial legislative and regulatory changes required for implementation, the Panel believes that its recommendations represent an effective and implementable package of reforms.

Following receipt of this Final Report, the AEMC will assess the Panel's recommendations, in the context of its recently completed report on the NTP and RIT-T, and will provide final advice to the MCE by the end of September 2008.

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1 Background

1.1 What led to this Review

On 3 July 2007, the Ministerial Council on Energy (MCE) directed the Australian Energy Market Commission (AEMC), under section 41 of the National Electricity Law(NEL), to conduct a review into electricity transmission network reliability standards, with a view to developing a consistent national framework for network security and reliability. The MCE's direction also requires the AEMC to conduct a review into the development of a detailed implementation plan for the national electricity transmission planning function and develop a new form of Regulatory Test, which amalgamates the reliability and market benefits criteria of the current Regulatory Test and expands the definition of market benefits to include national benefits. The AEMC viewed the project to establish a National Transmission Planner (NTP) as related to the discrete task of developing a consistent national framework for network security and reliability. The framework of consistent national transmission reliability standards will affect the requirement for transmission development projects considered by the NTP and individual TNSPs. The standards will also affect the technical design, scale, and criteria used to evaluate transmission projects.

On 17 August 2007, the AEMC requested that the Reliability Panel (the Panel), in accordance with section 38 of the NEL, undertake the review of the jurisdictional transmission reliability standards and provide advice to the AEMC. The Terms of Reference[1] require that the Reliability Panel provide its final report to the AEMC by 23 September 2008. The Panel's views will be considered by the AEMC in formulating its advice to the MCE. The MCE requires the AEMC to provide it with recommendations on a framework for nationally consistent transmission reliability standards by 30 September 2008.

However, the working approach adopted by the Panel is to submit an interim report to the AEMC by 30 July 2008 and a final report by 30 August 2008, so that the AEMC can consider the Panel's advice in the context of the AEMC's other recommendations to the MCE concerning: the role and functions of a NTP; and a new Regulatory Investment Test for Transmission (RIT-T). This working approach was amended on 10 July 2008, with details of the new process published on the AEMC website.[2]

This Transmission Reliability Standards Review, together with the NTP Review, are part of a range of reforms agreed to by the Council of Australian Governments (COAG) on 13 April 2007 in response to the Final Report of the Energy Reform Implementation Group (ERIG).[3] The other energy reforms agreed to by COAG in its

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1 See http://www.aemc.gov.au/electricity.php?r=20071221.150018

2 See http://www.aemc.gov.au/electricity.php?r=20071221.150018

3 See COAG Communiqué, 13 April 2007 and supplementary COAG document, "COAG Reform Agenda – Competition Reform April 2007"; both available at www.coag.gov.au

response to ERIG have implications for the Transmission Reliability Standards Review, and their relevance and interaction are discussed below.

1.1.1 ERIG Report

ERIG was established by COAG in February 2006 to develop proposals for:

- achieving a fully national electricity transmission grid;
- measures to address structural issues affecting the ongoing efficiency and competitiveness of the electricity sector; and
- measures to ensure transparent and effective financial markets to support energy markets.

ERIG's Final Report was published in January 2007.[4]

In relation to developing an efficient national transmission grid, ERIG concluded that there is a need for a consistent national framework for transmission reliability standards. ERIG concluded that jurisdictionally based transmission reliability standards are the "principle [sic] drivers for investment in transmission"[5] and that a "clear shortcoming…is the different standards to which networks are built in each NEM jurisdiction"[6].

ERIG noted the following range of concerns with existing transmission standards:

- There is a lack of specificity in the reliability standards set out in Schedule 5.1 of the National Electricity Rules (Rules) and the majority of jurisdictional reliability obligations, which are open to interpretation. The consequence of this is that TNSPs have considerable discretion in the application of reliability obligations at various locations across the network.
- There may be questions about conflicts of interest in circumstances where responsibility for either setting jurisdictional reliability criteria or for interpreting broad criteria contained in transmission licence conditions is delegated to the TNSP. "This conflict is exacerbated where the TNSP's revenue and profitability is also driven by constructing assets to meet their own reliability requirements."[7]
- "There are significant efficiency and investor certainty implications associated with the current transmission planning criteria. The lack of specificity in the

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4 ERIG 2007, *Energy Reform – The Way Forward for Australia*, A report to the Council of Australian Governments by the Energy Reform Implementation Group, Canberra, January 2007. (URL http://www.erig.gov.au)

5 ERIG 2007, p. 167

6 ERIG 2007, p. 181

7 ERIG 2007, p. 181

current criteria and the diversity of approaches across jurisdictions may create uncertainty for investors in generation."[8]

ERIG concluded that there would be benefits from using a consistent national approach to specifying transmission standards across the NEM. It suggested three possible approaches to establishing a consistent national standard for transmission reliability:

1. a probabilistic economic reliability standard;

2. a probabilistic outcomes based standard; or

3. a deterministic redundancy planning criteria.

These three approaches are defined and discussed in Chapter 2.

ERIG recommended that:

- "…reliability standards should at least be clear and specific as to how they are applied, be set by a body independent of the entity responsible for meeting these obligations, and be cast in technology neutral manner."[9]

- "Any technical standard should be defined narrowly and as clearly as possible."[10]

- "A consistent and clear national framework should be implemented through the redrafting of schedule 5.1 of the Rules." [11]

- "The Reliability Panel would be the appropriate body to undertake the necessary review and devise such a framework before the actual standards applying to individual connection points are specified by jurisdictions." [12]

- "There may be long term benefits from making this framework consistent with the IEC [International Electrotechnical Commission] standard on reliability centred design of transmission system". [13]

ERIG's recommendations on the development of consistent national framework for reliability standards are linked to its other recommendations concerning the function and form of the Regulatory Test.[14]

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[8] ERIG 2007, p.165

[9] ERIG 2007, p.182

[10] ERIG 2007, p.182

[11] ERIG 2007, p.182

[12] ERIG 2007, p.182

[13] ERIG 2007, p.182

[14] The Regulatory Test made by the AER in accordance with clauses 5.6.5A of the NER is the principal vehicle for transmission project assessment and consultation for the NEM. The Regulatory Test consists of a 'reliability limb' and a 'market benefits limb'. For further information on the

Of significance for this review of transmission reliability standards, ERIG warned that the "economic benefits from integrating the two limbs of the Regulatory Test in any future investment decision making process may be eroded by poorly specified and inconsistent reliability standards and planning criteria".[15]

The AEMC has examined the form and function of the Regulatory Test as part of the NTP Review, and submitted its final recommendations to the MCE on 30 June 2008. The MCE approved publication of the NTP Final Report and the AEMC published this report on 22 July 2008.[16]

1.1.2 COAG Response to ERIG

COAG agreed with the recommendations by ERIG concerning the establishment of an enhanced planning process for the nation's electricity transmission network. COAG considers that an enhanced planning process will "ensure a more strategic and nationally coordinated process to transmission network development, providing guidance to public and private investors to help optimise investment between transmission and generation across the power system."[17]

In relation to the review of jurisdictional electricity network reliability standards, COAG agreed that this review should be progressed, but with appropriate caution noting: the different physical characteristics of the network; existing regulatory treatments in balancing reliability and costs to consumers; and that these standards underpin security of supply.

The Panel notes the cautionary qualifications outlined by COAG, which have been considered by the Panel in this review.

1.2 Panel's approach to the review

There are five key mechanisms in the NEM which affect the secure and reliable delivery of electricity to end users:

1. the market itself, which seeks to match supply and demand across time, using a transparent spot pricing process and short- and long-term financial contracts;
2. the reliability standard of 0.002% unserved energy (USE), set by the Panel, and associated reliability mechanisms such as Value of Lost Load (VoLL) and the Cumulative Price Threshold (CPT);

Regulatory Test, see AEMC 2007, *National Transmission Planning Arrangements, Issues Paper*, 9 November 2007, Sydney.

[15] ERIG 2007, p.168

[16] AEMC 2008, National Transmission Planning Arrangements, Final Report to MCE, 30 June 2008, AEMC, Sydney. Available at http://www.aemc.gov.au/electricity.php?r=20070710.172341

[17] COAG 2007, "Council of Australian Governments' response to the final report of the Energy Reform Implementation Group", pp. 3–4 of Attachment to COAG Communiqué, 13 April 2007. Available at: http://www.coag.gov.au/coag_meeting_outcomes/2007-04-13/docs/coag_nra_competition_reforms.pdf

3. technical standards specified in the Rules relating to security and reliability in an operational timeframe;

4. jurisdictional transmission reliability standards relating to the design and planning of transmission and distribution networks; and

5. reliability safety net provisions, comprising the Reserve Trader and NEMMCO's powers of direction for security or reliability. These safety provisions allow NEMMCO to contract for reserves when it projects reserve shortfalls and issue directions to Market Participants in order to maintain power system security or reliability.

This review is focused solely on developing a consistent national framework for reliability standards relating to the design and planning of transmission networks. These transmission reliability standards are primarily set out in jurisdictional instruments, and relate to a planning timeframe, but must conform with the technical standards specified in the Rules relating to security and reliability in an operational timeframe.[18]

The review will not be examining issues concerning the reliability standard of 0.002% unserved energy because the Panel has recently reviewed this standard as part of its Comprehensive Reliability Review (CRR). For the same reason, the reliability safety net provisions of the Rules will not be re-examined. As a consequence of the CRR, the Panel has recently lodged Rule changes with the AEMC that aim to refine the NEM's reliability safety net mechanism.[19]

Technical standards concerning security and reliability of the bulk power system in an operational timeframe (in Chapter 5, Schedules 5.1a and 5.1 of the NER) and connection standards (Schedules 5.2 to 5.4 of NER) are the subject of a separate review by the Panel, which commenced on 9 May 2008.[20]

1.3 Issues Paper

The Panel published an Issues Paper[21] on 21 December 2007 that:

- outlined the existing transmission reliability standards in the NEM, which are largely set by each NEM jurisdiction;

- discussed the policy problems that a framework for nationally consistent transmission standards is trying to solve, the size and scope of the problem, and the motivations for changing current jurisdictional standards;

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18 See Chapter 2 and Appendix A for an explanation of planning and operational time horizons and how reliability is managed in these timeframes.

19 For details, see http://www.aemc.gov.au/electricity.php?r=20080307.151409

20 For details, see http://www.aemc.gov.au/electricity.php?r=20080509.151254

21 AEMC Reliability Panel 2007, *Transmission Reliability Standards Review, Issues Paper*, 21 December 2007, Sydney, Available at http://www.aemc.gov.au/electricity.php?r=20071221.150018

- discussed three potential frameworks that could be used to improve the consistency of transmission reliability standards across the NEM;
- examined the implications arising from any attempt to change the form and/or level of existing jurisdictional transmission standards;
- explored a range of issues associated with the implementation of a nationally consistent transmission reliability standard, including:
  - Who would define the framework?
  - To what level would the framework contain specific standards?
  - What implementation steps are required?
  - What process should be followed?
  - Inter-dependencies, such as standards for sub-transmission networks, the regulatory incentive regime and regulatory approval cycles.

The Panel sought input from interested parties on the matters raised in the Issues Paper.

1.4 Draft Report

The Draft Report,[22] published by the Panel on 24 April 2008:

- Set out areas of consensus which have emerged from submissions on the Issues Paper – as well as the Panel's own analysis – concerning a Nationally Consistent Framework (NCF) for transmission reliability standards. There are two areas of consensus. First, there is broad agreement that a NCF is desirable. Second, there is a degree of consensus about a number of high level principles for a national framework. However, establishing a NCF based around these areas of consensus will require significant changes to existing jurisdictional instruments, and potentially the NEL and the Rules .
- Explored the broad options for change, and the properties of these options.
- Detailed a range of specific options, and what has been said about them in submissions to the Issues Paper.
- Discussed a draft implementation regime and a transition plan, which would be required to introduce a NCF.

[22] AEMC Reliability Panel 2008, *Towards a Nationally Consistent Framework for Transmission Reliability Standards, Transmission Reliability Standards Review - Draft Report*, 23 April 2008, Sydney. Available at http://www.aemc.gov.au/electricity.php?r=20071221.150018

- Outlined what still needed to be resolved or further assessed before the Panel's Final Report is submitted to the AEMC.

The Draft Report was deliberately non-conclusive and canvassed a range of selected options that had emerged from earlier submissions and analysis. The Panel sought further input from interested parties on the range of options, the rationale for adopting each option, and steps needed for implementation.

1.5 International review

On 29 May 2008, the Panel published a summary report by KEMA entitled 'International Review of Transmission Reliability Standards' to assist the Panel in developing a framework for nationally consistent transmission reliability standards for the NEM.[23]

KEMA's report outlined the:

- the transmission reliability standards used in different international electricity markets; and
- the frameworks used in other markets to ensure consistency of transmission reliability standards across multiple political jurisdictions and/or multiple transmission network owners.

1.6 Interim Report

The Panel published an Interim Report on 5 August 2008. This report:

- presented the Panel's intended final principles for developing and assessing the range of competing frameworks for nationally consistent transmission reliability standards.; and
- set out the Panel's preferred option for a framework of nationally consistent transmission reliability standards.

The purpose of the Interim Report was to allow stakeholders to comment on the Panel's likely preferred position before it was finalised.

1.7 Structure of this paper

The remainder of this Final Report is structured as follows:

- Chapter 2 outlines the matters raised in the Issues Paper.

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[23] KEMA 2008a, *International Review of Transmission Reliability Standards, Summary Report* to AEMC Reliability Panel, KEMA Inc, Philadelphia, 27 May 2008. Available at http://www.aemc.gov.au/electricity.php?r=20071221.150018

- Chapter 3 sets out the final set of principles that the Panel recommends for assessing a range of competing frameworks for nationally consistent transmission reliability standards.

- Chapter 4 discusses two broad options for developing a framework for consistent transmission standards across the NEM: consistency through the alignment of regional standards within a high level framework, allowing for regional differences within a common framework; and uniform standards, universally applied.

- Chapter 5 outlines a range of specific options, developed in the Draft Report, for a framework for nationally consistent transmission planning standards.

- Chapter 6 develops the final set of options for a framework of nationally consistent transmission reliability standards.

- Chapter 7 explains the Panel's final recommendation on a preferred option for a nationally consistent framework for transmission reliability standards.

- Chapter 8 considers the relative merits of different forms of reliability standards: deterministic, probabilistic and hybrid.

- Chapter 9 discusses implementation of a framework for nationally consistent transmission reliability standards and sets out the Panel's recommendation for a preferred option.

- Appendix A provides an overview of the NEM and introduces basic concepts relating to power system reliability and security standards and planning methodologies.

- Appendix B outlines the existing transmission reliability standards in the NEM, and briefly compares them to standards in a selection of other electricity markets. Appendix B also discusses the policy problems that a framework for nationally consistent transmission standards is trying to solve, the size and scope of the problem, and the motivations for contemplating changes to current jurisdictional standards.

- Appendix C lists submissions to the consultation process.

- Appendix D sets out variants to two of the options presented in Chapter 6.

- Appendix E contains a detailed summary of stakeholders' views on the five draft options. It complements the high-level synopsis of stakeholder's assessments of the draft options presented in Section 6.2.

2 Matters raised in the Issues Paper

This chapter provides a brief overview of the matters raised in the Issues Paper, and provides the context for the range of the options discussed in later chapters.

2.1 Main themes of the Issues Paper

The reliable and secure supply of electricity is crucial to the Australian economy and public safety. Australia is an advanced, industrialised, 'digital' economy, in which production, commerce and many everyday processes rely on communications technology, and thus a reliable, secure and high quality electricity supply.

Since its inception in 1998, the NEM has provided the eastern seaboard of Australia with reliable and secure supplies of electricity. Over the last ten years, the performance of the NEM has been at least as good as – and in many cases better than – that provided in the past by the vertically integrated state electricity commissions which existed prior to the NEM. The NEM has achieved this level of reliability via the combination of its market and regulatory arrangements, and the response of its market participants; which include generators, retailers, loads, the system and market operator NEMMCO, and regulated networks service providers (NSPs).

Appendix A provides a general introduction to the NEM, explains what reliability is, how transmission reliability standards are defined in the NEM, and how these fit with other reliability mechanisms in the NEM. Also discussed are key concepts about reliability standards – such as the form and level of standard – which are used throughout the rest of this report.

The transmission network transports power from generators to end users. This network plays a critical role in ensuring sufficient power is available to end use customers, at a quality suitable for their use, at all times, and in the face of equipment failures or weather disruptions (e.g. lightning strikes). Standards for the design and operation of the transmission grid and plant connected to it (e.g. generators, loads) are one critical element for assuring continued reliable supplies of power at each point of the network.

There is a difference in the transmission reliability standards used over operational and planning horizons. Transmission standards can relate to two (overlapping) timeframes:

- design/planning horizon — which can be from a few months ahead to several decades ahead; and

- operational horizon — which ranges from the instantaneous through to several months into the future.

Security standards at the design/planning stage are concerned with ensuring that the power system can tolerate the outage of any component or several components. This entails building a degree of redundancy into the network that allows for equipment outages.

Operational horizon standards are contained in the Rules (Chapter 5 and its schedules), and are tightly related to the power system security and reliability requirements specified in Chapter 4 of the Rules. Planning horizon standards are largely contained in jurisdictional instruments, but do have to be consistent with the operational horizon standards. (See Appendices A and B for further discussion).

This review is focused on the planning standards, specifically the establishment of a framework for nationally consistent transmission reliability standards for planning purposes. The Panel is conducting a separate review of the operational standards contained in the body and schedules of Chapter 5 of the Rules, which commenced on 9 May 2008.[24]

The existing transmission reliability standards for network planning differ across NEM jurisdictions, as explained in Appendix B. Over the last few years, there have been reviews of transmission standards or sub-transmission standards in four of the five NEM jurisdictions: South Australia, Tasmania, Queensland, and New South Wales. These reviews have led to changes in standards that have affected (or will affect) the level of investment required to comply with the new standards, and regulatory determinations concerning TNSPs' levels of capital and operational expenditure, returns on regulated asset base, and transmission pricing.

Existing transmission reliability standards (for network planning) are largely determined on a jurisdictional basis. This reflects the historical development of transmission networks across the NEM, which were originally designed to meet the needs of each jurisdiction, and the fact that until relatively recently there was little interconnection between jurisdictions.

The form of standards and planning methodology differs across jurisdictions: deterministic, probabilistic, and hybrid approaches are used.[25]

The level of standards differs across and within jurisdictions, as does the degree of specificity in the standards:

- typically, reliability standards are higher for Central Business Districts (CBDs) in state capitals than they are for metropolitan, urban, and rural areas in a jurisdiction; and

- some jurisdictions specify the level of reliability at each connection point, while others do not.

The process for setting standards and the transparency of the process differs across jurisdictions and can be either:

- set by Government;

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24 Reliability Panel Technical Standards Review, see www.aemc.gov.au

25 See Appendices A and B for further discussion on various forms of standards and planning methodologies.

- set by the Jurisdictional Regulator; or
- set by Government, on advice from the TNSP.

The instruments used to give effect to standards also differ across jurisdictions. These include:

- State Legislation;
- Transmission License conditions;
- Transmission Grid Codes; and
- planning documents.

The increased level of interconnection between jurisdictions is a driver for increased consistency in transmission planning standards.

As mentioned in Chapter 1, ERIG identified a number of reasons for establishing a framework for nationally consistent transmission reliability standards. COAG's response to ERIG supported the establishment of a framework for nationally consistent transmission reliability standards (with some cautionary concerns), which in turn has resulted in the Panel being asked to conduct this review.

2.2 Specific questions in Issues Paper

The Issues Paper sought views on the following list of questions:

1. What are the potential issues arising from divergent transmission standards across NEM jurisdictions?

2. What is the size and scope of the policy and commercial issues arising from divergent transmission standards across NEM jurisdictions? Which are the most significant? How significant are they?

3. What motivations, if any, are there for greater national consistency of transmission standards across the NEM?

4. Are there other advantages and disadvantages of having transmission standards that are divergent and are set on a jurisdiction specific basis? Do the advantages outweigh the disadvantages? Or vice versa?

5. What does "nationally consistent" framework mean, and what does it not mean?

6. How is the notion of a "nationally consistent" framework best expressed?

7. What are the pros and cons of having jurisdictional transmission standards aligned through:

(a) Making the operational standards in the Rules more specific, thereby limiting the degree of discretion available to TNSPs in meeting the operational standards contained in the Rules.

(b) Expanding the transmission standards in the Rules to cover the planning horizon, as well as the operational horizon.

(c) Aligning the *form* of jurisdictional transmission standards across the NEM via coordinated changes to the jurisdiction specific instruments that specify the standards.

(d) Aligning *both the form and the level* of jurisdictional transmission standards across the NEM via coordinated changes to the jurisdiction specific instruments that specify the standards.

8. What are the pros and cons of having a uniform transmission standard applied across the NEM?

9. What are the costs and benefits of moving to a common form and level of transmission planning standard?

10. What allowances would have to be made in moving to a uniform standard (e.g. changes to transmission regulatory determinations and connection agreements)?

11. What are the costs and benefits of not moving to a common form and level of transmission planning standard?

12. What are the costs and issues if a common transmission standard leads to an inconsistency with the Distribution Network Service Provider (DNSP) sub-transmission standard in the same jurisdiction?

13. Which body is best placed to set any nationally consistent transmission standard and why? To whom, and how, should this body be accountable?

14. What interactions are there between jurisdictional transmission standards and other aspects of the regulatory regime?

15. What linkages are there between jurisdictional transmission standards and other reviews or Rule changes currently under consideration by the AEMC?

16. How should these interactions be taken into consideration in developing a framework for nationally consistent transmission reliability standards?

17. What are the process steps you think will be necessary to establish a transmission reliability framework for the NEM?

18. What difficulties do you see in implementing a nationally consistent transmission reliability framework and how could these best be managed or overcome?

3 Principles for a nationally consistent framework

This chapter explains the final set of principles that the Panel recommends for crafting and assessing a range of competing frameworks for nationally consistent transmission reliability standards.

These final principles are based on:

- areas of consensus identified from submissions to the Issues Paper;
- consideration of responses to the Panel's proposed principles, contained in the Draft Report;
- consideration of advice on the principles underpinning successful nationally consistent frameworks in a selection of foreign electricity systems; and
- further analysis and assessment by the Panel.

However, the Panel notes that establishing a NCF based around these principles will require significant changes to existing jurisdictional instruments, and potentially the NEL and the NER.

3.1 Areas of consensus

Based on submissions to the Issues Paper, there appear to be two broad areas of consensus on building a framework for nationally consistent transmission reliability standards for network planning. First, a nationally consistent framework is seen as desirable, compared to existing arrangements. Second, there is a commonality of views on a number of high level policy principles for a national framework.

Also discussed are other criteria that could be used to assess competing frameworks for nationally consistent standards.

3.1.1 Desirability of a nationally consistent framework

There is consensus on the desirability of a nationally consistent framework for transmission reliability standards. However, there is a divergence on views on the nature of that framework, the degree to which it specifies the level of standards, and the flexibility individual jurisdictions should have in setting standards. These differences of view are discussed in Chapter 5.

Submissions to the Issues Paper identified a range of motives for shifting towards a nationally consistent framework for transmission reliability standards, and the policy and commercial issues arising from a divergence in transmission standards across

NEM jurisdictions. Appendix C lists the submissions, which are available on the AEMC's website.[26]

The National Generators Forum (NGF) identified three potential issues with the NEM's existing arrangements, in which transmission standards diverge across jurisdictions:

1. Regulatory Complexity: There is increased regulatory complexity for investors in new generation or demand-side initiatives when assessing longer term network performance, levels of congestion and market access.

2. Equity: Different standards will drive different levels of transmission investment and therefore different costs to consumers across the NEM.

3. Regulatory Overhead: Multiple standards can result in duplication of administration and higher costs."[27]

The Group[28] considers the continued use of divergent transmission standards across the NEM results in:

- lack of competitive neutrality between generation and transmission;
- needless complexity;
- needless retention of jurisdictional discretion;
- potential for undue influence and discretion for TNSPs; and
- likely retention of simplistic deterministic standards.

The Group questions whether divergent, jurisdictionally based, reliability standards are consistent with the development of a NEM-wide national transmission plan. It is also concerned that TNSPs should be transparent and accountable to network users for network performance, because the enterprise value of market participants can be affected by the combination of: a) the network access regime in the NEM; b) the level of network performance; and c) network investments.

The NGF considers the key motivations for greater national consistency in transmission standards to include "reduced regulatory complexity, better definitions of standards across all jurisdictions, increased transparency of application of

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26 See http://www.aemc.gov.au/electricity.php?r=20071221.150018

27 NGF submission – Issues Paper, p. 3

28 "The Group" comprises. LYMMCO, AGL, International Power, TRUenergy, and Flinders Power.

standards, lower overall administration costs, and greater ability to review and reset standards as required in the future."[29]

In contrast, Grid Australia[30] views the shortcomings of the current arrangements being primarily related to a lack of transparency in both the process used to set standards and the standards themselves; rather than to differences in the level of standards between jurisdictions.

> "A clear and consistent national framework will be capable of addressing perceptions that TNSPs have a conflict of interest in applying reliability standards by ensuring that there is a clear and unambiguous standard determined by each jurisdiction. Transparency in relation to the applicable reliability standard will also improve investor certainty regarding the level of reliability they can expect from the transmission system and the understanding of reliability standards by generation and other non-network investors. In addition, transparency of the level of reliability the network should be planned to meet and the application of that standard focuses accountability on the TNSPs in meeting that standard."[31]

Grid Australia considers that a nationally consistent framework for deriving transmission standards would "complement the current regulatory framework, which is based on commercially motivated transmission service providers operating under regulatory incentives."[32] However, Grid Australia is strongly of the view that the level of the transmission planning standards should continue to be determined on a jurisdictional basis.

The Australian Energy Regulator (AER) "considers that the most pressing issue facing this review is the lack of transparency and clarity that is inherent in the current arrangements for setting reliability standards. This applies both at a jurisdictional level and at the national level through the National Electricity Rules."[33]

The AER is critical of the ambiguity inherent with deterministic reliability criteria, and the wide degree of scope this allows TNSPs to interpret and apply such standards.

Both the AER and the Electricity Supply Industry Planning Council (ESIPC) note that:

- the transparency of transmission standards could be improved;
- there could be greater clarity in processes used to determine standards; and

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29 NGF submission — Issues Paper, p. 3

30 ETNOF changed its name to Grid Australia on 2 April 2008.

31 Grid Australia submission — Issues Paper, p. 11-12

32 Grid Australia submission — Issues Paper, p. 12

33 AER, Submission – Issues Paper, p. 2

- significant linkages exist between the standards and the regulatory processes used to set regulated revenues and to assess network performance. Poorly defined reliability requirements make it difficult for the AER to assess whether the capital expenditure proposals of TNSPs are genuinely required to meet reliability requirements.

The AER also states that when reliability standards are ambiguous, some TNSPs may mitigate the risk of non-compliance by adopting a conservative approach of having "inappropriately high capital expenditure claims".[34]

There is consensus between Grid Australia, the Group, the NGF and the AER that ambiguity in transmission standards adds to the uncertainty faced by generation investors and investors in non-network responses, such as demand-side management.

The Victorian Energy Networks Corporation (VENCorp) "supports the adoption of a common reliability standard across all jurisdictions"[35] and favours having this standard set out in "one instrument, such as the Rules"[36], rather than as now, in a range of jurisdiction-specific legislation, regulations or transmission licenses. However, it recognises that considerable effort will be required to achieve this.

VENCorp tempers its support for common standards by stating "…while having a common standard is important, it is equally, if not more important, to have a transparency of reliability standards and their method of application in a planning environment, in each jurisdiction".[37]

3.1.2 High-level principles for a nationally consistent framework

There appears to be a consensus in submissions concerning some of the high level principles that would be incorporated into a framework for nationally consistent transmission reliability standards.

Specific principles around which there is consensus are:

1. Transparency – there should be greater transparency in the processes used for setting standards;

2. Governance — standards should be set by a body that is separate from the body that must apply the standard;

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34 AER Submission – Issues Paper, p. 2

35 VENCorp Submission — Issues Paper, p. 2.

36 VENCorp Submission — Issues Paper, p. 2

37 VENCorp Submission — Issues Paper, p. 2

3. Economic efficiency — the framework should result in reliability standards being derived from economic considerations;[38]

4. Specificity of standards — transmission reliability standards should be clearly specified on a connection point basis or on some other readily understandable basis (e.g. by geographic area, such as CBD, large regional city, etc.);

5. "Fit for purpose" standards – the framework should not be a "one size fits" approach. Rather it should allow for reliability standards to differ according to, say, the significance or criticality of the load centre — e.g. between CBD, metro and rural areas of a jurisdiction — or according to explicit customer valuation of reliability at each connection point; and

6. Accountability — TNSPs should be accountable to the appropriate authority for meeting the transmission standards, as well as to the AER for meeting the resultant service standards, as this is an integral part of regulatory incentive regime. If standards were set by a jurisdictional authority, it would most likely follow that the TNSPs would be accountable to that jurisdictional authority.

3.2 Other suggested criteria for assessing alternative frameworks and developing reliability standards

Both the AER and Grid Australia has put forward sets of principles to guide the development of frameworks for nationally consistent transmission standards, and the selection of an appropriate framework.

In addition to agreeing with criteria 1 to 5 above, the AER has suggested that standards should be "set in such a way as to be neutral between the technologies that are used to meet a given standard."[39]

Grid Australia considers the following five criteria should be adopted in order to assess alternative frameworks for developing reliability standards and selecting a preferred framework:[40]

- **Economic efficiency**. "The framework should result in reliability standards being derived from economic considerations. In particular the framework should provide for an assessment of the benefits of additional reliability compared with the costs of providing it."

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[38] The Panel notes that that the Commission has developed a new RIT–T, as part of the NTP Review. The RIT-T seeks to ensure the selection of the most economically efficient option for meeting a given reliability standard. If standards were derived from economic considerations, the proposed RIT-T would reinforce incentives to deliver to those standards in an economically efficient manner. This is akin to selecting a design for a "fit for purpose" engineering solution that meets a given standard – taking into account economic factors such as economies of scale and scope, option value, and future growth in demand - then conducting a competitive tender process to deliver that solution at least cost.

[39] AER Submission – Issues Paper, p. 3.

[40] Grid Australia Submission — Issues Paper, pp. 5–7.

- **Transparency.** There should be transparency in the standards resulting from the framework; the process used to derive the standards, and in the application of the standards. The standards should be "sufficiently clear to be understood by market participants that are not necessarily from a transmission planning background". In addition, the "framework will need to be consistently applied across all jurisdictions."

- **Accountability**. "Accountability is intrinsically linked to transparency. A framework that is easily understood makes it possible both to pinpoint the party that is responsible for setting the standard for the service level to electricity consumers and also makes clear the exact standard that the TNSP is required to meet. Accountability requires that outcomes can be readily measured and compared with the specified planning standard."

- **Effectiveness**. "A framework that is effective will enable investment to proceed in a timely manner and will meet customers' expectations for reliability. This criterion is also linked to transparency, as it ensures transparency of both the standard to be adopted and the application of that standard."; and

- **Robustness**. The framework should be robust enough to withstand external scrutiny and criticism. A framework that is similar to that used in other developed countries, comparable to Australia, "is likely to better withstand scrutiny in the event of an investigation following a major reliability failure".

In addition, Grid Australia has suggested that a desirable characteristic of any framework is that it should ensure **consistency between transmission and distribution network reliability standards** and co-ordinated planning of these networks, given that interactions between transmission and the sub-transmission systems (owned by DNSPs) are relatively common in delivering an overall reliability outcome for customers. In that context, it is noted that the setting of standards for DNSPs is outside the Panel's remit.

The Group stated:

> "The retention of jurisdictional network standards at the local distribution level, while potentially inefficient, has a limited impact on the operation of the wholesale NEM as the local network fulfils a different role to the main transmission system. A national standard for the major transmission and sub-transmission network should therefore not create any major inconsistencies."[41]

It is apparent that Grid Australia has a different view to the Group on the materiality of the interaction between the transmission networks and the sub-transmission networks owned by DNSPs. Those interactions may be material in some regions of the NEM, but not in others.

[41] The Group's submission — Issues Paper, p.16

3.3 The Panel's draft principles for a nationally consistent framework

In its Draft Report, the Panel agreed that the six consensus principles discussed in Section 3.2 should be used to guide the development of a framework for nationally consistent transmission reliability standards:

1. transparency;
2. governance;
3. economic efficiency;
4. specificity of standards;
5. "fit for purpose" standards; and
6. accountability.

To these six principles, the Panel proposed adding a further three:

7. the maintenance of at least existing levels of network performance;
8. standards should be technologically neutral, and not be biased towards network solutions where other non-network options can provide a comparable level of reliability; and
9. desirability for a consistent relationship between transmission and sub-transmission standards.

With regards to the specificity of standards (principle 4), it should be recognised that transmission connection points fall into two broad categories: a) large energy customers, such as smelters, and DNSPs; and b) Generators. The framework for standards will have to account for the fact that these customers can, in some cases, negotiate levels of standards that are above or below the general minimum levels of standards set within the framework.

The Panel suggests that it should also be recognised that transmission networks provide three broad types of service:

- access to connection services by generators and loads;
- regional reliability, facilitated through meshing and other forms of redundancy. This is facilitated through the joint planning of transmission and distribution networks within a jurisdiction; and
- interconnection service between regions, which can enhance reliability and security within and across regions, and facilitate greater competition in the supply of electricity than would occur without the interconnection in place.

The Panel sought views on its suggested principles, with the intent of using these principles in developing and assessing the options for a NCF that will be put to the Commission.

3.4 Views on Panel's proposed principles in Draft Report submissions

Submissions on the Draft Report generally supported most of the Panel's nine proposed principles (see Table 1).

Table 1: Support for Panel's proposed principles

Principle	Draft Report submission			
	Grid Australia	The Group	AER	VENCorp
1. Transparency	✓	✓	✓	✓
2. Governance	✓	✓	✓	✓
3. Economic efficiency	✓	✓	✓	✓
4. Specificity of standards	✓	✓	✓	✓
5. Fit for purpose	✓	✓	✓	✓
6. Accountability	✓	✓	✓	✓
7. Maintenance of at least existing levels of network performance	✓	×	No comment on principle, but the AER suggests that TNSPs be required to report on how delivered network capability compares to the performance requirements in the standard	×
8. Technology neutral	✓	✓	✓	✓
9. Maintains consistency between transmission and sub-transmission standards	✓	×	No comment	Concerned about adopting this principle.

3.4.1 Two of the Panel's draft principles questioned

Two of the Panel's proposed principles were questioned by both the Group and VENCorp:

(a) the maintenance of at least existing levels of network performance; and

(b) consistency between transmission and sub-transmission standards.

The Group suggested both of the above principles should be deleted.[42]

VENCorp considers that adoption of the first principle might risk entrenching inefficiencies where parts of the network were already overbuilt.

VENCorp raises the concern that if a common form of transmission standard were adopted across the NEM, then inconsistencies might arise between what it considers consistent transmission and distribution network planning standards and processes that are currently used in Victoria. This same issue has been raised earlier in the review by Grid Australia (see above), who is concerned about potential inconsistencies if the NCF were to adopt a probabilistic form of standards for transmission networks, while retaining a deterministic form of standards at the sub-transmission and distribution network level.

3.4.1.1 Maintenance of at least existing levels of network performance

The Group gives four reasons for omitting the principle of *Maintenance of at least existing levels of network performance*:

- "First, in some parts of the NEM, the grid has been over-built in the past and network performance has been in excess of what would be expected even if extremely risk averse and quite economically inefficient grid planning standards had been in place. This may have resulted from the lumpiness of major network investments or the use of unduly conservative planning assumptions. However, regardless of the reasons for it, there are no justifiable political, social or economic argument [sic] to continue unnecessarily 'gold-plating' the network merely because this is what has occurred in the past.

- Secondly, if a uniform national standard is to be adopted, this principle demands that the uniform standard be set for the whole network at a level that will enable the best historical network performance to be maintained.

- Thirdly, in order to determine the required quantum of the standard which would satisfy this principle, the body charged with the responsibility of setting the standard would need to undertake a comprehensive and quite detailed analysis of the actual historical network performance across the NEM, and then determine what reliability planning standard applied in the future would enable TNSPs to maintain this level of performance taking into account expected changes in transmission technologies, network design practices, asset management practices, network operations and so on. Alternatively, it would be forced to include a generous 'safety margin' in the proposed standard.

42 The Group – Submission on Panel's Draft Report, pp. 14–16.

- Finally, the impact on the reliability of supply enjoyed by consumers at their point of supply due to potential variations in transmission planning standards that could emerge as a result of a new consistent national framework for setting these standards will not be discernible by consumers. Any potential change in this respect will be swamped by the reliability performance of the local distribution network, which itself varies considerably from year to year largely as a result of variability in weather conditions."[43]

VENCorp also questioned whether a 'no worse' principle would result in continued inefficiencies, stating:

> "While this sounds like a reasonable objective, if the system or parts of the system are already overbuilt, then this can lead to continued inefficiencies."[44]

The AER made no specific comment on the principle of *maintenance of at least existing levels of network performance*, it suggested that a NCF could be enhanced by "… TNSPs being required to report on delivered network capability compared to the reliability standard at each connection point".[45]

3.4.1.2 Consistency between transmission and sub-transmission standards

Grid Australia affirmed that it considers the principle of *Consistency between transmission and sub-transmission standards* "is an issue of key importance". Grid Australia noted that the both the Panel's Issues Paper and Draft Report concurred with its view, on the basis that such consistency facilitates least cost development of both transmission and distribution networks.[46] Grid Australia also mentioned that distribution network standards were outside of the scope of the Commission's (and hence the Panel's) review.

In contrast, the Group advocates dropping this principle of on the grounds that:[47]

- "The form and quantum of existing jurisdiction-based sub-transmission and distribution grid reliability planning standards should not in any way constrain the development and implementation of a proper, economically based transmission grid."

- "While there may be some inefficiencies in the way the reliability standards for both the sub-transmission network and the distribution

43 The Group – Submission on Panel's Draft Report, pp. 14–15.

44 VENCorp – Submission on Draft Report, p. 5.

45 AER — Submission on Draft Report, p. 2.

46 Grid Australia — Submission on Draft Report, p. 2.

47 The Group – Submission on Panel's Draft Report, pp. 14–15.

network are currently defined and applied, that is not a matter that is the subject of this Review and, in our opinion, there is no good reason why the form or quantum of those standards should have any influence on the form or quantum of any proposed national transmission reliability standard."

- "For any part of the sub-transmission network that is considered to be a part of 'the main power system' it would be logical for that part of the network, in its transmission support role, to be required to meet any new national transmission grid planning standard. At the same time, it may also be required to meet the reliability standards that normally apply to sub-transmission networks in that area, and these standards may be more stringent or less stringent (in terms of the level of redundancy required) than the transmission grid planning standard."

- "In our view, these two different standards can readily co-exist even if the form and the quantum of each are different, and the expected performance of the sub-transmission network can be readily assessed against each as required. While it would be highly desirable for the economic rationale for each standard to be mutually consistent, in reality, these standards are generally defined in the form of a redundancy standard in which case the economics of the network built on this basis will vary considerably from place to place both within and between networks in any event."

The Group also considers its view on the possible co-existence of different forms and levels of standards at the transmission and sub-transmission level is consistent with the AEMC's position in its NTP Draft Report:[48]

> "The Commission does not consider that having two separate project assessment processes [the Regulatory Investment Test for Transmission networks (RIT-T) and the Regulatory Test for distribution networks] would prevent [the] joint planning process from continuing…"[49]

VENCorp makes five points on the relationship between transmission network standards and the standards applying to sub-transmission and distribution networks:

1. "The Victorian transmission planning arrangements uniquely require the relevant DNSPs to plan any augmentations of connection assets. […] this means that the DNSPs are responsible for planning the transformation capacity from the transmission network to the distribution network."[50] VENCorp is responsible for planning the "shared network", which comprises all transmission assets other than those defined to be DNSP or generator connection assets.

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[48] The Group – Submission on Draft Report, p 16.

[49] AEMC 2008, *National Transmission Planning Arrangements – Draft Report*, AEMC, Sydney, 2 May 2008, p. 32. Available at http://www.aemc.gov.au/electricity.php?r=20070710.172341

[50] VENCorp – Draft Report Submission, p. 8

2. While the South Australian transmission standards are focussed on connection point redundancy, there are two reasons why such standards may not be applicable to the Victorian system:

   – Because connection point planning in Victoria is carried out by DNSPs, who focus on transformation capacity.

   – In Victoria "the majority of connection points are meshed at the transmission level with other connection points, and therefore, the transmission lines supplying any single connection point are part of the shared transmission network."[51]

3. In the case of Victoria, a shift towards deterministic transmission standards would create an inconsistency with the probabilistic forms of standards and planning methods used by Victorian distribution networks. At present, there is consistency in that probabilistic planning standards and methods used in Victoria for both transmission and distribution networks.

4. A likely result of the hybrid approach, which uses economic criteria to set deterministically expressed transmission standards, is a change to the level of existing transmissions standards. "If a distribution deterministic standard can impose a constraint on the transmission standard, then it is not clear what purpose the economic considerations serve."[52]

5. "Standards of supply reliability, not redundancy, are the issues of concern in this review".[53]

3.5 Views in Draft Report submissions on the Panel's other draft principles

Submissions to the Draft Report expressed a range of views on the Panel's other seven draft principles.

3.5.1 Transparency

The principle of transparency was unanimously supported. However, submissions sought to have a more comprehensive definition of this principle, which specifies that transparency requires:

1. a clearly defined process be used to derive the standards. This process should involve public consultation processes akin to those imposed on the AEMC under the NEL for Rule making;

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51 VENCorp – Draft Report Submission, p. 8

52 VENCorp – Draft Report Submission, p. 8

53 VENCorp – Draft Report Submission, p. 8

2. the use of consistent terminology that provides a set of well defined reliability categories;

3. clarity and specificity in the standards resulting from the framework;

4. the standards be readily understood by market participants;

5. clarity in how the standards are applied and enforced;

6. the publication of the framework and the principles underpinning the framework;[54]

7. that each TNSP's planning process be transparent and auditable[55]; and

8. the use of a rigorous cost-benefit assessment methodology that is consistently applied across jurisdictions. The AER considers that guidelines on the cost-benefit assessment methodology should be developed, using a public consultation process. The AER suggests that these guidelines should specify: a definition of the cost-benefit methodology and how it will be applied; and details of the model to be used, the model assumptions and all variables identified—in particular, the assumed Value of Customer Reliability (VCR) at each connection point.[56]

3.5.2 Governance

All submissions supported the principle that transmission reliability standards should be set by a body that is separate from the body that must apply the standard.

With one exception, there is general consensus that:

- a jurisdictional body, independent from the TNSP, should set the level of the standards, following a transparent consultation process; and
- there will be significant jurisdictional input into the setting of standards.[57]

The Group, while strongly supporting having the standards set by a body independent of the TNSPs, advocates that this body being a national one rather than having jurisdiction specific standards set by independent, jurisdictional authorities.

The Group continues to favour "a consistent national framework that involves a uniform national grid reliability standard set by an appropriate national body."[58] However, it has changed its view on just who such a body should be. Instead of this

[54] VENCorp – Draft Report Submission, p. 4

[55] VENCorp – Draft Report Submission, p. 4

[56] AER – Draft Report Submission, pp. 1,2,3

[57] VENCorp — Draft Report Submission, p. 1; AER – Draft Report Submission, p. 3; Grid Australia — Draft Report Submission, pp. 5–6; Queensland Government – Submission on Draft Report, pp. 1-2.

[58] The Group – Submission on Panel's Draft Report, p. 17.

body being: a)"the AEMC on advice from the Reliability Panel and the AER"; the Group now favours b) the National Transmission Planner, whose recommendations on the national standard would have to be ratified by the AEMO Board, the Reliability Panel and the AER before it would come into effect.[59]

Two other features of the Group's proposed new governance arrangements are:

- "the NTP would be required to comply with the transparency requirements specified in the NER/National Grid Code when undertaking this work";
- "the timing of both the initial introduction of the new standard and any subsequent changes"… would be a decision…"of the AEMC, after further consultation with both the AER and market stakeholders."[60]

The Group sees several advantages in these governance arrangements:[61]

- "The NTP will have the relevant technical expertise and grid planning experience amongst its staff to undertake and/or supervise the detailed analysis that will be necessary in developing the details of the standard."
- The NTP "even though it is a grid planning body…will be completely independent of all of the market stakeholders directly involved in planning and/or investing in the grid at the TNSP level".
- "The multi-stage process which requires the AER and Reliability Panel to ratify the NTP's recommendations and the AEMC to determine the timing of their implementation provides stakeholders with what is in effect a quasi appeals mechanism if any stakeholders are particularly aggrieved with the NTP's processes or findings. In our view, this would be a more flexible and more appropriate way to deal with such grievances rather than using the formal appeal mechanisms under the Market Rules or the NEL. We would expect the processes for the Reliability Panel's role in ratifying the recommended standard and dealing with stakeholder concerns and the AEMC's role in establishing the implementation timetable would be specified, at least in broad terms, in the proposed National Grid Code."[62]

VENCorp raised the following concerns about: a) the proposed governance arrangements for setting the form and level and standards; and b) the Panel's own governance arrangements, membership and process for this review:

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59 The Group — Draft Report Submission, p. 17

60 The Group — Draft Report Submission, p. 17

61 The Group – Submission on Panel's Draft Report, p. 17.

62 The Group — Draft Report Submission, p. 17

"We also make the point that the further the RP [Reliability Panel] moves from the development of a Framework towards requiring how the criteria should be expressed, the closer it gets to mandating a particular level of reliability. This is not a matter for the TNSPs to be involved in. TNSPs should only plan to specific planning criteria such as that contained in the proposed Framework not assist in the setting of those criteria. Clearly, therefore, it should be the responsibility of each jurisdiction to determine whether the analyses done for connection points using the Framework criteria should be converted to a deterministic equivalent and the level of redundancy required."[63]

The AER has suggested that "consideration should be given to allow jurisdictions the option of appointing an independent national body, such as the Reliability Panel or Australian Energy Market Operator (AEMO), to set the reliability standards under the national framework."[64]

3.5.3 Economic efficiency

All submissions on the Draft Report consider *economic efficiency* to be a fundamental principle for formulating and assessing NCF options. All support a move towards having the level of standards at different connection points derived using a rigorous, transparent, cost-benefit methodology.

Both VENCorp and the AER support the publication of the VCR assumptions used to derive the level of the standards. The AER states:

"This would make the key driver of varying reliability levels transparent for all stakeholders and limit the scope for ambiguities to be re-created under the new framework."[65]

VENCorp also considers two separate principles are needed, both of which relate to economic efficiency:

- **an explicit VCR**; and
- **a clear statement of the economic and technical principles** that underpin the methodology used "to either assess investments or derive and review equivalent deterministic standards".[66]

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63 VENCorp — Draft Report Submission, p. 5.

64 AER – Draft Report Submission, p. 3.

65 AER – Draft Report Submission, p. 3.

66 VENCorp — Submission on Draft Report, pp. 3–4.

3.5.4 Specificity of standards

All submissions to the draft report support the principle that transmission reliability standards should be clearly specified on a connection point basis, or on some readily understandable basis (e.g. geographic area, such as CBD, large regional city, etc.).

However, both VENCorp and the Group raised issues about deterministically expressed (or redundancy) standards.

The Group questions whether a deterministic redundancy standard give an accurate measure of reliability at a particular connection point, across a broad range of operating conditions.[67] The Group sees this issue as critical to effective setting and enforcement of standards, and state:

> "If the aim is to in fact define a reliability standard, the principle of specificity ought to be one which aims to ensure that the standard is specified in a form which is indeed a true measure of reliability itself and not just a measure of redundancy."[68]

VENCorp's suggests that the NCF allow jurisdictions the option of whether to convert the level of connection point standards derived using the framework principles into equivalently expressed deterministic standards.

> "VENCorp has proposed that each jurisdiction can choose to apply the principles in the Framework directly to each augmentation or convert it to an equivalent deterministic standard. Provided both options' outcomes are directly referable to and measurable against the principles set out in the Framework, they will meet this objective."[69]

3.5.5 Fit for purpose

No submissions to the Draft Report questioned the fit for purpose principle. This reflects the fact that it was unanimously supported in submissions to the Issues Paper.

3.5.6 Accountability

There was broad consensus that accountability was a fundamental principle for an effective NCF.

Grid Australia considers that accountability requires:

67 The Group — Submission on Draft Report, pp. 13–14.

68 The Group — Submission on Draft Report, p. 14.

69 VENCorp — Submission on Draft Report, p. 4

- TNSPs to be accountable to the appropriate authority for meeting transmission standards; and
- that outcomes can be readily measured and compared with clear and specific planning standards.

These two facets of accountability appear to have unanimous support.

Given that accountability follows on from, and is strongly tied to, the principle of transparency, the views expressed in Section 3.5.1 above are relevant. Also relevant are comments in submissions in relation to the specificity of standards (see Section 3.5.4).

In VENCorp's opinion:

> "The most effective way of delivering TNSP accountability without having to first experience a deterioration of reliability is to have transmission plans developed or scrutinised by independent transmission planning authorities that have power to direct amendments to transmission plans (as happens in PJM and Alberta). A slightly different model is applied in British Columbia where it seems that the British Columbia Transmission Corporation (BCTC) is responsible for transmission planning along similar lines to Victoria. It seems as though an accountability model based on scrutiny at the time of planning would be a far more effective way of holding TNSPs accountable for their planning investments since it is capable of picking up problems at the planning stage. A planning standard on its own has great difficulty doing this."[70]

The AER has suggested that the accountability principle could be given effect in the framework by requiring TNSPs to report on delivered network capability compared to the reliability standard at each connection point. The AER also states:

- "The AER recognises that this would require a clear and transparent definition of how delivered outcomes are to be measured."
- "This information would be useful to the TNSP in understanding the actual performance of its network and be helpful to the AER in conducting assessments of capital expenditure proposals as the historic performance could then be compared to the reliability standard."[71]

3.5.7 Technological neutrality

This principle appears to be widely supported. The AER suggested that the application of this principle in a NCF could be strengthened by "including in the

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[70] VENCorp — Submission on Draft Report, p. 4

[71] AER — Submission on Draft Report, p. 4–5

deterministic standard expressions, a time allowance for customer reconnection in certain circumstances".[72]

3.6 Views in Draft Report submissions on the other suggested principles

3.6.1 Robustness

There are mixed views on the principle of *robustness*, advocated by Grid Australia, which appear to stem from the way in which Grid Australia has defined robustness.

Grid Australia (GA) defines robustness in terms of:

- using the same form of standards and planning methodologies:
    - as other advanced industrialised countries; and
    - that accord with past history and practice and are therefore 'tried and tested';
- ease in having the transmission system's performance readily audited against clearly defined standards in the event of a major interruption to power supplies.

Grid Australia considers there are risks in other NEM jurisdictions shifting to a probabilistic form of standards and planning methodology, similar to that used in Victoria. In particular, it is concerned that in the event of a significant event that disrupts reliable supplies in a region, the use of probabilistic standards and planning methods will make it difficult for an independent auditor to check the compliance of a TNSP's network design against pre-defined standards and to then benchmark these standards and the resulting power system performance against corresponding (deterministic) network standards that are prevalent in other advanced, digital-economies. Grid Australia claim that such an audit would be much easier with deterministic forms of standards —and easier to explain to policy makers, regulators and the public—than would be the case with probabilistic standards.[73]

Both VENCorp and the Group strongly disagree with Grid Australia's definition of robustness and the subsequent policy implications drawn by Grid Australia, which relate to the risks of the NEM being unique in adopting probabilistic standards.

VENCorp and the Group raise five objections to Grid Australia's position:

[72] AER — Submission on Draft Report, p. 2

[73] Grid Australia — Submission on Draft Report, p. 3.

1. The mere application of an approach in overseas jurisdictions does not necessarily make that approach robust.[74]

2. The NEM's design differs substantially from that applied in other countries and this is not seen as implying that the NEM is any less robust than markets in other countries. Rather, the NEM's design is tailored to the topography of the interconnected network, has proven to be one of the most successful electricity markets in the world, and is highly regarded internationally.[75] The NEM has been a leading pioneer in introducing features like: a) unit self-commitment; b) an energy-only design; c) co-optimised energy and frequency control ancillary service markets; and d) probabilistic standards and planning methodologies. "As has been the case for the development of the NEM, we should be aiming for world's best practice in the development and use of transmission reliability standards, even if this means we need to continue to be pioneers in this field as well."[76]

3. "…even though international application of probabilistic planning is in the embryonic stages, there is clearly a growing recognition of the need to move in this direction, particularly in places where competitive power markets have been introduced."[77]

4. Victoria is no longer a lone pioneer in the use of probabilistic standards and planning methods.[78] British Columbia and California are cited as examples where probabilistic planning criteria and methods are used, with British Columbia's unmeshed, linear, transmission network topography being considered by VENCorp as similar to that in many parts of the NEM. In 2004 New Zealand investigated switching to probabilistic standards and planning methods. For the last decade the Electric Power Research Institute (EPRI), a leading United States-based and industry funded research & development company, has advocated a switch to probabilistic standards and methods for transmission networks supporting electricity markets.

5. "VENCorp disputes Grid Australia's assertion that adoption of the same reliability standard would hold TNSPs immune from claims of negligence in their planning function. On the contrary, if overseas standards are followed without question or scrutiny for appropriateness, claims that TNSPs acted negligently in the event that reliability deteriorated would only be strengthened."[79]

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74 VENCorp — Submission on Draft Report, p. 5

75 VENCorp — Submission on Draft Report, p. 5; The Group – Submission on Draft Report, pp. 5–6.

76 The Group – Submission on Draft Report, p. 6

77 The Group – Submission on Draft Report, p. 5

78 VENCorp — Submission on Draft Report, p. 5; The Group – Submission on Draft Report, pp. 5–6.

79 VENCorp — Submission on Draft Report, p. 5

3.6.2 Effectiveness in ensuring investment is not delayed

Grid Australia recommended that the principle of effectiveness be adopted by the Reliability Panel. Grid Australia's latest definition of *effectiveness* is:

> "**Effectiveness:** which requires standards to facilitate timely delivery of investment to meet customer expectations of reliability and minimise disputes (as required by COAG)."[80]

Grid Australia gave a slightly different definition in its submission on the Issues Paper:

> "**Effectiveness**. A framework that is effective will enable investment to proceed in a timely manner and will meet customers' expectations for reliability."[81]

The Group in its presentation to the Panel's public forum on 30 April 2008 disagreed with the effectiveness principle, because it did not agree with Grid Australia's view that utilising probabilistic standards would delay investment decisions designed to improve power system reliability.[82] The Group also stated that deterministic standards are more open to dispute because a number of key assumptions used to derive the standards are hidden.

VENCorp's view is:

> "On the basis of Grid Australia's definition of 'effectiveness' (a standard that meets customer expectation of reliability and minimises disputes), use of a published planning criteria, economic cost benefit assessment and verifiable VCR explicitly derived from customers' stated expectations of level of reliability should make the planning process very effective since customers know what to expect and therefore disputes are minimised."[83]

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[80] Grid Australia — Submission on Draft Report, p. 3

[81] Grid Australia — Submission on Issues Paper, p. 7.

[82] See: [1] The Group – Presentation to Reliability Panel Forum, 30 April 2008, Melbourne Airport Hilton; and [2] AEMC Reliability Panel 2008c, "Transcript of Proceedings—Transmission Reliability Standards Review Public Forum, held on Wednesday, 30 April 2008, Melbourne Airport Hilton". Both available at http://www.aemc.gov.au/electricity.php?r=20071221.150018

[83] VENCorp Submission — Draft Report, p. 4.

3.7 KEMA's suggested principles

A consultancy report by KEMA, 'International Review of Transmission Reliability Standards', suggested an alternative set of principles for establishing a NCF.[84] KEMA's summary report was published by the Panel on 29 May 2008, in order to allow any comments on the KEMA report to be incorporated into submissions on the Panel's Draft Report.

Based on a review of a selection of countries with electricity markets, KEMA suggested nine principles on which to base the development a successful framework for nationally consistent transmission standards — see Table 2.

Most of KEMA's suggested principles appear to align with those proposed by the Panel in its Draft Report, but with some differences in emphasis or expression.

84 KEMA 2008a, *International Review of Transmission Reliability Standards— Summary Report* Report to AEMC Reliability Panel, KEMA Inc, Philadelphia, 27 May 2008. Available at http://www.aemc.gov.au/electricity.php?r=20071221.150018

Table 2: KEMA's views on the principles for a successful framework for nationally consistent transmission standards

KEMA's principle	Alignment with Panel's principles in Draft Report
Transparent—the transmission reliability standards and process should be published and consistently applied by Transmission Operators (TOs) in evaluating the transmission system and evaluating expansion plans.	Transparency
Consistent—the evaluations developed using the transmission reliability standards should produce consistent results such that independent parties can reproduce the results obtained by the TOs or other parties.	Transparency Accountability (Robustness/Auditable)
Independent—the transmission reliability standards should be set by a body that is independent of the TOs.	Governance
Economic—the transmission reliability standards must strike a reasonable balance between transmission system cost and customer reliability.	Economic efficiency
Specific—the transmission reliability standards should be clearly specified on a readily-understandable basis: • Identify the starting condition for the transmission studies: • Define the test that will be performed on the system; and • State what constitutes acceptable system performance.	Specificity of standards Transparency Accountability
Amendable—the specific requirements and many of the processes should be able to be amended without requiring legislative approval either through approval by the various regulatory bodies involved or an open stakeholder process.	Governance (Independence)
Open—the process should be open to stakeholders to the extent possible by making committee meetings open, publishing data and results on the internet, and by generally involving stakeholders in the process.	Transparency
Flexible (upward)—the transmission reliability standards should allow for reliability standards to be more stringent or add detailed specifics where appropriate—e.g. for central business districts (CBD), or according to explicit customer needs at their connection point.	Fit for purpose
Accountable—the consequences of not following the transmission reliability standards must be clearly defined along with the processes for enforcing the standards and reviewing or appealing any enforcement action.	Accountability

Source: KEMA 2008a, *International Review of Transmission Reliability Standards—Summary Report*

3.7.1 Views on Draft Report submissions on KEMA's suggested principles

None of the submissions on the Draft Report commented on the range of principles put forward by KEMA Consulting in its Summary report to the Panel, "International Review of Transmission Reliability Standards". The lack of comments might have been because of the close similarity between KEMA's suggested principles and those proposed by the Panel in its Draft Report.

3.8 The Panel's final principles for a nationally consistent framework

Table 3 shows the final set of principles the Panel recommends for a nationally consistent framework for transmission reliability standards. The Panel's final choice of ten principles has been arrived at taking into consideration:

- comments made in submissions on the Draft Report;
- KEMA's advice on principles that underpin successful frameworks for nationally consistent standards in a selection of other countries; and
- further analysis and consideration by the Panel.

The explanation of the principles extends and clarifies the explanation given in the Panel's Draft Report.

The final set principles excludes one of the principles that appeared in the Draft Report:

- The maintenance of at least existing levels of network performance.

Added to the set of set of draft principles contained in the in Panel's draft report are two other principles:

- Amendable;
- Effectiveness.

The Panel decided against adding the principle of *robustness*, as defined and advocated by Grid Australia.

The reasoning behind the Panel's final selection of principles is discussed below.

Table 3: Panel's final principles for a nationally consistent framework

Principle	Explanation
Transparency	The processes used for setting standards should be transparent and open, with ample opportunity for stakeholder input. The degree of transparency should be the same as that specified in the NEL for when the AEMC investigates whether to make a change to the Rules. The transmission reliability standards and process should be published and consistently applied by Transmission Operators (TOs) in evaluating the transmission system and evaluating expansion plans. The consequences of not following the transmission reliability standards must be clearly defined along with the processes for enforcing the standards and reviewing or appealing any enforcement action.
Governance	Standards should be set by a body that is separate from the body that must apply the standard.
Economic efficiency	The framework should result in reliability standards being derived from economic considerations and that strike a reasonable balance between transmission system cost and customer reliability.
Specificity of standards	Transmission reliability standards should be clearly specified on a connection point basis or on some other readily understandable basis (e.g. by geographic area, such as CBD, large regional city, etc.). The transmission reliability standards should be clearly specified on a readily-understandable basis that: • identifies the starting condition for the transmission studies; • defines the test that will be performed on the system; and • states what constitutes acceptable system performance.
Fit for purpose	The framework should not be a "one size fits" approach. Rather it should allow for reliability standards to differ according to, say, the significance or criticality of the load centre — e.g. between CBD, metro and rural areas of a jurisdiction — or according to explicit customer valuation of reliability at each connection point.
Amendable	The specific requirements and many of the processes should be able to be amended without requiring legislative approval; either through approval by the various regulatory bodies involved or an open consultation process.
Accountability	TNSPs should be accountable to the appropriate authority for meeting the transmission standards, as well as to the AER for meeting the resultant service standards, as this is an integral part of regulatory incentive regime. If standards were set by a jurisdictional authority, it would most likely follow that the TNSPs would be accountable to that jurisdictional authority.
Technology neutral	Standards should be technologically neutral, and not be biased towards network solutions where other non-network options

Principle	Explanation
	can provide a comparable level of reliability.
Maintains the ability to achieve consistency between transmission and sub-transmission standards	The ability to achieve consistency between the form of standards and associated planning methodologies at the transmission and sub-transmission level is *one* important element in least-cost joint planning of transmission and sub-transmission networks to deliver the appropriate level of reliability at each connection point. Other important elements that contribute to economically efficient network design—which are beyond the scope of the Panel's mandate—include: • the consistency of the different regulatory tests for transmission and distribution networks; • the effectiveness of any joint-planning arrangements; and • the regulatory incentive regime for transmission and distribution networks.
Effectiveness	The framework should enable investment to proceed in a timely manner and will meet customers' expectations for reliability and minimise the potential for disputes. The framework should recognise customers who have made long term investments in the expectation that the standard of reliability would be at least maintained into the future. The framework should allow for national and international comparison of standards in consistent formats.

3.8.1 Panel's considerations and reasoning

3.8.1.1 Transparency

The Panel agrees that a wider interpretation of the principle of transparency is needed and that the facets of transparency put forward in submissions have considerable merit.

Consequently, the Panel considers that transparency requires:

1. a clearly defined process be used to derive the standards. This process should involve public consultation processes akin to those imposed on the AEMC under the NEL for Rule making;
2. the use of consistent terminology that provides a set of well defined reliability categories;
3. clarity and specificity in the standards resulting from the framework;
4. that standards be readily understood by market participants;
5. clarity in how the standards are applied and enforced;

6. the publication of the framework and the principles underpinning the framework;

7. that each TNSP's planning process be transparent and auditable; and

8. the use of a rigorous cost-benefit assessment methodology that is:

   (a) clearly set out in guidelines, which are developed using a public consultation process; and

   (b) consistently applied across jurisdictions.

3.8.1.2 Governance

The Panel considers an essential principle is that the governance arrangements for the NCF have the level of standards set by body independent of the TNSP that must apply those standards and be held accountable to them.

The Panel is of the view that standards will continue be set at a jurisdictional level, rather than a national level.

The Panel also considers that there is merit in having the framework allow jurisdictions the option of appointing an independent national body, such as the Panel or the Commission, to set the reliability standards under the national framework. Such optionality has been used effectively within the Australian federation in areas such as industrial relations, corporate law, income taxation, and other standards (e.g. food).

3.8.1.3 Economic efficiency

The Panel sees the development of reliability standards based on a sound economic basis as a fundamental principle that supports:

- the reliability of supply in the NEM;
- efficient capital investments across networks, generation, and demand-side response; and
- aligning the design of the network with the value of customer reliability.

3.8.1.4 Specificity of standards

The Panel considers that having connection point specific standards aids transparency, regulatory decision making, and the accountability and enforcement of standards.

3.8.1.5 Fit for purpose

The Panel considers the principle of fit for purpose standards promotes economic efficiency by allowing the design of the network to reflect:

- the appropriate balance of costs and reliability benefits at different points of the network;
- the criticality of different loads; and
- wider policy objectives of governments (e.g. rural electrification objectives).

3.8.1.6 Amendable

The Panel considers that the *amendable* principle is desirable because it is consistent with:

1. Many aspects of transmission regulatory regime specified in the Rules, where legislative changes are not required and a body specified in the Rules is given delegated authority to change requirements or processes, following a public consultation process. Examples include:

    (a) Commission changing the Transmission Regulatory Regime and Pricing Principles (Chapters 6 and 6A of the Rules);

    (b) the AER being given authority to develop guidelines for transmission regulation; and

    (c) the role given to the Panel.

2. The general principle in the Rules that allow changes to the Rules via application to the Commission. The Commission then decides on the merit of the proposed change, with reference to the NEM Objective and can decide to make changes to the Rules. These decisions by the Commission do not require legislative approval, as the Commission is given delegated authority to make Rules on matters that are specified in Section 94 of the NEL and clause 18 of the Regulations.

3. Good regulatory practice, in that it provides flexibility to change aspects of the framework over time, while imposing strict checks and balances in requiring any such changes to be subject to an open consultation process. The Panel notes that in both South Australia and Tasmania, for example, there have been recent public reviews and consultations on potential amendments to both the form and the level of transmission standards (see Appendix B). These reviews were carried out by bodies independent of the transmission network owners in those jurisdictions, who are required to meet the standards. The Panel strongly supports such arrangements.

3.8.1.7 Accountability

The Panel considers that AER's suggestion for reporting on delivered network capability against the reliability standard at each connection point appears to be a facet the *accountability* principle. A framework which supports accountability by inference would facilitate reporting. Reporting against the reliability standards may be determined by the body which established those standards or may be undertaken by the AER under its powers.

3.8.1.8 Technology neutral

The principle of technological neutrality is supported by the Panel on the basis that it facilitates economically efficient investment by seeking to avoid distortions in investment between network and non-network options that can maintain reliability.

3.8.1.9 Consistency between transmission and sub-transmission standards

The Panel has decided to retain the principle of maintaining the ability to achieve consistency between transmission and sub-transmission standards.

The Panel concludes that it appears that VENCorp shares Grid Australia's desire to preserve the consistency between the standards and planning methodologies used at the transmission and sub-transmission and distribution levels.

The Panel notes the letter from the Queensland Government which emphasises the importance of this consistency, given that State's network topology and regulatory arrangements.[85]

The Panel considers the main concerns about including a principle of consistency between transmission and sub-transmission standards are:

(a) The creation of potential inconsistencies if there are differences in the forms of standards used for transmission and distribution networks. In particular, there is concern that if different forms of standards are used, this will result in different project assessment and evaluation methods being used, particularly if different regulatory tests are used to justify projects at the transmission, sub-transmission and distribution level. The consequence of this could be significant economic inefficiency and/or the risk of unacceptable reductions in the level of supply reliability (see discussion below).

(b) The inclusion of this principle in the NCF has the potential to proscribe the use of probabilistic planning methods, on an individual case-by-case project basis, in jurisdictions where this method is considered to be the most efficient and reliable approach to transmission planning.

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85 Queensland Government — Submission on Draft Report, pp. 1–2.

(c) Potentially sub-optimal joint-planning of transmission and distribution networks, resulting in inefficiencies arising from:

    (i) excessive capital expenditure;

    (ii) inadequate investment in the networks; or

    (iii) an inefficient use of lower cost, non-network alternatives—such as generation, network support and control services, and demand-side management—that can provide the same level of reliability as a network augmentation, or a level of reliability that better accords with the value or customer reliability at that connection point.

(d) Reduced reliability arising from inadequate investment in the networks, which could end up posing a significant cost on individual customers or the jurisdiction as whole under certain circumstances involving a single or a set of low probability events. There is a risk that such events might not have been adequately considered in the planning methodology or arise as result of the benefits of the project being systematically underestimated relative to its costs.

The Panel considers that one suggested enhancement to the Draft Report's Option E offers a way of allaying most of the concerns about this principle. The suggested enhancement is having the framework allow jurisdictions the option of applying probabilistic planning methods on a case-by-case basis.[86] The Panel believes that the inclusion of this optionality will provide a means for consistency between transmission and sub-transmission network planning to be maintained across jurisdictions, irrespective of whether they currently use deterministic or probabilistic planning methodologies at both their transmission and sub-transmission/distribution networks.

The Group is alone in opposing this principle, primarily because it does not see the materiality of the issue being significant and considers that it more than capable of being adequately managed through the joint-planning process of transmission and distribution network development.

The Panel disagrees with the Group on this matter and sees the ability to achieve consistency between transmission and sub-transmission standards as an essential principle for any NCF. The Panel notes:

(a) That is some jurisdictions, such as Queensland and New South Wales, there are stronger interactions between transmission networks and the sub-transmission networks owned by DNSPs, than there might be in other jurisdictions, such as Victoria.

(b) The strength of interactions between transmission and sub-transmission networks depend on a range of factors, including: a) the degree of meshing in the transmission network; b) the distances between load and generation

[86] AER — Draft Report Submission, p. 2–4; VENCorp — Draft Report Submission, p. 2–3.

centres; c) the ability to manage voltage and stability across the transmission and distribution networks; d) rates of load growth at different points on the network; e) the load densities and shapes at different locations on the network; f) economies of scale and scope; g) the lumpiness of investments; h) option value arising from flexible network design and switching arrangements; i) a lack of new transmission easements necessitating greater use of the sub-transmission network to maintain reliable supplies; j) relative costs of transmission and sub-transmission augmentations; and k) relative speed of development and commissioning.

(c) In some cases, meeting standards for sub-transmission or distribution networks can require significant investments to be made deep into the shared transmission network. Conversely, augmentations at the sub-transmission level can provide support the shared transmission network and delay or prevent augmentations to the transmission network.

However, the Panel believes that the Group's submission raises two important issues that will need further consideration by the Commission when it contemplates the Panel's recommendations against the wider policy matters relating to how such a framework will fit together with the Commission's other recommendations on the RIT-T and NTP role and functions. The three issues are:

(a) How to reconcile the Panel's support of the principle of maintaining the ability to achieve consistency between transmission and sub-transmission standards with the Commission's recommendation to the MCE (in the NTP Draft Report) that different regulatory tests for Transmission and Distribution networks are acceptable;

(b) How the NCF will accommodate differences across jurisdictions in the materiality of the interaction between the transmission networks and the sub-transmission networks owned by DNSPs.

3.8.1.10 Effectiveness

The Panel supports the principle of *effectiveness* and notes the MCE's desire that any new arrangements for transmission should not result in an extension of the time taken to commission required network augmentations.[87]

The Panel considers that appropriately established and transparent levels of standards are an important factor in facilitating the timely delivery of investment in meet customer expectations of reliability and minimise disputes.

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[87] COAG Communiqué, 13 April 2007 and supplementary COAG document, "COAG Reform Agenda – Competition Reform April 2007"; both available at www.coag.gov.au

However, the speed with which network augmentations are built depends on a range of factors, of which the reliability standard is but one. Other factors affecting the speed of network augmentation and its commissioning include:

- the assessment of proposed projects using the Regulatory Test and the time taken for this process to be completed;
- the degree of joint-planning required between TNSPs or between a TNSP and DNSPs;
- the time taken to identify, design and evaluate a range of alternative options and assess their feasibility prior to the application of the Regulatory Test;
- time taken to procure easements, planning and environmental approvals;
- construction lead times and waiting periods for vital equipment; and
- rapid changes in the development of new loads or generation that require transmission plans to be revised.

The divergence of views is submissions regarding whether effectiveness should be included as a principle, is based around a divergence of views on whether a probabilistic form of standards and associated planning methodology is as transparent and more prone to dispute because of that lack of transparency.[88]

The Panel is of the view that as long as standards are set in accordance with the other principles it is recommending—and that individual projects are subjected to the appropriate consultation and assessment requirements under the RIT-T—that a hybrid form of standards and planning methodology will result in the timely delivery of investment in meet customer expectations of reliability and minimise disputes. As discussed in Chapter 8, much of the debate to date on probabilistic versus hybrid forms of standard has overstated the differences between the two.

There is consensus on a shift towards setting the level of standards using a sound economic cost-benefits approach. The Panel considers that the use of an explicit, rigorously derived, VCR at the time when standards are being set can greatly assist in transparently signalling customer expectations of reliability and the value they place on reliability, and hence assist in setting appropriate connection point reliability standards.

The Panel notes that the AEMC has proposed a number of changes to the MCE for a new RIT-T, including thresholds, that are designed to facilitate rapid development of the network.

The Panel recommends that the AEMC re-examine the merits of the effectiveness principle, taking into account how a NCF might fit together with:

- the proposed RIT-T; and

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[88] Grid Australia — Submission on Draft Report vs. The Group — Submission on Draft Report.

- other, broader, aspects of the transmission regulatory regime that are designed to promote efficient investment in networks and between network and non-network investments.

3.8.1.11 Maintenance of at least past performance

The Panel has decided against a specific principle of *Maintenance of at least past performance* for three reasons.

- Firstly, and primarily, because the Panel agrees that such a principle can result in the entrenchment and continuation of inefficient investments in the case where the system or parts of the system are already overbuilt and network performance has been in excess of what would be expected even if extremely risk averse and quite economically inefficient grid planning standards had been in place.

- Secondly, the maintenance of network performance capability is more an issue that relates to accountability and enforcement, and is linked to a range of wider regulatory settings and processes.

- Thirdly, the maintenance of past performance can be achieved via the appropriate selection of a VCR.

The Panel recognises that for a range of reasons jurisdictions may wish to, or in fact do, impose such a condition. This is largely in recognition that customers make long term investments in the expectation that the ongoing reliability of the network will at least be maintained. As such, this point is recognised under the principle of *effectiveness*. This practice may continue into the future, but one of the key benefits of a NCF will be to give comfort to jurisdictions and policy makers that the setting of standards will ensure appropriate levels of reliability and be derived from sound economic and engineering principles. As such, there may be a reduction in the likelihood of jurisdictions mandating that standards must never decline over time, regardless of the circumstances.

The Panel notes that the AER have expressed support for an approach that increases the level of connection point reliability standards, where cost-benefit analysis indicates that an increased level of reliability is justified:

> "The AER supports the development of a default hybrid standard that would apply an iterative economic cost benefit comparison of the value of unserved energy at a connection point, against the cost of delivering a specific level of reliability. For instance, if the output of the economic modelling shows that with an N reliability standard there is a high value of unserved energy and the cost of moving to N-1 is less than the value of unserved energy, then the connection point would be classified as N-1."[89]

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[89] AER — Draft Report Submission, p. 3.

The Panel considers such an approach has considerable merit, because it creates a process whereby a jurisdictional body charged with setting the level of standards is required to compare the economic costs and benefits of a change in the level of connection points standards.

The AER's suggested approach appears to be similar to that employed in South Australia. In South Australia, there is a legislative requirement that limits a reduction in connection point standards, even when costs of meeting a past level of reliability exceed the current value of customer reliability at that point.[90] That is, the South Australian approach can be classed as a 'ratchet up' approach setting the level of standards at connection points.

The Panel strongly agrees with having a framework in which the level of connection point reliability standards are derived based on economic considerations, where the level of the reliability standard is set taking into account:

1. an explicit value of customer reliability to assess the benefits of reliability;

2. the expected costs of meeting that reliability standard; and

3. performance and technical requirements of the network.

However, the Panel also agrees that there are a number of situations where it is likely to be sensible and economically efficient to allow the level of standards to decline over time, including:

- where the system or parts of the system are already overbuilt and network performance has been in excess of what would be expected even if extremely risk averse and quite economically inefficient grid planning standards had been in place; and

- where assets become stranded. This can occur in cases where there is significant decline in load at a connection point, arising from a substantial decline in load served. For example, asset stranding could arise in the event of:

  – The loss of large electrical loads arising from factory or smelter closures;

  – Significant declines in population (e.g. migration out of country towns); and

  – Permanent reductions in household electricity usage —arising from a switch in energy sources (e.g. from electricity to gas appliances), energy conservation, or a significant increase in electricity prices (e.g. more cost-reflective prices or higher costs due to greenhouse gas abatement).

The Panel recommends that the AEMC revisit whether the principle of *Maintenance of at least past performance* should be a principle for the NCF, taking into account a wider range of policy considerations:

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90 See Appendix B for details of the South Australian approach to setting transmission standards.

1. The materiality of risks to dynamic efficiency posed by maintaining a level of standards that entrenches past investments in the network; noting that networks have high capital costs and long asset lives. That is, the Commission should consider the risks that the adoption of a such a principle could result in:

   (a) the continuing application of 'new gold leaf' to assets that are already unnecessarily 'gold plated'; or

   (b) the unnecessary maintenance of the performance of stranded assets.

2. The principles and interacting operation of other regulatory mechanisms, including:

   (a) the regulatory incentive regime;

   (b) the RIT-T and the regulatory test for distribution networks; and

   (c) guidelines and regulatory decisions made by the AER, which is charged with approving transmission revenues, monitoring TNSP performance, and some enforcement actions against TNSPs.

3. The role and functions of the NTP.

4. The expectations of customers, who, having made a long term investment, expect the level of reliability of the network to be at lest maintained.

3.8.1.12 Robustness

The Panel has not adopted the principle of *robustness* as defined by Grid Australia. A key emphasis in Grid Australia's definition is that the form of standards and associated planning methodology needs to be the same as that used in countries comparable to Australia in economic development and operating an electricity market. Grid Australia notes that such countries typically use deterministic standards. Other important concerns of Grid Australia are: that the standards be transparent; TNSPs can be held accountable; and that the performance of the system against the standards can be audited. Grid Australia sees deterministically expressed standards as being more transparent, easier to regulate, and more amenable to auditing and international benchmarking than probabilistic standards.

The Group and VENCorp disagree with Grid Australia.

The divergent views on the robustness principle are based on divergent views on the relative merits of probabilistic and deterministic standards and their associated planning methodologies; together with concerns about the confidence that can be placed in the reliability of a network developed from these differing approaches.

This issue is discussed in Chapter 8 and in a separate report by KEMA,[91] which is a supplement to the Panel's Final Report.

The Panel considers that both deterministically expressed and probabilistically expressed standards can be transparent, enforceable and auditable if they are developed in accordance with the other principles recommended by the Panel.

However, the Panel is of the view that, deterministically expressed reliability standards (which are based on an economic assessment at the time the level of standards is set) are easier to explain to governments, regulators and market participants than probabilistically expressed standards.

The Panel considers a framework developed under the principles outlined in this chapter would not push the boundaries of responsible regulatory regime design and development, and could be defended if scrutinised following any major reliability failure.

The Panel further notes that recognised attributes of a *robust* framework such as *transparency* and *accountability* are included as specific principles.

3.9 Submissions to Interim Report

Following publication of the Interim Report, the Panel held a stakeholder workshop for interested parties. The stakeholder workshop was attended by representatives from Grid Australia, VENCorp, The Group, and the Australian Energy Regulator. Each of these organisations broadly supported the principles for assessing the range of competing frameworks for nationally consistent transmission reliability standards.

Submissions to the Interim Report[92] were received from VENCorp, Grid Australia, and Energy Australia. Only the submission from Grid Australia commented on the principles for assessing the range of competing frameworks for nationally consistent transmission reliability standards. Grid Australia supported the principles.

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[91] KEMA 2008c, *Additional response regarding probabilistic planning methodologies*, Report to AEMC Reliability Panel, 31 July 2008. Available at http://www.aemc.gov.au

[92] Submissions to the Interim Report are available at http://www.aemc.gov.au/electricity.php?r=20071221.150018

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4 Options for change

This chapter discusses two broad options for developing a framework for consistent transmission reliability standards across the NEM:

1. consistency through the alignment of regional standards within a high level framework. This approach allows for regional differences within a common framework; and

2. uniform standards, universally applied; which represents one end of the spectrum for a nationally consistent framework

Also discussed are two key issues associated with any changes to the form and/or level of existing jurisdictional transmission reliability standards. First, the pros and cons of each broad option are discussed. Second, the costs and benefits of moving away from today's divergent jurisdictional standards to a more consistent national framework.

4.1 Before the NEM there were divergent standards, set regionally

Prior to the start of the NEM, transmission reliability standards were set on a regional (i.e. jurisdictional) basis. There was no formal framework to ensure "nationally consistent" standards, other than via joint TNSP planning and operation of the interconnectors joining the transmission grids of:

a) NSW and Victoria; and

b) Victoria and South Australia.

Informally, there may have been a degree of consistency provided via requirements on TNSPs to plan and operate their networks in line with "good industry practice"; and due to some standards (e.g. N - x) being derived from international "custom and practice".

This approach was consistent with the institutional arrangements in place prior to the establishment of the NEM, including the generally low level of interconnection between jurisdictions.

Under this approach, a degree of national consistency could arise by accident, rather than design, if all jurisdictions independently adopted the same form and level of transmission reliability standards, and applied them consistently to customers of similar types.

A somewhat more certain means of reaching a degree of national consistency using this approach would be for jurisdictions to agree to a common set of factors that each would have regard to when unilaterally determining their own standards. Agreeing on a common set of factors in this way could provide a "least change" option for moving towards nationally consistent framework.

In reality, there was no accidental alignment of jurisdictional transmission reliability standards, and this remains the case today (see Appendix B).

Since the mid 1990s, in the lead up to the start of the NEM, a range of national standards were developed for some aspects of the interconnected grid. This shift was prompted by the need to operate the NEM in a secure and reliable manner as a single control area and by the increased level of interconnection between jurisdictions, which means that electrical disturbances in one jurisdiction can affect the reliability of energy supplies in other jurisdictions.

4.1.1 Advantages

The benefits of a purely jurisdiction specific approach to setting standards include:

1. Accountability – since the jurisdiction "feels the heat" from consumers when there is a reliability failure, the jurisdiction should arguably be able to set the standards.

   In its submission to the AEMC, the Tasmanian Government — in proposing that a "level of general principles" would constitute a nationally consistent framework—states that "Tasmania would argue that reliability standards are legitimately the concern of those they affect and who pay for them".[93]

2. Flexibility – standards can be tailored to local conditions in each jurisdiction, taking into account:

   (a) historical expectations of reliability and nature of existing network;

   (b) load dispersion, density and growth within region;

   (c) nature of critical loads and economically important loads;

   (d) generation fleet mix and locations;

   (e) degree of interconnection with other NEM regions;

   (f) likelihood of localised critical contingencies — e.g. equipment failure;

   (g) effects of local climate on network performance envelope – for example, dust on circuits, lightning strikes, wind, heat, cyclones, icing, bush fires, etc.

3. It enables consistency of standards between TNSP and DNSPs within the jurisdiction, thereby facilitating least cost development of the network. This is material in those jurisdictions where the DNSP sub-transmission networks interact with the transmission networks to deliver the overall capability.

93 Department of Infrastructure, Energy and Resources (Tasmania) – Submission to AEMC National Transmission Planner Review, p. 2.

4. It is evolutionary, requiring few changes to existing networks, and to long term connection agreements. While significant changes to jurisdictional instruments and connection agreements will be required, these changes are likely to be fewer than those necessary to implement other alternative options.

It should be noted that standards can be tailored to local conditions under a national approach to setting the level of standards. In addition, while achieving consistency between transmission and distribution network standards might be easier under a jurisdictional approach to setting the level of standards, it might also be achieved under a national approach.

4.1.2 Disadvantages

However, there are some potential disadvantages to this approach, including that:

1. It entrenches jurisdiction specific network planning, which is at odds with the MCE's desire for a more co-ordinated development of the National Transmission Grid.

2. It may focus the attention of TNSPs on the development of their own networks in order to deliver reliable supply, potentially overlooking more economic means of meeting reliability standards, such as greater interconnection or network augmentations in other transmission networks that provide increased reliability benefits to loads on their network.

3. The existence of differing jurisdictional transmission standards may result in significantly different transmission network outcomes when the new Regulatory Test is applied to similar projects in different jurisdictions.[94] This has the potential to alter the economics of transmission relative to generation investments across the NEM.

4.2 Today's framework for transmission reliability standards

The NEM's existing framework for setting transmission reliability standards provides a degree of national consistency through a range of mechanisms:

1. NEM-wide power system performance standards relating to the operational timescale, which are contained in Schedules 5.1a and 5.1 of the Rules;

2. NEM-wide power system security standards, specified in Chapter 4 of the Rules; and

3. minimum connection point standards for loads, distribution networks, MNSPs, and generators connected to the transmission grid (Schedules 5.2 to 5.7 of the Rules).

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[94] That is, the Regulatory Investment Test for Transmission (RIT–T), developed by the AEMC as part of the National Transmission Planner Review.

The existing framework also allows transmission reliability standards to diverge across (and within) jurisdictions, through:

1. Allowing jurisdictions to specify network connection point reliability standards or performance standards with greater precision than in the Rules. These jurisdictional transmission standards complement the standards in the Rules and apply to both the operational time horizon and longer term planning horizons; and

2. Allowing negotiated standards of reliability to be higher or lower than the minimums, with agreed standards specified in connection agreements between network users and TNSPs.

Accountability for the performance of the bulk power system against the reliability standards is ensured via a range of interacting mechanisms:

- monitoring by the Reliability Panel of the level of USE in each jurisdiction;
- enforcement of the Rules by the AER;
- enforcement of transmission licence conditions, including with transmission codes, by the Minister or regulator in a jurisdiction;
- compliance with regulatory rulings made by the AER;
- AER imposed service standards, with performance incentives, and monitoring across the regulatory cycle;
- financial penalties relating to network performance that are specified in network connection agreements; and
- the exposure of TNSPs to general legal remedies for negligence.

To summarise, the overall framework is one in which there are minimum national standards for network performance and security in an operational timeframe, with a measure of discretion given to jurisdictions in setting specific standards that are consistent with the national minimum standards. The way in which jurisdictional standards are given effect, together with the form and level of those standards, is left to the discretion of the jurisdiction. There is scope for individual energy users to negotiate higher or lower reliability standards. At a broad level, there is a degree of national consistency in the accountabilities of TNSPs. All TNSPs have to answer to national institutions, such as the AER, jurisdictional regulators or governments, and network users.

4.3 Issues with existing framework

As discussed in Chapter 1, while the Rules specify a common set of standards for transmission, there are additional standards set at a jurisdictional level which affect the design, construction and operation of transmission networks.

ERIG noted that differences in jurisdiction specific standards and their interpretation could be leading to a pattern of investment in transmission networks across the NEM that is not as efficient as it otherwise could be and that this could be distorting the efficient balance of investment between transmission, demand side response, and generation. A specific issue raised by ERIG is that without a framework for greater national consistency in transmission standards, the projected benefits arising from the establishment of a National Transmission Network Development Plan and the development of a new Regulatory Test, would be significantly diminished. Greater consistency in transmission standards is viewed as key step in facilitating the efficient development of the national transmission network.

In agreeing to this review of jurisdictional transmission reliability standards, COAG stated the development of consistent national framework should proceed "with appropriate caution noting the different physical characteristics of the network, existing regulatory treatments in balancing reliability and costs to consumers, and that these standards underpin security of supply."[95]

Appendix B outlines how both the form and level of existing jurisdiction specific transmission standards differ across the NEM. Furthermore, jurisdictional transmission standards are imposed by a wide variety of legal and regulatory instruments, including: Acts of Parliament, Transmission License conditions, Transmission and Distribution Network Codes, Network Management Plans, Connection Agreements, and Planning processes.

In order to have a nationally consistent framework for transmission reliability standards, there will need to be broad agreement on the specification of the form of standards, and the mechanism by which the detailed standards are determined.

The Issues Paper sought views on:

(a) issues with the current arrangements;

(b) motives for establishing a framework for nationally consistent transmission standards;

(c) what such a framework means; and

(d) the steps necessary to establish a framework within the confederation of jurisdictions comprising the NEM.

Views on items (a) and (b) in submissions to the Issues Paper are summarised in Chapter 3. This chapter discusses the nature of a nationally consistent framework and the views on that expressed in submissions to the Issues Paper.

[95] COAG 2007, "COAG Reform Agenda — Competition Reform April 2007", p. 5 (available at www.coag.gov.au).

4.4 "Nationally consistent" framework

The notion of a "nationally consistent" framework is open to a range of interpretations, which potentially have very different implications for the design, construction and operation of the network and the costs of reliably and securely delivering power to customers.

A key factor in efficiently designing and operating transmission networks is that the level of reliability accords with the economic and/or social value placed on reliability. Power supply interruptions in a densely populated area will affect a greater number of businesses, transport networks, households and industries than the same interruption in a sparsely populated area. Also, the consequences of the loss of load in a densely populated area are likely to pose greater public safety issues than the loss of load in a sparsely populated area. Because of this, some loads are treated as critical, with a high level of network redundancy built in to maintain secure and reliable supplies, or in some cases with stand-alone back-up generation that operates when grid supplied power fails. For example, in a metropolitan area, an interruption to power supplies could cause failures of computer systems, telecommunications, railways, traffic lights, and the loss of mains power to critical loads such as hospitals. In contrast, the loss of supply to an isolated farm or a remote load will disrupt a smaller number of people and businesses and will most likely pose fewer public safety issues.

Efficient network design weighs up customers' valuations of reliability against the cost of delivering that reliability. The customers' valuations of reliability can be either explicit (i.e. explicit ex-ante values, expressed in $ by individual customers or groups of customers) or implicit (i.e. an ex-post, implicit value arising from the application of the mandated reliability standards). In instances where the valuation of reliability equals or exceeds the costs of delivery, it is a relatively straightforward decision to upgrade the network or pursue equally reliable non-network solutions that deliver the desired level of reliability. Where the costs of delivering the reliability by network augmentation exceed the customers' valuation of it, several other factors might come into consideration, including: a) government policies on electrification of rural and remote communities; b) potential lower-cost investments by the customer as an alternative to improve reliability, such as connection asset modifications and off-grid power supplies; and c) whether contracted network support and control services could be used to deliver the desired reliability for a cost equal to less than customers' valuation of reliability.

Another important, practical consideration is that transmission network standards and performance are maintained at levels which are at least as good as in the past, <u>provided customers value it at these levels</u>.[96] Australia's increasing dependence on

[96] In South Australia, the *Electricity Act 1996* (SA) obliges distribution network licence holders (such as ETSA Utilities) to maintain distribution network standards and performance at levels that are least as good as those that existed prior to the electricity industry reforms of the mid-1990s (see Clause 23(n)(v) of *Electricity Act 1996* (SA), available at http://www.legislation.sa.gov.au). This legislative requirement on distributors directly affects the network design and operational requirements of the SA transmission licence holder (ElectraNet SA) via its network access obligations to distributors. Also, the transmission network standards specified in the South Australian *Electricity Transmission*

digital technology is one reason for requiring highly reliable power supplies. Another reason is that businesses have (collectively) made substantial investments in their production capacity based on assumptions about the prevailing level of reliability. The Panel notes that political and policy considerations are likely to be taken into account by the MCE. A deterioration in network performance might be considered an indicator of serious shortcomings in the regulatory regime; or be interpreted, by some, as evidence that the policies which led to the establishment of the NEM have failed to deliver better quality services.

However, as discussed in Chapter 3, the Panel notes that there are two specific circumstances where it can be inefficient to maintain the same level of standards as in the past:

1. where the network is substantially overbuilt (or over-engineered), even when compared to highly conservative reliability planning standards; and

2. where there are stranded assets, which can result from a significant decline in load served at a connection point (e.g. smelter closure) or a decline in the level of reliability customers are willing to pay for.

The economic costs of maintaining the performance of such assets in line with past standards might be significant, and impose an ongoing burden on customers because of the high capital costs and long life of such network assets. It may be more efficient to let the performance of such assets decline over time to a level of reliability standard that accords with the customer valuation of reliability at that connection point; taking into account the reliability contribution such assets may have on other parts of the shared network.

Transmission network standards in Australia recognise the differing economic and social impacts of supply reliability in metropolitan and rural areas. In most NEM jurisdictions, the transmission network reliability standards for capital city central business districts are at higher level than in other metropolitan and rural areas. In addition, there is scope for parties connecting to the transmission grid to negotiate a higher or lower standard of reliability than the minimum standards set out in the Rules and in jurisdictional transmission standards.

The key implication of this is that a "nationally consistent" framework does **not** mean that a single level of reliability ("one size fits all") applies to all locations on the network. For example, developing a "nationally consistent" transmission framework would not mean that the reliability standard for electricity supplies to state capital CBD areas should be the same as the standard for part of the network supplying a modest, relatively remote load.

However, a "nationally consistent" transmission framework may mean that loads of similar size or critical importance should have the same reliability standard regardless of in which jurisdiction (or NEM region) they are located. For example,

Code implicitly seek to ensure that network performance is at least equal to that delivered in the past (see http://www.escosa.sa.gov.au/webdata/resources/files/080313-ElecTransCode_ETC05_V2_-Final.pdf).

should the level of reliability for, say, the Adelaide CBD and the Brisbane CBD be identical or not?

Finally, under any “nationally consistent” transmission framework, there should continue to be scope for parties to negotiate a different standard of service as part of their connection agreement, as long as this does not affect the ability of the network to meet the minimum standards applying to other users.

4.4.1 Elements of a framework

From a policy perspective, a framework for nationally consistent transmission reliability standards for network planning is likely to include:

1. a form of standard that is consistent across jurisdictions. Three forms of standard are possible: Deterministic; Probabilistic; and a Hybrid that allows deterministic standards to be expressed probabilistically or probabilistic standards to be expressed as an equivalent deterministic standard;

2. a clear statement of who is responsible for setting the level of standards;

3. a transparent process for setting and regularly reviewing standards; and

4. the scope of the standards being clear as to their coverage and specificity.

4.4.2 Submissions to the Issues Paper

There are divergent views in submissions on the meaning of a nationally consistent framework and the elements that would comprise the framework.

The AER, ESIPC, Grid Australia and EnergyAustralia do not consider it necessary for a single, uniform, national standard to be established. “The AER does not consider that this review needs to set a single national reliability standard.”[97] Grid Australia notes that the MCE charged the AEMC with the task of developing a framework for nationally consistent transmission reliability standards, with the setting of the level of standards being carried out on a jurisdictional basis within that framework.

> “Grid Australia believes that a nationally consistent framework for reliability standards could be represented by a consistent set of provisions, set out either in the NEL or the Rules that determines:
>
> - the form of the reliability standard, which should be consistent across jurisdictions;
>
> - the process by which that standard is set and reviewed; and

97 AER, Submission – Issues Paper, p. 1.

- the body responsible for determining the standard.

> Importantly, a nationally consistent framework does not necessarily mean that there is also a consistent level of reliability standard between jurisdictions."[98]

ESIPC opposes the establishment of a uniform standard, considering it to be unjustified on the basis of economic cost-benefit analysis carried out in South Australia. ESIPC also raise the issue of state sovereignty and the state-based recovery of network costs: "given that each state pays for the level of reliability that its customers receive, the Planning Council sees no reason why each jurisdiction should not continue to be free to determine the level of reliability that is appropriate for its constituents."[99]

The Tasmanian government has similar views to ESIPC:

"Tasmania believes that a nationally consistent approach could be at the level of general principles and does not necessarily imply a 'one size fits all' approach. Tasmania would argue that reliability standards are legitimately the concern of those they affect and who pay for them, that it is not yet clear there is a single best way to approach them and that no-one has demonstrated a need or net benefit from a one size fits all approach."[100]

In contrast, both the NGF and Group consider it incumbent on those who support the continued use of jurisdictionally set standards to demonstrate why they are needed in the NEM.

The NGF states:

> "It is potentially inconsistent to have a national electricity market with divergent state based standards that impact both reliability and security settings in the market. There would need to be a demonstration from the individual jurisdictions as to how having different standards delivers a net benefit compared with a single standard".[101]

The Group's view is that:

> "it is incumbent on those who wish to retain jurisdictionally based standards to demonstrate why the benefits would outweigh the added costs and economic inefficiencies of such a system. This question should be expanded to consider why, since the economic regulation of the TNSPs has been the responsibility of national regulators since the inception of the NEM, we should still persist with State-based transmission codes which usually address

[98] Grid Australia submission – Issues Paper, p. 7.

[99] ESIPC, Submission – Issues Paper, p. 1.

[100] Department of Infrastructure, Energy and Resources (Tasmania) – Submission to AEMC National Transmission Planner Review, p. 2.

[101] NGF submission – Issues Paper, p. 3.

> quite a number of other issues in addition to transmission planning standards."[102]

The NGF considers that "A 'nationally consistent' framework would define the scope, development, implementation, and administration of reliability standards applied by all transmission planning bodies in the NEM. It would mean that future development of the network should deliver the same average level of reliability, for comparable loads, right across the NEM."[103]

The Group considers that a "nationally consistent framework" means:

> "a standardised national approach for development, implementation, application and enforcement of policies, procedures and practices in the NEM, particularly where this will enhance the achievement of the NEM objective of optimal economic efficiency in the market."[104]

The Group also has clear views on what a "nationally consistent framework" **does not** mean.

> "In our view, it does not mean agreement to the adoption of a broad set of principles at the national level which still allow a wide range of discretion in their interpretation and application at either a jurisdictional or individual NSP level, which aptly describes the current situation in regard to TNSP planning and investment decision making. Equally, it does not mean the automatic adoption of the most stringent jurisdictional standard across the NEM, but a true harmonisation around an economically efficient level of network service provision."[105]

These differing views on what a nationally consistent framework means are reflected in the proposals put forward in submissions to the Issues Paper. The details of these proposals are discussed in Chapter 5. Chapter 6 and Appendices D and E set out refinements and clarifications to these initial proposals. These refinements arose in submissions to the Draft Report, and form the basis of the final set of options assessed by the Panel. Chapter 7 has the Panel's assessment of its recommended option against its final set of principles, which were outlined at the end of Chapter 3.

4.5 Consistency through the alignment of regional standards

As discussed above, the current NEM framework provides a significant degree of consistency in transmission reliability standards in the operational timeframe, but allows for some jurisdictional differences within that common framework. However, there is less harmonisation of standards over the planning horizon, and hence

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[102] The Group's submission – Issues Paper, p.14.

[103] NGF submission – Issues Paper, p. 3.

[104] The Group's submission – Issues Paper, p. 14.

[105] The Group's submission – Issues Paper, p. 14.

allowance for greater divergence across jurisdictions in the standards that underpin transmission network planning and investment decisions.

A move to a nationally consistent framework of transmission standards is therefore primarily concerned with standards that apply over the planning horizon, rather than the operational horizon.

There are at least four possible ways in which a nationally consistent framework of transmission reliability standards could be achieved through closer alignment of regional standards:

1. making the operational standards in the Rules more specific, thereby limiting the degree of discretion available to TNSPs in meeting the operational standards contained in the Rules;

2. expanding the transmission standards in the Rules to cover the planning horizon, as well as the operational horizon;

3. aligning *the form* of jurisdictional transmission standards across the NEM via coordinated changes to the jurisdiction specific instruments that specify the standards; and

4. aligning *both the form and the level* of jurisdictional transmission standards across the NEM via coordinated changes to the jurisdiction specific instruments that specify the standards.

Some of the above models for closer alignment of jurisdictional transmission reliability standards are likely to require adjustments to TNSPs' accountabilities, incentives, penalties and regulatory processes and determinations.

4.5.1 Submissions to the Issues Paper

There are two broad views expressed in submissions concerning how the framework would provide for a transition towards a more nationally consistent set of transmission planning standards.

First, there is a view that the framework should align the form, but not the level, of jurisdictional transmission standards across the NEM. This would be achieved via coordinated changes to the jurisdiction specific instruments that specify the standards. This first approach is supported by Grid Australia, the AER, ESIPC, the Tasmanian Government, and EnergyAustralia.

Second, there is the view that the framework should *both the form and the level* of jurisdictional transmission standards across the NEM via either:

(a) coordinated changes to the jurisdiction specific instruments that specify the standards; or

(b) changes to the National Electricity Rules; or

(c) through a new National Grid Code.

These three options under the second approach are supported, respectively, by VENCorp, the NGF and the Group.

4.6 Uniform standards, universally applied

COAG asked the MCE to "task the AEMC with reviewing transmission network reliability standards with a view to developing a consistent national framework for network security and reliability, for MCE decision"[106]. At one end of the spectrum of "nationally consistent frameworks", lies an approach of uniform standards, universally applied. Uniform standards, applied across the NEM, would ensure national consistency of transmission reliability. Under a uniform transmission reliability standard, the form and level of the standards would be the same across the NEM for loads which have the same implicit or explicit value of customer reliability.

For example, a uniform, deterministic, reliability standard could be applied when planning all transmission networks in the NEM, which required that the networks be built to deliver:

- N - 0 secure transmission for rural loads on a single circuit line;
- N - 1 secure transmission for all remaining areas other than state/territory capital CBD;
- N - 2 secure transmission for the state/territory capital CBD; and
- 0.002% reliability for each NEM region over the long term/10-year time horizon.

Alternatively, a uniform standard could have a form that is probabilistic, applied to all connection points with a similar value of customer reliability, and designed to deliver 0.002% reliability to each NEM region over the long term/10-year time horizon.

Any uniform standard could be above or below the existing jurisdictional standards. This could present considerable challenges in implementing the new standard, and have a number of costs and benefits. For example, as discussed in Chapter 3, it may result in a "disconnect" between the reliability standards of the TNSP transmission network and the DNSP sub-transmission network within the same jurisdiction. (Note that DNSP reliability standards lie outside the scope this Reliability Panel review).

[106] "Council of Australian Governments' Response to final report of the Energy Reform Implementation Group", Attachment A of Ministerial Council of Energy letter to AEMC, 3 July 2007 directing it to conduct the National Transmission Planner Review (Available at http://www.aemc.gov.au/electricity.php?r=20070710.172341).

4.7 Costs and benefits of moving to a uniform transmission standard

Any move towards a common form and level of "uniform" transmission standard across the NEM is likely to result in changes in the levels of transmission reliability and investment in jurisdictions over time.

A shift to a different form of standard could involve significant changes in the resources required for transmission planning. For example, probabilistic standards may require greater modelling and analysis than deterministic standards.

A uniform standard could be above or below the existing standards in various jurisdictions, resulting in a potentially significant change (either increase or decrease) in the capital and operational expenditures required to meet the new standard.

If significantly higher capital expenditure were required, this would contribute to an increase over time in the level of transmission charges faced by those connecting to and using the network. These higher charges may deliver higher level of reliability, consistent with value to customers inherent in the higher standard.

Conversely, the shift to a lower level of transmission standard could see a gradual reduction in capital expenditure and transmission changes, which may be seen as a benefit, consistent with a reduction in transmission reliability. It should be expected that any proposal to reduce the transmission reliability standard in a jurisdiction would likely draw close scrutiny, and a need for a compelling justification, consistent with the reliability needs and valuations of customers.

The transition to any new standard is likely to require special allowances to be made in TNSP Regulatory Determinations by the AER, which would flow on into transmission pricing structures.

4.7.1 Submissions to the Issues Paper

In submissions to the Issues Paper, there are three areas in which there appears to be a broad degree of consensus:

1. There is no proposal for a regime in which a uniform level of standard is applied to all connection points. All submissions recognise that it is economically efficient to align the level of standards at a connection point with the customer value of load at each point, where the value of load can directly or indirectly reflect the criticality of that load. The consequence of this is that standards can differ across connection points in a jurisdiction.

2. All submissions favour having standards specified on a connection point basis or some other specific basis (e.g. CBD, large regional cities, etc.), with a robust economic framework used to establish those standards.

3. No submissions favour the adoption of the highest level of jurisdictional standards as the uniform standard for the NEM. Conversely, any dilution of existing jurisdictional standards could only occur with the consent of the jurisdiction.

However, there are differences of view, relating to:

1. the costs and benefits of moving towards a common *level* of standards across jurisdictions;

2. who should be responsible for setting the level of standards and enforcing them;

3. whether, once the level of standards are established within an economic framework, it is also necessary to apply a full cost-benefit analysis to expenditure proposals that seek to ensure connection point reliability meets the standards; and

4. accountabilities of TNSPs and the body/bodies who set the standards

Views on the above matters are discussed further in Chapter 5, together with the initial position adopted by the Panel in its Draft Report. These views formed the basis of five Draft Report options (Options A to E), set out in Chapter 5, which the Panel sought comments on. Submissions on the Draft Report resulted in refinements and clarifications to these five options, which are discussed in Chapter 6. These refined options informed the development of the Panel's recommended option (Option F). Chapter 7 assesses Option F against the Panel's final set of principles, which were outlined in Section 3.8.

5 Specific options in the Draft Report

This chapter outlines a range of specific options, developed in the Draft Report, for a framework for nationally consistent transmission planning standards. These specific options were drawn from submissions to the Issues Paper, and reflect the different views of touched on in the last chapter. Also outlined is an option developed by the Panel, which draws on a number of the characteristics contained in submissions to the Issue Paper. There are five options (A to E). The Panel sought comment on these options in submissions to the Draft Report.

5.1 Summary of options contained in Draft Report

The submissions on the Issues Paper put forward a range of options for developing a consistent national framework for transmission reliability standards.

The options can be classified into five broad groups, as shown in Table 1. Options A through D were put forward in submissions, while Option E is an additional option developed by the Panel for consultation purposes.

5.2 Common features

Table 1 reveals a degree of consensus on four policy principles:

1. Transmission standards should be set independently from the body that has to comply with the standards.
2. There should be greater transparency in the process used to set standards and the level of standards should be specified on a connection point basis.
3. The level of standards should be economically-derived.
4. The framework should facilitate more efficient investment in transmission, generation and demand-side management.

It is also apparent that there is lot of common ground between Options A and B on one hand, and Options C and D on the other.

Option E is an additional option, developed by the Panel, which is based on the Panel's preliminary analysis. Option E incorporates many of the features on which there is consensus and contains a number of other features. This option is discussed further in Section 5.4 below.

The maintenance of consistency between transmission and sub-transmission standards is one area that distinguishes Options A and E from Options B, C and D. Options A and E appear to clearly allow such consistency to be maintained, while it is ambiguous, at best, whether this will be the case under the other three options.

Table 1: Options for a consistent national framework for transmission reliability standards — Draft Report

Features	Option A	Option B	Option C	Option D	Option E
Form of standard	Deterministic, derived from economic considerations (the 'hybrid' approach). Use consistent terminology. Preferably set out standard at each connection point.	Probabilistic, or Deterministic, derived from economic considerations (the 'hybrid' approach). If deterministic standards are used, projects should be subject to scrutiny to assess their economic efficiency.	Probabilistic or deterministic. "The potential benefits of a purely probabilistic approach need to be balanced against the benefits of a deterministic approach which is generally easier to understand."	Probabilistic, with more developed probabilistic assessments than currently used by VENCorp.	Hybrid form, common across NEM.
Scope of standards	Tailored to each jurisdiction. Allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction.	Common across NEM jurisdictions. Allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction, depending on customer valuation of reliability.	Common form and level of standard across NEM jurisdictions. Location specific standards are required, in which 'there would be limited discretion for planning bodies to deliver different reliability outcomes for generators and consumers across jurisdictions.'	Common across NEM jurisdictions. Allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction, depending on customer valuation of reliability.	Allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction, depending on criticality of load or an explicit valuation of customer reliability. Introduction of a national 'reference standard' on a 'for information basis', against which the standard levels in each jurisdiction can be compared.
Where are the standards specified?	Jurisdictional instruments. The standards could be published in the same place and in similar form across all jurisdictions (e.g. Annual Planning Reports).	Contained in a single instrument, such as the National Electricity Rules.	Contained in a single instrument, the National Electricity Rules.	National Transmission/Grid Code, which would replace existing jurisdiction specific transmission codes/license conditions and incorporate the technical standards currently set out in Schedules 5.1, 5.1a and other parts of Chapter 5 of the NER.	Framework expressed in National Electricity Rules. In order to give effect to the framework, it is likely that changes to the NER, NEL and jurisdictional instruments (laws, licenses, regulations, guidelines) will be required.
Process for setting standards	Clear transparent process for setting standards.	Clear transparent process for setting standards.	Regular, transparent reviews of form and level of standards.	Clear transparent process for setting standards.	Clear transparent process for setting standards.

Features	Option A	Option B	Option C	Option D	Option E
Who sets the level of standards?	Determined by each jurisdictional government, or a body appointed by the relevant jurisdictional government, separate from the TNSP. Periodically reviewed, prior to each TNSPs' revenue determination process	Determined by jurisdictional government or body appointed by government that is independent of the jurisdictional TNSP that owns transmission assets.	Determined by the AEMC on the advice of the Reliability Panel and AER.	Determined by the AEMC on the advice of the Reliability Panel and AER.	Determined by a jurisdictional authority separate from the TNSP. Establish an information base of standards, managed in a consistent way by individual jurisdictions or by a central authority, such as the National Transmission Planner. The format, structure and levels of the standards should be reviewed every five years.
Accountability of the standard setting body	To jurisdictional government	To jurisdictional government	To MCE	To MCE	To jurisdictional government
Accountability of TNSPs	To jurisdictional government and AER	To jurisdictional government and AER	To AER	To AER	To jurisdictional authority and AER
Retains consistency between transmission and DNSP sub-transmission standards?	Yes.	Uncertain, depending on whether 'hybrid' or probabilistic form of transmission standard is implemented. No, if framework is probabilistic standards (since DNSP sub-transmission standards are deterministic). Yes, if 'hybrid' form of standards is used.	Possibly, if the transmission standards are also applied to parts of the sub-transmission system that have a significant influence on the operation of the main transmission network. May not be achievable as DNSP sub-transmission standards are set by jurisdictions, and outside the role of the Panel.	No, because proposing probabilistic transmission standards, whereas DNSP sub-transmission standards are deterministic.	Yes
Drawn from submissions by	Grid Australia, AER, ESIPC, EnergyAustralia, Tasmanian Government	VENCorp	National Generators Forum (NGF)	The Group	Panel's additional option, based on preliminary analysis
Likely changes	Little or no change in SA; significant changes elsewhere including to State legislation, regulations and licences.	Little or no change in Victoria; significant changes elsewhere including to State legislation, regulations and licences.	Widespread changes, in which the form and level of the standard is specified in a single instrument, rather than in jurisdictional instruments.	Widespread changes, including several items which appear to be outside scope for this review.	Significant changes, including to NER, NEL, State legislation, regulations and licences

5.2.1 Who sets the standards?

All submissions to the Issues Paper supported a move to having transmission standards set independently from the body that has to comply with the standards. However, there was divergence of views on whether the standards should be set on a jurisdictional basis or a NEM wide basis.

VENCorp supports governance arrangements whereby the setting of standards is made by a body separate from any TNSP that owns assets in a jurisdiction. VENCorp states that in cases where TNSPs "own assets in the jurisdictions they have planning responsibility for…there seems to be a inherent conflict of interest in giving [those] TNSPs the responsibility for interpreting and applying existing jurisdictional standards."

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Grid Australia supports transmission reliability standards being set by jurisdictional governments or by bodies appointed by those governments. There are several reasons for this:

- A jurisdictional government, or its appointed proxy, is "in the best position to address the specific requirements of a given jurisdiction given its understanding of specific jurisdictional circumstances."[108]
- "It is also appropriate for the responsibility for determining reliability standards to be jurisdictionally based, given that it is the jurisdictional government that faces the political, social and public safety consequences of any failure in reliability in that jurisdiction. For that reason Grid Australia does not support the role of determining the level of reliability standards to be conducted by a national body, including the National Transmission Planner, the AEMC, the Reliability Panel or the MCE."[109]
- DNSP (sub-transmission) standards are currently set on a jurisdictional basis and there are no plans to change this. "The importance of consistency between TNSP and DNSP [sub-transmission] standards is a further factor supporting the determination of the level of reliability standards for transmission also at a jurisdictional level."[110]

"[Grid Australia] does not consider that the TNSP should have any responsibility for determining the reliability planning standard. A framework under which the standards are determined by a body separate to the TNSP is consistent with the current governance arrangements in each jurisdiction and complements the current

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[107] VENCorp, Submission – Issues Paper, p. 2

[108] Grid Australia Submission — Issues Paper, p. 12.

[109] Grid Australia Submission — Issues Paper, p. 12.

[110] Grid Australia Submission — Issues Paper, p. 12.

regulatory framework, which is based on a commercially motivated transmission service provider operating under regulatory incentives."[111]

The Group favours having the transmission reliability standards set by the AEMC "on the advice of both the Reliability Panel and the AER. The AEMC would be accountable to the MCE for this activity in the same way as it is accountable for all of its other functions and responsibilities".[112]

5.2.2 Dynamic efficiency — transmission, generation and demand-side investments

All submissions to the Issues Paper seek to establish a framework which facilitates efficient investment in transmission, generation and demand-side management.

It is recognised that transmission reliability standards, the interpretation and application of those standards by TNSPs, and the resulting transmission investment programme can all affect investments in generation and demand-side response.

VENCorp considers that the development of a consistent national reliability standard could more effectively harness the potential of non-network alternatives, such as demand-side management and Network Support and Control Services, in ensuring reliable energy supplies.[113] VENCorp also states that having standards specified in a range of jurisdictional instruments makes "compliance difficult and expensive, particularly for prospective investors and those participants that have interests in more than one jurisdiction."[114]

The AER states: "Poorly defined reliability standards also create unnecessary uncertainty for investors in generation. Transmission capacity and congestion is a key determinant of generation location decisions. In making their location decisions investors will need to form a view about changes to transmission congestion over time. Open ended reliability standards make future capital expenditure by the TNSPs less predictable, in turn making future congestion more difficult to predict."[115]

ESIPC note that confusion about reliability standards at specific customer exit points and generator entry points added to the confusion of investors in deciding where to locate new investments for loads or generation.[116]

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111 Grid Australia Submission — Issues Paper, p. 12.

112 The Group, Submission – Issues Paper, Attachment 3, pp. 15–16.

113 VENCorp, Submission – Issues Paper, p.2

114 VENCorp, Submission – Issues Paper, p.2

115 AER, Submission – Issues paper, p. 3

116 ESIPC, Submission – Issues Paper, p. 2.

5.3 Preferred frameworks—submissions to Issues Paper

5.3.1 AER's framework

The AER's proposed framework is designed to improve the clarity, transparency and independence of the transmission reliability standards used across the NEM.

The AER suggest a framework for nationally consistent reliability standards in which standards:

- "are set following a transparent process, a rigorous cost-benefit assessment and thorough public consultation;
- are set independently of the transmission network service provider;
- are as specific as possible, preferably outlining the reliability standard to be achieved at each connection point; and
- are set in such a way as to be neutral between the technologies that are used to meet the given standard." [117]

"Establishing these high level principles would not require the formation of a one size fits all model. For example, the models currently used in South Australia and Victoria, whilst varying significantly, would still be consistent with the high level principles outlined above."[118]

5.3.2 ESIPC's framework

ESIPC considers "the purpose of any national framework should…concentrate on ensuring that generators, investors and customers can readily identify and understand the reliability standards that apply at various points in the network both within and across states."[119]

Under ESIPC's proposed framework each jurisdiction sets what it considers an appropriate level of transmission reliability, using a consistent terminology, and employing a transparent process for setting the standard. The outcomes of the process should be transparent and published in the same way across all jurisdictions.

In developing such a framework, ESIPC recommend that the Panel focus on:

- *Consistent terminology*. Providing a set of reliability categories that are well defined and that must be used in each jurisdiction.
- *Transparent recording* of connection point reliability standards and the period of time over which conformance with that standard is expected to be maintained.

117 AER, Submission – Issues paper, p. 3

118 AER, Submission – Issues paper, p. 3

119 ESIPC, Submission – Issues Paper, p.

This information should be published in the same place (e.g. the Annual Planning Report) and in a similar form by each jurisdiction.

- *Accountability*. TNSPs should be held accountable for targeting, achieving, and demonstrating that they achieve, the right reliability level. The approach used in South Australia is for ESCOSA to independently review the reliability standards on an economic basis every five years so that the new standards are published prior to the TNSP going through its Revenue Proposal process.

5.3.3 VENCorp's framework

- VENCorp supports the introduction of a common reliability standard across the NEM. It states that the standard should be:
  - widely available;
  - have clear and unambiguous guidelines to enable it to be consistently and easily applied throughout each jurisdiction; and
  - are specified in one instrument, such as the NER.
- The setting, interpretation and application of transmission reliability standards should be done by a body that is independent from the TNSP that owns transmission in a jurisdiction.
- The framework for setting deterministic standards should give greater consideration to the economic costs and benefits associated with that standard. VENCorp considers that: [120]
  - "Tying reliability to an 'N – x' standard may lead to uneconomic investment results because to take that standard to its logical extreme would involve the duplication (and triplication and higher) of every component of the transmission system. It is more apt to be described as a 'redundancy standard' rather than a reliability standard. Even if different redundancy standards are adopted for say rural and CBD areas, it is unlikely that on their own they will achieve efficient outcomes."
  - "…no matter what reliability standard is chosen…if the standard is set too high or too low, it will result in allocative inefficiency because it encourages over-building or under-building". Without a cost-benefit analysis of transmission investments, there will be allocative inefficiency because the smearing transmission costs across customers results in a disconnect between value customers assign to reliability and the cost of the reliability delivered by an "arbitrary reliability standard".
- Transmission projects should be subjected to a economic assessment of costs and benefits.

120 VENCorp, Submission – Issues paper, pp. 2–3.

- A standard (be it deterministic or probabilistic) that used economic analysis of costs and benefits would facilitate more efficient planning across the network, by allowing for differing levels of reliability:
  - between CBDs;
  - within a CBD area; and
  - between CBD areas, metropolitan areas and rural areas.
- Reliability and security, while forming part of the NEM objectives, "need to be considered in the context of efficient investment, operation and use of the national electricity system. In other words, reliability and security are not attributes of the system that are to be achieved at any cost."[121]

5.3.4 Grid Australia's framework

- Grid Australia consider the framework should specify: the form of the standard; the process by which the standard is derived; and who derives the standard; but not specify the level of the standard.
- Grid Australia opposes the adoption of a single national standard because it views it as inconsistent with COAG's directive to the AEMC on the development of a consistent national framework for transmission reliability standards.
- As discussed in Chapter 3, Grid Australia suggest the following range of criteria be used in assessing the alternative frameworks for developing reliability standards and selecting a preferred framework:
  - economic efficiency;
  - transparency;
  - accountability;
  - effectiveness; and
  - robustness.
- "Grid Australia considers that the following framework best meets the assessment criteria …and should be adopted as the consistent, national regime for transmission reliability planning standards:
  - there should be a consistent *form* of reliability standard applied in all jurisdictions;
  - the form of reliability standard should be *deterministic, derived from economic considerations* (the 'hybrid' approach);

121 VENCorp, Submission – Issues Paper, p. 5

- the level of reliability standard should be determined by each jurisdictional government, or a body appointed by the relevant jurisdictional government, separate from the TNSP; and
- the level of reliability standard should be periodically reviewed, prior to each TNSPs' revenue determination process."[122]

- "The nationally consistent framework should be set out in the NEL and the NER, as appropriate. The entrenched framework would include the processes for setting the standards, the form of the standard and the bodies responsible for reviewing the standards in each jurisdiction."[123]
- "A deterministic standard derived from economic considerations ranks the highest of the alternative forms of reliability standards in terms of providing transparency, enhancing accountability and being robust. It also ranks above deterministic standards per se through the explicit inclusion of a link to the underlying costs and benefits of providing alternative levels of reliability at the time at which the standards are reviewed."[124]

It is understood that Grid Australia regards a framework along the lines of the existing South Australian arrangements to be consistent with these criteria.

5.3.5 The Group's framework

- The Group proposes a framework that switches to a probabilistic reliability standard across the NEM and uses a probabilistic planning methodology. "It may be reasonable to apply an economically based deterministic standard in limited circumstances where it is considered a full probabilistic planning assessment is not warranted. In these cases, the deterministic standard would be used as a surrogate for the proper economic value based standard in a much more streamlined planning and investment evaluation methodology."[125]
- "The national focus of the regulatory framework governing the transmission networks should be streamlined and made much more consistent across all jurisdictions in the NEM by:
  - Replacing the state-based transmission/grid codes with a single national transmission/grid code developed by the AEMC as an adjunct to, and complementary with, the Market Rules;
  - Transferring the technical aspects of network requirements and standards from the Market Rules to the new national transmission/grid code;

122 Grid Australia, Submission – Issues Paper, p.14

123 Grid Australia, Submission – Issues Paper, p.14

124 Grid Australia, Submission – Issues Paper, pp.14–15

125 The Group, Submission – Issues Paper, Attachment 1, p. 4

– Minimising as much as possible any residual jurisdictional variations from a uniform national approach to all matters covered by the new national grid code;

– Dispensing entirely with the role of Jurisdictional Planning Bodies under the Market Rules; and

– Establishing an independent National Transmission Planner that performs a broad range of network planning and operations coordination and oversight functions across the NEM."[126]

- "In our view, this regulatory and institutional framework would best meet the needs of market participants and maximize the prospects for achievement of the NEM Objective within the current NEM policy constraints set by the MCE and COAG."[127]

- "It would significantly enhance the transparency of TNSP activities and their accountability to network users, and it would materially improve the future investment climate for all new infrastructure in the main power system."[128]

5.3.6 NGF's framework

The NGF considers that three things are needed before a framework for nationally consistent transmission standards is established:

1. A clear statement of the policy problems that arise from the existing, divergent jurisdictional standards;

2. The development of assessment criteria that can be used to establish a range of potential frameworks and inform the selection of a preferred framework; and

3. Any framework for transmission standards needs to have regard to, and be consistent with, other transmission initiatives currently under development; such as: the establishment of the National Transmission Planner, Australian Energy Market Operator (AEMO), and the Regulatory Investment Test (RIT).

The NGF is open to the form of standards being either probabilistic or deterministic, and suggests the benefits of each need to be weighed up against each other.

Regardless of which form of standard is chosen, the NGF favours greater "transparency of the processes associated with the application of the the standards in the transmission planning and development programs".[129]

The NGF states that the key motivations for establishing greater national consistency of transmission standards across the NEM include: "reduced regulatory complexity,

[126] The Group, Submission – Issues Paper, Attachment 1, p. 4

[127] The Group, Submission – Issues Paper, Attachment 1, p. 4

[128] The Group, Submission – Issues Paper, Attachment 1, p. 4

[129] NGF, Submission – Issues Paper, p.2

better definitions of standards across all jurisdictions, increased transparency of application of standards, lower overall administration costs, and greater ability to review and reset standards as required in the future."[130]

The NGF put that "It is potentially inconsistent to have a national electricity market with divergent state based standards that impact both reliability and security settings in the market. There would need to be a demonstration from the individual jurisdictions as to how having different standards delivers a net benefit compared with a single standard."[131]

"A 'nationally consistent' framework would define the scope, development, implementation, and administration of reliability standards applied by all transmission planning bodies in the NEM. It would mean that future development of the network should deliver the same average level of reliability, for comparable loads, right across the NEM."[132]

"The benefits of moving to consistent standards is likely to be delivered by a single instrument, possibly part of the NER, that defines the nature of the standard (e.g. probabilistic, deterministic or hybrid) and at what locations in the network they are to be applied. In other words, there would be limited discretion for planning bodies to deliver different reliability outcomes for generators and consumers across jurisdictions. A single instrument will facilitate reviews and changes to standards as and when required."[133]

The NGF suggests that four implementation steps are required:

1. "AEMC to undertake the assessment of the net benefits of a national transmission reliability framework against an agreed set of criteria;

2. So long as there are no obvious net costs, the AEMC should develop a national transmission reliability standard framework, consistent with the National Transmission Planner arrangements for jurisdictional stakeholder and MCE approval;

3. Once approved, the Reliability Panel could develop a proposed form and level of a transmission standard – in consultation with the AER and market participants.

4. AEMC to implement the new framework with agreed standards in accordance with a timetable agreed with the transmission planning bodies."[134]

130 NGF, Submission – Issues Paper, p.3

131 NGF, Submission – Issues Paper, p.3

132 NGF, Submission – Issues Paper, p.3

133 NGF, Submission – Issues Paper, p.4

134 NGF, Submission – Issues Paper, p.6

5.3.7 Tasmanian government's framework

The Tasmanian government indicates that there are few benefits from changing its existing arrangements, in which the standards are set by the jurisdiction, and the form of standard is deterministic, within an economic framework.[135]

5.3.8 EnergyAustralia's framework

EnergyAustralia (EA) supports harmonising the national framework for transmission reliability, noting that "care should be taken to address the differences that exist across States".[136]

EnergyAustralia supports Grid Australia's suggestion that a framework include the following three features:

- The Panel is the appropriate body to develop the national framework;
- A jurisdictional authority should set the standards for each Jurisdiction; and
- The framework should be a deterministic model, with economic considerations.

However, EA is concerned the new framework for transmission standards "might be inadvertently or inappropriately be [sic] applied to it"[137] and duplicate and/or overlap with the network reliability framework specified in its DNSP licence and the regular process for reviewing DNSP standards.

5.4 Panel's proposed framework — Draft Report

In its Draft Report, the Panel developed a further possible option (Option E) for a framework for nationally consistent transmission reliability standards. This option is based on the Panel's preliminary analysis, draws on many of the features put forward in submissions, and has some additional features.

The Panel's proposed framework included the following features:

1. A clear statement of the policy principles that underlie the selection of the framework (see Chapter 3). There appears to be a consensus on a number of the principles.

2. The framework to be specified in the Rules. In order to give effect to the framework, it is likely that changes to the Rules, NEL and jurisdictional instruments (laws, licences, regulations, guidelines) will be required.

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135 Department of Infrastructure, Energy and Resources (Tasmania), Submission on National Transmission Planner Review Issues Paper, received by AEMC 16 January 2007, p. 2, Available at http://www.aemc.gov.au/electricity.php?r=20070710.172341

136 Energy Australia, Submission – Issues Paper, p. 1.

137 Energy Australia, Submission – Issues Paper, p. 1.

3. A common form of standard, derived from economic considerations and expressed in deterministic form for ease of understanding (i.e. the 'hybrid' approach);

4. A specification of who will determine the level of standards, with requirements that:

   (a) the process used will be transparent; and

   (b) decisions on the level of standards at specific locations on the network should be based on sound principles of economic efficiency.

5. The level of standards would continue to be set on a jurisdictional basis, but:

   (a) using a much more transparent process; and

   (b) having the standards set by a body independent of the TNSP that has to apply the standard.

6. Level of standard should be clearly specified on a connection point basis and the level of standard could differ within and across jurisdictions.

7. The creation of an information base, managed in a consistent way by individual jurisdictions or by a central authority, such as the NTP, which provides a single point of reference on:

   (a) detailed information on reliability standards in each jurisdiction;

   (b) the national reference standard; and

   (c) comparison of connection point standards in a jurisdiction against the relevant national reference standard.

8. The creation of an information mechanism which involves the introduction of a national 'reference standard', on a for information basis, against which the standard levels in each jurisdiction can be compared.

9. The format, structure and levels of the standards should be reviewed every five years.

5.5 Panel sought views on each of the Draft Report's specific options

The Panel sought feedback on its proposed option for a NCF and the other options put forward in submissions to Issues Paper.

The Draft Report sought views on seven specific questions:

1. What do you see as the pros and cons of your preferred option against the other options?

2. How could the Panel's proposed option be enhanced?

3. Which of the options would be acceptable? That is, what could you live with, rather than what you would really like?

4. If the level of standards is reviewed every five years, well ahead of the AER's regulatory determination for a TNSP, how much time should be allowed for the new level of standards to be transitioned into effect and the TNSP is held accountable to those standards?

5. What would a national reference standard look like?

6. Which body should set the proposed national reference standard:

   – The National Transmission Planner when formed?

   – The Reliability Panel, which sets and reviews the 0.0002% Unserved Energy (USE) standard?

7. How do you see the NCF for planning standards meshing with the framework for transmission operational standards set out in Schedule 5.1 of the Rules? The Panel will commence a review of these transmission operational standards during 2008.

5.6 Panel sought views on the detailed provisions for the options

In its Draft Report the Panel also sought input from stakeholders on specific details of their preferred options, in order for the Panel to recommend a practical and implementable NCF. The Panel sought views on any areas considered significant in achieving the Panel's proposed draft principles for a nationally consistent framework set out in section 3.4. In particular, the Panel sought comments on the following range of questions:

1. To what connection points should connection point standards apply?

2. How could standards specified on a connection point basis (or an easily identified clustering of connection points, such as CBD, large metropolitan, rural, etc.) be used to specify the reliability standard applying to the shared network behind those transmission connection points?

3. To what extent are generator dispatch patterns provided for in determining the reliability at a particular connection point?

4. If a probabilistic standard is to be employed, how can performance against the standard be measured and hence network service providers be held accountable?

5. How should the costs and benefits of particular levels of reliability standard be measured? Where several approaches to measurement exist, what reasons are there for preferring one approach over others?

5.7 Responses to Draft Report's options

The next chapter contains a summary of views on the five options outlined above, and sets out the refined set of final options the Panel has assessed in order to formulate its draft recommendations to the AEMC.

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6 Final framework options for assessment

This chapter develops the final set of options for a framework of nationally consistent transmission reliability standards. This final set of options has been developed taking into account: the views in submissions on the Draft Report on the five options outlined in the last chapter; the Panel's final set of principles for a framework; and further consideration and analysis by the Panel.

6.1 Characterisation of the five draft options

The five specific options in the Draft Report (Options A to E) will henceforth be referred to as the 'draft options'.

6.1.1 Summary of main points of difference between the draft options

One of the key distinguishing features separating options A and E from options B, C, and D is the form of standards resulting from the framework.

Options A and E prescribe that a hybrid planning standard must be published for each connection point. A hybrid form standard can be expressed in the same way as a deterministic redundancy standard (e.g. N – x redundancy), but the level of the standard is set periodically using an economic cost-benefit analysis approach.

In contrast, options B, C and D all prescribe or allow a probabilistic form of standard.

Only options C and D propose the introduction of a nationwide standard level. Under this approach, the AEMC would set a nationwide standard on the advice of the Reliability Panel and the AER. All other options would allow jurisdictional bodies to set the reliability standard level under a single national framework.

Option D uses *both* a different form of standard (probabilistic) and applies a single set national level of standards to similar classes of connection points, regardless of jurisdiction.

Option E differs from the other options, and specifically from Option A, in that it introduces a *national reference standard* on a 'for information basis'. The purpose, setting and operation of the *national reference standard* were clarified by the Panel at its Public Forum on 30 April 2008.[138] The Panel stated that the proposed national reference standard would be set at a high level, rather than at a connection point level, so as to avoid unnecessary duplication of jurisdictionally set connection point standards. The purpose of the *national reference standard* is to provide a point of information, clarification and contrast against which jurisdictional standards can be compared.

[138] AEMC Reliability Panel 2008c, "Transcript of Proceedings—Transmission Reliability Standards Review Public Forum, held on Wednesday, 30 April 2008, Melbourne Airport Hilton", p. 22. Available at http://www.aemc.gov.au/electricity.php?r=20071221.150018

6.2 Stakeholders’ high-level assessments of the draft options and their preferred options

Below are high-level synopses of stakeholders’ assessments of the draft options, together with their consideration on what constitutes a preferred option.

Appendix E contains a more detailed, complementary discussion of the material below and provides further insight into:

- suggested variations to the draft options; and
- proposals on how specific features could be given effect.

These suggestions and proposals are broadly outlined below, and were put by stakeholders in response to the Panel’s Draft Report.

6.2.1 Grid Australia

- Grid Australia assessed all the draft options against the draft principles.
- Grid Australia’s preferred draft options are A and E, in that order, on the grounds that they, respectively, meet all and all bar one of the draft principles. Grid Australia also sees Options A & E as providing a better fit with current regulatory arrangements.
- Grid Australia ranks Option D the lowest, because Grid Australia considers it fails to meet most of the draft principles. Grid Australia consider that this is due to Option D’s use of probabilistic form of standards, applied on a case-by-case basis — rather than ‘easily understood’ deterministically expressed standards, which are derived from economic considerations in regular independent reviews before each regulatory reset.
- Grid Australia sees Options B & C as similar to Option D — primarily because, like Option D, Options B & C also use probabilistic standards and planning methods.

6.2.2 AER

- The AER prefers Option E over others on grounds that it is the option best able to satisfy the four high level principles the AER had initially proposed:
  - “following a transparent process, a rigorous cost benefit assessment and thorough public consultation
  - independently of the TNSP
  - as specifically as possible, outlining the reliability standard to be achieved at each connection point
  - in such a way as to be neutral between the technologies that are used to meet the given standard.”

- The AER suggests a number of enhancements to Option E, relating to:
  - "Providing clear guidance in the national framework on how the economic modelling should be undertaken by jurisdictional bodies and how the output of this modelling should be translated into reliability standards.
  - Allowing TNSPs the option of undertaking additional probabilistic studies in respect of particular transmission investment solutions and where this shows an economically more efficient solution, allowing the TNSP to submit this as a modified reliability standard.
  - Including in the deterministic standard expressions, a time allowance for customer reconnection in certain circumstances, to strengthen the technological neutrality of the model.
  - Considering the feasibility of TNSPs being required to report on delivered network capability compared to the reliability standard at each connection point."[139]
- The AER also suggests that consideration should be given to allowing:

  (a) the national reference standard to be set by the Reliability Panel, with different reference standards to generic groups of loads (e.g. rural, semi-rural, urban, etc.);

  (b) "…jurisdictions the option of appointing an independent national body, such as the Reliability Panel or AEMO, to set the reliability standards under the national framework." [140]

The AER's variant of Option E —which will be referred to as Option E2—is outlined in Appendix D.

6.2.3 VENCorp

VENCorp considers "that adoption of a deterministic (or hybrid) standard in Victoria would lead to the forfeiture of efficiencies gained in transmission investment by the adoption of a cost benefit analysis while maintaining a high level of transmission system reliability."[141] In support of this, VENCorp referred to its public consultation in 2001, which affirmed the continued use of probabilistic standards and planning in Victoria, several years after these replaced deterministic standards and planning methods there.[142] That consultation concluded that considerable efficiencies were likely to arise if Victoria adopted probabilistic standards and planning methods.

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[139] AER, Submission on Draft Report, p. 1.

[140] AER, Submission on Draft Report, p. 2.

[141] VENCorp, Submission on Draft Report, p. 10.

[142] VENCorp 2001, "Consultation Paper—Electricity Transmission Network Planning Criteria", VENCorp, Melbourne, p. 19.

> "With regard to the scale of the efficiencies that could be lost from VENCorp adopting a deterministic or hybrid approach, VENCorp has assessed the impact of moving to a strict N – 1 deterministic standard during a review of its planning approach conducted in 2001. This analysis showed that VENCorp's cost-benefit approach, on average, resulted in a 3-year deferment in an investment from the N – 1 timing. Across VENCorp's augmentation at that time, this resulted in a $32.4M total present value cost saving (in 1991 dollars) over all projects over an n-1 approach." [143]

VENCorp also sought to demonstrate this using a present day example of the assessment of a transformer augmentation using both deterministic and probabilistic planning methods. [144]

VENCorp sought to:

> "…clarify that we do not believe the South Australian model or a hybrid model per se to be deficient or defective; rather, given the Victorian system, VENCorp's planning responsibility for the shared network portion only and the way that the network has been planned in the past, the South Australian model, like a pure deterministic/redundancy standard, would seem to achieve a less efficient investment result for no discernable difference in transmission network reliability."[145]

To address the concerns raised above, VENCorp's submission on the Draft Report contains a new option proposal, developed by VENCorp as a modification to the Panel's proposed Option E. This will henceforth be referred to as Option E1, and is detailed in Appendix D.

- VENCorp considers the three distinguishing features of Option E1 are:

  (a) Flexibility in the expression of standards, which are derived from an economic—technical analysis that is consistent with the NCF. Option E1 provides jurisdictions with the option "to choose whether they will convert their analysis under the Framework to a deterministic equivalent for each connection point (as is done in South Australia for connection points) or apply the Framework on a case by case basis to all potential and actual network augmentations (like Victoria).

  (b) It allows individual jurisdictions to elect whether to use probabilistic planning methods on a project-by-project basis, if it considers that this approach results in economic efficiencies.

  (c) It contains, as a principle, the publication of economic and technical parameters, assumptions and assessment methodologies (e.g. cost-benefit analysis, a nationally agreed method of calculating VCR, generation

[143] VENCorp, Submission on Draft Report, p. 7.

[144] VENCorp, Submission on Draft Report, pp. 7–8.

[145] VENCorp, Submission on Draft Report, p. 8.

patterns, load assumption, network assumptions, outage probabilities, contingencies studied, etc.). VENCorp considers that this will increase transparency and accountability by allowing planning proposals and augmentations to be readily compared against each other, regardless of jurisdiction.

- VENCorp then seeks to assess how Options E and E1 compare to the Panel's draft principles.

- VENCorp concludes:

  - "the Framework proposed by VENCorp [i.e. Option E1] meets the RP's criteria or transparency, accountability etc and its 'features' criteria.

  - We believe that the suggested approach would allow for a more cohesive approach to planning to take place throughout the NEM without being too prescriptive in the manner in which planning takes place."[146]

6.2.4 The Group

- The Group prefers Option D, seeing it as the best option when assessed against all draft principles.

- The Group represents a significant group of private investors in the energy industry, who want:

  – Competitive neutrality between network and non-network investments;

  – Regulatory stability; and

  – Predictability in the likely outcome of future network planning decision-making.

- The Group considers arguments against probabilistic standards and planning methods as "lacking in credibility".

However, the Group:

1. Pragmatically puts forward a range of variations to specific features of its preferred model:

   (a) form of standards;

   (b) scope of standards; and

   (c) where the standards are specified.

[146] VENCorp, Submission on Draft Report, p. 10.

2. Explains how these variations to specific features relate to the specific features of other draft options and how these features could be implemented so as to:

   (a) allow Victoria to continue using probabilistic standards and planning methods;

   (b) further develop probabilistic standards and planning methods; and

   (c) facilitate the increased adoption of probabilistic standards and planning methods across the NEM over time.

The Group's variants of Option D —Options D1 to D5—are outlined in Appendix D.

The Group concludes by urging that Panel to publish an interim report for comment, which includes:

- The final list of principles or assessment criteria used by the Panel;
- The final list of options assessed;
- A summary of the analysis undertaken to assess each of the options and compare them; and
- The Panel's interim findings and draft recommendations to the AEMC.

6.3 Final set of options to be assessed

The Panel has developed a final set of options for an NCF, which are to be assessed against the final set of principles outlined in Chapter 3.

The final set of options have been formulated having regard to:

1. The Panel's further consideration of the principles on which a NCF should be built and against which options should be assessed (Chapter 3);

2. The draft options derived from submissions to the Issues Paper (Chapter 5);

3. Stakeholders' high-level comments on the draft options (Section 6.2);

4. Stakeholders' detailed comments and suggestions concerning the draft options (Appendices D and E);

5. Further assessment by the Panel of one particularly contentious feature of the draft options for an NCF—the form of standards. The divergent views of stakeholders concerning the relative merits of the draft options stems, in large part, from concerns regarding probabilistic versus deterministically expressed hybrid forms of standard and their associated planning methods. Different views on merits of different forms of standard and their associated planning methodologies directly affect stakeholder assessments of options against a range of framework principles. Specific concerns are raised about the transparency, accountability and efficiency of probabilistic and deterministically expressed

standards; both of which would be derived from economic and technical assessments under all the proposed NCF options. Chapter 8 summarises the Panel's analysis and assessment on these issues.

6. Advice from KEMA—an international power system engineering consultancy firm—on transmission reliability standards in six power systems (see Section 8.13);[147]

7. Further advice from KEMA[148] on:

   (a) The consideration and/or use of probabilistic standards and planning methods in British Columbia, California, New Zealand, and Victoria;

   (b) The Electric Power Research Institute's (EPRI) advocacy and ongoing research and development of probabilistic standards and planning methods, and the analytical tools required to support these methods;

   (c) The similarities, differences, advantages and disadvantages of:

      (i) deterministically expressed reliability standards (i.e. N – x); and

      (ii) probabilistic standards.

   (d) The similarities, differences, advantages and disadvantages of:

      (i) deterministic planning methods; and

      (ii) probabilistic planning methods.

KEMA's additional advice to the Panel is summarised in Section 8.14.

6.3.1 Final set of Options

The final set of options to be assessed by the Panel comprises:

- The five draft options (Options A to E) that appeared in the Draft Report. These are reproduced in Table 1;
- Variants of Option D, which have been proposed by the Group (see Appendix D). These variants are labelled Option D1, Option D2, and so forth; with the variations to specific features of Option D being displayed in blue text;

[147] See [1] KEMA 2008a, *International Review of Transmission Reliability Standards— Summary Report*, Report to AEMC Reliability Panel, KEMA Inc, Philadelphia, 27 May 2008; and [2] KEMA 2008b, *International Review of Transmission Reliability Standards— Detailed Summaries*, Report to AEMC Reliability Panel, KEMA Inc, Philadelphia, 31 July 2008

[148] KEMA 2008c, *Additional response regarding probabilistic planning methodologies*, Report to AEMC Reliability Panel, 31 July 2008. Available at http://www.aemc.gov.au

- Variants of Option E, which have been proposed by the AER and VENCorp (see Appendix D). These variants are labelled Options E1 and E2; with the variations to specific features of Option E being displayed in blue text; and

- A new option (Option F), developed by the Panel having regard to submissions to the Draft Report including the variants of Options D & E. This is presented in Table 2.

Table 1: Final options for a consistent national framework for transmission reliability standards — Draft options

Features	Option A	Option B	Option C	Option D	Option E
Form of standard	Deterministic, derived from economic considerations (the 'hybrid' approach). Use consistent terminology. Preferably set out standard at each connection point.	Probabilistic. If deterministic standards are used, projects should be subject to scrutiny to assess their economic efficiency.	Probabilistic or deterministic. "The potential benefits of a purely probabilistic approach need to be balanced against the benefits of a deterministic approach which is generally easier to understand."	Probabilistic, with more developed probabilistic assessments than currently used by VENCorp.	Hybrid form, common across NEM.
Scope of standards	Tailored to each jurisdiction. Allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction.	Common across NEM jurisdictions. Allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction, depending on customer valuation of reliability.	Common form and level of standard across NEM jurisdictions. Location specific standards are required, in which 'there would be limited discretion for planning bodies to deliver different reliability outcomes for generators and consumers across jurisdictions.'	Common across NEM jurisdictions. Allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction, depending on customer valuation of reliability.	Allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction, depending on criticality of load or an explicit valuation of customer reliability. Introduction of a national 'reference standard' on a 'for information basis', against which the standard levels in each jurisdiction can be compared.
Where are the standards specified?	Jurisdictional instruments. The standards could be published in the same place and in similar form across all jurisdictions (e.g. Annual Planning Reports).	Contained in a single instrument, such as the National Electricity Rules.	Contained in a single instrument, the National Electricity Rules.	National Transmission/Grid Code, which would replace existing jurisdiction specific transmission codes/license conditions and incorporate the technical standards currently set out in Schedules 5.1, 5.1a and other parts of Chapter 5 of the NER.	Framework expressed in National Electricity Rules. In order to give effect to the framework, it is likely that changes to the NER, NEL and jurisdictional instruments (laws, licenses, regulations, guidelines) will be required.
Process for setting standards	Clear transparent process for setting standards.	Clear transparent process for setting standards.	Regular, transparent reviews of form and level of standards.	Clear transparent process for setting standards.	Clear transparent process for setting standards.

Features	Option A	Option B	Option C	Option D	Option E
Who sets the level of standards?	Determined by each jurisdictional government, or a body appointed by the relevant jurisdictional government, separate from the TNSP. Periodically reviewed, prior to each TNSPs' revenue determination process.	Determined by jurisdictional government or body appointed by government that is independent of the jurisdictional TNSP that owns transmission assets.	Determined by the AEMC on the advice of the Reliability Panel and AER.	Determined by the AEMC on the advice of the Reliability Panel and AER.	Determined by a jurisdictional authority separate from the TNSP. Establish an information base of standards, managed in a consistent way by individual jurisdictions or by a central authority, such as the National Transmission Planner. The format, structure and levels of the standards should be reviewed every five years.
Accountability of the standard setting body	To jurisdictional government.	To jurisdictional government.	To MCE.	To MCE.	To jurisdictional government.
Accountability of TNSPs	To jurisdictional government and AER.	To jurisdictional government and AER	To AER.	To AER.	To jurisdictional authority and AER.
Retains the ability to achieve consistency between transmission and DNSP sub-transmission standards?	Yes.	Uncertain, depending on whether 'hybrid' or probabilistic form of transmission standard is implemented. No, if framework is probabilistic standards (since DNSP sub-transmission standards are deterministic). Yes, if 'hybrid' form of standards is used.	Possibly, if the transmission standards are also applied to parts of the sub-transmission system that have a significant influence on the operation of the main transmission network. May not be achievable as DNSP sub-transmission standards are set by jurisdictions , and outside the role of the Panel.	No, because proposing probabilistic transmission standards, whereas DNSP sub-transmission standards are deterministic.	Yes.
Drawn from submissions by	ETNOF, AER, ESIPC, EnergyAustralia, Tasmanian Government.	VENCorp.	National Generators Forum (NGF).	The Group.	Panel's additional option, based on preliminary analysis.
Likely changes	Little or no change in SA; significant changes elsewhere including to State legislation, regulations and licences.	Little or no change in Victoria; significant changes elsewhere including to State legislation, regulations and licences.	Widespread changes, in which the form and level of the standard is specified in a single instrument, rather than in jurisdictional instruments.	Widespread changes, including several items which appear to be outside scope for this review.	Significant changes, including to NER, NEL, State legislation, regulations and licences.

Table 2: Additional Option developed by the Panel since the Draft Report

Features	Option F
Form of standard	Hybrid form: • economically derived (using CVR or similar measure); and • capable of being expressed in deterministic manner.
Scope and level of standards	Applied on a jurisdictional basis. Allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction, depending on criticality of load or an explicit valuation of customer reliability. The body responsible for specifying the standard in any particular jurisdiction should be required to publish a report that: • compares the jurisdictional standard (specified at a high-level of broad customer types) to the corresponding national reference standards; and • provides a comprehensive explanation of any divergence between the jurisdictional and reference standards.
National Mechanisms	Introduction of a national 'reference standard' on a 'for information basis', against which high level standards for broad types of connection points (e.g. CBD, metro, rural) can be compared. The amendments would operate in conjunction with the new Regulatory Test for Transmission (RIT-T).
Specifying the standards	Framework expressed in National Electricity Rules. • In order to give effect to the framework, changes to the NER, NEL and some jurisdictional instruments (e.g. laws, licenses, regulations, guidelines) will be required. Standards specified in jurisdictional instruments. • The standards should be published in the same place and in similar form across all jurisdictions (e.g. Annual Planning Reports).

Features	Option F
Process for setting standards	Clear transparent process for setting standards including consultation.
Who sets the level of standards and publishes information?	Levels determined by a jurisdictional authority separate from the TNSP. Under the framework, each jurisdiction would have the option of appointing an independent national body — such as Reliability Panel – to set the jurisdiction's reliability standards The NTP to establish an information base of standards. The format, structure and levels of the standards would be reviewed every five years, and timed to fit appropriately with the periodic AER determination of the principal TNSP in each jurisdiction.
Development, review and application of standards	Each jurisdiction would have: **Pre-set standards**, where the jurisdiction standard setting body uses economic analysis to set standards, which are capable of being expressed in a deterministic form. The format, structure and levels of the standards would be reviewed at no greater than five year intervals. In addition, a jurisdiction may apply a: **Flexible application**, where the jurisdictional standard setting body could, at its option, allow a TNSP to defer an investment that would otherwise be needed to meet that standard if the TNSP could demonstrate that, under the prevailing circumstances, it would be uneconomic to proceed with the investment at that point in time. (Flexible application may also provide the opportunity to bring forward investments if justified by economic assessment). The framework would require assessment of a full range of hybrid (deterministically expressed) standards, which also include a time allowance in which the standard is required to be met. For example, a hybrid standard would be "N – (1 in 30 minutes)", meaning that a connection point must recover from a single contingency, but there would be an allowance of thirty minutes that permits a non-network technology (e.g. local generation or load management) to provide the redundancy.
Accountability of the standard setting body	The body that sets the levels of jurisdictional standards would be accountable to the jurisdictional government. The body that sets the national reference standards would be accountable through the NER to a body yet to be considered by the AEMC.
Accountability of TNSPs	To jurisdictional authority and AER. TNSPs required to report on delivered network capability compared to the reliability standard at each connection point.

Features	**Option F**
Retains the ability to achieve consistency between transmission and DNSP sub-transmission standards?	Yes, consistency can be maintained because: • all jurisdictions would have hybrid standards that are capable of being expressed in deterministic equivalent manner; • each jurisdiction could apply these hybrid standards to the joint planning of transmission and sub-transmission networks, regardless of whether a deterministic or probabilistic planning methodology is applied when applying the new RIT-T.
Likely changes	Significant changes, including to NER, NEL, State legislation, regulations and licences. The AEMC should consider recommending to the MCE an implementation program and process that involves relevant stakeholders.
Option Developed	Drawn from submissions and analysis by the Reliability Panel.

The next chapter assesses Option F against the Panel's final principles/criteria, which are specified in Section 3.8.

7 Panel's assessment of Option F against the final set of principles

This chapter explains the Panel's final recommendation for a nationally consistent framework for transmission reliability standards.

7.1 Panel's final recommendation

Option F is the Panel's final recommendation for a nationally consistent framework for transmission reliability standards.

In coming to this recommendation, the Panel has had regard to:

1. The performance of each option against the final set of principles/criteria laid out in Section 3.8;

2. The draft options derived from submissions to the Issues Paper (Chapter 5);

3. Stakeholders' high-level comments on the draft options—particularly those relating to Option E, which a number of submissions saw as the best or equal best of the draft options;

4. Stakeholders' specific suggestions on new features that could improve a NCF—particularly those suggestions that provide jurisdictions with the options of:

   (a) using flexible standards and probabilistic planning methods; and

   (b) nominating a national body to set jurisdictional standards.

5. Having a framework that is flexible enough to allow Victoria to continue using flexible standards and a probabilistic planning methodology on a case-by-case basis, and allowing other jurisdictions the option of doing the same. This is consistent with Victoria having a significantly different transmission planning and regulatory model to that employed in the other NEM jurisdictions;

6. KEMA's reports on the use of deterministic standards and planning methods in a selection of advanced industrialised countries; [149]

7. Further assessment by the Panel of one particularly contentious feature of the draft options for an NCF—the form of standards.

8. Further advice from KEMA on: [150]

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[149] See [1] KEMA 2008a, *International Review of Transmission Reliability Standards— Summary Report*, Report to AEMC Reliability Panel, KEMA Inc, Philadelphia, 27 May 2008; and [2] KEMA 2008b, *International Review of Transmission Reliability Standards— Detailed Summaries,* Report to AEMC Reliability Panel, KEMA Inc, Philadelphia, 31 July 2008

(a) The consideration and/or use of probabilistic standards and planning methods in British Columbia, California, New Zealand, and Victoria;

(b) The Electric Power Research Institute's (EPRI) advocacy and ongoing research and development of probabilistic standards and planning methods, and the analytical tools required to support these methods;

(c) The similarities, differences, advantages and disadvantages of:

(i) deterministically expressed reliability standards (i.e. N-x); and

(ii) probabilistic standards.

(d) The similarities, differences, advantages and disadvantages of:

(i) deterministic planning methods; and

(ii) probabilistic planning methods.

9. Interactions between transmission reliability standards and the transmission regulatory regime—including the new RIT-T.

The Panel's consideration and reasoning in making this recommendation follows.

7.2 Panel's considerations and reasoning

The Panel has four main reasons for preferring Option F as the framework for nationally consistent transmission reliability standards. Specifically:

1. It is genuinely national, and although the hybrid form of standards are derived economically they will be capable of deterministic expression and comparison;

2. It appears to provide the greatest degree of transparency and accountability of all the options considered;

3. It promotes economic efficiency;

4. Its implementation would allow a range of specific jurisdictional needs to be accommodated such as:

   (a) the capability to achieve joint transmission/distribution planning;

   (b) the capability for Victoria to continue to use its probabilistic planning methods on a case-by-case basis whilst providing a forward looking view of overall reliability standards; and

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150 KEMA 2008c, *Additional response regarding probabilistic planning methodologies*, Report to AEMC Reliability Panel, 31 July 2008. Available at http://www.aemc.gov.au

(c) the application and use of existing processes in jurisdictions that currently provide either hybrid standards or independent setting of those standards; and

5. It allows all jurisdictions the option of using flexible standards and probabilistic planning methods on a case-by-case basis if they wish as an adjunct to the pre-set standards.

7.2.1 Transparency

In assessing each of the options against the criterion of Transparency, the following judgements have been made by the Panel:

1. There is a high degree of transparency when the process for setting standards is clear, includes public consultation, and employs a methodology that is readily understood. Transparency is also enhanced by having standards that are specific, are expressed in a way that is readily understood by all stakeholders and which are comparable across jurisdictions.

2. The use of **pre-set standards** can provide a greater degree of transparency than **flexible standards**. This is especially the case if the flexible standards are not capable of being expressed in a deterministic manner. The reasons for this view include:

   (a) Standards set ahead of the regulatory period provide all stakeholders with a clear view of the reliability level that a TNSP is required to meet. This clarity assists the AER in setting capital expenditure for the next regulatory period and jurisdictions, the AER and network users in holding the TNSP accountable for delivery of that reliability.

   (b) Flexible standards, in particular those that are not capable of being expressed in a deterministic manner, are less readily understood by interested parties and require a greater degree of explanation. However, it is acknowledged that probabilistically expressed standards allow a wider range of reliability indices to be used compared to standards that are specified on deterministic (redundancy) basis — i.e. N – x.

3. Flexible standards that *are capable* of being expressed in a deterministic manner are more transparent than flexible standards that are *not capable* of being expressed in a deterministic manner.

4. Transparency is increased when there is an information base of standards, managed in a consistent way by individual jurisdictions or by a central authority, such as the NTP. Included in this information base would be information on the economic and technical methods, parameters and tests used to derive the level of standards and evaluate network performance against those standards.

5. National reference standards increase transparency by providing a means for jurisdiction specific standards—at a high level of connection point aggregation

(e.g. CBD, metro, rural, etc.)—to be compared to the corresponding reference standards and across jurisdictions.

7.2.1.1 Assessment of Option F

Option F is assessed as having a very high level of Transparency because it:

1. Has a national reference standard;

2. Is considered likely to result in the predominant use across jurisdictions of pre-set standards, which will either be deterministically expressed or capable of such expression;

3. Allows the flexibility for standards to be developed and applied through the progressive consideration of augmentations within a jurisdiction, on a case-by-case basis—but only as an option chosen by jurisdictions. For the most part, it is anticipated that standards will be pre-set—whereby the format, structure and levels of the standards should be reviewed at no greater than every five years; and

4. May place an explicit obligation on the body responsible for specifying the standard in any particular jurisdiction to publish a report that:

   (a) compares the jurisdictional standard (specified at a high-level of broad customer types) to the corresponding reference standards; and

   (b) provides a comprehensive explanation of any divergence between the jurisdictional and reference standards.

7.2.2 Governance

Good governance requires that the body that sets the standards is separate from the body that must apply the standard.

The principle of Governance is linked to the principles of Transparency and Accountability.

There are two primary reasons why there may be doubts about the adequacy of the governance arrangements of an option:

- Where flexible standards are used in place of pre-set standards, the accountability of the standard setting body might be open to question;

- Where pre-set standards are used, it is incumbent on each jurisdiction to set up an appropriately resourced, expert and experienced body — separate from the TNSP asset owner(s) — to develop and review the level of standards.

7.2.2.1 Assessment of Option F

Option F is assessed highly against the Governance criterion because, under Option F, standards are set by a different body to that which must apply the standard.

7.2.3 Economic efficiency

There are a number of facets to the criterion of Economic Efficiency that affect the rating of each of the options. The facets include:

- Setting of standards – are the level of standards set using an explicit CVR methodology based on sound economic-technical principles?
- Does the planning methodology used provide greater opportunity for economic efficiencies to be identified and tested on a case-by-case basis?
- Timing of investments — can the timing of investments be optimised, taking into account the reliability costs and benefits of delaying or bringing forward a network augmentation?
- Technology neutrality — by being technologically neutral, does the option facilitate an efficient allocation of investments between network and non-network investments that can deliver a similar level of reliability?

7.2.3.1 Assessment of Option F

Option F scores highly against the criterion of Economic Efficiency because:

1. It uses an explicit CVR methodology, based on sound economic-technical principles;
2. When pre-set levels of standards are used, it provides certainty for TNSPs and regulators when forecasting, designing and evaluating likely capital expenditures over the 5-year regulatory period;
3. It provides additional opportunities for economic efficiencies to be identified and tested on a case-by-case basis;
4. It enables the timing of investments to be optimised, taking into account the reliability costs and benefits, on an individual project basis; and
5. Arguably, it provides greater scope for non-network solutions to be considered when setting standards.

7.2.4 Specificity of standards

To rate well against the Specificity criteria, the framework should contain standards that:

1. Are clearly specified on a connection point basis or on some readily understandable basis (e.g. by geographic area, such as CBD, large regional city, etc.); and

2. Clearly:

   (a) identifies the starting condition for the transmission studies;

   (b) defines the test that will be performed on the system; and

   (c) states what constitutes acceptable system performance.

7.2.4.1 Assessment of Option F

Option F has standards that are specified on a load connection point basis. These standards can be either:

1. **Pre-set**—whereby the format, structure and levels of the standards should be reviewed at no greater than every five years; or

2. **Flexible**—the standards are developed and applied through the progressive consideration of augmentations within a jurisdiction, on a case-by-case basis.

The specificity of standards is potentially compromised when a jurisdiction opts to develop, review and apply the standards using a flexible approach. The reasons for this include:

1. Flexible standards can change over the course of a regulatory period, resulting in changes to the exact specification of the level of the standard at a connection point;

2. When flexible standards are used, over time there may be changes in:

   (a) the starting conditions for transmission studies;

   (b) the definition of tests performed on the system; and

   (c) what is considered acceptable system performance.

3. There are questions relating to:

   (a) how to specify the level of standards for the combined shared network and load connection points in Victoria, given that standards for these are respectively set—using a flexible approach—by VENCorp and Victorian DNSPs.

   (b) potential issues with the specification of standards in other jurisdictions if inconsistencies arise between the form of standards used at the transmission and sub-transmission level.

4. Concerns that the planning methodology used may not adequately test for rare, extremely low probability, compound contingencies, that have the potential to cause widespread, costly interruptions to supply. And, even if such rare contingencies are tested by the planning methodology, the CVR used to assess the costs and benefits of network upgrades might not be a true reflection of the costs and benefits associated with avoiding such a rare contingency.

7.2.5 Fit for purpose

Option F meets the criterion of being Fit for Purpose because it allows reliability standards to differ according to some explicit customer valuation of reliability at each connection point.

7.2.6 Amendable

An option would satisfy the Amendable criterion because it allows the specific requirements and many of the processes for setting standards to be amended without requiring legislative approval; either through approval by the various regulatory bodies involved or via an open consultation process.

7.2.6.1 Assessment of Option F

Option F rates highly against the Amendable criterion because although:

- the level of standards may be set before each 5-year regulatory period and set within instruments that are relatively difficult to change or which require legislative change or regulatory approval (e.g. transmission licences, the NER)

Option F allows a jurisdiction to elect to:

- have standards that can be changed within a 5- year regulatory period on a case-by-case basis by applying the framework's economic-technical methodology to re-set the reliability standard and then evaluate a range of options that can deliver to that new standard; and/or

- appoint an independent national body to set the jurisdiction’s reliability standards.

7.2.7 Accountability

The principle of Accountability is tightly linked to the principle of Transparency.

Accountability pertains to:

(a) the body that sets the level of the standards; and

(b) the bodies that apply the standards (i.e. network planners, asset owners, asset operators).

These bodies should be accountable to:

- network users;
- jurisdictions; and
- regulators.

TNSPs should be accountable to the appropriate authority for meeting the transmission standards, as well as to the AER for meeting the resultant service standards, as this is an integral part of the regulatory incentive regime.

If standards are set by a jurisdictional authority, it would most likely follow that the TNSPs would be accountable to that jurisdictional authority.

The body that sets the standards should be accountable to the jurisdictional government. Network users will also hold this standard setting body to account.

7.2.7.1 Assessment of Option F

Options F rates very highly against the Accountability criterion because it:

1. Has clear accountabilities for both:
   (a) the body that sets the level of the standards; and
   (b) the bodies that apply the standards;
2. Specifies the use of a hybrid form of standards that is capable of being expressed in deterministic manner;
3. Has national reference standards; and importantly
4. Requires TNSPs to report on delivered network capability (to load connection points) in comparison with the reliability standard.

7.2.8 Technology neutrality

The principle of Technology Neutrality is strongly linked to the principle of Economic Efficiency. Standards that are technologically neutral—and by definition not biased towards network solutions where other non-network options can provide a comparable level of reliability—can contribute to:

- the full and efficient utilisation of existing capacity before additional network capital expenditure is incurred;
- the efficient use of non-network technologies, such as network control ancillary services, in place of network augmentation; and

- an economically efficient balance between investments in networks, generation and demand side management.

7.2.8.1 Assessment of Option F

Option F is assessed highly against the criterion of Technology Neutrality because it allows a range of non-network solutions to be considered in setting standards and for these solutions to be considered not just every five years when fixed standard are reviewed, but possibly throughout the course of the regulatory period, on a project-by-project basis, if a jurisdiction opts for a more flexible approach to developing and setting standards.

However, Option F may allow technological bias to be introduced, as a consequence of a jurisdiction opting to modify the standard away from the level that is derived from the application of economic cost-benefit approach having regards to an explicit CVR as an input.

7.2.9 Maintains the ability to achieve consistency between transmission and sub-transmission

Maintaining the ability to achieve consistency between the standards and associated planning methodologies at the transmission and sub-transmission level is *one* important element in least-cost joint planning of transmission and sub-transmission networks to deliver the appropriate level of reliability at each connection point.

Other important elements that contribute to economically efficient network design include:

- the consistency of the different regulatory tests for transmission and distribution networks;
- the effectiveness of any joint-planning arrangements; and
- the regulatory incentive regime for transmission and distribution networks.

7.2.9.1 Assessment of Option F

Option F is assessed highly against this criterion because:

1. It provides scope for consistency to be maintained between transmission and sub-transmission standards in all jurisdictions, as a result of using a hybrid form of standards that is capable of being expressed in a deterministic manner;
2. It has a clear requirement that the form of standards be capable of deterministic expression.

7.2.10 Effectiveness

A framework that meets the criterion of Effectiveness should:

1. Enable investment to proceed in a timely manner;
2. Allow customers' expectations for reliability to be met;
3. Minimise the potential for disputes; and
4. Include allowance for governments to make decisions on the level of reliability taking account of a wider range of factors than might be considered by a body appointed to set the levels of connection point standards, using an economic cost-benefit framework that utilises explicit VCR estimates.

7.2.10.1 Assessment of Option F

Option F rates highly against the criterion of Effectiveness because Option F explicitly allows scope for jurisdictions to fast-track a transmission project by choosing to alter the level of the standard in specific circumstances.

7.3 Submissions to Interim Report and Stakeholder Workshop

Following publication of the Interim Report, the Panel held a stakeholder workshop for interested parties. The stakeholder workshop was attended by representatives from Grid Australia, VENCorp, The Group, and the Australian Energy Regulator. Each of these organisations broadly supported Option F as the preferred option for a nationally consistent framework for transmission reliability standards, subject to implementation detail.

Submissions to the Interim Report[151] were received from VENCorp, Grid Australia, and Energy Australia. All three submissions supported Option F as the preferred option for a nationally consistent framework for transmission reliability standards subject to the implementation detail.

Energy Australia expressed concern that sub-transmission could be captured by the national framework, which in most cases would result in the same asset being subject to two different (and potentially conflicting) sets of standards for reliability.

The Panel believes the proposed framework addresses Energy Australia's concerns in two ways. Firstly the framework has been developed to maintain the ability to achieve consistency between transmission and sub-transmission standards (Principle 9). This is intended to avoid conflicts between standards. Secondly, the scope and level of the standard are set by the jurisdiction, and most likely by the same institution that sets standards for DNSPs. As such, each jurisdiction is able to achieve the desired level of consistency between transmission and lower voltage networks, and could choose whether or not to include some, all or none of the sub-transmission under the national framework. The Panel acknowledges Energy Australia's point that sub-transmission (or sometimes known as dual function assets)

[151] Submissions to the Interim Report are available at http://www.aemc.gov.au/electricity.php?r=20071221.150018

is currently a subset of a transmission network under the Rules, and as such is an issue that will require attention when developing implementation details.

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8 Hybrid vs. Probabilistic standards and planning methods

In the course of this review there has been considerable debate about key features of a framework for nationally consistent transmission reliability standards:

1. the form of reliability standards:
   - deterministic;
   - hybrid;
   - probabilistic;
2. the relative merits of different forms of standards;
3. the process used to develop, review and set the level of standards, which can either be:
   (a) a pre-set process—whereby the format, structure and levels of the standards are reviewed at a fixed time intervals, but remain fixed between reviews.
   (b) a flexible process—whereby the format, structure and levels of standards are developed and applied through the progressive consideration of network augmentations, on a case-by-case basis.
4. the merits of two different planning methodologies that are used to assess whether individual investments meet the standards:
   - a deterministic planning methodology; and
   - a probabilistic planning methodology.

This chapter examines these issues in further detail, and concludes with the Panel's findings on the:

- form of standards;
- merits of different forms of standards;
- process for setting standards; and
- merits of different planning methodologies.

In coming to its findings on these matters, the Panel has been informed by: submissions to its Issues Paper and Draft Report; advice from KEMA (a power system engineering consultancy) on international standards and planning methods; a Public Forum on 30 April 2008; discussions with stakeholders; and the Panel's own research and analysis.

8.1 Background of the debate

Throughout this review there has been a strong divergence of views among stakeholders on what form of standards is appropriate for a nationally consistent framework.

These different views on the appropriate form of standard reflect fundamentally different perspectives on:

1. the transparency and accountability of different forms of standards.
2. the ease with which different forms of standards could be audited and compared to transmission planning standards in other advanced economies.
3. the extent to which different forms of standards can express the reliability of the power system to a range of contingencies.
4. the levels of reliability implied by different forms of standards, which is related to:
   (a) the levels at which standards are set; and
   (b) questions about the relative merits of probabilistic and deterministic planning methods to test power system reliability under a range of (low probability) contingencies; and
5. the economic efficiency arising from the application of different forms of standards using different planning methodologies. In particular, whether the form of standards and planning methodology limits the choice of:
   (a) technology solutions available (network vs. non-network); and
   (b) timing of investments;

   in ways that reduce the economic efficiency of investments made to deliver a given level of reliability.

The Panel's Draft Report noted the lack of consensus on the form of standards that should be specified in the framework:

- The adoption of probabilistic standards and a probabilistic planning methodology is advocated by the Group and by VENCorp.
- Most other submissions to the Panel's Issues Paper favour deterministically expressed standards (i.e. N - x), which are derived from economic considerations (i.e. a "hybrid" form of standard).

The Panel's Draft Report also noted that:[152]

(a) Although there were no submissions supporting purely deterministic standards, such standards exist in two jurisdictions (Queensland and NSW), whose amenability to change is not known.

(b) Purely deterministic standards do have some merits (e.g. consistency with international custom and practice) and will still need to be considered in comparing the pros and cons of the options.

(c) The Group's submission argues strongly for probabilistic standards versus deterministic. This submission represents the views of generation companies that collectively own one quarter of the installed generation capacity in the NEM, and who are actively seeking to make new generation investments that will contribute to the ongoing reliability of the NEM.

(d) GridAustralia's submission argues strongly for the retention of deterministically-expressed standards to, inter alia, preserve consistency with the sub-transmission networks owned by DNSPs, and to preserve the resultant joint least-cost planning and development.

The Panel's Draft Report sought further input on the question:

> Should the form of standards adopted within the national framework be hybrid (deterministic expression derived from economics) or probabilistic?

The Draft Report indicated that the Panel would investigate this issue further, taking into account independent advice on the form of standards and planning methodologies employed in a selection of electricity markets around the world.

8.2 Form of transmission standard and planning methodologies

There are two main forms in which a transmission reliability standard can be expressed. For a long time, transmission standards in many countries have been expressed in a **deterministic form**, along the lines of an 'N – x' standard. More recently, transmission standards in some jurisdictions have been expressed in a **probabilistic form**.

In addition, a so-called **hybrid form** of standard is sometimes used, in which the level of the standard is derived from economic and power system performance considerations, but expressed in deterministic terms. The economic and technical analyses used to set the level of hybrid standards typically employ a combination of deterministic and probabilistic planning methods.

Transmission network planners use different analytical techniques to assess whether the network meets these different forms of standard. These analytical approaches

[152] AEMC Reliability Panel 2008, *Towards a Nationally Consistent Framework for Transmission Reliability Standards, Transmission Reliability Standards Review - Draft Report*, 23 April 2008, Sydney, pp. 55–56.

and the responses they trigger to the network plan constitute the network **planning methodology** (see Table 1 below).

8.2.1 Deterministic form

A deterministic form of transmission reliability standard requires that the bulk power system can continue to provide adequate and secure supplies of energy to customers after any of a range of contingencies occurs. The contingencies involve outages (i.e. faults, failures) of some important elements of the power system, such as lines, transformers or generators. A deterministic standard does not take into account the probability of an outage. Taking into account these contingencies, planners and operators of the power system aim to incorporate sufficient redundancy so that any system failures can be prevented, either through automatic system protection mechanisms or manual intervention by operators. In the event of a contingency, the power system is required to remain within its performance parameters (e.g. flow limits, voltage levels, stability criteria), system security maintained, and all loads supplied without interruption from the contingency.

The contingency list plays a critical role in determining the level of reliability. The more comprehensive the contingency list, the lower the chance of a system failure from contingencies not listed.

When deterministic standards are used, they are often expressed as 'N – x', where x can be 0, 1 or 2, as discussed in Appendix A. An N – 0 security standard is often used when there is a radial line serving a load — if the line fails, there is no way the load can continue to be served by the network. Continued supply in this case can be provided by a back-up generator or, if the load is small enough, by stored energy (batteries). Greater reliability is provided by having each load supplied by more than one source, typically via a meshed network, but this is not always cost effective. The need for redundancy is the main reason that transmission networks are meshed. This meshing generally provides N - 1 secure or higher levels of reliability.

Deterministic standards have traditionally been used to plan power systems, and have played a key role in the delivery of high levels of power system reliability that people are used to in modern, industrialised economies.

Transmission planners use power flow modelling and other analytical techniques to assess the effects of each contingency on the power system. The effects of the contingency are assessed against the system performance and reliability criteria to determine whether any criteria are breached. Based on this analysis, measures of system reliability, such as loss-of-load probabilities, frequencies and durations can be calculated. This information then feeds into the design, planning and operational processes for the transmission network (see Table 1 and Section 8.6 below).

8.2.2 Probabilistic form

A probabilistic form of transmission reliability standard requires that the bulk power system be expected to provide adequate and secure supplies of energy to customers under a wide range of contingencies. A probabilistic form of transmission reliability standard explicitly takes into account the probabilities of contingencies (e.g. transformer failure rates) under a range of possible operating conditions (e.g. electric load levels, system states) that also have probabilities assigned to them. Each contingency is treated as a random event, with some events more likely to occur than others. Probabilistic modelling methods are applied to models of the physical power system to calculate expected values of system reliability measures, based on probability distributions regarding power system performance. The results of this modelling inform the design and planning of the transmission network (see Table 1 and Section 8.7 below).

A probabilistic transmission standard could, for example, be expressed as the likelihood of a customer at a given supply point being without supply or the likely time without supply. The existing NEM reliability standard of 0.002% USE is a probabilistic form of standard.

Victoria is the only jurisdiction in the NEM which uses a probabilistic transmission planning standard to supplement the operational standards in the Rules.[153] The Victorian transmission planning process treats operator responses to contingencies as deterministic events, but assigns probabilities to system states and contingent events. Probabilistic assessments are then made concerning the level of power system performance, with an economic value assigned to any customer load that is not served. If power system performance does not meet the probabilistic standards or if the estimated value of the lost customer load is greater than the cost of network operational actions (e.g. NCAS contracting) or augmentation, the transmission network plan is reviewed.

The probabilistic standards and planning methodology employed in Victoria is discussed further in Section 8.13.1. It is important to note that the Victorian approach uses a mixture of deterministic and probabilistic planning methods—see Section 8.13.1.— so is in fact a type of 'hybrid' approach to setting the level of standards and transmission planning. This is discussed further in Section 8.14.

8.2.3 Hybrid form

With a hybrid form of standard, the standard is derived from economic considerations, but expressed deterministically, for ease of understanding. The planning methodology used can be either the restricted probabilistic approach employed when deterministic standards are used or the comprehensive probabilistic methodology used with probabilistic standards (see Table 1 below).

Sometimes a probabilistic standard is expressed in an equivalent, but deterministic manner. For example, the NEM's 0.002% USE reliability standard is operationalised by NEMMCO into a deterministic standard for minimum level of reserve in each NEM region.

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153 VENCorp 2007, *Victorian Electricity Transmission Network Planning Criteria*, Issue No. 2, VENCorp, Melbourne, 3 May 2007. (URL http://www.vencorp.com.au/index.php?pageID=8070&action=filemanager&folder_id=497&sectionID=8246)

In South Australia, the transmission reliability measures are derived using probabilistic methods but expressed deterministically to facilitate understanding and comparison with the deterministic transmission standards in the SA Electricity Transmission Code.[154]

The South Australian standard setting and planning methodology is outlined in Section 8.13.2. It is similar to the Victorian approach, but differs in that:

- the level of standards are fixed over the course of the 5-year transmission regulatory period; and
- the level of standards is expressed in deterministically (i.e. N - x) for each load connection point.

[154] Electricity Network Owners Forum (ETNOF), Letter to Commissioner Ian Woodward, AEMC, received 5 November 2007.

Table 1: Forms of standards and associated planning methodologies

Form of standard	Description	Planning methodology used
Deterministic	• A type of redundancy standard. • The bulk power system is designed so that it can continue to provide adequate and secure supplies of energy to customers after any of a range of contingencies occurs. • The contingencies involve outages (i.e. faults, failures) of some important elements of the power system, such as generators, lines or transformers. • The probability of these outages is *not* explicitly taken into account (but may be implicit in the standard). • Standards are typically expressed as an (N – x) redundancy level, where N is the number of elements in service on the bulk power system and x is the number of those elements experiencing an outage.	• Using a range of probabilistic inputs – such as demand forecasts, generation patterns, and electrical flows — a model of the bulk power system is subjected to range of simulated contingencies. • Taking into account these contingencies, planners and operators of the power system aim to incorporate sufficient redundancy so that system failures can be prevented, either through automatic system protection mechanisms or manual intervention by operators. • In the event of a contingency, the power system is required to remain within its performance parameters (e.g. flow limits, voltage levels, stability criteria), system security maintained, and all loads supplied without interruption from the contingency. • In effect, the deterministic standard is applied to a limited, plausible, set of probabilistic planning scenarios, and the deterministic standard needs to be met in all cases. If the standard is not met, the operational and/or investment plans are altered until the standard is met. • An *implicit* value of customer reliability is an *output* of the modelling and planning processes. • The contingency list plays a critical role in determining the level of reliability. The more comprehensive the contingency list, the lower the chance of system failure from contingencies not listed. • Note that around the world, deterministic standards and planning methods have traditionally been used to plan bulk power systems.

Form of standard	Description	Planning methodology used
Probabilistic	• The bulk power system is designed so that it can continue to provide adequate and secure supplies of energy to customers following a wide range of contingencies. • The probabilities of contingencies (e.g. transformer failure rates) are explicitly taken into account. • The degree of reliability designed into the system is linked to explicit customer valuations of reliability. Higher valuations of reliability result in a higher level of redundancy, either at particular points of the network or the network as a whole.	• A wide range of probabilistic inputs are used in a model of the bulk power system, which is then subjected to wide range of simulated contingencies. • Probabilistic inputs include: demand forecasts, generation patterns, electrical flows, and contingencies (e.g. generation and transmission plant failure rates). • An *explicit* value of customer reliability is a key *input* to the modelling and planning processes. Different values of customer reliability can be used at different connection points, reflecting variations in the criticality of load and the willingness of customer to pay for reliability. • Each contingency is treated as a random event, with some more likely to occur than others. (Low probability, but high impact, contingencies that might be excluded from a contingency list used in deterministic planning approach, are included). • Probabilistic modelling is carried out, involving the repeated random sampling of contingencies and modelling the effects of the contingencies on the physical power system is carried out. • The results of this probabilistic modelling are used to calculate expected values of system reliability measures, based on probability distributions regarding power system performance. • The results of this modelling inform the operation, design and planning of the transmission network. • In effect, the probabilistic standard is applied to an extensive range of probabilistic planning scenarios. • If the standard is not met at any given point along the probability distribution of outcomes, the operational and/or investment plans are altered only if the explicit value of customer reliability exceeds the costs incurred in meeting the standard.

Form of standard	Description	Planning methodology used
Hybrid	• The bulk power system is designed so that it can continue to provide adequate and secure supplies of energy to customers after any of a range of contingencies occurs. • The standard is derived from economic considerations, but expressed in deterministic terms.	Because the standards are derived from economic considerations, much of the economic analysis which typifies probabilistic planning is part of the standard-setting process. Once the standards are derived, they are able to be expressed in deterministic form. A deterministic planning approach is then applied to those standards. Alternatively, a probabilistic approach can be applied on a case-by-case basis to assess a range of investment options that satisfy the deterministically expressed standards. This application of probabilistic planning methods potentially allows the timing of transmission network investments to be adjusted in ways that balance likely reliability benefits against the costs of a range of network and non-network options that can be used so as to meet the standard.

8.3 Redundancy versus Reliability

As discussed above (and in Appendix A), the reliability and security of the bulk power system can be managed at the planning and design stage and the operational stage.

At the planning stage, reliability and security can be enhanced through a range of measures, including:

1. building redundancy into the network, via:
   (a) duplication of key network elements, such as lines and transformers; and
   (b) meshing of the network—through the creation of loops and multiple electrical paths between different locations on the network;
2. co-ordinating investments between transmission, generation and loads across different locations on the network;
3. entering into short- and long-term network support contracts with generators and loads. These parties can change the level of energy production or consumption at different points of the network in ways that can increase the reliability or security of power supplies delivered by the network;
4. joint planning of transmission and sub-transmission networks in order to deliver a desired level of reliability;
5. interconnection with other regions; or
6. augmentation, re-configuration, and replacement of transmission network assets.

When there is a higher level of redundancy built into the system and the elements that comprise it, then it follows that the system should be better able to withstand contingencies such as the loss of an element. That is, in general, higher redundancy should mean a higher level of reliability.

However, as discussed in Appendix A, the level of reliability is also maintained in an operational time horizon through a range of actions, including:

1. the security constrained dispatch process for energy and market ancillary services;
2. operators acting to maintain power system security;
3. decisions on the scheduling of network and generation outages;
4. network switching;
5. enablement and use of network support and control services; and

6. NEMMCO interventions, which include contracting for additional reserves and issuing directions.

Given the high capital costs of network investments, long asset lives, and low probability of some contingencies (or series of contingencies), it is not always economically efficient to have the same level of redundancy at different points of the network. It might be possible to design and operate the network to deliver a desired level of reliability with a high degree of confidence; and do so with lower levels of capital and operating expenditure.

To summarise, the degree of redundancy in built into the network is affected by:

- the level of transmission standards;
- the contingencies that the bulk power system is required to withstand;
- the probabilities of those contingencies; and
- the economic costs and benefits arising from different ways of designing and operating the network so as to deliver a given level of reliability.

8.4 Level of transmission standard

The level of transmission standard plays a critical role in determining the reliability, security and costs of the network.

When the form of standard is deterministic, if the level of the standard has a greater level of network redundancy, this implies that the security of the network and its capital and/or operational costs will be higher. For example, an N - 2 secure network will be more expensive to build and operate than a N - 1 secure network.

A level of a probabilistic transmission standard can be set using a range of methods, but again if a high standard of security is set (e.g. a very low probability of power system failure), this implies higher capital and operational expenditure on the network.

Choices about the level of standard can be influenced by a range of factors, including:

- judgements about the criticality of particular loads;
- judgements about the economic value of lost load for particular customer classes;
- public safety;
- difficulty and cost of restoring the power system to normal operations following shutdown;
- economic benefits of secure and reliable power supplies;

- differing costs of network construction, operational actions, and non-network solutions (e.g. demand side response);
- compatibility with standards used in other modern "digital economies", in which production, commerce and many everyday processes rely on computer technology.

There may be little choice on the level of standard, if it is set by state governments, who may wish to take into account a range of other factors.

Existing jurisdictional transmission standards have been set having regard to historical levels of reliability, the factors listed above, and "good industry practice" concerning the operation of bulk power systems, which has developed internationally over the last 100 years.

Across the NEM, the level of transmission reliability standard is generally "N - 1 secure" for meshed parts of the transmission network, "N - 0 secure" for radial lines serving a single load in rural areas, and the equivalent of "N - 2 secure" in CBD areas.

8.5 Types of transmission network augmentation in the NEM

Augmentation of the transmission network may be characterised as being primarily associated with one of three portions of the network. Whilst there are multiple effects associated with most transmission augmentations, because of the meshed nature of such networks, the principal effect of most developments may be characterised as follows:

- Interconnection of the network between regions has offsetting effects on both generators and loads in adjacent regions through the market settlements process. Interconnection can also affect regional reliability, principally through the availability of adequate generation to meet loads, and the reliability of interconnecting transmission elements has an effect on that aspect of supply to customers.
- Regional reliability involves multiple components of the transmission network, normally shared by more than one participant. The region may be further characterised by the type of customer involved, for example as predominantly CBD, rural, or associated with a major customer; and
- Connection point reliability is normally associated with the dedicated connection assets that supply a DNSP or single customer. Such connection assets may be classified as negotiated transmission services, in the case of a supply to a single major customer. However, the connections between TNSPs and DNSPs are prescribed services, regardless of which party provides them.

A discussion of network planning processes follows, relating to these categories of augmentation. These different planning processes can employ deterministic or probabilistic planning methods, or a combination of both methods.

8.5.1 Transmission interconnection planning

Transmission interconnectors link adjacent NEM regions, which provide the regional connections between generation and load. The presence of an interconnector allows the sharing of generation resources between regions.

Interconnection results in market settlement prices in adjacent regions which will differ only due to the effect of electrical losses, up to the point at which the capacity of the interconnection constrains inter regional flows. Beyond the point where inter regional flows are constrained, the market settlement prices in adjacent regions diverge markedly. In the limit, where the capacity of the regional generation plus interconnector flow to a region falls short of the regional load, the market price approaches its limit of VoLL.

An interconnector augmentation permits potentially greater flows to take place between regions under the appropriate generation and load conditions. This has the following effects:

- there are offsetting financial effects on market participants (generators and loads) in adjacent regions. For a greater range of generation and load scenarios, the adjacent regional reference prices would be more closely aligned; and
- there would be a reduced likelihood that the available generation in one or both regions will be inadequate to supply the regional load.

The application of a probabilistic planning process using a plausible range of generation and load scenarios and under contingent conditions is necessary to determine the economic desirability of augmenting interconnection. That analysis needs to accommodate:

- hourly demand forecast scenarios;
- generation scenarios to match the demand, incorporating assumed generation availability rates and bidding assumptions;
- a range of technical network performance criteria and limitations; and
- the maintenance of system security for network contingency events, to ensure that the power system can continue to operate within its safety and technical requirements.[155]

This complex form of probabilistic analysis is required in order to enable a proposed interconnection augmentation to pass the market benefits assessment requirements of the Regulatory Test.

[155] Victorian Electricity Transmission Network Planning Criteria, VENcorp, 3 May 2007.

8.5.2 Regional reliability and connection planning

Within the transmission regions, the market effects that characterise interconnections are much less significant and the two functions and benefits associated with network augmentation are: a) its effect on the reliability of supply to customers; and b) improved transfer capability between connection points.. Whilst the probabilistic form of analysis outlined above can still be carried out to analyse network augmentations, there are less complex alternative ways to establish the need to augment the network.

8.6 Deterministic network planning processes

As outlined in Table 1, a deterministic planning process is characterised by analysis of the network with a view to ensuring that specific criteria, such as "N - 1", or "N - 2", are met at all times. The criterion may vary for different portions of the network or for different connection points. Augmentation of the network is proposed when a criterion can no longer be met, for instance through the growth of connected loads, for peak load conditions.

The deterministic planning criteria will usually embody the following factors:

- the nature of the load and the potential consequence of its interruption. Thus, for example, loads in a CBD or those associated with underground mines, where the safety of the public is involved, will commonly be provided with a more reliable supply.

- customer expectations in relation to the reliability of supply and the relative cost of increasing the reliability of supply. Rural customers will ordinarily experience a lower level of supply reliability than their urban counterparts.

- the anticipated rate of incidence of equipment failure, the duration of its likely repair and the relative cost of providing stand-by capacity. Thus, a CBD area supplied by several underground cables, for which fault repair times can be significant, may be planned to an "N - 2" criterion to allow for the likelihood of the concurrent failure of more than one element.

Whilst the deterministic planning process seemingly allows little room for interpretation, in its application there are many ways in which judgement is ordinarily exercised by the planner, which can substantially affect the planning outcomes. These assumptions are broadly associated with the demand placed on the network; and the network's capability to meet that demand:

- The forecast loads to which the augmentation criteria are applied are possibly the most significant area of potential variation. The forecast load will have a probability of exceedance, which may be determined either subjectively or statistically. This will take into account the variation in loads that commonly arises from weather and from other effects. This may involve the temperature correction of demands using statistical techniques but more commonly involves the subjective adjustment of outlying historical demands.

- The forecast load will thus reflect the planner's knowledge or expectation of the characteristics of the upper portion of the load duration curve.

- The ratings assigned to network equipment will also have a significant effect upon planning outcomes. Permissible ratings are normally based on thermal considerations. Thus ratings will vary with ambient weather conditions (temperature, and assumed wind in the case of overhead lines).
  - The thermal inertia of each network element determines the duration for which a high load can be sustained without damage. Hence the assumed pre-contingency loading and the duration of the contingency loading are both significant. As a consequence, the ratings assigned to network elements will commonly also reflect the characteristics of the upper portion of the load duration curve.

It is possible for deterministic planning methods to be modified in order to take account of limits on the maximum number of hours of load at risk of non-supply under contingency conditions (see Box 1)

Box 1: A modified deterministic planning methodology used in NSW distribution networks

A modified deterministic planning approach can have as its basis a set of deterministic planning criteria, but these are modified to allow for the maximum number of hours of load at risk of non-supply under contingency conditions.

The NSW licence conditions for distribution networks are an example of this particular approach. The NSW distribution network planning approach allows both the value to customers of non supply and the load profile to be taken into account directly in setting the planning criteria – the hours of load at risk can be tailored to specific areas of the network as well as the magnitude and characteristics of the load involved.

An advantage of the NSW distribution network planning approach is in its relative ease of application, compared with the more complex probabilistic approach, which is a particular advantage with distribution augmentations.

The NSW distribution network planning approach permits a more finely detailed specification of augmentation requirements than a purely deterministic planning methodology. Furthermore, it significantly reduces the level of discretion applied by planners in making assumptions, either on the application of the deterministic approach or inherent in the probabilistic method.

A further advantage of the NSW distribution network planning methodology is that by providing greater clarity on assumptions that need to be made concerning customer demand forecasts near the time of peak load and the contingencies to be catered for, it is more amenable to the regulatory review of its application.

8.7 Probabilistic network planning processes

It was noted that probabilistic planning processes are required and remain appropriate for the analysis of network interconnection. However, they are also applied to the analysis of regional reliability and to network connections in Victoria (see Sections 8.13.1 and 8.15 below).

The probabilistic planning process follows a two step process.[156] First, a "screening test" is applied to identify areas of potential network concern. This screening test checks the performance of the network against a range of deterministic criteria and performance requirements that are the same as those employed in the deterministic planning process. Second, each potential weakness in the network highlighted by this screening test is then subjected to more detailed probabilistic analysis, to determine the overall likelihood of non supply.

The basic input assumptions involved in this process are as follows:

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[156] See Section 8.15 below for further discussion of how probabilistic planning methods are applied in Victoria, British Columbia and California.

- the incidence and coincidence of anticipated loads;
- the rate of failure of those equipment elements which are critical to the continuity of supply and the likely duration of their repair; and
- equipment ratings, which are time variant to reflect thermal considerations.

This probabilistic analysis is then extended to perform a cost-benefit comparison of the cost of non supply (by generators; or to customers) with the cost of the network augmentation. The inputs to this element of the analysis are as follows:

- the cost of unserved energy to customers; and
- anticipated market prices, where generator connection or network interconnection is involved.

It should be noted that such detailed individual analysis is only practicable for application to a limited number of augmentations.

8.8 Comparison of the Deterministic and Probabilistic network planning processes

From the forgoing, it is readily apparent that each of the significant assumptions used for the probabilistic assessment of network augmentation is also embodied in the deterministic planning process, either *directly*, through the determination of the planning criteria, or *indirectly*, through the application of those criteria by planners. For example:

- The cost of unserved energy;
- Equipment failure rates and down times; and
- Network loads and their profiles at or near critical periods.

Equipment ratings are used in an equivalent manner for the two analysis variants.

It must also be noted that the type of judgement that is applied by planners in conducting either form of analysis is similar – the outcome of a probabilistic analysis is critically dependent upon the assumptions on matters like equipment failure rates and the value of unserved load to customers. Moreover, there is usually significant uncertainty in forecasting these parameters.

8.9 A hybrid planning approach

As discussed below in Section 8.15, the probabilistic planning methodologies currently in use around the world are actually hybrid methods, because they *combine* deterministic and probabilistic planning methods.

8.10 Consistency with distribution planning

Distribution networks supply end use customers and are generally characterised by requiring a relatively large number of augmentations, compared with transmission networks. However, at the sub-transmission level (33 to 132 kV), the distinction is less apparent and the number and scale of augmentations is usually comparable.

It is clear that the level of service experienced by end use customers is affected by the reliability of both the transmission and distribution networks. It is thus important that for the efficient delivery of service that the augmentation planning of the transmission and distribution networks be consistent.

Because of the very significant number of distribution augmentations, it is not currently practical for DNSPs to apply a probabilistic form of analysis to their networks. Distribution planning is normally carried out using deterministic rules to develop augmentation proposals. However it should be noted that the NSW licence conditions are in the hybrid form outlined above, particularly as applied to significant loads like the CBD.

A hybrid planning approach for planning transmission regional reliability and connection would permit those criteria to be directly compared with those employed for distribution planning and facilitate consistency between them.

8.11 Panel's Draft Report view on the form of standards and different transmission planning methodologies

The Panel's view in its Draft Report was:

> The Panel notes that while probabilistic standards and planning methods for complex systems might have developed considerably over the last fifteen years, as suggested by the Group, as yet few power systems in advanced economies are developed in this way. The jurisdiction of Victoria is an international pioneer in this regard. While the methods used in Victoria might be improved upon, as suggested by the Group, the adoption of such an approach across the NEM would present many challenges.
>
> A further consideration is that, in many jurisdictions, the standards for the sub-transmission networks owned by DNSPs are set in a deterministic form. The Panel considers that it may be desirable for there to be a consistent relationship between transmission and sub-transmission standards. This consistency could assist in least cost joint planning of transmission and sub-transmission networks.

The above view, expressed by the Panel in its Draft Report, was informed by:

1. A survey of existing standards in the NEM (see Appendix B); and

2. A comparison of the standards used in a selection of power systems in:[157]

   (a) Europe:

      (i) Germany;

      (ii) Great Britain;

      (iii) Nordel (Denmark, Sweden, Norway, Finland); and

   (b) North America:

      (i) PJM;

      (ii) California;

      (iii) Alberta;

      (iv) WECC;

      (v) NERC

   This group of foreign power systems was selected because, like the NEM, all of have multiple transmission operators whose activities support wholesale electricity markets.

8.12 Stakeholder views on the form of standards and different transmission planning methodologies

Two major reasons are put forward in favour of probabilistic standards and planning methods:

> A probabilistic approach which incorporates an appropriate value of reliability to electricity users is the only way to ensure that competitive neutrality is preserved between the various competing forms of investment (generation in potentially different locations, network infrastructure, NLCAS[158] and demand management measures). The probabilistic approach enables different forms of investment with potentially different reliability impacts to be assessed against one another and for the option providing the best overall value proposition for the market to be identified.
>
> The probabilistic approach ensures that each investment option is assessed and measured in a way that is totally compatible with the National Electricity

[157] See KEMA 2008a, *International Review of Transmission Reliability Standards— Summary Report*, Report to AEMC Reliability Panel, KEMA Inc, Philadelphia, 27 May 2008.

[158] NLCAS = Network Loading Control Ancillary Services.

Objective, i.e., each is assessed in terms of its relative economic efficiency from an overall market perspective.[159]

Proponents of the use of deterministic planning standards and planning methods consider that they are easier to implement, more readily understood, and result in less contentious investment decisions than would otherwise be the case where probabilistic approaches are applied. The use of deterministic planning standards and planning methodologies also appears to be generally consistent with international custom and practice.

Submissions acknowledge that deterministic standards utilise planning methods that assess the deterministic standard against a limited set of probabilistic planning scenarios and limited contingency list.

The Panel's Draft Report position was criticised on the grounds that the international markets selected only represented markets in which deterministic standards and planning methods were used. While Victoria was acknowledged as pioneer, it is no longer unique in adopting probabilistic standards and planning methods. VENCorp and the Group urged the Panel to investigate a range of other markets where probabilistic standards and planning methods were either in use (to some extent) or where such methods had been contemplated. These markets included British Columbia, California, and New Zealand. The Group also drew attention to the research and development of probabilistic standards and planning methods that is being carried out by EPRI, a North American power industry-funded research organisation.

For additional discussion of stakeholders' views on the form of standards and different planning methods—made in response to the Panel's Draft Report—see Chapter 3 and Appendix E.

8.13 Australian experience with hybrid and probabilistic approaches

Three jurisdictions in Australia have used hybrid or probabilistic approaches to either set the level of standards or in planning their networks:

- Victoria — transmission network and load connection points at the sub-transmission level that connect to the transmission network;
- South Australia — transmission network and connection points to it; and
- Queensland— Energex's distribution network in the period 1989 to 2003.

8.13.1 Victoria

Victoria employs a mixture of deterministic and probabilistic planning methods to:

[159] The Group – Submission to Issues Paper, p. 3.

1. set the level of standards for its:

   (a) shared transmission network; and

   (b) sub-transmission and distribution network assets that connect loads to the transmission network.

   Importantly, the process for setting the level of standards is a flexible one, whereby the format, structure and levels of standards are developed and applied through the progressive consideration of network augmentations, on a case-by-case basis, throughout the course of the 5-year regulatory period.

2. apply probabilistic planning methods to evaluate augmentations that would meet the standards. This is also done on a project-by-project basis over the course of the 5-year regulatory period.

The Victorian approach is in fact one particular type of "hybrid"— which uses a mixture of deterministic and probabilistic assessment methods to determine the level of standards.[160] KEMA states:

> VENCorp uses a two-step hybrid approach in developing its transmission plans:
>
> - The first step involves a deterministic analysis of the coming ten-year period. This analysis is used to identify points on the shared transmission network where there might be deterministic reliability criteria violations.
>
> - The second step uses probabilistic methods to further evaluate the system and refine proposed solutions to the criteria violations during the coming five-year period. In the first five years of the planning horizon, probabilistic planning methods are applied to alternative solutions to the criteria violations found the first step.[161]

KEMA classifies the Victorian hybrid approach as a **"hybrid-subtractive"** approach[162]. Under a hybrid-subtractive approach:

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160 For details of the Victorian planning methodology, see: [1] VENCorp 2001, "Consultation Paper - Electricity Transmission Network Planning Criteria", Victorian Energy Networks Corporation, Melbourne; [2] VENCorp 2007, "Victorian Electricity Transmission Network Planning Criteria", Issue 2, Approved by Matt Zema, CEO, VENCorp, Melboure, 3 May 2007; [3] Alinta, Citipower, Powercor, SP Ausnet and United Energy 2007, *2007 Transmission Connection Planning Report,* Produced jointly by the five Victorian Electricity Distribution Businesses, Melbourne; [4] SP Ausnet 2008, *Distribution System Planning Report 2008-2012*, SP Ausnet, Melbourne; [5] VENCorp 2008a, "Submission on AEMC Reliability Panel Draft Report - Transmission Reliability Standards Review", VENCorp, Melbourne, 3 June 2008; [6] VENCorp, *Victorian Annual Planning Report 2008* (especially chapters 6 & 7) available at http://www.vencorp.com.au/index.php?newsID=4860.

161 KEMA 2008c, "Additional response regarding probabilistic planning methodologies", Report to AEMC Reliability Panel, 14 July 2008, p. 10.

162 KEMA 2008c, "Additional response regarding probabilistic planning methodologies", Report to AEMC Reliability Panel, 14 July 2008, p. 12

> any projects identified in the deterministic analysis are subject to review using the probabilistic analysis. Any deterministic projects that do not pass the probabilistic analysis are delayed or eliminated as justified by the probabilistic analysis.[163]

The other approach can be called **"hybrid-neutral"**, in which:

> projects identified in the deterministic analysis are not reviewed using the probabilistic analysis. With this approach, projects identified in the probabilistic analysis can add to the list of proposed projects but will not eliminate or delay projects identified in the deterministic analysis.[164]

The details of "hybrid-subtractive" and "hybrid-neutral" are explained in Section 8.14 below, together with their application in British Columbia, Victoria and California.

VENCorp in their submission to the Interim Report, state that they believe that KEMA has not accurately described their planning processes, and that they believe it is inaccurate to call their planning method "hybrid-subtractive". VENCorp explain that this is because their initial network-wide study of the Victorian system which employs deterministic methodology is very rudimentary, and that most of the work is carried out using exhaustive cost benefit analyses making extensive use of probabilistic methodologies to calculate the energy at risk. VENCorp does not fully exclude any augmentation following the initial deterministic study.

VENCorp also disagrees with KEMA's statement that probabilistic planning methods are confined to use of a "generic approach to redispatch". VENCorp analyses are conducted under a number of different system configurations including various generation assumption.

The process used in Victoria for setting standards is a flexible one in which the level of standards is continuously refined on a case-by-case basis throughout the 5-year regulatory period.

The Victorian approach contrasts with other types of hybrid approaches, in two ways.

- First, the level of standards in Victoria is not expressed in a deterministic form, whereas in other places, such as South Australia, the probabilistically derived standards are translated into an equivalent deterministic form.

- Second, other implementations of "hybrid" standards involve a process for setting standards in which economic-technical analysis, with an explicit CVR, is used to set the level of standards once only. After the level of standards are established, they remain fixed over the 5-year regulatory period.

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163 KEMA 2008c, *ibid*, p. 4.

164 KEMA 2008c, *ibid*, p. 4.

8.13.2 South Australia

The standard setting process, form of standards, and planning methodology used in South Australia:[166]

1. employs a mixture of deterministic and probabilistic planning methods to set the level of transmission load connection point standards; and

2. once the level of standards are set, uses deterministic planning methods to evaluate augmentations that will meet the standards.

The SA approach is similar to the Victorian one, but differs in two important regards:

(a) Standards are expressed in a deterministic manner (i.e. N - x)—after the level of standards has been derived from a probabilistic, economic-technical analysis, that incorporates explicit CVR measures (which are the same as those in Victoria) to assess the reliability costs and benefits of changes to the level of reliability at each load connection point.

(b) The process used to review and set standards occurs once every five years, with the level of standards fixed ahead of the transmission regulatory period. Once these standards are established, deterministic planning methodologies are applied to assess both the need for and types of augmentations (or other solutions) that can deliver network capability in line with the standards. However, probabilistic planning methods could also be applied.

8.13.3 Queensland

Between 1989 and 2003, Queensland's Energex distribution network employed a probabilistic planning approach, which was criticised by an independent review on the grounds that it made inadequate use of load flow analysis. Energex's particular probabilistic planning approach was used to limit network augmentations over a period in which there was rapid growth in network usage, driven by high rates of population and economic growth.

The 2004 EDSD (Sommerville) Report into widespread blackouts in Queensland in early 2004, found that widespread power failures in Energex's distribution area were the result of a range of factors, including: [167]

- the level of standards and the planning methods used by Energex, both of which were suspect and did not conform with good industry practice regarding the use of *either* deterministic or probabilistic planning methodologies. In particular,

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166 For details of the SA approach, see Appendix B.

167 Queensland Government 2004, *Electricity Distribution and Service Delivery for the 21st Century – Queensland*, Detailed Report of the Independent Panel (Chairman Darryl Sommerville), Department of Natural Resources Mines and Energy, Brisbane, 19 July 2004.

Energex used a poor planning methodology, which was not robust because it did not include sufficient load flow modelling and contingency analysis. This lack of load flow modelling was caused, in part, by insufficient resourcing of Energex's network planning division;[168]

- high growth putting pressure on the distribution network;
- inadequate maintenance of the distribution network, particularly poor clearance of trees from lines;
- a lack of line under–grounding in a part of Queensland with strong tropical storms;
- a loss of skilled planning staff;
- inadequate investment in the distribution network over a sustained period of time;
- the incentives on and decisions made by Energex's management team; and
- shortcomings in the distribution network regulatory process administered by the Queensland Competition Authority (QCA).

The EDSD Report was highly critical of Energex's network standards, planning methodology, investment programme and network operations and maintenance processes.

The report's recommendations included that Energex:

(a) apply deterministic standards and a deterministic planning methodology that makes full use of power flow analysis;

(b) substantially increase the level of investment in its network;

(c) adequately resource its planning department; and

(d) make significant changes to its network operations and maintenance processes.

As discussed in Appendix B, all the recommendations of the EDSD Review were adopted by the Queensland Government, and these also had significant impacts on the form of standards, planning methodology applied by Powerlink, the Queensland TNSP. The adoption of the EDSD Review's recommendations, in combination with high demand growth, has led to significant new investments in transmission, sub-transmission and distribution networks in Queensland..

168 Ibid, p. 20.

8.14 International experience with deterministic standards and planning methods

KEMA prepared a report for the Panel which contrasts the frameworks for establishing consistent transmission planning standards across multiple transmission network operators (or TOs).[169]

It turned out that all the sample systems used deterministic standards and planning methodologies.

8.14.1 Selection of international power systems

A selection of six international power systems with multiple TOs was made. Each of these power systems support wholesale electricity markets:

1. Germany;
2. Great Britain (GB);
3. Nordel (Norway, Sweden, Finland, and Denmark);
4. Alberta (AESO);
5. PJM; and
6. California Independent System Operator (CAISO).

In addition, for North America, KEMA examined the relationship between the minimum, nation-wide reliability standards set by the North American Electric Reliability Corporation (NERC), an the more specific and stringent regional standards applied in different parts of North America. NERC plays a critical role in setting minimum national standards, which are the basis of standards set by regional reliability councils, such as the Western Electricity Council (WECC).

These systems present a variety of governance/political environments—single and multiple political jurisdiction; and while all have multiple transmission companies they may have a single or multiple control areas managed by a single or multiple system operators. There are also multiple transmission regulatory environments. A comparison of political and regulatory environment of the selected systems is shown in Table 2.

169 KEMA 2008a, *International Review of Transmission Reliability Standards – Summary Report*, Prepared for the AEMC Reliability Panel, KEMA Inc., Philadelphia, 27 May 2008.

Table 2: Political and regulatory environments of the selected systems

System	Political jurisdictions	Transcos	Control areas	Transmission regulatory regime		
				Regulated rate of return	Incentive-based	
					CPI-X price cap	Revenue cap
Caiso	1	10	1	✓		
PJM	14	16	1	✓		
AESO	1	3	1	✓		
GB	1	3	1		✓	
Germany	1	4	4		✓	
Nordel	5	6	6	Sweden, Iceland		Norway, Finland, & Denmark

Source: KEMA 2008a, *International Review of Transmission Reliability Standards— Summary Report*

8.14.2 Key findings on transmission standards and planning methods in sample power systems

KEMA's key findings for above mentioned power systems include:[170]

1. Form of standards

   – All the international power systems studied use a deterministic form of standard together with a deterministic planning methodology.

2. The level of standards:

   (a) is generally N - 1 (or higher);

   (b) the overall minimum standards do not diverge across connection points (or groups of connection points) in the power system though regions and individual systems are allowed to have more stringent criteria;

   (c) is set by a body independent from the transmission owners (TOs) in the North American markets, GB, and Germany. In Nordel and Germany the TOs play a role in setting transmission standards.

3. The degree of decentralized planning differs:

   (a) A national transmission plan exists only in the Great Britain market;

   (b) A regional transmission plan exists in the three North American markets; and

   (c) In Germany and Nordel, there is no national transmission plan.

[170] KEMA 2008a, *International Review of Transmission Reliability Standards – Summary Report*, Prepared for the AEMC Reliability Panel, KEMA Inc., Philadelphia, 27 May 2008, pp. 1-5.

4. TOs are obligated to comply with regional/national plans where they exist.

5. The distinction between the transmission and sub-transmission network does not exist in the systems sampled so there is no difference in the standards and arrangements for joint-planning and operation of transmission and sub-transmission networks.

6. These selected markets, while different from the Australian National Energy market (NEM) in some ways, are similar to the NEM in many ways such as:

   (a) They are economically developed nations that depend on affordable and reliable electric supply;

   (b) They have developed high-voltage transmission networks;

   (c) They serve types of customers that range from central business districts to rural farming areas;

   (d) They have multiple TOs providing service within a single market structure; and

   (e) They have separated the generation and transmission functions and ownership, and have a variety of independent power providers.

7. The frameworks used in other countries for setting consistent standards nationally (or regionally in the case of the North America, where "regionally" spans several state jurisdictions) show, to varying degrees, provide insights into a range of principles that can underpin a successful framework. KEMA's views on these principles are discussed in Section 3.7 above.

8.14.3 Differences with the NEM

KEMA identified four aspects of planning standards where the practices in the NEM diverged from the sample systems it surveyed. The four difference were:[171]

1. In NEM there are significant regional differences in the standards whereas all the sample systems had universal minimum standards.

2. The form of the standards in NEM is a mixture of deterministic and probabilistic approaches whereas the sample systems all used the deterministic form of standards.

3. The form and level of standards in NEM are set by individual jurisdictions whereas the sample systems all have a trans-jurisdictional body that sets the form of the standards and a common minimum level of standards.

[171] KEMA 2008a, *International Review of Transmission Reliability Standards – Summary Report*, Prepared for the AEMC Reliability Panel, KEMA Inc., Philadelphia, 27 May 2008, pp 19.

4. In NEM there are different levels of standards depending on the type of customer and area. In the sample systems this is not generally the practice, though there was some variation among them.

8.15 International experience with hybrid and probabilistic approaches

The Panel subsequently commissioned KEMA to provide it with additional advice on four issues; specifically to:

1. review deterministic, probabilistic, and hybrid planning methodologies;

2. compare the probabilistic planning methods of British Columbia, California, and New Zealand with that used in Victoria. Also to investigate the research and development of probabilistic planning methods by EPRI;

3. respond to the comments regarding the KEMA report made by VENCorp and the Group, and

4. critically review the pros and cons of these general approaches to transmission planning.

KEMA's advice on items 1, 2 and 4 is summarised below; but readers are urged to read KEMA's full report, which has been published separately and accompanies this Final Report.[172]

8.15.1 Review deterministic, probabilistic, and hybrid planning methodologies

By way of introduction KEMA noted the following salient points about how power system planning and operations affect reliability:[173]

- Blackouts are usually caused by a sequence of low probability outages. Disturbances have occurred after a series of successive unscheduled equipment outages more severe than N - 2 following low probability events.

- History has shown that even scheduled outages have affected power systems' balanced operation, demonstrating the grid's complexity during managed conditions. […] The point is that blackouts often occur when conditions are outside those normally included in planning criteria.

- Another frequent aspect of blackouts is that some equipment does not operate as designed. The bulk power system includes hundreds of elements such as transmission lines, generators and substations. Each of

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172 KEMA 2008c, *Additional response regarding probabilistic planning methodologies,* Report to AEMC Reliability Panel, 31 July 2008.

173 KEMA 2008c, *Additional response regarding probabilistic planning methodologies,*", Report to AEMC Reliability Panel, 31 July 2008, pp. 2–3.

these elements includes hundreds of individual components. At any given time the system has literally tens of thousands of components that could fail or misoperate. That the bulk electric system continues to operate in face of such complexity is because of planned redundancy and operator flexibility during real-time operation.

- Sometimes even experts lose the sense of planning criteria being realistic tests of the system, but not being tests of actual system conditions. The range of actual operating conditions would be impossible to evaluate effectively. Bulk transmission systems typically have about 3% of their elements out of service on any given day. These outages are due to equipment failures, routine outages, scheduled maintenance, etc.

- Sometimes there is confusion regarding power system 'planning' and 'operating' criteria. Planning criteria must address a much more uncertain future than operating criteria. It might appear logical that if the system fails the planning criteria, the planner can fall back on the flexibility that system operators have to solve problems. But this ignores the much higher uncertainty in planning for conditions five and ten years in the future.

- The planning criteria are set to allow for this difference in uncertainty. It is just wrong to mix planning and operating criteria and studies.

- Failing planning criteria means that the system has reached an unacceptable risk of having a blackout. The failure means that plans must be developed to remove the criteria violations.

8.15.1.1 Deterministic methods

KEMA's characterisation of deterministic planning methods accords with that given above in Section 8.2.

However, KEMA draws the following analogy:

> Deterministic transmission planning criteria are similar to the kinds of tests a physician might make. As an analogy, consider someone getting a blood cholesterol test. If the cholesterol level is above 200 then that person is considered to be at risk. There is no assessment of the risk that that person will have a heart attack that day, or that year, or the next year. They may never have a heart attack. But they have reached a predetermined level where they are considered to have an unacceptable risk for heart attack. A prudent person would not wait until they experienced chest pains but would take actions to reduce their cholesterol level so that the risk of failure (heart attack) is reduced to acceptable levels.

> In a similar way, the system planner must make plans to modify the system so that the unacceptable risk of failure is reduced to acceptable levels based on planning criteria.[174]

KEMA also noted the limited set of contingencies that can be assessed using a deterministic planning methodology, but noted its robustness depended on the comprehensiveness of the contingency list used in planning studies:

> In a deterministic planning method, expected future conditions are simulated for a few load levels and system conditions. For each load level a computer model is used to simulate the effect of losing any single element on equipment thermal loadings and voltages. An acceptable limit for thermal loading is set for each element as is a range of acceptable voltages. So long as the results are within the acceptable limits no action is required. If the limits are violated then plans must be developed to eliminate the violation.
>
> Because there are so many possible system conditions that could occur in the future, deterministic criteria are set to test the system to see that it is robust enough that it can survive the many other events that are not actually being studied.

The results of these deterministic tests feed into the development of transmission network plans. These plans take into account the relative costs of different investment options that enable the standards to be met:

> With a deterministic planning method, alternative plans are ranked based on cost and, where possible, transfer capability—a technical measure as to how much the solution strengthens the system.

8.15.2 Probabilistic methods

KEMA describes probabilistic planning methods is a similar way to the description in Section 8.2 above

KEMA then states:[175]

> One major weakness of deterministic methods is that it does not directly consider the probability of outages. Probabilistic methods consider both the impact of an event (contingency) and its probability. Probabilistic planning can also capture multiple component failures and recognize not only the severity of the events but also the likelihood of their occurrence.

174 KEMA 2008c, *Additional response regarding probabilistic planning methodologies,*", Report to AEMC Reliability Panel, 31 July 2008, p. 3.

175 KEMA 2008c, *Additional response regarding probabilistic planning methodologies,*", Report to AEMC Reliability Panel, 31 July 2008, p. 3.

The deterministic method assumes that the "worst" case has been identified for study. But the worst case may be missed. Some serious system problems may not necessarily happen at the peak load. And the system is exposed to risk under less than worst-case conditions. Probabilistic methods can be used to quantify the risk for many of these system conditions.

As discussed above, most major outages are usually associated with multiple component failures. These severe outages will not usually be captured by deterministic analyses. Probabilistic methods offer the possibility of including such events by using risk management techniques in planning to keep system risk below an acceptable level.

The big advantage of the probabilistic method is that it can be used to estimate an expected value of load at risk. The expected value can be in MWh or MW. Either of these measures could be converted into a customer cost using an estimate of the impact on customers. It is the combination of the impact of an event (in MWh or MW) together with its probability that is at the heart of the probabilistic method.

Probabilistic methods can be used to provide many additional measures of reliability. These include expected energy not served (the most commonly used measure); and the number, frequency and duration of outages; as well as, similar delivery point indices.

8.15.3 Hybrid methods

KEMA characterise hybrid planning standards and planning methods in a somewhat different way to that used by the Panel. The Panel and others have been characterising "hybrid standards" as being deterministically expressed, but derived from economic-technical assessments that use probabilistic approach. Once the standards are derived in this way, they are expressed deterministically, and deterministic or probabilistic planning methods can be applied.

KEMA have a different definition, which hinges on the fact that all probabilistic planning methodologies currently in use are, in fact, an amalgam of deterministic and probabilistic assessment methods:

> "Hybrid methods combine deterministic and probabilistic methods. In practice … the probabilistic methods being used are actually hybrid methods.
>
> There is no inherent conflict between the deterministic and probabilistic methods. In a hybrid method each method acts as a check on the other. In the hybrid method, deterministic methods are used to identify any needed system improvements. Probabilistic methods are then used to see if there additional system improvements that can be economically justified when considering probabilities, especially of rare or combination events.

There are two noted variations regarding whether improvements identified by the deterministic methods must then be justified by a probabilistic analysis:

- In the first approach, projects identified in the deterministic analysis are not reviewed using the probabilistic analysis. With this approach, projects identified in the probabilistic analysis can add to the list of proposed projects but will not eliminate or delay projects identified in the deterministic analysis. This approach might be called "hybrid-neutral".

- In the second approach, any projects identified in the deterministic analysis are subject to review using the probabilistic analysis. Any deterministic projects that do not pass the probabilistic analysis are delayed or eliminated as justified by the probabilistic analysis. This approach might be called "hybrid-subtractive".

In both approaches, a project that was not justified in the deterministic analysis can be added to the expansion plans if it is justified by the probabilistic analysis." [176]

An illustrative example is provided in KEMAs' report.[177]

8.15.4 Probabilistic planning methods of British Columbia, California, New Zealand, and Victoria

KEMA assessed three power systems where probabilistic planning methods are used — Victoria, California, and British Columbia—and categorised each as using either a "hybrid-neutral" or "hybrid-subtractive" planning methodology (Table 3). KEMA notes that California has proposed moving from "hybrid-neutral" to a "hybrid-subtractive" approach, but it is unclear whether this proposal will be approved by FERC.

176 KEMA 2008c, *Additional response regarding probabilistic planning methodologies*, Report to AEMC Reliability Panel, 31 July 2008, pp. 3–4.

177 KEMA 2008c, *Additional response regarding probabilistic planning methodologies*", Report to AEMC Reliability Panel, 14 July 2008, pp. 4–5.

Table 3: Comparison of probabilistic planning methods in British Columbia, California and Victoria

Power system	System planner	Probabilistic planning methodology used	
		Hybrid neutral	Hybrid subtractive
British Columbia	British Columbia Transmission Corporation (BCTC)	✓	
California	CAISO	✓	
Victoria*	VENCorp		✓

* VENCorp, in its submission to the Interim Report, disagreed with KEMA's characterisation of its planning methodology as hybrid subtractive.

8.15.4.1 New Zealand

New Zealand's Electricity Commission and transmission system planner, Transpower, have recently investigated ways of improving the NZ transmission planning process.[178] Probabilistic transmission planning techniques are one of the options being considered. [179] However, the current transmission planning process involves only deterministic methods, with a N - 1 level of deterministic standards for the main transmission network.[180]

8.15.4.2 EPRI

EPRI has for a long time carried out research and development of probabilistic planning methods, and has advocated them as being the most suitable approach in restructured electricity markets.[181] In recent years, the focus of EPRI software deployment in this area has been on their probabilistic reliability assessment (PRA) software.[182]

KEMA notes that the slow uptake of probabilistic planning approaches in North America is likely to continue, in part because of a 2005 shift to mandatory,

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178 PB Associates 2004, "Probabilistic Transmission Planning: Comparative Options & Demonstration", report prepared for the New Zealand Electricity Commission, PB Associates, August 2004. http://www.electricitycommission.govt.nz/pdfs/opdev/transmis/pdfsgeneral/probablistic-planning.pdf.

179 KEMA 2008c, p. 9.

180 Transpower 2005, "North Island 400kV Project: Main Transmission System Planning Criteria", Transpower New Zealand Ltd, Wellington, March 2005 http://www.electricitycommission.govt.nz/pdfs/opdev/transmis/gup/Vol2/Supporting-docs/6-NI-400kV-PlanningCriteria.pdf

181 EPRI 2003, *"Moving Toward Probabilistic Reliability Assessment Methods: A Framework for Addressing Uncertainty in Power System Planning and Operation"*, Electric Power Research Institute, Palo Alto, CA: 2003. URL http://www.epriweb.com/public/000000000001002639.pdf

182 EPRI 2008, "2008 Portfolio 40 Grid Planning: Program Overview", EPRI, Palo Alto, CA. URL http://mydocs.epri.com/docs/Portfolio/PDF/2008_P040.pdf

deterministic standards across North America, and in part because it will take time for these methods to become accepted.[183]

8.15.5 KEMA's summary findings on the pros and cons of deterministic, probabilistic and hybrid standards and planning approaches

KEMA's final assessment of the pros and cons of probabilistic and hybrid standards and planning methods is as follows:[184]

> "Neither approach—deterministic or probabilistic—is clearly superior or is guaranteed to include all reliability risks:
>
> - The deterministic approach can only identify criteria violations identified for the few conditions that it studies. And while the quality of the cases studied may be superior, they are limited in number and scope. This is why the results of deterministic approaches are treated as an 'index' of system health rather than a measure of reliability.
>
> - Probabilistic approaches consider a wider range of system conditions and a larger number of contingencies. They can be used to calculate a range of reliability measures and provide the basis for cost/benefit analysis. Because probabilistic measures cannot evaluate the millions of possible system states, they will underestimate the potential benefit of a given project or plan.
>
> Either approach has limitations that might cause it to "miss" a needed system improvement. For the time being, it would seem most prudent to evolve a hybrid-neutral approach that would allow projects identified by either the deterministic or probabilistic approach to move forward. The hybrid-neutral approach is preferred over the hybrid-subtractive because the probabilistic analysis, which may underestimate benefits, should not eliminate or delay projects or plans identified by the deterministic approach.
>
> Good planning criteria and methods have three characteristics:
>
> - They clearly identify starting conditions including load levels, generation dispatch, system configuration, import/exports, etc.
>
> - They clearly identify the tests to be performed, including the type of contingencies (single and multiple), the transmission elements that can suffer these contingencies, what system adjustments are allowed following a contingency (for multiple contingency events), etc.

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183 KEMA 2008c, p. 8.

184 KEMA 2008c, pp. 12–16.

- They clearly state decision criteria, the measures to be used and what constitutes passing each test.

In addition, it is very helpful if the specific detailed criteria are in a form that can be revised from time to time as necessary. This usually means that the criteria are part of an appendix to a more general reliability document. The general reliability document will spell out the procedures and requirements for changing the criteria. While it may be appropriate for the general reliability document, it is usually better that the specific detailed criteria are not part of government legislation, acts, or administrative rulings.

Table 4 uses these three characteristics to compare the main features of deterministic and probabilistic methods for transmission planning. The table notes where there is an apparent preference by using a star (★) symbol."

Table 4: KEMA's summary comparison of deterministic and probabilistic planning methods

	Deterministic	Probabilistic	Comment/preference (★)
Starting conditions			
Load levels	Typically just a few—winter and summer peak, and 'stressed' conditions	★ Usually many hours of a "standard" year are simulated	★ Probabilistic methods study many more load levels and conditions
Generation dispatch	Usually optimized for each load level	Usually evaluates many more generation scenarios than deterministic, but usually does a poorer job of scheduling unit outputs	★ Deterministic allows tailored generation dispatch to match conditions being studied, but probabilistic considers many more generation scenarios, so there is no obvious preference
Special conditions	★ Unusual system configurations as well as special import/export conditions can be studied	Special conditions are generally not studied	★ Deterministic methods consider these special conditions
Tests performed			
Contingencies-single	★ Evaluates all single contingencies	Evaluates all single contingencies	★ Both study all single contingencies, but deterministic can do a better job of redispatch for important generation contingencies
Contingencies-multiple	Evaluates selected multiple contingencies including extreme events (more severe than N - 2)	★ Evaluates all double contingencies, does not evaluate extreme events (more severe than N - 2)	★ Probabilistic can identify important contingencies that deterministic may miss
Contingencies-combinations of generation and transmission	Evaluates selected important combination contingencies, conditions can be tailored to match the conditions	Evaluates nearly all combinations but uses a generic approach to generation redispatch	★ No advantage
Contingency probabilities	Based on judgment	Based on generalities	★ No advantage
Generation redispatch	★ Tailored to specific conditions being studied	Uses a generic approach to redispatch	★ The deterministic method allows for a generation redispatch to be tailored to the specific conditions being studied
Analysis types	★ Steady-state and dynamic	Steady state	★ Deterministic can consider dynamic and voltage/var limits more thoroughly
Decision criteria			
Easily understood	★ They are easily understood by the stakeholders and regulators	Less so, though they are easier for economic comparisons	★ Deterministic is easier to understand and explain
Violations tracked	Pass or fail	★ Can calculate many indices	★ Probabilistic methods provide information regarding many more reliability indices
Cost/benefit	Does not provide any reasonable measure of customer benefits	★ provides estimated customer benefits for various plans and alternatives	★Probabilistic much more useful information for decision-making

Source: KEMA 2008c, *Additional response regarding probabilistic planning methodologies,* pp. 19–20.

8.16 Panel's consideration and findings

After considering the issues around the form of standards and different planning methodologies, the Panel has made a number of findings concerning:

- form of standards,
- merits of different forms of standards,
- process for setting standards,
- merits of different planning methodologies,
- the development of a framework for estimating CVR.

These findings have influenced the design of the Panel's recommended framework (Option F).

8.16.1 Form of standards

The Panel considers that a deterministically expressed form of standards is the most transparent. The level of standards should be set taking explicit account of the CVR of different classes of end users.

The national reference standard will also contribute to greater transparency and accountability.

8.16.2 Merits of different forms of standards

The Option F framework allows for flexibility in the expression of standards, as an option, but generally specifies the use of deterministically expressed standards.

8.16.3 Process for setting standards

The process for setting standards in Option F is a pre-set process, whereby the format, structure and levels of the standards are reviewed at fixed time intervals, but remain fixed between reviews.

However, jurisdictions can elect to set standards using a flexible process, whereby the pre-set levels of standards can be adjusted and over-written by a progressive, rigorous, probabilistic assessment of network augmentations, on a case-by-case basis.

8.16.4 Merits of different planning methodologies

Option F allows jurisdictional planning bodies to apply purely deterministic planning methods or probabilistic planning methods, which are either "hybrid–neutral" or "hybrid–subtractive".

8.16.5 Customer Value of Reliability

Given the critical role that the CVR plays in determining the level of load connection point standards, and consequently the standards of the shared transmission network, the framework should ensure that a transparent, robust methodology is used on a consistent basis across all jurisdictions to determine the CVR.

Such a methodology does not mean that CVRs used in each jurisdiction will be the same for similar connection points, rather that it will be possible to compare reliability standards against a national reference standard.

The Panel notes commentary from some stakeholders that the existing CVR estimation methodologies will need to evolve and be subjected to continuous improvement.

9 Implementation and Recommendations

Implementing a framework for nationally consistent transmission standards will present a number of challenges.

9.1 Elements of an implementation regime and transition plan

Given the existing arrangements in the NEM, the implementation of any framework for nationally consistent transmission standards will require significant changes to jurisdictional and national laws, regulations, and codes.

An **implementation regime** will require changes to some or all of:

1. Jurisdictional laws, which place obligations on transmission companies and jurisdictional regulators;

2. Jurisdictional transmission and distribution network licenses;

3. Jurisdictional transmission network codes;

4. Jurisdictional transmission standards;

5. The National Electricity Law; and

6. The National Electricity Rules.

Such changes will need to be transitioned, in a co-ordinated manner, across the NEM. Jurisdictional governments and, possibly, the Commonwealth government will have to agree on a **transition plan**, which will have to:

a) account for the regulatory regime and its settings; and

b) specify the required steps and timetable to fully implement the new framework.

Given that compliance with transmission standards is a critical component in the licensing and regulatory regime faced by TNSPs, any transition plan will have to have regard to how the establishment of a new nationally consistent framework of standards affects the committed investment plans of TNSPs and assessment of future capital and operational expenditures of TNSPs.

If the level of standards is changed, the transition to any new standards is likely to require special allowances to be made in TNSP Regulatory Determinations by the AER, which would flow on into transmission pricing structures.

Similarly, if the form of standards is changed or if there are significant changes in the planning methodologies used, the AER might need to make adjustments to the regulatory allowances of TNSPs. For example, if the planning methodologies used to assess deterministic standards utilised a greater number of scenarios, probabilistic inputs or a more comprehensive contingency list, network planning studies may become more costly and require additional resources. The use of more advanced and comprehensive probabilistic planning methodologies, as suggested by the Group, will require additional resources for network planning even in jurisdictions where such methodologies are currently utilised (e.g. Victoria).

Finally, the Panel notes that both the implementation regime and transition plan would have to have regard to:

- relevant policy directives by the MCE;
- the emerging governance arrangements of the Australian Energy Market Operator (AEMO), National Transmission Planner (NTP), and TNSPs;
- the MCE's response to the AEMC's recommendations on a new Regulatory Test, called the Regulatory Investment Test for Transmission (RIT-T). These recommendations were made in June 2008, as part of the Commission's NTP Review report to the MCE;
- the findings of NEMMCO's current review of Network Support and Control Services (NSCS).[185] This review might address the question of governance arrangements for the procurement and use of NSCS, for which responsibilities are currently split between NEMMCO and TNSPs; and
- existing regulatory decisions and the actions taken by TNSPs as a result of those decisions.

9.2 Submissions to Issues Paper

Three submissions to the Panel's Issues Paper made specific comments on implementation issues.

Comments in submissions by Grid Australia, the Group and EnergyAustralia:

1. Concurred with the Panel's view that adjustments in AER regulatory determinations might be required. These adjustments could relate to both capital expenditure and the service target incentive scheme for each TNSP;
2. Noted the linkages between a framework for nationally consistent transmission standards and the role and functions of the NTP;
3. Stated that jurisdictions would have to commit appropriate resources in order to review the level of standards;
4. Drew attention to the potential impact that changes in transmission standards could have on existing connection agreements; and

185 See NEMMCO's website for more information: http://www.nemmco.com.au/powersystemops/168-0089.html.

5. Highlighted possible overlaps between nationally consistent transmission standards and the jurisdiction specific frameworks of standards and planning processes used by network companies, such as EnergyAustralia and others, with a mix of transmission, sub-transmission and distribution assets.

Grid Australia

- "Any change in the levels of reliability standards applicable to any jurisdiction as a result of the move to a consistent national framework will have cost implications in terms of required network capital expenditure, compared with the levels that underpin the current regulatory determinations for each TNSP. It would therefore be appropriate either for any new levels of planning standard to apply from the start of the new regulatory period for each TNSP or, if they are introduced during a regulatory period, for there to be an explicit adjustment mechanism to allow for the change to be reflected in regulated revenues. Grid Australia notes that the current NER make provision for a cost pass through mechanism, which covers 'service standard events' (amongst others)"

- Grid Australia also notes the interaction between the mandated level of reliability standard and the service performance incentive mechanism developed by the AER. Grid Australia considers that any change to the reliability standards imposed on TNSPs should be fully reflected in the calculation of the service performance incentive mechanism, so that the TNSPs do not face any financial penalty as a result.

- The treatment of existing long-term connection agreements, which may contain references to specific reliability levels, will also be an important transition issue. Grid Australia notes that the appropriate treatment of these agreements is likely to depend on particular circumstances, which will differ between jurisdiction and between TNSPs. Grid Australia further notes that in reviewing the level of reliability (as distinct from the introduction of a consistent national framework for reliability), the consultation process conducted by ESCOSA in South Australia allows for issues in relation to particular connection agreements to be considered. This appears to be an effective means of ensuring that these issues are addressed.

- Finally it is important to recognise that individual jurisdictions will need to arrange appropriate resources in order to conduct the reviews of the level of reliability standards that are proposed as part of Grid Australia's recommended national framework.[…] Transitional issues will arise in relation to timing and resources for the jurisdictions (or the body appointed by the jurisdiction) before they are in a position to conduct the first of these reviews."[186]

The Group

> "Transmission standards need to be developed in a form that is consistent with the transmission regulatory framework, the new "nationally consistent" approach to transmission planning which should emerge from the AEMC's NTP Review".[187]

EnergyAustralia

EnergyAustralia noted the potential for a framework for nationally consistent transmission standards to overlap or duplicate the jurisdiction specific network planning framework applied to its transmission, sub-transmission and distribution assets.[188]

NGF

In its submission on the AEMC's NTP Issues Paper, the NGF stated that it would be "quite unrealistic" to expect all three components of the NTP Review (i.e. the National Transmission Planner, Regulatory Investment Test, and a framework for nationally consistent transmission standards) to come into effect at a single point in time.

> "Each component of the new arrangements will have to have a different priority and presumably different implementation timetable.
>
> The 3 key implementation milestones will be:
>
> 1. The changeover to the new RIT process;
>
> 2. The promulgation of the new transmission planning methodologies and processes (and associated reliability standards/investment thresholds);
>
> 3. The preparation of the first National Transmission Network Development Plan (NTNDP).
>
> From the NGF's perspective, implementing (1) and (2) above should be higher priority issues for the new NTP than (3)."[189]

186 Grid Australia, Submission – Issues Paper, pp.13–14

187 The Group, Submission – Issues Paper, Attachment 3, p. 18

188 EnergyAustralia, Submission – Issues Paper, p. 2

189 NGF, Submission on the AEMC's National Transmission Issues Paper, p. 46

9.3 Submissions to Draft Report

One submission to the Panel's Issues Paper made specific comments on implementation issues.

GridAustralia

GridAustralia considered that Options A and E raised fewer implementation issues than Options B,C and D, and that therefore viewed Options A and E as more practical and workable. GridAustralia made specific observations about the implementation issues of three options:

- **Option A**: little or no change in South Australia, with significant changes elsewhere, including to State legislation, regulations and licences, and the appointment of jurisdictional bodies to carry out the reviews of the levels of the standards;

- **Option E**: similar to Option A but additional effort and resources would be required to develop the reference standard;

- **Option D**: widespread changes including significant resources would be required to implement a change in the form from deterministic to probabilistic

GridAustralia also proposed that, due to the effect any change in the level of standard would have on the amount of capital and operational expenditure required by a TNSP, any review of the level of standards applying in a jurisdiction should occur at least 24 months prior to the start of the new regulatory period for a TNSP in that jurisdiction.

9.4 Amendments required by Jurisdictions

The Panel has identified the following current jurisdictional sources of transmission reliability standards that would require amendment to implement a nationally consistent framework for transmission reliability standards.

Jurisdiction	Jurisdictional source of standard
New South Wales	Contained in a Network Management Plan which TransGrid is obliged to produce by legislation for acceptance by the Department of Water and Energy.
Queensland	Transmission Authority (licence) issued to Powerlink by the Queensland Government and S.34 of the Queensland *Electricity Act 1994*.
South Australia	The Essential Services Commission of South Australia (ESCOSA) determines the reliability standards for South Australia through the South Australia Electricity Transmission Code which is published on the ESCOSA website.
Tasmania	Regulations issued by the Tasmanian Government. Supplied by Tasmanian Reliability and Network Planning Panel (RNPP). Brought in formally on 3 December 2007.
Victoria	Victorian Electricity System Code (VESC).

9.5 Development of an implementation and transition plan

The Panel acknowledges the significant issues raised by stakeholders regarding an implementation and transition plan. The Panel agrees with those stakeholders who highlighted the linkages between a framework for nationally consistent transmission standards and the role and functions of the NTP.

Due to those linkages the Panel believes the AEMC is best placed to develop an implementation and transition plan. The AEMC will be able to consider the issues raised in this report, by the Panel and stakeholders, in the wider context of its NTP Review report, and to take a holistic view which it will be able to incorporate into its advice to the MCE in September 2008.

The Panel recommends that the AEMC develop a comprehensive implementation and transition plan in full consultation with industry stakeholders and jurisdictions. The Panel recognises that to commence a new work-stream to develop such a plan, the AEMC would likely require a further direction from the MCE following an MCE decision on the framework design.

9.6 Recommendation

The Panel makes the following recommendations for the AEMC's consideration, in the wider context of its NTP review. That:

1. the principles for a nationally consistent framework presented in Table 3 of Chapter 3 be recommended by the AEMC to the MCE;

2. Option F, as presented in Table 2 of Chapter 6, be recommended by the AEMC to the MCE as the framework for nationally consistent transmission reliability standards;

3. the AEMC consider the appropriate institutions to:
    - i. determine the national "information" reference standard;
    - ii. set the level of the standards if the standard setting is referred to the national level by a jurisdiction; and
    - iii. be the institution to which the national reference standard setting body is accountable to,

   taking into consideration consistency with the governance arrangements which apply to the various NEM institutions; and

4. the AEMC develop a comprehensive implementation and transition plan for the nationally consistent framework which it recommends to the MCE.

A NEM transmission reliability standards

This appendix provides a general introduction to the National Electricity Market (NEM), what reliability is, how transmission reliability standards are defined in the NEM, and how these fit in with other reliability mechanisms in the NEM. The appendix also discusses key concepts about reliability standards — such as the form of standard, the level of standard, and planning methodologies — which are used throughout the rest of the paper.

A.1 What is the NEM?

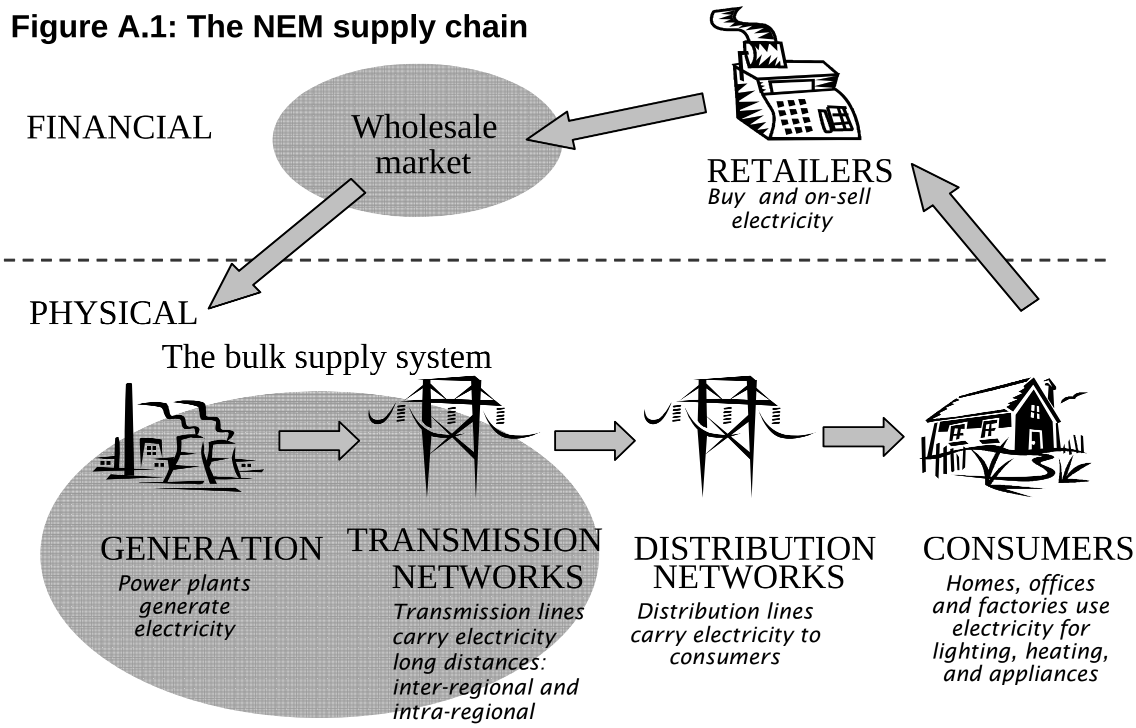
The NEM is the single interconnected power system stretching from Queensland through New South Wales, the Australian Capital Territory, Victoria, and South Australia to Tasmania. It does not currently include the Northern Territory or Western Australia. The NEM is divided into pricing regions which closely align with State borders (the ACT forms part of the NSW region).[190]

The NEM comprises a number of elements including (see figure A1):

- a wholesale market for the sale of electricity by generators to wholesale consumers (typically retailers and large consumers), and which allows trading in contracts between generators, wholesale consumers and merchant traders;
- the physical power system used to deliver the electricity from generators via transmission networks (together referred to as the “bulk supply system”) and local distribution networks; and
- retail arrangements whereby retailers on-sell the energy they purchase to end-user consumers such as households and businesses.

[190] Prior to 1 July 2008, there was an additional region encompassing the Snowy Mountains Hydro Electric Scheme. This region was abolished on 1 July 2008 following an AEMC decision on 27 September 2007 to make a Rule to abolish the Snowy Region, and therefore alter the boundaries of the NSW and Victoria regions. All other region boundaries in the NEM remained unchanged.

Figure A.1: The NEM supply chain



The NEM is a partially-regulated market. That is, generators and retailers operate according to competitive market conditions, whereas owners of "natural monopoly" assets – transmission networks and distribution networks – are largely regulated. An option for market network service providers also exists for specific network assets to operate under competitive market arrangements. This means that if public or private enterprises are to provide adequate generation capacity to meet demand at all times, there needs to be sufficient financial incentives for them to do so. These incentives are delivered through the operation of a wholesale spot market.

Spot electricity prices are calculated for each region every five minutes (known as a dispatch interval). Six dispatch prices are averaged every half-hour (trading interval) to determine the regional spot market price used as the basis for settling the market.

The wholesale spot price can vary considerably, potentially dramatically, in short periods of time. The degree to which the price moves is important to many stakeholders. A large proportion of suppliers and consumers negotiate financial contracts to manage the financial risk associated with market volatility. Those contracts are private arrangements in that the prices are not visible other than to the participants who are party to the contracts.

All electricity generated is traded via the spot market (this is known as a "gross pool" arrangement) and dispatched centrally by the National Electricity Market Management Company (NEMMCO) – the market and system operator. NEMMCO also manages the security of the power system and provides ongoing information to market participants about forecast and actual supply and demand. NEMMCO and transmission network companies also acquire specific technical or ancillary services from generators and consumers to support the operation of the physical power system.

A.2 What is "reliability"?

Broadly, the reasons why consumers may not receive a continuous, uninterrupted supply of electricity may fall into two categories. The first is technical: action has been taken to ensure that power system equipment is protected from damage or exceeding operating limits that, if left unchecked, may lead to wider interruptions to supply. This is *security*. Ensuring that the power system is operated securely is the responsibility of NEMMCO and the network operators. The second is non-technical: quite simply there is not enough capacity to generate or transport electricity across the networks to meet all consumer demand. This is *reliability*. This second reason is economic to the extent that it must be cost-effective for generators and networks to have enough capacity to meet demand at all times.

Operational standards for power system security are set in the Rules and by the Panel.[191] Operational standards are concerned with maintaining the integrity of the power system in the short term, following a sudden fault or failure of a component of the system, such as a line, transformer or generator. Such sudden faults or failures of key components of the bulk power system are called contingencies. In technical terms, the formal definition of reliability includes single credible contingencies[192] but excludes non-credible contingencies, including multiple contingencies, which are classified as security events.[193]

These operational standards affect the design and planning of transmission networks, but there are other, longer term, considerations that affect network planning, including: jurisdictional transmission standards; economies of scale and scope in building transmission networks; long term load growth at different points of the network; and the regulatory regime and its incentives.

For security or reliability reasons, or a combination of both, some consumers may be without electricity for some of the time. Most commonly, interruption to supply is caused by unforeseeable events such as storm damage to local distribution networks. Such events are, as explained above, security. From the consumer's perspective, however, there usually appears to be little if any difference between an interruption caused by a reliability issue and one caused by a security issue. But from a market design perspective, the two causes have very different ramifications: security events

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191 Chapter 4 of the Rules sets out system security standards, while system performance standards are set out in Schedules 5.1 and 5.1a of the Rules and jurisdictional transmission codes, licenses, legislation or network management plans.

192 A credible contingency event is defined in clause 4.2.3(b) of the Rules as "a contingency event the occurrence of which NEMMCO considers to be reasonably possible in the surrounding circumstances including the technical envelope." A contingency event is defined as "an event affecting the power system which NEMMCO expects would be likely to involve the failure or removal from operational service of a generating unit or transmission element."

193 For example, the unserved energy arising from events in NSW on 13 August 2004 was a security event rather than a reliability one.

– managed through standards applied by NEMMCO and network operators – usually pass quickly, whereas a reliability issue is far more likely to be long term as it may be the symptom of a fundamental problem – a lack of sufficient supply capacity – which will take time to rectify.

There are any number of responses to the question of what degree of reliability is tolerable and how much value is ascribed to increased reliability. One group of consumers may tolerate a different level of reliability, and therefore would be willing to pay a higher price for reliable supply, from another. For example, businesses are likely to be less tolerant of interruption to supply during working hours, whereas families are likely to be less tolerant of power interruptions outside of working hours. Potentially, each individual consumer may have a unique tolerance threshold and there are millions of consumers in the NEM. Thus, the question as to what degree of reliability is tolerable also raises an issue concerning how differing expectations regarding reliability and the cost of that reliability can be communicated most effectively to suppliers.

There is also an important relationship between reliability and security. Security is fundamental to the operation of the power system. However, larger amounts of generation and network capacity generally will make it less likely that interventions will be required to keep the power system secure (although this is subject to how that capacity is distributed throughout the system and how reliable each component is itself).[194] Therefore, the level of reliability tolerated by consumers in respect of a system may impact on the technical risk that the system will be unable to supply electricity.

Transmission reliability standards are therefore concerned with both security and reliability, in both the short (i.e. operational) timeframe and in the long (i.e. planning) timeframe.

A.3 Security and reliability standards

Standards concerning the design and operation of the transmission system play a central role in ensuring the reliable and secure delivery of power to customer loads.

> Stated simply, the ultimate objective of the transmission system is to deliver power reliably and economically from generators to loads. Power systems are large, highly complex, ever-changing structures that must respond continuously in real time. Electricity must be produced and delivered instantaneously when it is demanded by load [because it is not cost effective to store large volumes of electricity]. Power outages are not acceptable, so the system must also tolerate sudden disruptions caused by equipment failure or

[194] In a large power system with a strongly meshed network, the physical mass and inertia of the system contribute to its resilience a contingency of a given size. If the same sized contingency occurred on a smaller, less meshed, power system, it is likely that a greater level of manual intervention will be required to maintain power system security and reliability.

> weather. And the system must perform as economically as possible, with transactions and sales monitored as accurately as possible.[195]

In order to ensure the secure and reliable operation of the power system, there are standards that relate to the design, construction, and operation of the system. These performance standards are critically important because the interconnected nature of the network and the physics of power flows mean that the loss of a single element (e.g. transmission line, generator, transformer) can instantaneously result in changes in power flows through all other elements of the network. The rapid change in flows through the other elements can overload them, resulting in an automatic shutdown of the affected elements. This pattern can continue in such a way that there are cascading blackouts across part of or the whole of the network.

Security standards are concerned with maintaining the integrity of the bulk power supply system (i.e. generation and transmission — see Figure A.1). This means that uncontrolled cascading outages must be prevented by designing and operating the power system in such a way that it will continue to operate normally without major disruption when an component, such as a transmission line or generator, fails.

> "Normal operation means that (1) the frequency of the system stays within acceptable bounds, (2) all voltages at all locations are within required ranges, (3) no component is overloaded beyond its appropriate rating, and (4) no load is involuntarily disconnected."[196]

Transmission security standards for the NEM are contained in Schedule 5.1 of the Rules and jurisdiction specific laws, transmission licences, and regulatory instruments. These are discussed further in Appendix B. Improving the national consistency of these jurisdictional transmission standards is the subject of this review.

Transmission standards can relate to two (overlapping) timeframes:

- design/planning horizon — which can be from a few months ahead to several decades ahead; and
- operational horizon — which ranges from the instantaneous through to several months into the future.

Security standards at the design/planning stage are concerned with ensuring that the power system can tolerate the outage of any component or several components. This entails building a degree of redundancy into the network that allows for equipment outages. A power system comprising N elements that is resistant to a single component being out of service is said to be N – 1 secure. This means that all customer loads would continue to be supplied even with one bulk power system element out of service. A higher level of security is provided when the transmission

[195] Alvaro, F. and Oren, S. 2002, "Transmission System Operation and Interconnection", in US Department of Energy, *National Transmission Grid Study: Issues Papers*, US DOE, Washington D.C., May 2002, p. A-1.

[196] Alvaro, F. and Oren, S. 2002, p. A-3

system is planned to be N – 2 secure or N – 3 secure. With a N – 2 secure standard, no customers loads will be affected even if two elements are out of service. This is a very high standard of transmission security requiring substantial capital expenditure, and in Australia it is generally only applied to central business districts of state capitals where there are large concentrations of customers with critical loads.

In designing a N – 1 secure network, transmission planners also need to take into account limitations that occur in real time operations timeframe.

> "One way this is sometimes done is by considering the simultaneous failure of any one line and any one generator when doing planning timeframe studies. In an operations timeframe, however, N-1 security means that the current system must be able be able to tolerate the 'next worst' contingency. Because an actual operating system may have already sustained the outage of one or two components, this is tantamount to operating the system in an N-2 or N-3 condition from the planning point of view. Previous contingencies are 'sunk events' from the perspective of system operations. This means that, once a contingency occurs, meeting the N-1 criterion means considering the altered system, not the original system, as the new base case to which the criterion must be applied."[197]

The performance capability of a transmission network can be greatly affected by the significant elements connected to the distribution network (sometimes known as sub-transmission). In these cases, there needs to be compatibility between the reliability standards of the transmission network and distribution networks. This, in turn, requires considerable interaction between distribution and transmission network planners and operators, to ensure that the most economically efficient network augmentations take place and that transmission network reliability/security is maintained in an operational timeframe through appropriate co-ordination of actions on the transmission and sub-transmission networks.

Maintaining N – 1 security in an operational timeframe requires that the system operator maintain sufficient quantities of two types of reserve:

- spinning reserves — provided by generators that can instantaneously adjust their output up or down in response to fluctuations in load or generation so that system frequency can be continuously maintained in a narrow operating band around 50 Hz; and

- contingency reserves — which allow the integrity of the power system to be maintained following a contingency. In the NEM, contingency reserves are defined over 6 seconds, 60 seconds and 5 minute timeframes.

Both types of reserve have to be available on a geographically dispersed basis, to ensure secure operation when an outage causes the power system to separate into islands (e.g. when a bush fire or lightening strike causes the electrical separation of

[197] Alvaro, F. and Oren, S. 2002, p. A-6

two NEM regions). That is, prior to and after a contingency occurs, system operators need to be able to change the level of generation output (and reserves) at different locations around the network, so as to maintain the security of the power system and continue supplying loads, even when parts of the system have become electrically separated from one another.

Maintenance of security in an operational timeframe utilises a combination of:

- real time monitoring of all elements of the power system;
- communicating information on the current state of the system;
- estimating the future state of the system;
- assessing credible contingencies and taking appropriate precautionary or corrective action;
- controlling the system so it adjusts to changing circumstances and remains secure and reliable.

There are several ways the power system can be controlled:

- transmission line switching;
- automatic fault clearance;
- voltage control — transformer tap changes, Static VAR Compensators (SVCs), capacitor banks, Syncronous Condensors, etc.;
- dispatch process;
- Frequency Control Ancillary Services (FCAS);
- Network Control Ancillary Services (NCAS); and
- directions from the system operator.

In the NEM, during the operational timeframe, the maintenance of power system security is shared between NEMMCO and TNSPs and involves tight co-ordination of their activities.

However, during the planning timeframe, power system security is assured through:

- the design and construction of the transmission network; and
- ensuring that there is sufficient installed generation capacity to meet load, without involuntary load shedding.

The design and construction of transmission networks in the NEM is the responsibility of the Jurisdictional Planning Body (JPB), which in most cases is the jurisdictional TNSP.

The NEM uses a number of market and regulatory mechanisms to ensure that there is sufficient installed generation and network capacity to meet load over the long term, including:

- the supply-demand balance and long term contracts for energy supply;
- reliability standard of 0.002% USE over the long term;
- the setting of the Value of Lost Load (VoLL), a cap on spot prices;
- Reliability Safety Net — "Reserve Trader" and NEMMCO's powers of direction;
- system performance and security standards contained in the NEM;
- jurisdictional transmission reliability standards; and
- regulatory incentives for network owners and operators arising from the combination of (CPI – X) regulation, WACC, asset depreciation rates, the Regulatory Test, allowed capital and operating expenditure, and network performance incentives.

As mentioned in Chapter 1, this review is only focussing on the development of a framework for nationally consistent transmission network reliability standards. Under the existing arrangements in the NEM, there is some degree of national consistency in transmission standards because jurisdictional transmission standards all have to be aligned with the technical standards specified in the Rules relating to security and reliability in an operational timeframe (Schedule 5.1a and 5.1 of the Rules). Increasing the degree of national consistency in transmission reliability standards primarily requires that any new framework allow the alignment of transmission standards used in the planning timeframe.

The Panel has already investigated the 0.002% USE reliability standard, the Reliability Safety Net, and the level of VoLL as part of the Comprehensive Reliability Review.[198]

The AEMC has already completed major reviews of various aspects of the regulatory regime affecting transmission networks, and has implemented changes to Chapter 6 of the Rules,[199] pricing of regulated network services,[200] and the principles underlying the Regulatory Test. [201]

In 2008, the Panel will carry out a separate review of the technical standards in the Rules that relate to power system security and network connections. Nonetheless,

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198 AEMC Reliability Panel 2007, *Comprehensive Reliability Review, Final Report*, AEMC, Sydney December.

199 AEMC 2006a, *National Electricity Amendment (Economic Regulation of Transmission Services) Rule 2006 No. 18*, Rule Determination, 16 November 2006, Sydney.

200 AEMC 2006c, *National Electricity Amendment (Pricing of Prescribed Transmission Services) Rule 2006 No. 22,* Rule Determination, 21 December 2006, Sydney.

201 AEMC 2006b, *Reform of the Regulatory Test Principles, Final Determination*, 30 November 2006, Sydney.

one possible framework for nationally consistent transmission reliability standards would be to extend the existing Schedule 5.1 and 5.1a technical standards so that they cover issues relating to longer term planning timeframes, as recommended by ERIG.[202]

A.4 Form of transmission standard and planning methodologies

There are two main forms in which a transmission reliability standard can be expressed. For a long time, transmission standards in many countries have been expressed in a deterministic form, along the lines of a "N – x" standard. More recently, transmission standards in some jurisdictions have been expressed in a probabilistic form. Transmission network planners use different analytical techniques to assess whether the network meets these different forms of standard. These analytical approaches and responses they trigger to the network plan constitute the network **planning methodology** (see Table A.1 below).

A.4.1 Deterministic form

A deterministic form of transmission reliability standard requires that the bulk power system can continue to provide adequate and secure supplies of energy to customers after any of a range of contingencies occurs. The contingencies involve outages (i.e. faults, failures) of some important elements of the power system, such as lines, transformers or generators. A deterministic standard does not take into account the probability of an outage. Taking into account these contingencies, planners and operators of the power system aim to incorporate sufficient redundancy so that any system failures can be prevented, either through automatic system protection mechanisms or manual intervention by operators. In the event of a contingency, the power system is required to remain within its performance parameters (e.g. flow limits, voltage levels, stability criteria), system security maintained, and all loads supplied without interruption from the contingency.

The contingency list plays a critical role in determining the level of reliability. The more comprehensive the contingency list, the lower the chance of a system failure from contingencies not listed.

When deterministic standards are used, they are often expressed as "N – x", where x can be 0, 1 or 2, as discussed above. An N – 0 security standard is often used when there is a radial line serving a load — if the line fails, there is no way the load can continue to be served by the network. Continued supply in this case can be provided by a back-up generator or, if the load is small enough, by stored energy (batteries). Greater reliability is provided by having each load supplied by more than one source, typically via a meshed network, but this is not always cost effective. The need for redundancy is the main reason that transmission networks are meshed. This meshing generally provides N – 1 secure or higher levels of reliability.

202 ERIG 2007, p.182

Deterministic standards have traditionally been used to plan power systems, and have played a key role in the delivery of high levels of power system reliability that people are used to in modern, industrialised economies.

Transmission planners use power flow modelling and other analytical techniques to assess the effects of each contingency on the power system. The effects of the contingency are assessed against the system performance and reliability criteria to determine whether any criteria are breached. Based on this analysis, measures of system reliability, such as loss-of-load probabilities, frequencies and durations can be calculated. This information then feeds into the design, planning and operational processes for the transmission network (see Table A.1 below).

A.4.2 Probabilistic form

A probabilistic form of transmission reliability standard requires that the bulk power system be expected to provide adequate and secure supplies of energy to customers under a wide range of contingencies. A probabilistic form of transmission reliability standard explicitly takes into account the probabilities of contingencies (e.g. transformer failure rates) under a range of possible operating conditions (e.g. electric load levels, system states) that also have probabilities assigned to them. Each contingency is treated as a random event, with some events more likely to occur than others. Probabilistic modelling methods are applied to models of physical power system to calculate expected values of system reliability measures, based on probability distributions regarding power system performance. The results of this modelling inform the design and planning of the transmission network (see Table A.1 below).

A probabilistic transmission standard could, for example, be expressed as the likelihood of a customer at a given supply point being without supply or the likely time without supply. The existing NEM reliability standard of 0.002% USE is a probabilistic form of standard.

Victoria is the only jurisdiction in the NEM which uses a probabilistic transmission planning standard to supplement the operational standards in the Rules.[203] The Victorian transmission planning process treats operator responses to contingencies as deterministic events, but assigns probabilities to system states and contingent events. Probabilistic assessments are then made concerning the level of power system performance, with an economic value assigned to any customer load that is not served. If power system performance does not meet the probabilistic standards or if the estimated value of the lost customer load is greater than the cost of network operational actions (e.g. NCAS contracting) or augmentation, the transmission network plan is reviewed.

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[203] VENCorp 2007, *Victorian Electricity Transmission Network Planning Criteria*, Issue No. 2, VENCorp, Melbourne, 3 May 2007. (URL http://www.vencorp.com.au/index.php?pageID=8070&action=filemanager&folder_id=497&sectionID=8246)

A.4.3 Hybrid form

With a hybrid form of standard, the standard is derived from economic considerations, but expressed deterministically, for ease of understanding. The planning methodology used can be either the restricted probabilistic approach employed when deterministic standards are used or the comprehensive probabilistic methodology used with probabilistic standards (see Table A.1 below).

Sometimes a probabilistic standard is expressed in an equivalent, but deterministic manner. For example, the NEM's 0.002% USE reliability standard is operationalised by NEMMCO into a deterministic standard for minimum level of reserve in each NEM region.

In South Australia, the transmission reliability measures are derived using probabilistic methods but expressed deterministically to facilitate understanding and comparison with the deterministic transmission standards in the SA Electricity Transmission Code.[204]

A.5 Level of transmission standard

The level of transmission standard plays a critical role in determining the reliability, security and costs of the network.

When the form of standard is deterministic, if the level of the standard has a greater level of network redundancy, this implies that the security of the network and its capital and/or operational costs will be higher. For example, an N – 2 secure network will be more expensive to build and operate than a N – 1 secure network.

A level of a probabilistic transmission standard can be set using a range of methods, but again if a high standard of security is set (e.g. a very low probability of power system failure), this implies higher capital and operational expenditure on the network.

Choices about the level of standard can be influenced by a range of factors, including:

- judgements about the criticality of particular loads;
- judgements about the economic value of lost load for particular customer classes;
- public safety;
- difficulty and cost of restoring the power system to normal operations following shutdown;
- economic benefits of secure and reliable power supplies;

[204] Electricity Network Owners Forum (ETNOF), Letter to Commissioner Ian Woodward, AEMC, received 5 November 2007.

- differing costs of network construction, operational actions, and non-network solutions (e.g. demand side response);

- compatibility with standards used in other modern "digital economies", in which production, commerce and many everyday processes rely on computer technology.

There may be little choice on the level of standard, if it is set by state governments, who may wish to take into account a range of other factors.

Existing jurisdictional transmission standards have been set having regard to historical levels of reliability, the factors listed above, and "good industry practice" concerning the operation of bulk power systems, which has developed internationally over the last 100 years.

Across the NEM, the level of transmission reliability standard is generally "N – 1 secure" for meshed parts of the transmission network, "N – 0 secure" for radial lines serving a single load in rural areas, and the equivalent of "N – 2 secure" in CBD areas.

Table A.1: Forms of standards and associated planning methodologies

Form of standard	Description	Planning methodology used
Deterministic	• A type of redundancy standard. • The bulk power system is designed so that it can continue to provide adequate and secure supplies of energy to customers after any of a range of contingencies occurs. • The contingencies involve outages (i.e. faults, failures) of some important elements of the power system, such as generators, lines or transformers. • The probability of these outages is *not* explicitly taken into account (but may be implicit in the standard). • Standards are typically expressed as an (N – x) redundancy level, where N is the number of elements in service on the bulk power system and x is the number of those elements experiencing an outage.	• Using a range of probabilistic inputs – such as demand forecasts, generation patterns, and electrical flows – a model of the bulk power system is subjected to range of simulated contingencies. • Taking into account these contingencies, planners and operators of the power system aim to incorporate sufficient redundancy so that system failures can be prevented, either through automatic system protection mechanisms or manual intervention by operators. • In the event of a contingency, the power system is required to remain within its performance parameters (e.g. flow limits, voltage levels, stability criteria), system security maintained, and all loads supplied without interruption from the contingency. • In effect, the deterministic standard is applied to a limited, plausible, set of probabilistic planning scenarios, and the deterministic standard needs to be met in all cases. If the standard is not met, the operational and/or investment plans are altered until the standard is met. • An *implicit* value of customer reliability is an *output* of the modelling and planning processes. • The contingency list plays a critical role in determining the level of reliability. The more comprehensive contingency list, the lower the chance of system failure from contingencies not listed. • Note that around the world, deterministic standards and planning methods have traditionally been used to plan bulk power systems. •

Form of standard	Description	Planning methodology used
Probabilistic	• The bulk power system is designed so that it can continue to provide adequate and secure supplies of energy to customers following a wide range of contingencies. • The probabilities of contingencies (e.g. transformer failure rates) are explicitly taken into account. • The degree of reliability designed into the system is linked to explicit customer valuations of reliability. Higher valuations of reliability result in a higher level of redundancy, either at particular points of the network or the network as a whole.	• A wide range of probabilistic inputs are used in a model the bulk power system, which is then subjected to wide range of simulated contingencies. • Probabilistic inputs include: demand forecasts, generation patterns, electrical flows, and contingencies (e.g. generation and transmission plant failure rates). • An *explicit* value of customer reliability is a key *input* to the modelling and planning processes. Different values of customer reliability can be used at different connection points, reflecting variations in the criticality of load and the willingness of customer to pay for reliability. • Each contingency is treated as a random event, with some more likely to occur than others. (Low probability, but high impact, contingencies that might be excluded from a contingency list used in deterministic planning approach, are included). • Probabilistic modelling is carried out, involving the repeated random sampling of contingencies and modelling the effects of the contingencies on the physical power system is carried out. . • The results of this probabilistic modelling are used to calculate expected values of system reliability measures, based on probability distributions regarding power system performance. • The results of this modelling inform the operation, design and planning of the transmission network. • In effect, the probabilistic standard is applied to an extensive range of probabilistic planning scenarios. • If the standard is not met at any given point along the probability distribution of outcomes, the operational and/or investment plans are altered only if the explicit value of customer reliability exceeds the costs incurred in meeting the standard.

Form of standard	Description	Planning methodology used
Hybrid	• The bulk power system is designed so that it can continue to provide adequate and secure supplies of energy to customers after any of a range of contingencies occurs. • The standard is derived from economic considerations, but expressed in deterministic terms.	Because the standards are derived from economic considerations, much of the economic analysis which typifies probabilistic planning is part of the standard-setting process. Once the standards are derived, they are expressed in deterministic form. A deterministic planning approach is then applied to those standards. Alternatively, a probabilistic approach can be applied on a case-by-case basis to assess a range of investment options that satisfy the deterministically expressed standards. This application of probabilistic planning methods potentially allows the timing of transmission network investments to be adjusted in ways that balance likely reliability benefits against the costs of a range of network and non-network options that can be used so as to meet the standard.

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B Today's transmission standards

This appendix discusses existing transmission reliability standards in the NEM and briefly compares them to standards in a selection of other electricity markets. It also seeks to identify the potential issues that might arise from inconsistencies in jurisdictional transmission standards, the size and scope of any issues, and the motivations for changing to a nationally consistent framework.

B.1 Transmission standards and network planning processes

Jurisdictional transmission planners seek to design their networks to ensure that: (a) power system performance is within the technical limits of the system; (b) the power system can be controlled by the system operator in such a way that security requirements are met; and (c) that demand at all points of the network can be met in accordance with the jurisdictional Reliability Standard of 0.002% USE each year.

The regulatory regime for transmission also requires transmission planners to seek to design the network so these three objectives can be met at least economic cost, taking into account the value placed by customers on reliable supplies of electricity.

System performance standards define the technical limitations of the bulk power system, such as voltage ranges, reactive power limits, stability limits, maximum fault currents and fault clearance times. These performance standards can be thought of as defining a “performance envelope” within which the power system must operate.

System security standards oblige the system operator to take actions to ensure that the power bulk power system operates within its system performance standards, prior to and following a network contingency. The security standards also define the timeframe in which operational actions must be taken to restore the system to a secure state following a contingency. Operational actions include network switching, changes to dispatch of energy and/or ancillary services, and at a last resort, involuntary load shedding.

The focus of this review is on jurisdictional reliability standards, which primarily focus on the transmission planning timeframe. However, the network design and construction also needs to take into account the network performance and security in the operational timeframe set out in Chapter 5 of the Rules . The Chapter 5 Rules standards provide a nationally consistent benchmark for reliability and security in the operational timeframe. Jurisdictional transmission reliability standards are complementary to those in the NER. They can provide a greater degree of prescription about how reliability and security will be met in the operational timeframe than the standards set out in the NER. In addition, jurisdictional standards specify how the network will be planned and operated to meet specific local requirements.

Therefore, at present, while there is NEM wide consistency of transmission standards in an operational timeframe — albeit with some room for TNSP flexibility in delivering to those operational standards — there is a divergence in the reliability standards applied to planning transmission networks in NEM jurisdictions. It is this difference in transmission reliability standards that the MCE wishes to have addressed through the development of a framework for nationally consistent transmission standards.

B.2 NEM-wide transmission standards[205]

B.2.1 System performance standards

The bulk power system *performance standards* for all transmission networks in the NEM are set out in:

- Schedules 5.1a and 5.1 of the Rules; and
- jurisdiction specific transmission codes, licenses, legislation or network management plans.

In addition, in some cases, there may be location specific transmission system performance requirements, which are related to customer connection agreements. Schedule 5.1 of the Rules recognises that transmission reliability standards can be set in these connection agreements. It is understood that some of these customer connection agreements, where the Distribution Network Service Providers (DNSPs) is the customer, can have widespread geographical coverage (e.g. all DNSP connections points to be supplied at N – 1) , and are long term.

The system performance standards include:

- frequency operating standards, which are determined by the Reliability Panel;
- stability criteria;
- steady state and transient voltage ranges;
- reactive power limits;
- fault levels; and
- protection systems and fault clearance times.

Many of these performance standards also apply to DNSPs because of the strong interactions, in many cases, between the transmission or sub-transmission networks owned by DNSPs and the transmission networks owned by TNSPs.

These clauses of the Rules place explicit obligations on network service providers to design and operate their networks such that the system performance standards are

205 Phrases that are italicized in this section have the meaning defined in the National Electricity Rules.

met both before and after credible contingency events. The nature of the credible contingency events and their severity are also specified.

B.2.2 System security standards

System security standards in Chapter 4 of the Rules require NEMMCO and NSPs to take actions to maintain power system security, while keeping the system within the system performance standards specified in Schedules 5.1a and 5.1 of the Rules.

The system security standards specify two states of system security — *satisfactory operating state*[206] and *secure operating state*[207] — that are defined in terms of *credible* and *non-credible contingency events*. The *technical envelope,* defined in clause 5.2.5 of the Rules, is used as the basis for categorising credible contingency events. Under clause 4.2.3, NEMMCO has guided discretion in determining the list of credible contingencies and non-credible contingencies.

The most common types of credible contingencies are loss of the largest generator in a region, fault on a line, and loss of a transformer. Non-credible contingencies, such as lightening strikes or bushfires, are treated as system security events but can be re-classified as credible contingencies, if NEMMCO deems them so.

General principles for maintaining power system security are contained in clause 4.2.6 of the Rules. Arising from these principles are obligations on NEMMCO and TNSPs to maintain power system security, and to do so within set operational timeframes. First, NEMMCO must operate the power system so that is normally in a *secure state*. Second, following a contingent event, NEMMCO must take reasonable actions to return the system to a *secure state* as soon as practicable, but within 30 minutes.

The Rules recognise the strong inter-play between power system security and reliability. A *reliable operating state* (defined in clause 4.2.7) occurs when all loads are being supplied and are expected to continue being supplied and that there are sufficient levels of *short term* and *medium term capacity reserves* to meet the *power system security and reliability standards*.

B.3 Jurisdictional transmission network standards

Jurisdictional standards for transmission networks exist because transmission networks were developed on a state by state basis, with interconnection between jurisdictions only occurring relatively recently.[208]

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[206] Clause 4.2.2 of the Rules defines a *satisfactory operating state*.

[207] A *secure operating state* is defined in clause 4.2.4 of the Rules.

[208] The first interconnection was that between the NSW and Victorian state transmission grids in November 1959. Other interconnections and their commissioning dates are: Victoria—South

When the NEM was established, governments made a policy decision to retain jurisdictionally based transmission network companies and planning arrangements, rather than forming a single national transmission company, which would acquire all the assets of the existing jurisdictional TNSPs and thereafter develop and operate the transmission network to some agreed standards.[209] This decision on the corporate governance framework for transmission allowed jurisdictions to retain tighter control over jurisdictional network reliability standards, pursue corporatisation and privatisation at different paces, and pursue any other state government policy objectives via the pricing of electricity (e.g. "state development" agendas, uniform pricing for urban and rural consumers).

In addition, jurisdictional reliability standards reflect the political reality that if the lights go out in a jurisdiction, it is the government of the jurisdiction that faces the economic and political consequences and manages many of the public safety issues arising from a blackout.

Importantly, jurisdictional transmission reliability standards specify the *minimum standards* for the shared transmission network. A key aspect of the existing framework for transmission network development is the ability for network users to negotiate a standard of network reliability that is higher or lower than the minimum standard. Details of any negotiated standard are generally contained in the connection agreement between the network user and the TNSP, which sets out the terms and conditions of access to the network.[210]

As mentioned in Chapter 2, the form of existing jurisdictional reliability standards is either:

- deterministic;
- probabilistic; or
- hybrid, in which a probabilistic standard is translated into an equivalent deterministic standard.

Table B.1 below sets out for each jurisdiction:

1. the form of the jurisdictional transmission standard;

Australia (1990), Directlink (July 2000), Queensland–NSW Interconnector (February 2001), Murraylink (October 2003), and Tasmania—Victoria (April 2006).

209 For a summary of the policy decisions concerning the corporate structure of transmission in the NEM, see Firecone 2007, *The Evolution of Transmission Planning Arrangements in Australia*, Report to the Australian Energy Market Commission, Firecone Ventures Pty Ltd, Melbourne, October, pp. 2-6. Available at http://www.aemc.gov.au

210 Schedules 5.2 to 5.7 of the Rules specify various technical requirements under three types of transmission access standard: an *automatic access standard*, *a minimum access standard*, and a *negotiated access standard*. These technical requirements are consistent with the power system performance and security obligations contained in Schedules 5.1a and 5.1 and Chapter 4 of the Rules.

2. the jurisdictional transmission standard;

3. the jurisdictional source of the standard;

4. interactions between transmission and distribution network standards;

5. interactions between transmission standards between interconnected transmission networks; and

6. interactions between jurisdictional transmission standards and NEMMCO's security and reliability standards.

The following key observations can be made:

- The form of standard differs across NEM jurisdictions. The form of standard is deterministic (N – 1) in three out of five jurisdictions. Victoria uses a probabilistic standard. SA uses a probabilistic standard, but expresses it in a deterministic fashion (N – 1).

- The level of standard varies across NEM jurisdictions. In most jurisdictions, the planning standard is for N – 1 secure operations in areas outside CBD, with an equivalent of N – 2 secure operations in CBD. These deterministic security levels may be an explicit requirement with penalties (up to and including loss of license) associated with non-compliance. For example, in South Australia, the level of deterministic standards is set out in the *Electricity Transmission Code*[211], while in Queensland the level of standard is specified in an act of parliament and the transmission license.[212] Alternatively, when a probabilistic form of standard is used, such as in Victoria, a higher level of network reliability may be implied if a higher Value of Customer Reliability (VCR) is used for network planning for CBD areas compared to that used for residential areas.[213]

- The source of transmission standards is not uniform across jurisdictions, and is a combination of the Rules and jurisdictional instruments. The range of jurisdictional instruments used to specify the standard is diverse, ranging from legislation, transmission licences and system codes, or Network Management Plans.

- There is, in many cases, a strong interaction with local DNSP planning standards. Both the Rules and jurisdictional standards require joint planning of transmission (owned by the TNSP) and sub-transmission networks (owned by the DNSP),

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211 ESCOSA 2006, *Electricity Transmission Code ET/05*, 1 July 2008, ESCOSA, Adelaide. (URL http://www.escosa.sa.gov.au/webdata/resources/files/060906-R-ElecTransCodeET05.pdf)

212 For details, see Powerlink 2006, *Planning Criteria Policy*, Version 1.0, Powerlink Queensland, Brisbane 23 March 2006 (Available at http://www.aer.gov.au)

213 See *Transmission Connection Planning Report 2006*, Produced jointly by the Victorian Electricity Distribution Businesses 2006 (URL http://www.sp-ausnet.com.au/CA256FE40021EF93/Lookup/PlanningRep/$file/TCPR2006.pdf)

given that the latter connect to the former and can affect the performance of the transmission network.

- There are few interactions with transmission planning standards in interconnected jurisdictions. Apart from TNSPs jointly planning interconnectors, there is little interaction on the issue of jurisdictional transmission standards.[214] However, there are examples of effective joint reliability planning across jurisdictional boundaries. These include the joint planning by Queensland and NSW TNSPs and DNSPs to deliver the requisite reliability (at lowest cost) to the border areas of Gold Coast/Tweed and Goondiwindi.

- There are strong interactions between jurisdictional transmission standards and NEMMCO's security and reliability standards. All jurisdictional planning and operational standards have to be consistent with the Rules standards applying to NEMMCO in an operational timeframe. Jurisdictional planning standards are generally more prescriptive than the Rules operational standards relating to reliability and security performance levels for connection points.

[214] Recent reviews of transmission standards in South Australia and Tasmania did have regard to standards applied in other NEM jurisdictions. See Section B.3.1 below.

Table B.1: Jurisdictional transmission standards

	NSW – TransGrid	QLD – Powerlink	SA – Electranet	TAS — Transend	VIC — VENCorp
Form of standard	Deterministic	Deterministic	Expressed as deterministic, but based on probabilistic analysis	Deterministic – Performance based – limits either the size of customer load that may be interrupted, or the length of interruption, or both.	• Deterministic assessment of operational actions for specific network conditions. • Probabilistic assessment used to account for uncertainty in system conditions.
Transmission reliability standard	N – 1 across jurisdiction, with the exception of modified N – 2 in CBD	N – 1 in accordance with good electricity industry practice. No variation across jurisdiction. In addition, as far as technically and economically practicable, the transmission grid is to be augmented or extended to provide enough capacity to provide network services to persons authorised to connect to the grid or take electricity from the grid.	There are 6 categories of reliability standard in SA with a defined category applying to each connection point. The standard categories range from "N" to "equivalent" "N – 2" line and transformer capacity, depending on the load and importance of load at risk at each connection point.	Load interruption standard has two elements: 1. for an intact system • N-1 for connections >25 MW • no asset failure will interrupt > 850 MW or cause system black; • unserved energy limits credible contingency 300 MWh • any asset failure 3 000 MWh 2. for network element out of service • unserved energy limit credible contingency 18 000 MWh	Largely based on system performance and system security requirements defined in the NER, with some additional jurisdictional fault level and voltage limit standards contained in clauses 110.1 and 110.2 of the Victorian Electricity System Code (VESC). The transmission reliability standard applied to each connection point is a function of the sector specific Value of Customer Reliability (VCR) used for that point. This approach implies that the Melbourne CBD,

	NSW – TransGrid	QLD – Powerlink	SA – Electranet	TAS — Transend	VIC — VENCorp
					which uses the highest VCR ($62 215/MWh), has a higher level of network redundancy than most other parts of the Victorian transmission network.
Jurisdictional source of standard	Contained in a Network Management Plan which TransGrid is obliged to produce by legislation for acceptance by the Department of Water and Energy.	Transmission Authority (licence) issued to Powerlink by Qld Govt and S.34 of the Queensland *Electricity Act 1994*.	The Essential Services Commission of SA (ESCOSA) determines the reliability standards for SA through the SA Electricity Transmission Code which is published on the ESCOSA website.	Regulations issued by Tas Government. Supplied by Tasmanian Reliability and Network Planning Panel (RNPP). Brought in formally on 3 December 2007.	Victorian Electricity System Code (VESC).
Interaction with local DNSP standards	Via joint planning with each NSW/ACT DNSP. DNSPs expect their standards to be reflected into the transmission system.	Via joint planning with ENERGEX and Ergon, who are required to meet N – 1 for their sub-transmission system and for bulk and major zone substations (i.e the distribution "backbone").	Via joint planning with ETSA Utilities. If required by the SA Electricity Transmission Code, contingency supply is provided where available via the distribution network.	Via Joint Planning with Aurora Energy under the NER requirements based on jurisdictional network security & planning criteria	• VIC Distribution System Code (DSC) sets out quality and reliability standards for DNSPs. • DNSPs align the planning process for connection assets to the transmission network with VENCorp's planning approach. • No interaction between NER transmission standards and those in DSC, apart from obligations on VENCorp to address fault levels and

	NSW – TransGrid	QLD – Powerlink	SA – Electranet	TAS — Transend	VIC — VENCorp
					voltage limits at sub-transmission level.
Interaction of standards between connecting TNSPs	Powerlink and TransGrid plan supply to Terranora/NSW Far North Coast and to Goondiwindi in conjunction with the relevant DNSP(s). Joint planning with VENCorp on interconnected assets and interconnector upgrade assessment.	Powerlink and TransGrid plan supply to Terranora/NSW Far North Coast and to Goondiwindi in conjunction with the relevant DNSP(s).	There are no connection points or transmission supplied customers in SA that are affected by directly adjacent TNSP reliability standards. However, as the Murraylink HVDC interconnection is utilised to provide N – 1 supply to the Riverland, its continued ability to do so is affected by the available capacity of the adjacent transmission networks.	There are no connection points or transmission supplied customers in Tasmania that are affected by directly adjacent TNSP reliability standards. Tasmania is connected to the NEM by the only MNSP - Basslink.	VENCorp has conducted joint planning studies with TransGrid and ElectraNet when assessing interconnector upgrades. These studies relevant to the technical standards have typically been conducted using the same approach adopted by VENCorp when assessing intra-regional constraints.
Interaction of TNSPs with NEMMCO's system security and reliability standards	NEMMCO operates the power system assuming a credible contingency can occur at any time. • When the system is intact, this is equivalent to N – 1. • If there are prior outages (planned or forced) or loss of multiple network elements is assessed as credible, NEMMCO's operation will be more onerous than N – 1.				VENCorp's simulation of system operational actions (or security standards) are directly based on NEMMCO's system operation obligations, as defined in Ch. 4 of the NER, particularly clauses 4.2.2, 4.2.3, 4.2.4 and 4.2.6.

	NSW – TransGrid	QLD – Powerlink	SA – Electranet	TAS — Transend	VIC — VENCorp
Comparison with standards under the Rules	The jurisdictional standards specify the level of **redundancy for planning** (not explicit in the NER). The jurisdictional standards are consistent with, and rely on, the technical planning standards prescribed in the NER.		The jurisdictional standards specify the level of **redundancy for connection points** (not explicit in the NER). The jurisdictional standards are consistent with, and rely on, the technical planning standards prescribed in the NER.	The jurisdictional standards specify the level of **performance for connection points** (not explicit in the NER). The jurisdictional standards are consistent with technical planning standards prescribed in the NER.	Additional jurisdictional standards are complementary and additional to the NER standards. They add constraints on the planning process in areas that are more discretionary under the NER. VESC standards on fault levels are about co-ordinated planning with asset owners and DNSPs, while the voltage targets are not a limit but rather a desired operating level that would not constrain planning.

Sources: Correspondence from ETNOF, ESCOSA, VenCorp

B.3.1 Reviews of jurisdictional transmission standards

In recent years, there have been reviews of the jurisdictional transmission standards in both South Australia and Tasmania, and indirectly via the review of sub-transmission standards in Queensland as part of the Electricity Distribution and Service Delivery (Somerville) report. Sub-transmission standards have also been revised in New South Wales.

B.3.1.1 Tasmania

The Tasmanian review, completed in June 2006 by the Tasmanian Energy Regulator, aimed to align the transmission planning standards in Tasmania with the operational security standards specified in the Rules and set minimum network performance standards against which proposals can be assessed under the reliability limb of the Regulatory Test.[216] The new transmission standards seek to maintain the same level of performance that Tasmanians are accustomed to.

The Tasmanian Energy Regulator accepted the advice of the Tasmanian Reliability and Network Planning Panel (RNPP), including:

- Retaining a form of deterministic (N – 1) transmission standard, rather than moving to a probabilistic form of standard like that used in Victoria;
- The transmission security and planning criteria are "performance based", meaning that they specify limits on either the size of customer load that may be interrupted, or the length of interruption, or both. The criteria do not prescribe the particular technical solutions the TNSP should use to meet the performance criteria. Instead, the TNSP is allowed discretion to determine the least cost means of meeting the transmission standard, in line with the reliability limb of the Regulatory Test.
- The transmission security and planning standards do not apply to energy intensive customers connected directly to the transmission grid (e.g. smelters, pulp mills). The standards for these large customers are set in power supply agreements or connection agreements.
- Additional capital expenditure, over and above that allowed for in the AER's current regulatory allowance, is required for the transmission network to meet the new minimum transmission standards. This capital expenditure is estimated to total $31–38 million over five years if transmission solutions, such as new transformers or lines, are used to bring the existing network up to the new standards.

The Tasmanian Government has informed that AEMC:

216 OTTER (Office of the Tasmanian Energy Regulator) 2006, *Transmission Network Security and Planning Criteria*, Final Report, Reliability and Network Planning Panel, OTTER, Hobart July.

Tasmania has just instituted Tasmanian Transmission Network Performance Requirements through Regulations under the Electricity Supply Industry Act (1996), proclaimed on 3 December 2007 and would not want to see these interfered with without good reason.

The Tasmanian network performance requirements (also known as security and reliability planning criteria) were developed with regard to the long term interests of Tasmanian electricity consumers and took note of approaches in other States. The Tasmanian approach can be described as a deterministic approach based on an assessment of unserved energy at risk. Where the investments are large, there is an additional requirement for a cost benefits test to be done, to the satisfaction of the Tasmanian Minister for Energy

It is hard to see what national benefit might arise from changes to Tasmania's network performance requirements. The Tasmanian system is a small 'cul de sac' at the end of a long DC cable. It is unusual in having a large number of small generators serving a few large industrial loads and in having a small and dispersed population.[217]

B.3.1.2 South Australia

A 2006 review of South Australian transmission standards by the Essential Services Commission of South Australia (ESCOSA) decided to retain the deterministic standard used in the SA Electricity Transmission Code (ETC).[218] ESCOSA's determination was informed by a 2004-05 review of transmission connection point reliability standards, carried out by the Electricity Supply Industry Planning Council (ESIPC) at the request of ESCOSA.[219]

ESCOSA's final decision sets out new transmission standards for the ETC, which took effect on 1 July 2008.

Under the new standards, Clause 2.2.2 of the ETC specifies six categories of transmission reliability standard, with a defined category applying to each connection point.[220] The standard categories range from "N secure" to 'equivalent' "N – 2 secure" for transmission line and transformer capacity, depending on the load and importance of load at risk at each connection point. The highest transmission

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217 Department of Infrastructure, Energy and Resources (Tasmania), Submission on National Transmission Planner Review Issues Paper, received by AEMC 16 January 2007, p. 2, Available at http://www.aemc.gov.au/electricity.php?r=20070710.172341

218 ESCOSA 2006, *Review of the Reliability Standards specified in Clause 2.2.2 of the Electricity Transmission Code*, Final Decision, Essential Services Commission of South Australia (ESCOSA), Adelaide, September.

219 ESIPC 2005, *Transmission Code Review*, Electricity Supply Industry Planning Council (ESIPC), Adelaide, October.

220 ESCOSA 2006, *Electricity Transmission Code ET/05*, 1 July 2008, ESCOSA, Adelaide. (URL http://www.escosa.sa.gov.au/webdata/resources/files/060906-R-ElecTransCodeET05.pdf)

standard (equivalent to N – 2 secure) applies to the Adelaide CBD, reflecting an implicit high value of customer load in that area.

The new transmission standards also specify:

- time limits for the "best endeavours" restoration of secure supplies in the event of a contingency affecting a transformer or line;
- grace periods allowing the TNSP up to three years to address breaches of the transmission standards;
- standards for and limits on the use of non-network solutions, such as transmission network support provided by DNSPs, generation or voluntary load reduction;
- timeframes for replacing or repairing transformers that have failed; and
- obligations on the South Australian TNSP to hold an inventory of spare transformers.

B.3.1.3 Queensland

There has been an indirect review of Queensland's transmission standards, via the review of sub-transmission standards carried out as part of the Electricity Distribution and Service Delivery (EDSD) Review, chaired by Mr Darryl Somerville.[221]

In Queensland, the DNSPs own sub-transmission networks which interact with the TNSP's transmission network to deliver the total transmission capability.

The EDSD (Somerville) report on distribution networks in July 2004 followed a series of distribution network problems in the previous summer.

The Queensland government adopted the EDSD recommendations, which included a requirement for the DNSPs to plan their sub-transmission networks and distribution "backbone" to an N – 1 standard.[222,223] This aligned with, and effectively affirmed, the N – 1 standard which existed in the TNSP's licence.

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[221] State of Queensland (Office of Energy) 2004, *Electricity Distribution and Service Delivery for the 21st Century, Queensland, Summary Report of the Independent Panel* (Chairman: D. Somerville), Department of Natural Resources, Mines and Energy, Brisbane, July. (Available at http://www.dme.qld.gov.au/Energy/independent_report.cfm)

[222] Premier of Queensland (Hon Peter Beattie), "Electricity Fact Sheet Available for all Queenslanders", Media Release, 18 August 2004 (URL http://statements.cabinet.qld.gov.au/MMS/StatementDisplaySingle.aspx?id=36920)

[223] Minister of Energy, Queensland (Hon. John Mickel), "Energy Minister Establishes Review Implementation Team", Media Release, 15 September 2004, (URL http://statements.cabinet.qld.gov.au/MMS/StatementDisplaySingle.aspx?id=37277)

B.3.1.4 New South Wales

It is understood that in 2005 the NSW government subsequently adopted the same sub-transmission and distribution network standards as Queensland and made them part of the license conditions of NSW DNSPs from 1 August 2005.[224],[225]

TransGrid's *Network Management Plan 2007-2011* provides details on the transmission planning approach and standards used in NSW.[226]

B.4 International transmission standards

The Panel commissioned two consultancy reports from KEMA Consulting[227] to provide further analysis of:

- the transmission reliability standards used in different international electricity markets; and
- the frameworks used in other markets to ensure consistency of transmission reliability standards across multiple political jurisdictions and/or multiple transmission network owners.

KEMA analysed the following markets (Table B.2):

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224 Minister of Energy (NSW) 2007, *Design, Reliability and Performance Licence Conditions imposed on Distribution Network Service Providers by the Minister for Energy*, Published August 2005 and amended on 1 December 2007 (URL http://www.ipart.nsw.gov.au/electricity/documents/DesignReliabilityandPerformanceLicenceConditionsforDNSPs-23November2007.PDF)

225 TransGrid 2007a, "APR 2007 Outline" (Garrie Chubb, Manager Network Planning), NSW Annual Planning Report 2007 Public Forum (URL http://www.transgrid.com/trim/trim261655.pdf)

226 TransGrid 2007b, *Network Management Plan 2007-2011*, TransGrid, Sydney (URL http://www.transgrid.com.au/trim/trim211409.pdf)

227 See: [1] KEMA 2008a, *International Review of Transmission Reliability Standards— Summary Report*, Report to AEMC Reliability Panel, KEMA Inc, Philadelphia, 27 May 2008; and [2] KEMA 2008b, *International Review of Transmission Reliability Standards— Detailed Summaries*, Report to AEMC Reliability Panel, KEMA Inc, Philadelphia, 31 July 2008; [3] KEMA 2008c, *Additional response regarding probabilistic planning methodologies*, Report to AEMC Reliability Panel, 31 July 2008. All three KEMA reports are located at: http://www.aemc.gov.au/electricity.php?r=20071221.150018

Table B.3: Transmission reliability standards and planning methodologies used in selected foreign electricity markets

Market	Deterministic	Probabilistic	
		Hybrid neutral	Hybrid subtractive
North America			
North American Electric Reliability Corporation (NERC)	✓		
PJM	✓		
California Independent System Operator (CAISO)	✓	✓	
Alberta	✓		
British Columbia Transmission Corporation (BCTC)		✓	
Western Electricity Coordinating Council (WECC)	✓	✓	
Europe			
Great Britain	✓		
Germany	✓		
Nordpool	✓		
Australia / New Zealand			
New Zealand	✓		
Victoria*			✓

* VENCorp, in its submission to the Interim Report, disagreed with KEMA's characterisation of Victoria's planning methodology as hybrid subtractive.

The reliability standards employed in these international markets are discussed further in Chapter 8 of this report, and in the KEMA reports.

B.5 Potential issues arising from divergent transmission standards

It has been suggested that there are issues that may arise from divergent jurisdictional transmission standards, including:

- sub-optimal development and use of the national transmission grid arising from the application of the Regulatory Test to networks with differing standards;
- poor balance between transmission and generation investments within and across NEM jurisdictions, and relatively low level of interconnection; and
- technological bias in meeting jurisdictional transmission reliability criteria through network solutions rather than non-network solutions.

The Panel has investigated issues that have been observed in overseas electricity markets in which transmission planning standards vary across jurisdictions—see Chapter 8 and the KEMA reports.[228]

B.6 Size and scope of problems

As discussed above, there appears to be considerable variation in the form and level of transmission planning standards across the NEM.

However, this lack of uniformity of jurisdictional transmission standards does not appear to have manifested itself in the form of noticeably different levels of delivered power system reliability across the NEM.[229] Arguably, jurisdiction specific transmission standards, together with NEM-wide system performance and security standards, appear to have continued to deliver power system reliability in line with that experienced in the years before the start of the NEM in 1998. The differences in transmission standards do not appear to have led to materially different reliability outputs. Thus, on what basis should changes to the transmission reliability standards be pursued?

What is the relative importance of having the same transmission reliability standards for, say, the Adelaide CBD and the Brisbane CBD? How does that compare with the relative importance of having the same network standards for the TNSP/DNSP jointly responsible for delivering reliability to those respective CBDs?

[228] KEMA 2008a, 2008b, and 2008c — *ibid*.

[229] See AER (Australian Energy Regulator) 2007, *State of the Energy Market 2007*, AER, Melbourne, pp. 45–47 and pp. 132–134 (URL http://www.aer.gov.au/content/index.phtml/itemId/713232)

B.7 Motivations of changing existing jurisdictional transmission standards

Since the creation of the NEM, there are at least three motivating reasons for changing the existing jurisdictional transmission standards.

First, the transmission network is an increasingly interconnected system. The number of interconnections across jurisdictions has increased significantly since the start of the market, and this has resulted in greater financial trading and physical power flows across jurisdictions. These increased physical flows, together with market related changes in power flows, have required system planners and operators to pay greater attention to physical interactions that affect system security and reliability. The construction or augmentation of an interconnector can dramatically alter the economics of alternative projects, such as transmission or generation, that deliver the same level of reliability. Given the significant sunk capital costs associated with power generation and transmission projects, and their long asset lives, there are potentially significant dynamic efficiency benefits in optimising the timing, scale and use of transmission and generation assets. Conversely, there are likely to be significant, on-going, economic costs from having a poorly balanced mixture of transmission and generation assets.

Second, there is a need to derive an optimal balance between transmission and generation investments over space and time using a combination of market incentives and regulatory incentives. Power system reliability and security is no longer solely determined by a system planner, that designs, builds, owns and operates all the generation and transmission assets within a jurisdiction, with little or no regard to what occurs in other jurisdictions. Instead, generation investments are driven by a range of market-related factors concerning financial risks and payoffs, and the co-ordination of generation expansion with transmission planning augmentation occurring primarily through information disclosure in Transmission Annual Planning Reports, the SOO ANTS, connection applications, and public consultations on major transmission upgrades.

Third, it is claimed by ERIG that prospective benefits arising from any new National Transmission Planning arrangements and Reliability Test will be significantly diminished if divergent jurisdictional transmission standards continue to be used instead of nationally consistent standards.

B.8 Submissions to Issues Paper

There is broad consensus on the range of problems created by the existing arrangements for setting transmission planning standards across the NEM and motivations for change. As discussed in detail in Chapter 4, submissions stated that the shortcomings of today's approach to transmission planning standards and methods include:

- a lack of transparency in both the level of standards and the ways in which those standards are set. This has a detrimental impact on the accountability of parties who set the level of standards and TNSPs that must apply and demonstrate compliance with the standards;

- regulatory complexity for investors in new generation or demand side management capacity when seeking to assess long term levels of network performance, congestion and access; and

- concerns over potential perceptions of conflicts of interest and poor governance in cases where a TNSP is involved in setting the standards it subsequently is required to meet.

Different views on the size and scope of problems with today's standards and the motivations for changing them are reflected in the various options put forward for a NCF, which are discussed in Chapters 5 and 6 and Appendices D and E.

C List of submissions

C.1 Issues Paper

Eight submissions were received in response to the Issues Paper:

Organisation	Abbreviation
Australian Energy Regulator	AER
Electricity Supply Industry Planning Council	ESIPC
Electricity Transmission Network Owners Forum	ETNOF
EnergyAustralia	EA
Loy Yang Marketing Management Company (LYMMCO), AGL Hydro, International Power, TRUenergy, Flinders Power	The Group
National Generators Forum	NGF
Powerlink Queensland	Powerlink
Victorian Energy Networks Corporation	VENCorp

In addition, the Tasmanian Government's Department of Infrastructure, Energy and Resources commented on the Transmission Reliability Standards Review Issues Paper in its submission on the National Transmission Planner Review's Issue Paper.[230]

C.2 Draft Report

Four submissions were received in response to the Draft Report:

Organisation	Abbreviation
Australian Energy Regulator	AER
Grid Australia	GA
Loy Yang Marketing Management Company (LYMMCO), AGL Hydro, International Power, TRUenergy, Flinders Power	The Group
Victorian Energy Networks Corporation	VENCorp
Queensland Government	—

[230] Department of Infrastructure, Energy and Resources (Tasmania), Submission on National Transmission Planner Review Issues Paper, received by AEMC 16 January 2007. Available at http://www.aemc.gov.au/electricity.php?r=20070710.172341.

C.3 Public Forum

On 30 April 2008, the Panel held a public forum in Melbourne on its Draft Report, "Towards a Nationally Consistent Framework for Transmission Reliability Standards".

Two presentations were made to the Panel at this forum:

Organisation	Abbreviation
Grid Australia	GA
Loy Yang Marketing Management Company (LYMMCO), AGL Hydro, International Power, TRUenergy, Flinders Power	The Group

All of the above submissions and presentations are available on the AEMC's website together with a transcript of the 30 April 2008 public forum.[231]

C.4 Interim Report

Four submissions were received in response to the Interim Report:

Organisation	Abbreviation
Grid Australia	GA
VENCorp (×2)	VENCorp
Energy Australia	EA

231 See http://www.aemc.gov.au/electricity.php?r=20071221.150018.

D Variants of Option D and Option E

This Appendix describes five variants of Option D, and two variants of Option E. The variants of Option D (see Table 1) were proposed by the Group, and the variants to Option E (see Table 2) were proposed by the AER and VENCorp. The variations to specific features are displayed in blue text.

D.1 Thinking behind variant options

The stated motivations and objectives for the suggested range of variations to Options D and E include:

1. Allowing individual jurisdictions to elect whether to use probabilistic planning methods on a project-by-project basis, if it considers that this approach results in economic efficiencies.

2. Providing for flexibility in the expression of standards that are derived from an economic—technical analysis that is consistent with the NCF. The standards can be expressed in an equivalent deterministic form (i.e. N - x), or some other form which provides stakeholders with a clear view of the overall reliability standard for each connection point (and the network as a whole); noting that overall connection point reliability is influenced by both:

   (a) the reliability of transmission assets upstream of the connection point (i.e. assets in the "shared transmission network"); and

   (b) the reliability of connection point assets.

3. Giving jurisdictions the option of appointing an independent national body, such as the Reliability Panel or AEMO, to set the reliability standards under the national framework.

4. Including in the deterministic standard expressions, a time allowance for customer reconnection in certain circumstances, to strengthen the technological neutrality of the model.

5. Requiring TNSPs to report on delivered network capability compared to the reliability standard at each connection point.

6. Requiring a common set of guidelines and methodology for calculating the Value of Customer Reliability (VCR or CVR), for use across the NEM.

7. In very limited circumstances, allowing the use of deterministic "surrogates" in cases where standards are **not** derived from economic-technical considerations that include a an explicit VCR. The use of such surrogates would be tightly prescribed in guidelines be confined to small to medium individual projects or project sequences.

8. Establishing a NEM-wide “default standard”, but allowing jurisdictions the right to modify the standard for a specific purpose.

Table 1: Final options for a consistent national framework for transmission reliability standards–Option D variants

Features	Option D	Option D1	Option D2	Option D3	Option D4	Option D5
Form of standard	Probabilistic, with more developed probabilistic assessments than currently used by VENCorp.	Probabilistic, with more developed probabilistic assessments than currently used by VENCorp.	Probabilistic, with more developed probabilistic assessments than currently used by VENCorp.	Hybrid form, as proposed in Options A, B & E. • The principal standards are derived from a customer value of reliability (CVR). • Deterministic surrogates of the principal standards can be developed, with strict guidelines for their application. These surrogates are not standards in themselves, they are merely seen as a more streamlined way of applying the CVR in grid planning studies. • Use of deterministic surrogates confined to small to medium individual projects or project sequences. • All large investment projects to be subjected to a more complete probabilistic planning assessment. • For medium sized projects, interested parties have right to request the application of a more complete probabilistic assessment. • TNSPs should have the right to undertake full probabilistic analyses and not use a deterministic surrogate if they so desire. • A new improved method of probabilistic assessment be jointly developed by a TNSP-based working group chaired by the NTP, and follow public consultation process specified in the Rules. When this method is finalised and approved by the AER, its use should be mandatory for all probabilistic based assessments. Until then, pragmatic interim assessment techniques may be used.		
Scope of standards	Common across NEM jurisdictions. Allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction, depending on customer valuation of reliability.	Common across NEM jurisdictions. Allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction, depending on customer valuation of reliability.	Common across NEM jurisdictions. Allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction, depending on customer valuation of reliability.	Tailored to each jurisdiction as per Option A (without a reference standard being published). The precise form of the standard be exactly the same across all jurisdictions and only the quantum of the standard be tailored. Some limitations be placed on the extent to which the standard	Tailored to each jurisdiction, but with publication of a national 'reference standard' as per Option E. The body responsible for specifying the standard in any particular jurisdiction should be required to publish a report	Retain the common default standard across all jurisdictions, but grant each jurisdiction the right to modify the standard for a specific purpose. The process by which the jurisdiction invoked such a right should be clearly specified in the form of a regulatory instrument.

Features	Option D	Option D1	Option D2	Option D3	Option D4	Option D5
				can be tailored in each jurisdiction to protect against a plethora of "regional" as opposed to "jurisdictional" based standards emerging. The body responsible for specifying the standard in any particular jurisdiction be required to publish a report comparing the various standards across all of the jurisdictions and provide a comprehensive explanation of the reasons for their standard, particularly in relation to the differences between it and the other jurisdictional standards in force. The frequency with which jurisdictional based standards may be reviewed and revised be limited, and timed to fit appropriately with the periodic ARR determination of the principal TNSP in each jurisdiction. Allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction.	comparing the jurisdictional standard with the [national] reference standard and provide a comprehensive explanation of the reasons for their standard particularly in relation to the differences between it and reference standard. Allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction.	Interested stakeholders should be consulted before a decision is made. It's application would be time limited and only apply to a nominated project or group of projects. •The cost impacts of the decision would be borne initially by the jurisdiction. Allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction.
Where are the standards specified?	National Transmission/Grid Code, which would replace existing jurisdiction specific transmission codes/license conditions and incorporate the technical standards currently set out in Schedules 5.1, 5.1a and other parts of Chapter 5 of the NER.	National Transmission/Grid Code, which would replace existing jurisdiction specific transmission codes/license conditions and incorporate the technical standards currently set out in Schedules 5.1, 5.1a and other parts of Chapter 5 of the NER.	Combined in a single instrument, such as the NER, as per Options B & C. Three caveats: •Sufficient steps be taken at the national level to ensure that the legal force and effect of these provisions within the NER take precedence over any conflicting	Jurisdictional instruments. The standards could be published in the same place and in similar form across all jurisdictions (e.g. Annual Planning Reports). Somewhere within the national regulatory regime, there would need to be specified all of those	Jurisdictional instruments. The standards could be published in the same place and in similar form across all jurisdictions (e.g. Annual Planning Reports).	Common, NEM-wide, default standard specified in in a single instrument, such as the NER, as per Options B & C. Any jurisdiction that elects to make modifications to the default standard will be required to publish its

Features	Option D	Option D1	Option D2	Option D3	Option D4	Option D5
			jurisdictional based legislation or regulatory instrument. •Appropriate implementation guidelines be developed and published to ensure that TNSPs have minimal discretion in their interpretation and application of the relevant standard. •New compliance and appeal related provisions tailored to specific needs of the planning process be developed and introduced rather than relying on the existing general provisions.	things necessary to be able to maintain "national consistency". In these circumstances, this would suggest at the very least that some reasonably comprehensive new NER provisions would be needed.	Somewhere within the national regulatory regime, there would need to be specified all of those things necessary to be able to maintain "national consistency". In these circumstances, this would suggest at the very least that some reasonably comprehensive new NER provisions would be needed.	modified standard in Jurisdictional instruments. The standards could be published in the same place and in similar form across all jurisdictions (e.g. Annual Planning Reports). Same 3 caveats as Option D2.
Process for setting standards	Clear transparent process for setting standards.	Clear transparent process for setting standards.	Clear transparent process for setting standards.	Clear transparent process for setting standards.	Clear transparent process for setting standards.	Clear transparent process for setting standards.
Who sets the level of standards?	Determined by the AEMC on the advice of the Reliability Panel and AER.	Determined by the National Transmission Planner, whose recommendations on the national standard would have to be ratified by the AEMO Board, the Reliability Panel and the AER before it would come into effect.	Determined by the National Transmission Planner, whose recommendations on the national standard would have to be ratified by the AEMO Board, the Reliability Panel and the AER before it would come into effect.	Determined by a jurisdictional authority separate from the TNSP. Establish an information base of standards, managed in a consistent way by individual jurisdictions or by a central authority, such as the National Transmission Planner. The frequency with which jurisdictional based standards may be reviewed and revised be limited, and timed to fit	Determined by a jurisdictional authority separate from the TNSP. Establish an information base of standards, managed in a consistent way by individual jurisdictions or by a central authority, such as the National Transmission Planner.	NEM-wide default standard determined by the National Transmission Planner, whose recommendations on the national standard would have to be ratified by the AEMO Board, the Reliability Panel and the AER before it would come into effect. Any jurisdiction that elects to modify the default standard is required to

Features	Option D	Option D1	Option D2	Option D3	Option D4	Option D5
				appropriately with the periodic ARR determination of the principal TNSP in each jurisdiction.	The frequency with which jurisdictional based standards may be reviewed and revised be limited, and timed to fit appropriately with the periodic ARR determination of the principal TNSP in each jurisdiction..	follow the process contained in Option D3.
Accountability of the standard setting body	To MCE	To AEMO Board, Reliability Panel, AER and ultimately the MCE	To AEMO Board, Reliability Panel, AER and ultimately the MCE	To jurisdictional government	To jurisdictional government	To AEMO Board, Reliability Panel, AER and ultimately the MCE
Accountability of TNSPs	To AER	To AER	To AER	To jurisdictional authority and AER	To jurisdictional authority and AER	To jurisdictional authority and AER
Retains consistency between transmission and DNSP sub-transmission standards?	No, because proposing probabilistic transmission standards, whereas DNSP sub-transmission standards are deterministic.	No, because proposing probabilistic transmission standards, whereas DNSP sub-transmission standards are deterministic.	No, because proposing probabilistic transmission standards, whereas DNSP sub-transmission standards are deterministic.	No, because proposing probabilistic transmission standards for at least large investment projects, whereas DNSP sub-transmission standards are deterministic.	No, because proposing probabilistic transmission standards for at least large investment projects, whereas DNSP sub-transmission standards are deterministic.	No, because proposing probabilistic transmission standards for at least large investment projects, whereas DNSP sub-transmission standards are deterministic.
Drawn from submissions by	The Group	The Group	The Group	The Group	The Group	The Group
Likely changes	Widespread changes, including several items which appear to be outside scope for this review.	Widespread changes, including several items which appear to be outside scope for this review.	Significant changes, including to NER, NEL, State legislation, regulations and licences.	Significant changes, including to NER, NEL, State legislation, regulations and licences.	Significant changes, including to NER, NEL, State legislation, regulations and licences.	Significant changes, including to NER, NEL, State legislation, regulations and licences.

Table 2: Final options for a consistent national framework for transmission reliability standards–Option E variants

Features	Option E	Option E1	Option E2
Form of standard	Hybrid form, common across NEM.	Hybrid, with standards based upon the economic and technical principles in the Framework. Flexibility in the way standards are expressed. Jurisdictions can elect to use deterministic equivalent standards (like Options E &A) or express the standards in some other way that is transparent. For those jurisdictions electing to express their planning standards as a deterministic equivalent, an N - x form would be used. TNSP may opt to undertake the cost-benefit approach (i.e. apply a probabilistic planning methodology), on a project-by-project basis, to determine reliability requirements.	Hybrid form, common across NEM. AER support the development of a default hybrid standard that would apply an iterative economic cost benefit comparison of the value of unserved energy at a connection point, against the cost of delivering a specific level of reliability. TNSPs given the option of submitting a “modified reliability standard”, derived from the application of probabilistic planning methods to determine the economic costs and benefits and reliability impacts of various options to address a particular transmission need. The TNSP could either undertake the relevant expenditures within its existing revenue determination or submit proposed expenditures to the AER as part of its next revenue reset application. Where deterministically expressed standards are applied using a deterministic planning methodology, the AER sees merit in having the standards specify a time allowance for customer reconnection in certain circumstances.
Scope of standards	Allowance for connection point reliability standards to differ between CBD, metro and rural areas of a jurisdiction, depending on criticality of load or an explicit valuation of customer reliability. Introduction of a national “reference standard” on a “for information basis”, against which the standard levels in each jurisdiction can be compared.	Same as Option E (and Option A) for any jurisdiction electing to use deterministic equivalent standards. Any TNSP opting to undertake the cost benefit approach could provide the effective reliability for each connection point. Further, this effective standard can be used for any comparative analysis with a national reference standard.	Same as Option E, but with the Reliability Panel to set national reference standards for generic types of loads, (e.g. CBD, urban, semi-rural, rural etc).
Where are the standards specified?	Framework expressed in National Electricity Rules. In order to give effect to the framework, it is likely that changes to the NER, NEL and jurisdictional instruments (laws, licenses, regulations, guidelines) will be required.	Framework expressed in National Electricity Rules. In order to give effect to the framework, it is likely that changes to the NER, NEL and jurisdictional instruments (laws, licenses, regulations, guidelines) will be required. A distinction may be required between where the framework is specified and where TNSP deterministic standards are defined, depending on what scope a jurisdiction is allowed to define the deterministic standard.	Framework expressed in National Electricity Rules. In order to give effect to the framework, it is likely that changes to the NER, NEL and jurisdictional instruments (laws, licenses, regulations, guidelines) will be required.
Process for setting standards	Clear transparent process for setting standards.	Clear transparent process for setting standards.	Clear transparent process for setting standards.

Features	Option E	Option E1	Option E2
Who sets the level of standards?	Determined by a jurisdictional authority separate from the TNSP. Establish an information base of standards, managed in a consistent way by individual jurisdictions or by a central authority, such as the National Transmission Planner. The format, structure and levels of the standards should be reviewed every five years.	Same as Option E (and Option A) for any jurisdiction electing to use deterministic equivalent standards. For TNSPs that have opted to undertake the cost-benefit approach: • The jurisdictional authority would have responsibility for assessing the cost-benefit approach and its consistency with the Framework; and • Reviewing any effective standards prepared by the TNSP that are used for comparative purposes.	Same as Option E, but with added feature of allowing jurisdictions the option of appointing an independent national body, such as the Reliability Panel or AEMO, to set the reliability standards under the national framework.
Accountability of the standard setting body	To jurisdictional government	To jurisdictional government	To jurisdictional government
Accountability of TNSPs	To jurisdictional authority and AER	To jurisdictional authority and AER	To jurisdictional authority and AER TNSPs required to report on delivered network capability compared to the reliability standard at each connection point.
Retains consistency between transmission and DNSP sub-transmission standards?	Yes	Can retain consistency, provided the jurisdictional authority requires this to be the case. Consistency could be maintained if: 1. jurisdiction employs deterministically expressed hybrid standards at both the transmission and sub-transmission level; or 2. jurisdiction employs probabilistically expressed hybrid standards at both the transmission and sub-transmission level.	Can retain consistency where the jurisdictional authority requires this to be the case.
Drawn from submissions by	Panel's additional option, based on preliminary analysis	VENCorp	AER
Likely changes	Significant changes, including to NER, NEL, State legislation, regulations and licences	Significant changes, including to NER, NEL, State legislation, regulations and licences	Significant changes, including to NER, NEL, State legislation, regulations and licences