Security and Reliability Council

Security of Supply Standards

Review of winter energy and capacity margins

15 August 2012

Note: This paper has been prepared for the purpose of discussion with the Security and Reliability Council. Content should not be interpreted as representing the views or policy of the Electricity Authority.

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1 Paper Overview

1.1 The Authority has requested the SRC's views on the security of supply standards

1.1.1 The Authority wrote to Security and Reliability Council (SRC) members on 3 August 2012, requesting the SRC provide their views on proposed changes to the Winter Energy Margin (WEM) and Winter Capacity Margin (WCM) security of supply standards (the letter is attached as Appendix 1).

1.1.2 The Authority has completed a review of the WCM and WEM standards, taking into account various changes to the generation and transmission mix since the standards were first established. A consultation paper has been published and submissions have been received from industry participants.

1.1.3 The Authority has also made further progress on consideration of summer capacity issues (as requested at the SRC's August 2011 meeting). A separate paper has been provided to this meeting outlining the status of the summer margins review.

1.1.4 This paper contains:

a) an overview of the winter margins and a précis of the consultation paper; and

b) a summary of the main themes resulting from submissions.

1.1.5 To promote discussion at the SRC meeting, this paper puts forward questions at relevant points. There is no requirement on the SRC to reply to these specific questions. The SRC can choose to make its comments to the Authority in any form it considers appropriate, and on any aspects of the standards and this review.

1.1.6 The Board will consider the proposed Code amendments resulting from this review in October 2012, in the light of submissions and SRC feedback.

2 Précis of the winter margins consultation paper

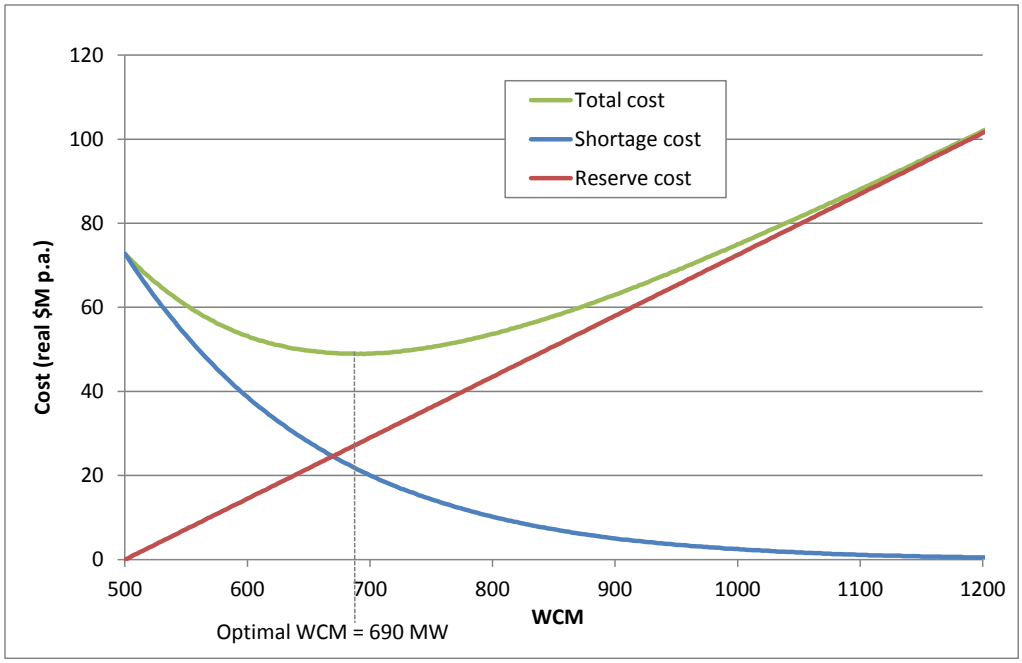
2.1 About the margins

2.1.1 The capacity and energy security of supply standards, and the corresponding winter capacity margin (WCM) and winter energy margin (WEM) metrics, are key parts of the medium-term security of supply monitoring framework that is set out in the Electricity Industry Participation Code 2010 (Code) and overseen by the system operator.

2.1.2 The security of supply standards indicate the efficient margins of generation over expected demand to cope with unpredictable supply and demand, and are applied over a horizon of 5-10 years.

2.1.3 It is important to appreciate that the standards are not meant to create a "bright line", with there being "enough generation" if the actual WEM and/orWCM is above the standard and "insufficient generation" if the actual WEM and/orWCM is below the standard. Rather, the standards are meant to indicate the level of WEM/WCM that corresponds to an efficient level of security. Whether above or below the line, there is always a finite risk of scarcity. This principle is illustrated in Figure 1.

Figure 1: An efficient level of security



(The efficient capacity margin is that which achieves the minimum combined cost of capacity and unserved energy – i.e. the lowest point on the green curve.)

2.1.4 The standards are set out in the Code, and the manner in which the WCM and WEM metrics are calculated is set out in the Security of Supply Forecasting and Information Policy (SOSFIP). The SOSFIP is a document which is prepared by the system operator and incorporated by reference into the Code.

2.1.5 The current standards were established by the Electricity Commission in 2007/2008. At the time they were introduced it was recommended that they be reviewed within five years to take into account changes in the mix of generation and inter-island transmission.

2.1.6 At that time, the regulatory framework contemplated that the Commission might need to procure Reserve Energy in order to reduce the likelihood of electricity shortages. The WCM and WEM were thresholds that could trigger the procurement of Reserve Energy.

2.1.7 When the regulatory framework was amended in 2010 to establish the Authority, the Reserve Energy Scheme was abolished and the WCM and WEM metrics became monitoring tools.

2.1.8 The Authority published a consultation paper "Winter Energy and Capacity Security of Supply Standards" (http://www.ea.govt.nz/our-work/consultations/sos/winter-energy-capacity-security-supply-standards/) for which submissions closed on 7 August 2012.

Question: *Do you consider the standards are readily comprehended by relevant stakeholders, and that their role is clearly understood?*

2.2 The consultation paper proposed a reduction in the winter capacity margin…

2.2.1 The Consultation Paper proposed that the Code be amended to replace the current capacity security standard (WCM) of 780 MW with a range of 650-750 MW, where:

a) WCM below 650 MW would indicate there has been an inefficiently low level of investment in capacity (i.e. the cost of adding more capacity would be more than justified by the reduction in shortage costs at times of insufficient capacity);

b) WCM between 650 and 750 MW would indicate a roughly efficient level of investment in capacity; and

c) WCM above 750 MW would indicate the level of investment in capacity has been inefficiently high (i.e. the cost of adding more supply would not be justified by the reduction in shortage costs at times of insufficient capacity).

2.2.2 The proposal to move from a threshold to a range for the WCM acknowledges the uncertainty in the assumptions and analysis.

2.3 …and a reduction in the winter energy margins

2.3.1 The Consultation Paper proposed that the Code is amended to replace the current national energy security standard (NZ-WEM) of 17% with a range of 14-17%, where:

a) NZ-WEM below the lower standard of 14% would indicate there has been an inefficiently low level of investment in energy supply (i.e. the cost of adding more supply would be more than justified by the reduction in shortage costs during extended dry sequences);

b) NZ-WEM between 14% and 17% would indicate a roughly efficient level of investment in energy supply; and

c) NZ-WEM above the upper standard of 17% would indicate the level of investment in energy supply has been inefficiently high (i.e. the cost of adding more supply would not be justified by the reduction in shortage costs during extended dry sequences).

2.3.2 Similarly, the Consultation Paper proposes that the Code be amended to replace the current South Island energy security standard (SI-WEM) of 30% with a range of 26-30%.

2.3.3 As with the WCM, the proposal to move from a threshold to a range for the WEM standards acknowledges the uncertainty in the assumptions and analysis.

Question: *Do you support the proposal to change the standards from thresholds to ranges?*

2.4 Changes were also proposed to the way the margins are represented in the SOSFIP

2.4.1 Transpower, as the system operator, carries out the Annual Security Assessment (ASA). A key part of the assessment is preparing projections of WCM and WEM under various scenarios. To some extent the methodology and input assumptions used by Transpower are set out in the Security of Supply Forecasting and Information Policy (SOSFIP), but some details are only provided in the ASA itself and others are not documented at all.

2.4.2 The Consultation Paper proposed the system operator amend the SOSFIP to ensure that:

a) the WCM and WEM are calculated in a way that is consistent with the derivation of the standards (to avoid an “apples and oranges” situation); and

b) enough information about the methodology and input assumptions is provided for the Authority and other stakeholders to be able to have confidence that WCM and WEM are being calculated appropriately.

3 The standards seek to determine efficient levels of supply

3.1 WCM Analysis

3.1.1 The analysis described in the Consultation Paper seeks to find the optimal WCM – that is, the value of WCM corresponding to a level of generation capacity that minimises the expected sum of shortage costs (at times of capacity scarcity) and "peak" or "reserve" generation costs.

3.1.2 Figure 1 (on page 3) illustrates the trade-off between shortage cost and "peak" generation costs which determines the optimal level of WCM. The figure indicates that the optimal WCM is approximately 690MW and highlights that the optimal level is relatively insensitive in the range of +/- 50MW.

3.1.3 A number of factors have contributed to the reduction in the optimal level of WCM from 780MW to 690MW. These factors include changes to the generation mix, the pending availability of the new Pole 3, improved data about intermittent generation, an increase in "peak" generation costs, and correcting an error in the original analysis.

3.1.4 This result was tested against a wide range of sensitivities to key assumptions, leading to a "most likely" optimal WCM in the range of 650-750MW.

3.1.5 The analysis of the optimal WCM highlighted that the 20% contribution factor currently assigned to wind generation when calculating the WCM is likely to be too low. Analysis of updated wind generation data (which has become available since the original 2008 analysis was undertaken) suggests that a 25% contribution factor is likely to be more appropriate. Accordingly, the Consultation Paper includes a recommendation that the amendments to the SOSFIP include the use of a 25% contribution factor for wind generation.

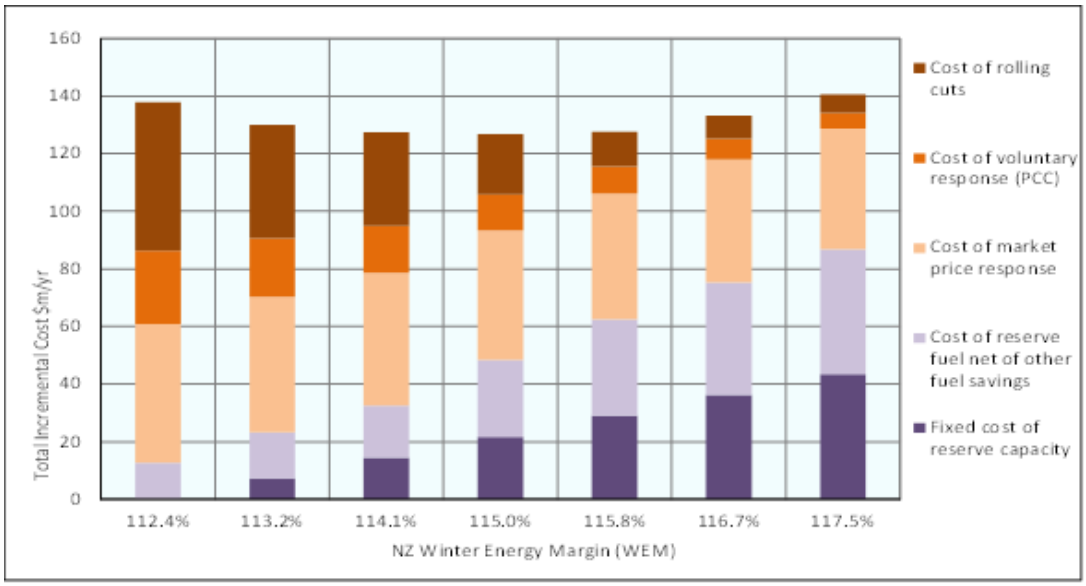
Questions: *Do you agree that recent system and market changes support a reduction in the capacity standard (i.e. would you expect the efficient level of capacity required to be lower than at the last review in 2007/8)? Would you expect to see new investment in generation if WCM fell below 650 MW? Would you expect to see no new investment, and/or retirement of existing generation, if WCM was above 750 MW (as it is now)?*

3.2 NZ-WEM Analysis

3.2.1 The analysis described in the Consultation Paper seeks to find the optimal WEM using a similar approach to deriving the optimal WCM – that is, the value of WEM corresponding to a level of generation capacity that minimises the expected sum of shortage costs (at times of energy scarcity) and "reserve" generation costs. In this case the analysis considers shortage costs arising from periods with extreme low inflows, resulting in possible public conservation campaigns and possible periods of rolling outages, and excludes shortage costs arising from capacity shortfalls.

3.2.2 Figure 2 illustrates the trade-off between the various components of shortage cost and "reserve" generation costs which determines the optimal WEM. It indicates the optimum is approximately 15% and highlights that the optimal level is relatively insensitive in the range of +/- 1%.

Figure 2: Deriving the optimal NZ-WEM



3.2.3 A number of factors have contributed to the reduction in the optimal level of WEM from 17% to 15% including changes to the generation mix, the pending availability of the new Pole 3, an increase in "reserve" generation costs, and the increase in inter-island transmission capacity.

3.2.4 This result was tested against a wide range of sensitivities to key assumptions, leading to a "most likely" optimal NZ-WEM in the range of 14-17%.

Questions: *Do you agree recent system and market changes support a reduction in the energy standards (i.e. would you expect the efficient level of energy supply to be lower than was required at the last review in 2007/8)? Would you expect to see new investment in generation if NZ-WEM fell below 14%? Would you expect to see no new investment, and/or retirement of existing generation, if NZ-WEM was above 17% (as it is now)?*

3.3 SI-WEM Analysis

3.3.1 The SI-WEM is designed to cover the situation where the NZ-WEM may be above the standard, but a potential security issue remains in the South Island. This can occur if the North Island generation available to help meet a South Island shortage is significantly limited by transmission constraints between the islands.

3.3.2 The SI-WEM analysis, using the same approach as for determining the NZ-WEM standard, indicates an optimal SI-WEM of approximately 28% (c.f. the current 30%).

3.3.3 Moderate variations in the level of SI-WEM (i.e. from 26-30%) have relatively little impact on the total cost.

4 Current margins are comfortably above the proposed (and existing) standards

4.1.1 Part 7 of the Code specifies that the system operator must prepare and publish, at least annually, an ASA containing supply and demand forecasts covering at least 5 years, in order to assess whether the WCM and WEM standards are likely to be met.

4.1.2 Forecasts provided in the most recent ASA (published in February 2012) include forecast WCM and WEM under a range of scenarios including new power station projects categorised as

“committed”, “high probability”, medium probability” and “low probability. Table 1 compares the forecasts in the 2012 ASA with the proposed new WCM/WEM standards. (Projections are shown graphically in

Figure 3 and Figure 4.)

Table 1: First year in which WCM/WEM may fall to inefficiently low levels (based on 2012 ASA)

New Investment in power stations	WCM 650-750MW	NZ-WEM 14-17%	SI-WEM 26-30%
Committed	2016	2017	>2020
High Probability	2016	>2020	>2020
Medium Probability	>2020	>2020	>2020

4.1.3 Table 1 suggests that:

a) WCM will remain above the proposed efficient range of 650-750MW until 2015 (at least), but if only the currently "committed" and "high probability" power station investments proceed margins may fall below the bottom of the proposed efficient range in 2016;

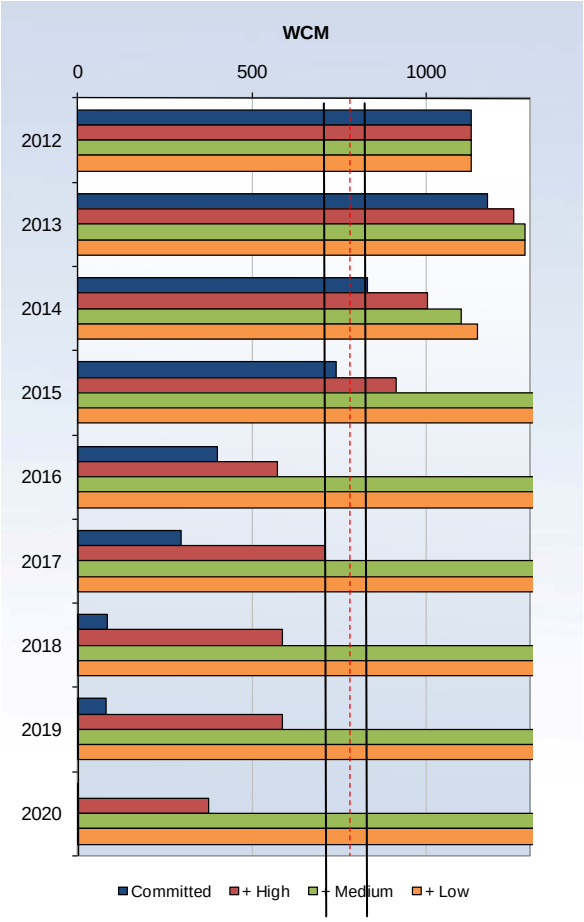
b) NZ-WEM will remain above the proposed efficient range of 14-17% until at least 2015, but may fall below the bottom of the proposed efficient range by 2017 if even "high probability" power station investments do not proceed; and

c) SI-WEM will remain above the proposed efficient range of 26-30% until at least 2016, and is not anticipated to fall below the bottom of the proposed efficient range between now and 2020.

4.1.4 These outcome appears to be consistent with the view being increasingly expressed in some quarters of the electricity industry that there is no immediate need for further investment in new generation once the currently committed investments are complete.

Question: *Do you consider that the standards and margins are giving the correct results? (i.e. are the dates when the margins look likely to be reached consistent with your view of the market)*

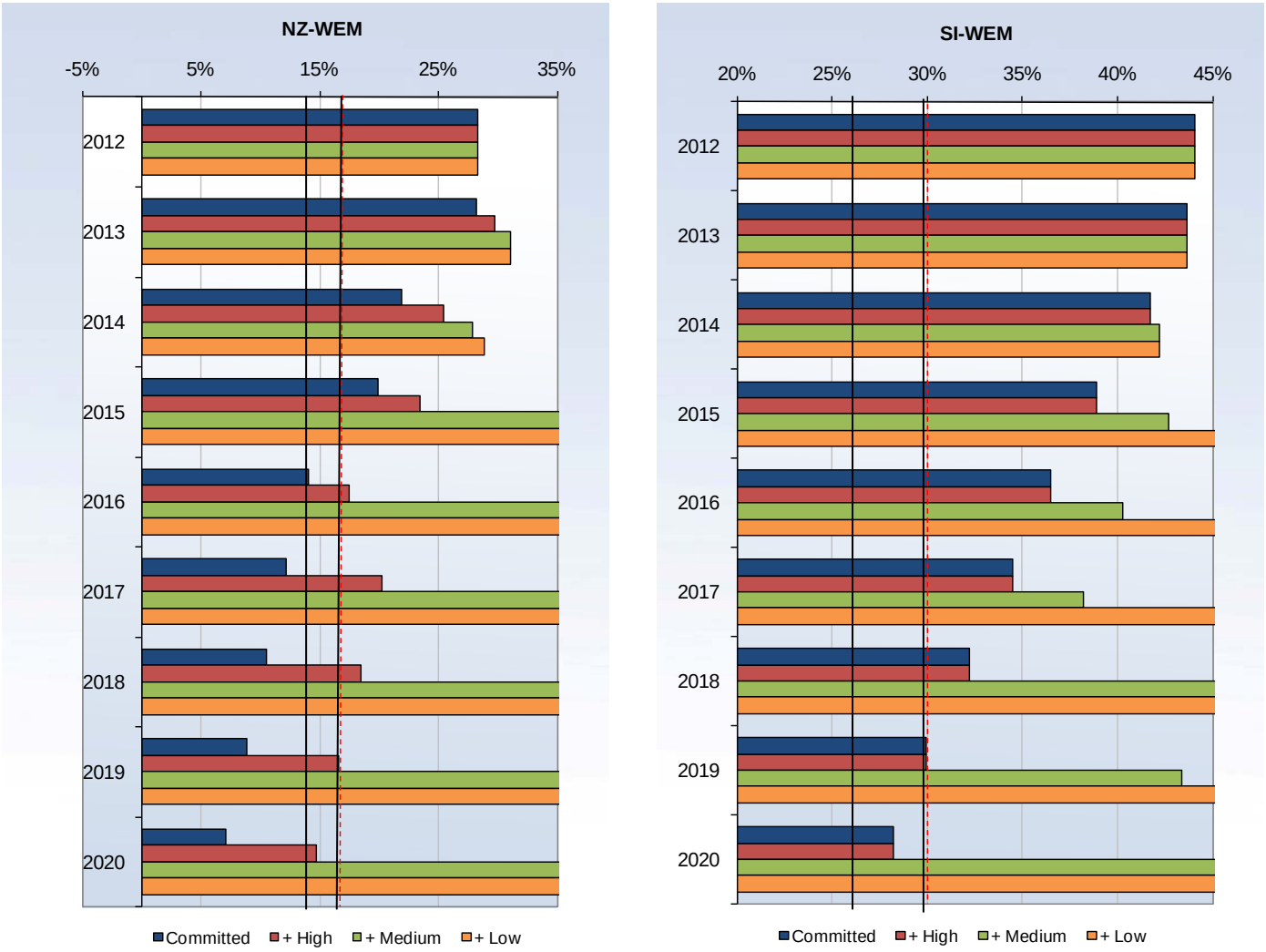
Figure 3: Projections of WCM from the 2012 ASA



Red dashed line indicates current security standard (780 MW).

Black solid lines indicate proposed security standards (650 – 750 MW).

Figure 4: Projections of NZ-WEM and SI-WEM from the 2012 ASA



Red dashed lines indicate current security standard (17% for NZ-WEM, 30% for SI-WEM).

Black solid lines indicate proposed security standards (14-17% for NZ-WEM, 26-30% for SI-WEM).

5 The major generator-retailers, MEUG and Transpower provided submissions

5.1.1 Submissions on the consultation paper have now been received and published on the Authority's website. The submitters were:

a) Contact Energy;

b) Genesis Energy;

c) Major Electricity Users' Group (MEUG);

d) Meridian Energy;

e) Mighty River Power;

f) Transpower; and

g) TrustPower.

5.1.2 Generally the submissions are supportive of the Authority's proposal. Contact Energy, MEUG, Mighty River Power, and Transpower all support the proposed Code amendments. Meridian Energy also supports the proposed Code amendments, on the proviso that wider ranges are adopted for the Winter Capacity Margin (WCM) and South Island Winter Energy Margin (SI-WEM) standards. No submitters indicated that they did not support the proposed Code amendments.

5.1.3 Nevertheless some submitters disagreed with the Authority on specific points.

6 Key themes resulting from submissions

6.1.1 This section discusses some key themes raised in the submissions.

6.2 General support for the move to range-based standards

6.2.1 Two parties commented on the proposed move from thresholds to ranges, both approvingly:

a) Genesis Energy noted that *"a range of values provides a more realistic representation of what is considered an efficient level of investment, given the underlying uncertainties in the calculations"*; and

b) Mighty River Power commented that *"we fully agree with and welcome the recognition in the paper that there is a continuum of investment efficiency that is better reflected by expressing the standards as a range rather than a single number. The current standards run the risk of being interpreted as an absolute standard below which security of supply is comprised, which in reality is not the case."*

6.2.2 No parties opposed the move to a range-based standard.

6.2.3 Meridian Energy, while broadly supporting the proposals in the consultation paper, took issue with the actual ranges proposed, commenting that *"the ranges… should allow for the impact of all factors which may have a bearing on the optimal level of investment. As such, the specified efficiency range should incorporate the full range of variance identified by the Authority's various sensitivity cases. We therefore propose that the Authority adopt the following ranges:*

a) "565-800MW for the WCM;

b) "14-17% for the NZ-WEM (as proposed); and

c) "24-31% for the SI-WEM."

6.2.4 The Authority notes Meridian's comment and agrees that it is important to select an appropriate range. However, it does not entirely agree with Meridian's proposition that the range should cover "*the full range of variance identified by the Authority's various sensitivity cases*". Some of the sensitivities are shown for illustrative purposes, but represent extreme cases and should not be assigned significant weight. Rather, the range-based standard is intended to provide a *reasonable estimate of the range in which the efficient margin is likely to fall*.

6.2.5 Before proceeding to amend the Code, the Authority plans to review the three ranges (for WCM, NZ-WEM and SI-WEM) to ensure they are derived in a consistent way and that each range provides a reasonable estimate of the range in which the efficient margin is likely to fall. This may lead to some changes, though likely not as great as the changes proposed by Meridian.

Question: *Do you agree that providing a reasonable estimate of the range is more appropriate than identifying the full potential extent of the range?*

6.3 Assumptions for transfer levels from the North to South Island were questioned

6.3.1 The SI-WEM measure, which assesses the adequacy of South Island generation to manage extended dry sequences, involves an assumption about the average level of transfer from the North Island to the South Island during a dry period.

6.3.2 This transfer level is calculated on the basis of a large surplus of North Island generation (if there is *not* expected to be a large surplus of North Island generation, then the NZ-WEM measure will bind before SI-WEM).

6.3.3 The proposed assumption is an average north-to-south transfer of 480 MW.

6.3.4 Several participants commented on this assumption:

a) Contact Energy commented that *"the Authority needs to show it has taken into account lower North Island (LNI) constraints and the effect of the LNI constraints on net south transfer"*;

b) Genesis Energy warned that *"we consider that this figure [i.e. 480 MW] is very high, even for bi-pole operation. We recommend that the Authority look at past operation of the bi-pole and the factors in play during these times. We suggest that the Authority consider a lower value of 200-300 MW for the mean transfer"*;

c) Meridian Energy agreed that 480 MW is appropriate;

d) TrustPower commented that *"the industry may not have a consistent understanding of how much energy can actually be shifted south during dry periods, particularly after the commissioning of Pole 3"* and suggested *"the industry would benefit significantly if the System Operator were to undertake and publish a full assessment of the potential [for south flow post Pole 3], taking into account all relevant intra-island influences";* and

e) Transpower noted that *"there are various factors that may affect south transfer over time. Given the SO must calculate SI-WEM up to 10 years ahead in the ASA, the [appropriate assumption] may vary in different years"*.

6.3.5 The Authority is aware that the assumed average north-to-south transfer of 480 MW is higher than has been observed in recent dry periods with a monopole HVDC link, or, for that matter, in earlier dry periods when a bipole HVDC link was available.

6.3.6 The south transfer assumption is based on outcomes of the simulation model used to derive the WEM standards. In this modelling work, the Authority has assumed that north-to-south transfers will only be limited by:

a) Bunnythorpe-Haywards thermal limits of 890 MW; and

b) inter-island link capacity of 580 MW.[1]

6.3.7 The Authority has specifically excluded other constraints, such as:

a) limits driven by the 110 kV network in the lower North Island;

b) lower North Island voltage constraints;

c) availability of South Island instantaneous reserve; and

d) AC constraints in the Waitaki Valley,

on the basis that these constraints are already in the process of being mitigated, or can be resolved in the short to medium term.

6.3.8 The Authority has further assumed that market dynamics will support an efficient level of south transfer.[2]

6.3.9 Based on these assumptions and the simulation modelling carried out, the Authority considers that an average north-to-south transfer of 480 MW is appropriate.

6.3.10 TrustPower has suggested that the system operator should undertake and publish an assessment of the potential for south flow. The Authority proposes to forward this suggestion to the system operator, noting that it appears to have merit and may best be addressed through the System Security Forecast.

Question: *Do you agree with the Authority's assumptions regarding the influence of market dynamics and the exclusion of specific constraints from consideration?*

6.4 Wind's contribution to capacity margins was debated

6.4.1 The WCM measure, which assesses the adequacy of North Island generation and inter-island transmission to meet North Island peak demand, involves an assumption about the "value" of wind generation.

6.4.2 The consultation paper proposes that this "wind contribution factor" should increase from 20% to 25% - e.g. a 100 MW wind farm would contribute 25 MW to WCM, rather than 20 MW as previously.

6.4.3 To some extent this is a second-order issue, as (for example) the change from 20% to 25% wind contribution factor only increases WCM by 25 MW if there is 500 MW of wind. Nonetheless several submitters commented on the issue, so their comments and the Authority's responses are summarised here.

6.4.4 The proposal to increase the wind contribution factor was opposed by some:

[1] The system operator has indicated that these limits are reasonable, given that other transmission constraints are excluded.

[2] Events of the current winter provide an interesting case study as to whether these assumptions might bear out in practice. While there have been some interesting market dynamics witnessed, it is considered appropriate to try and capture these in these margins, that are based on the expectation of efficient outcomes.

a) Contact Energy warned that *"it does not appear prudent to increase the wind contribution factor given the limited data available. In addition this appears to be inconsistent with the System Operator's current real time modelling of wind for capacity"*;

b) Genesis Energy disagreed with the increase of the wind contribution factor to 25%: *"we recommend that the Authority use a more conservative figure. We consider that peak demand can actually, at times, be negatively correlated with wind. We suggest the Authority undertake more analysis of the power factor of wind over peak periods only, to better understand its contribution"*; and

c) Mighty River Power questioned *"the validity of increasing the wind contribution factor from 20 to 25 percent. In relative terms this is a considerable increase to the contribution wind makes to capacity and appears to be based off observations from a single year and site. We do not consider this to be an adequate basis upon which to alter the wind contribution factor and would support retaining the current level."*

6.4.5 On the other hand:

a) Meridian Energy considered that the increase to 25% *"appeared appropriate given the assumptions and analysis presented"*; and

b) MEUG commented that *"the analysis supporting 25%... is pragmatic"*.

6.4.6 The Authority considers it is reasonable to expect that the capacity contribution of wind would have increased since the original WCM standard was set in 2008, with wind generation becoming increasingly diverse (i.e. no longer confined to the Tararuas), and highly productive new wind farms coming online.

6.4.7 It is reasonable to expect that this trend will not reverse in future (providing future wind development continues to be of reasonably high quality, and is not confined to the Tararua area).

6.4.8 The analysis carried out supports these expectations and, in the Authority's view, is robust and fit for purpose.

6.4.9 Regarding specific comments:

a) there is no reason why real-time operational procedures need use the same wind contribution factor as in the calculation of WCM, as suggested by Contact Energy – the factor that is appropriate to use will depend on the timescale, the conditions and the asymmetry of risk;

b) the Authority agrees that wind can be negatively correlated with peak demand and has already included this dynamic in the modelling; and

c) the analysis is not based on observations from a single year and site as suggested by Mighty River Power, rather on a multi-year dataset including a combination of synthetic and actual wind generation data.

6.4.10 On this basis, the Authority considers that the 25% wind contribution factor is appropriate.

Question: *Do you consider the Authority's conclusion regarding the wind contribution to be appropriate?*

Appendix A: Authority letter to SRC members, 'WCM and WEM security of supply standards', 3 August 2012.

3 August 2012

Security and Reliability Council

By Email

Dear Council members

WCM and WEM security of supply standards

This memo is to update the Security and Reliability Council (SRC) on the Authority's process for reviewing and updating the Winter Capacity Margin (WCM) and Winter Energy Margin (WEM) security of supply standards. The standards were discussed at the SRC's August 2011 meeting, where it was noted they would be reviewed by the Authority in 2012.

The function of these standards is to serve as points of reference in determining how likely it is that there will be efficient levels of generation and inter-island transmission available to meet demand in the next 5-10 years.

The capacity security of supply standard (WCM) is used in the process of assessing whether there will be an efficient level of peaking generation and transmission capacity for north transfer to meet peak demand.

The energy security of supply standards[1] (WEM) are used in the process of assessing whether there will be an efficient level of reserve generation and transmission capacity for south transfer to manage extended dry sequences.

The Authority has now completed its review of these standards (taking into account factors such as the imminent availability of HVDC Pole 3 and changes to the generation mix) and is proposing some changes. The Authority has published a consultation paper "Winter Energy and Capacity Security of Supply Standards" (http://www.ea.govt.nz/our-work/consultations/sos/winter-energy-capacity-security-supply-standards/) and has sought submissions from participants by 7 August 2012.

The consultation paper proposes to:

- amend Part 7 of the Code to change the security of supply standards; and
- submit to the system operator a proposal for a variation to the Security of Supply Forecasting and Information Policy (SOSFIP) to change the calculation of the WCM and WEM security metrics.

[1] There are separate energy margins for New Zealand and the South Island.

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The Authority Board has requested the SRC's comments on the proposed changes. The SRC secretariat will provide the SRC with a summary of the consultation paper and the industry submissions, in advance of the 29 August 2012 meeting.

Work on potential summer security standards is proceeding in parallel and an update will be provided to the SRC in due course (as requested at the August 2011 meeting).

Yours sincerely

Fraser Clark
SRC Secretariat

cc: Carl Hansen
Kieran Devine, Transpower NZ Limited