ELECTRICITY AUTHORITY
TE MANA HIKO

Security Standards Assumptions Document

14 November 2012

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1 Introduction

1.1 Under section 8 of the Electricity Industry Act 2010, the system operator must provide information, and short- to medium-term forecasting, on all aspects of security of supply. Section 8(3) of the Act requires the Electricity Industry Participation Code 2010 (Code) to specify the functions of the system operator and specify how those functions are to be performed.

1.2 Part 7 of the Code requires the system operator to prepare and publish a security of supply forecasting and information policy (SOSFIP). In turn, the SOSFIP sets out that the system operator will prepare and publish an annual security assessment (ASA) that contains detailed supply and demand modelling that extends at least five years and enables interested parties to assess whether the electricity market is expected to be capable of meeting the security of supply standards.

1.3 The security of supply standards have been reviewed and updated in 2012.[1] Part 7 of the Code now specifies that the standards are:

(a) a New Zealand winter energy margin (NZ-WEM) of 14-16%;

(b) a South Island winter energy margin (SI-WEM) of 25.5-30%; and

(c) a North Island winter capacity margin (WCM) of 630-780 MW.[2]

1.4 Clause 7.3 of the Code further sets out that:

(2A) The Authority may publicise a security standards assumptions document.

(2B) Subject to subclause (2C) and (2E), if the Authority has publicised a security standards assumptions document under subclause (2A), the system operator must use the assumptions set out in that document in preparing a security of supply assessment under the security of supply forecasting and information policy.

(2C) The system operator may use different assumptions from those in a security standards assumptions document to prepare a security of supply assessment if—

(a) the system operator considers that there are good reasons to use different assumptions; and

(b) the system operator includes in the security of supply assessment—

(i) a detailed explanation of the assumptions used to prepare the security of supply assessment; and

(ii) a statement of the reasons for using those assumptions instead of the assumptions publicised by the Authority.

(2D) If the system operator uses different assumptions from those in a security standards assumptions document to prepare a security of supply assessment, the system operator must show in the security of supply assessment how the security of supply assessment would differ if the assumptions in the security standards assumptions document had been used.

1 http://www.ea.govt.nz/our-work/consultations/sos/winter-energy-capacity-security-supply-standards/submissions/

2 There is no South Island winter capacity margin because the South Island generally has ample capacity to meet peak demand.

(2E) Despite subclause (2C), the system operator is not required to include the information referred to in subclause (2C)(b) in a security of supply assessment if the system operator considers that it would have good reason to refuse to supply the information under clause 2.6.

1.5 This document is a security standards assumptions document (SSAD) under clause 7.3 (2A) of the Code. It sets out key assumptions that the system operator must use in its ASA, except where the exceptions listed above apply.

1.6 The Authority has chosen to publish a SSAD at this point in order to ensure that:

(a) 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) sufficient information about the methodology and input assumptions is provided for the Authority and other stakeholders to have confidence that WCM and WEM are being calculated appropriately.

1.7 The document sets out:

(a) the formulae to be used to calculate WCM and WEM;

(b) some key assumptions relating to generation, demand, and transmission;

(c) the relationships between the levels of WEM and WCM and measures such as the expected amount of shortage or the cost-benefit of new generation investment. These relationships are not needed in order to calculate WEM or WCM, but will provide useful points of reference in explaining the results of the ASA to stakeholders; and

(d) the conditions under which the document will be updated.

1.8 Many of the assumptions required in order to calculate WCM and WEM (such as the course of future generation investment) are not set out in this SSAD. The system operator is expected to make its own informed assumptions in these areas (and to publish these assumptions, to the extent that confidentiality permits).

1.9 The system operator may also provide sensitivities exploring the effect of varying any assumptions.

1.10 Readers who seek information about the security of supply framework or the current security of supply situation may instead wish to consult the system operator's publications such as:

(a) the SOSFIP[3] and emergency management policy;[4]

(b) the most recent ASA;[5] and/or

(c) weekly security updates.[6]

[3] http://www.ea.govt.nz/dmsdocument/8555

[4] http://www.ea.govt.nz/dmsdocument/12280

[5] http://systemoperator.co.nz/sos-reporting

[6] http://www.systemoperator.co.nz/latest-sos-update

2 Formulae to be used to calculate WCM and WEM

2.1 This section documents current practice (as applied in, for example, the system operator's ASA 2012). It does not reflect a change in approach.

2.2 The sections that follow set out what values should be used for some (not all) of the terms in the formulae in this section.

Determining WCM

2.3 With regard to WCM, all references to *winter* daytime mean the period from 1 April to 31 October, between 7 am and 10 pm.

2.4 WCM must be determined using the following formula (all units in MW):

$$WCM = (EAC_{NI} – EDC_{NI}) + SICC(EAC_{SI} – EDC_{SI})$$

where:

EAC_{NI} is North Island expected available capacity;

EDC_{NI} is North Island expected demand for capacity;

SICC is the South Island capacity contribution, which is a monotone non-decreasing function of the South Island surplus;[7]

EAC_{SI} is South Island expected available capacity; and

EDC_{SI} is South Island expected demand.

2.5 North Island expected available capacity (EAC_{NI}) must be determined by the following formula (all units in MW):

$$EAC_{NI} = TC_{NI} + HC_{NI} + WC_{NI} * WCF + OC_{NI}$$

where:

TC_{NI} is the installed capacity of North Island thermal generation sources, allowing for forced and scheduled outages;

HC_{NI} is the installed capacity of North Island controllable hydro schemes, allowing for forced and scheduled outages, and de-rated to account for constraints which affect output during peak times;

WC_{NI} is North Island wind capacity;

WCF is a wind capacity contribution factor; and

OC_{NI} is the expected generation available in winter daytime from other North Island generation types (including geothermal, cogeneration, solar and uncontrolled hydro schemes).

7 See Figure 1

2.6 South Island expected available capacity (EAC_{SI}) must be determined by the following formula (all units in MW):

$$EAC_{SI} = HC_{SI} + WC_{SI} * WCF + OC_{SI}$$

where:

HC_{SI} is the installed capacity of South Island controllable hydro schemes, allowing for forced and scheduled outages, and de-rated to account for constraints which affect output during peak times;

WC_{SI} is South Island wind capacity; and

OC_{SI} is the expected generation available in winter daytime from other South Island generation types (currently including uncontrolled hydro, but could be extended to e.g. solar or cogeneration if these became relevant).

2.7 Expected demand for capacity in each island (EDC_{NI} and EDC_{SI}) must be determined by the following formula (all units in MW):

$$EDC_{island} = H100 * (1+PL) – DR\_IL$$

where:

H100 is a forecast of the average over the highest 200 half hours of island winter daytime demand;[8]

PL is an allowance for intra-island transmission losses at peak times; and

DR_IL is the expected demand response and interruptible load at peak times.

Determining WEM

2.8 With regard to WEM, all references to *winter* mean 1 April to 30 September.

2.9 NZ-WEM and SI-WEM must be determined using the following formulae (all units in GWh):

$$NZ\text{-}WEM = 100\% \times (EAE_{NZ} / EDE_{NZ} – 1)$$

$$SI\text{-}WEM = 100\% \times ((EAE_{SI} + NIC) / EDE_{SI} – 1)$$

where:

EAE_{NZ} is national expected available energy;

EDE_{NZ} is national expected demand for energy;

EAE_{SI} is South Island expected available energy;

NIC is North Island contribution to the South Island, equal to the assumed mean north-to-south transfer capability (in GW) multiplied by the number of hours in winter; and

EDE_{SI} is South Island expected demand for energy.

8 H100 is an unusual measure of demand. It was chosen for use in the WCM measure because it is reflective of the level of the top end of the load duration curve, but (unlike annual peak) is reasonably stable from year to year.

2.10 National expected available energy (EAE_{NZ}) and South Island expected available energy (EAE_{SI}) must be determined by the following formulae (all units in GWh):

$$EAE_{NZ} = TG_{NI} + WG_{NI} + WG_{SI} + HG_{NI} + HG_{SI} + OG_{NI} + OG_{SI} + SS_{NZ}$$

$$EAE_{SI} = WG_{SI} + HG_{SI} + OG_{SI} + SS_{SI}$$

where:

TG_{NI} is the maximum expected North Island thermal generation available to meet winter energy demand, allowing for forced and scheduled outages and available fuel supply;

WG_{NI} and WG_{SI} are the expected winter wind generation in each island, based on long-run average supply;

HG_{NI} and HG_{SI} are the amounts of hydro generation in each island that can be produced from expected winter inflows;

OG_{NI} and OG_{SI} are the expected winter generation available from other types of generation (such as geothermal or cogeneration) in each island, based on long-run average supply;

SS_{NZ} is a reference level of national storage on 1 April; and

SS_{SI} is a reference level of South Island storage on 1 April.

2.11 Expected demand for energy, either for the South Island (EDE_{SI}) or nationally (EDE_{NZ}), must be determined by the following formula (all units in GWh):

$$EDE_{region} = WD * (1+AL) – NDR$$

where:

WD is a forecast of total winter demand;

AL is an allowance for average transmission losses (within the South Island for SI-WEM, nationally for NZ-WEM); and

NDR is an allowance for the normal demand response to electricity prices.

3 Key assumptions – generation

Thermal generation

3.1 In order to allow for forced and scheduled outages, the following de-ratings should be applied to thermal generation:

(a) 5.4% for combined cycle gas turbines in the calculation of NZ-WEM;

(b) 6.7% for coal-fired Huntly units in the calculation of NZ-WEM;[9] and

(c) 3% for all thermal generation (excluding cogeneration) in the calculation of WCM.

3.2 Note that the full-winter derating to be used in the calculation of NZ-WEM is intentionally larger than the peak-time derating to be used in the calculation of WCM, because it takes into account:

(a) the impact of the low risk of long term outages; and

(b) occasional weekend or deferrable outages required to deal with plant problems that can arise.

3.3 Unless there is significant new information, the above assumptions about the availability of thermal generation should be retained, in order to be consistent with the derivation of the security standards.

3.4 In the calculation of NZ-WEM, Huntly should be derated by 130 MW overnight to reflect spinning reserve and frequency keeping requirements (equating to a further 303 GWh derating over the winter period. Alternatively, the best available information on the expected level of reserve requirement in dry year conditions should be used.)

3.5 All thermal generation should be assumed to be fully fuelled (i.e. their ability to contribute to WEM and WCM is not restricted by fuel availability constraints) unless there is credible information to the contrary.

Hydro generation

3.6 In order to allow for forced and scheduled outages, a derating of 2% should be applied to major controllable hydro generation in the calculation of WCM.

3.7 Further, in the calculation of WCM:

(a) Matahina, Patea and Tokaanu should be derated by 13 MW, 5 MW and 20 MW respectively to account for their limited short-term storage; and

(b) the Waikato hydro scheme should be derated by 60 MW to account for the impact of chronological flow constraints.

3.8 Unless there is significant new information, the above assumptions about the availability of controlled hydro should be retained, in order to be consistent with the derivation of the security standards.

3.9 In the calculation of NZ-WEM, the reference hydro storage level at 1 April (SS_{NZ}) should be 2750 GWh. (This figure was calculated as part of the derivation of the security standard, and denotes storage in Lakes Te Anau, Manapouri, Hawea, Tekapo, Pukaki, Waikaremoana, and Taupo.)

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9 Once this 6.7% derating is applied, there is no need to apply any further adjustments to model routine Huntly weekend outages (as was done in the ASA 2012).

3.10 In the calculation of SI-WEM, the reference hydro storage level at 1 April (SS_{SI}) should be 2400 GWh.

3.11 These reference levels should be retained, in order to be consistent with the derivation of the security standards. It may also be appropriate to test the effects of using higher reference levels, to represent access to contingent storage (e.g. in Lake Pukaki).

Other renewable generation

3.12 In the calculation of WCM, Transpower should use a wind capacity contribution factor in the range of 20-25%.

3.13 The Authority considers that 25% is the best available estimate of the contribution factor of wind.[10] Nonetheless it may be reasonable for the system operator to retain the current 20% until there is more data on the performance of actual wind farms at times of capacity scarcity.

10 http://www.ea.govt.nz/our-work/consultations/sos/winter-energy-capacity-security-supply-standards/submissions/

4 Key assumptions – demand

4.1 The ASA should clearly indicate what demand forecast is used and how it is derived.

Netting off generation

4.2 Any generation that is not modelled on the supply side should instead be netted off the demand forecast, and conversely. The goal is to avoid either double-counting or zero-counting any supply. It may be preferable (but is not obligatory) for the system operator to:

(a) model all grid-connected generation on the supply side;

(b) model all major embedded wind farms on the supply side; and

(c) net all other embedded generation off the demand forecast.

4.3 In any event, the ASA should clearly indicate what generation is netted off the demand forecast.

Transmission losses

4.4 The system operator should assume transmission losses of:

(a) 2.88% within the North Island, and 4.88% within the South Island, in the calculation of WCM;

(b) 3.5% (nationally) in the calculation of NZ-WEM; and

(c) 4.5% (in the South Island) in the calculation of SI-WEM.

Demand-side response

4.5 In the calculation of WEM, demand should be reduced by 2% to account for normal demand-side response. This is intended to represent the demand reduction that typically occurs in the electricity market in response to periods of high spot prices, but to exclude any demand response that arises from energy savings campaigns or the forced rationing of demand.

4.6 In the calculation of WCM, an allowance of 176 MW should be made for expected demand response and interruptible load in the North Island at peak times.[11] No allowance need be made for South Island peak-time demand response or interruptible load.

4.7 Unless there is significant new information, the above assumptions about demand-side response and interruptible load should be retained, in order to be consistent with the derivation of the security standards.

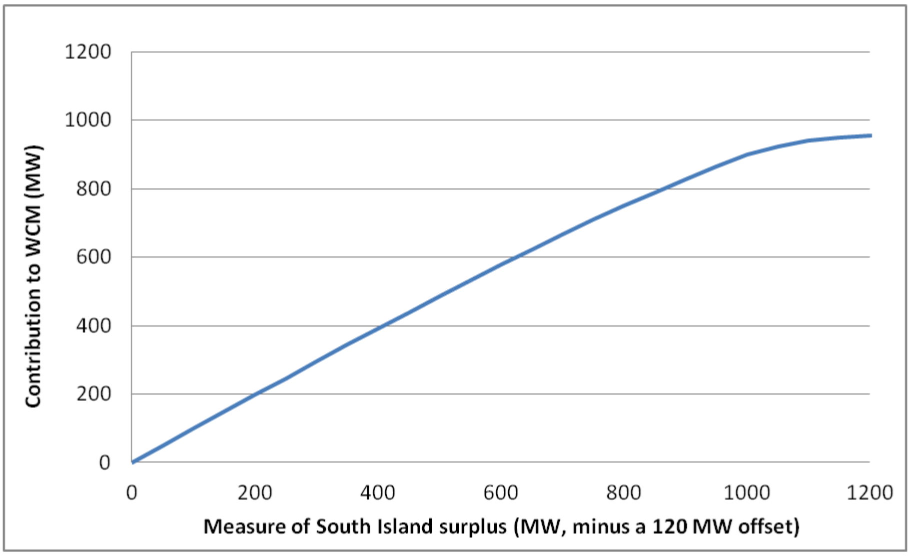
[11] This figure was originally based on 166 MW of IL (based on empirical observations of the amount of IL dispatched at peak times), plus a nominal 10 MW of demand-side response.

5 Key assumptions – transmission

South Island contribution to North Island WCM

5.1 In the calculation of WCM, the South Island capacity contribution curve shown in Figure 1 should be used.

Figure 1: South Island contribution curve



5.2 Values on the curve are supplied in Table 1.

Table 1: Values on South Island contribution curve

South Island surplus (MW, minus a 120 MW offset)	Contribution to WCM (MW)	South Island surplus (MW, minus a 120 MW offset)	Contribution to WCM (MW)
0	0	650	622
50	50	700	666
100	99	750	710
150	148	800	750
200	198	850	788
250	247	900	827
300	295	950	865
350	344	1000	900
400	392	1050	925
450	439	1100	940
500	486	1150	949
550	532	1200+	956
600	578		

5.3 Each point on the curve represents the "value" of South Island exports in terms of meeting North Island peak, over the course of a winter. (For the avoidance of doubt, it does not indicate the amount of power that can be transferred over the HVDC in a single trading period.)

5.4 The curve should be interpreted relative to the zero point, rather than in absolute terms. For instance, increasing *[South Island expected supply minus South Island expected demand minus 120 MW]* from nil to 600 MW is equal in value to adding 578 MW of idealised peaking generation in the North Island.

5.5 This curve is generated using the Authority's convolution model. If for some reason the curve needs to be recalculated (for example, as a result of changes to the HVDC configuration), then the system operator should request the Authority to do so.

North Island contribution to SI-WEM

5.6 For the purpose of calculating SI-WEM, the mean north-to-south transfer capability over the HVDC link should be assumed to be 480 MW.

5.7 This figure is net of losses – i.e. it reflects the power received in the South Island. It is derived from hydrothermal modelling, and is based on the assumptions that:

(a) there is ample North Island surplus (if there is not, then this should be identified through the calculation of NZ-WEM); and

(b) the only transmission constraints that will significantly restrict the ability to export power to the South Island are Bunnythorpe-Haywards thermal limits and the capacity of the HVDC link.

5.8 The system operator might wish to use a different figure if it:

(a) took the view that the figure of 480 MW did not adequately reflect the effect of these constraints (given the level of demand and wind generation in the lower North Island); or

(b) considered that there were other transmission constraints that would materially affect south transfer and could not readily be mitigated in a 'dry year' situation.

6 Explaining WCM and WEM

6.1 In explaining ASA results, it will be useful to show the relationship between the levels of WEM and WCM and:

(a) expected levels of shortage; and

(b) the cost-benefit of additional generation investment.

6.2 Based on the modelling used to set the standards, these relationships are as shown in Table 2 and Table 3.

Table 2: Figures for explaining WCM

WCM (MW)	Expected hours p.a. of energy or reserve shortfall *(as a result of capacity shortage)*	National benefit-cost ratio of additional investment in peaking generation *(considering only benefits in terms of reducing capacity shortage)*
500	61	3.03
550	47	2.33
600	36	1.74
650	28	1.25
690	**22**	**1**
700	21	0.94
750	16	0.66
800	11	0.48
850	8	0.34
900	6	0.27
950	4	0.17
1,000	3	0.12

Table 3: Figures for explaining NZ-WEM

NZ-WEM (%)	Expected amount of energy shortfall, as % of total demand *(including conservation campaigns and rolling cuts, but excluding 2% "market-based response")*	National benefit-cost ratio of additional investment in dry-year generation *(considering only benefits in terms of reducing energy shortage)*
12.4	0.12%	2.1
13.2	0.10%	1.5
14.1	0.08%	1.1
15.0	**0.06%**	**1.0**
15.8	0.04%	0.7
16.7	0.03%	0.4
17.5	0.02%	0.3

7 Revision of this document

7.1 This is the first SSAD published by the Authority.

7.2 The Authority considers the assumptions in this document to be reasonable for use in the system operator's ASA. However, as set out in the Introduction, there are conditions under which the system operator can vary from these assumptions.

7.3 It is not anticipated that this document will require annual review. However, the Authority will revise the document as necessary – at least, whenever it updates the security standards themselves.