Loy Yang Marketing Management Company Pty. Ltd.

AGL Southern Hydro Pty. Ltd.

International Power (Hazelwood, Synergen, Pelican Point and Loy Yang B)

TRUenergy Pty. Ltd.

NRG Flinders Pty. Ltd.

Hydro Tasmania

31 March 2006

Dr John Tamblyn
Chairman
AEMC
Level 16, 1 Margaret St,
SYDNEY NSW 2000

By email: submissions@aemc.gov.au

Dear John

Supplementary Technical Data Appendix to:
Southern Generators Response to Requests for Making of a Rule –

- **Snowy Region Boundary by Snowy Hydro Ltd; and**
- **Alternative Snowy Region by Macquarie Generation Ltd.**

The above group of participants "Southern Generators" provided to you a submission on these proposed rule changes dated 24 March 2006. In that submission we noted that we intended to provide some further Technical information as it became available. Please accept the following as "Appendix 2" to our earlier submission.

We can conclude from this analysis that for some real constraints the Macquarie Generation proposal would have provided a more accurate representation than existing

regions, however in others it would be less accurate. For all constraints, the Snowy Hydro proposal would have been equal to or worse than the existing regions with the Tumut trial in place.

This conclusion illustrates the importance of detailed technical modelling to ensure an appropriate conclusion.

Yours faithfully

Ben Skinner
(on behalf of the "Southern Generators")

Appendix 2: How the various proposals would have handled actual constraints

The following table lists the most significant 29 constraints (in terms of hours binding) that impacted the Snowy-Victorian Interconnector from 1 July 2005 to 24 March 2006. NEMMCO's description of the constraint is also included.

These constraints are then compared in terms of locational accuracy to the various regional boundary proposals, i.e. how closely do the boundaries of each proposal match to the location of the constraint. If a significant generation centre lies between the constraint and the boundary then we describe that constraint as being poorly represented by the boundary.

The constraints are considered against the accuracy of their representation in the:

- Current regional boundaries;
- Current regional boundaries taking into account the Tumut CSC/CSP trial that effectively provides a local marginal price at Tumut;
- Snowy Hydro proposed regional boundaries following abolition of the snowy region;
- Macquarie Generation proposed regional boundaries following the abolition of the snowy region and the creation of Southern NSW and Northern Vic regions.

We can conclude from this analysis that for some real constraints the Macquarie Generation proposal would have provided a more accurate representation than existing regions, however in others it would be less accurate. For all constraints, the Snowy Hydro proposal would have been equal to or worse than the existing regions with the Tumut trial in place.

Note regarding Inter vs Intra-Regional Constraints

These constraints have impacted the Snowy-Vic *interconnector* flow as modelled within the NEMDE. An inspection shows some relate to network elements remote from the regional boundary with generation elements between the constraint and "interconnector". We have listed such constraints as poorly represented by the existing boundaries. This raises a question as to whether these existing constraints should be represented as *intra*-regional.

The constraint orientation decision is arbitrary and for historical reasons a number of Victorian network constraints that would appear to be *intra* regional continue to be represented as *inter*.

Direct physical representation of constraints in the NEMDE should make the distinction irrelevant as the NEMDE optimises all generators according to the lowest presented offer. However as the settlement impact is vastly different, generators are incentivised to present offers that optimise their own returns, ultimately resulting in a different dispatch.

Note on Non-thermal Constraints

Some constraints are related to transient or dynamic stability, which means the risk of the power system losing synchronism (i.e. separating into islands) following the most critical contingent disturbance-in these cases a short-circuit fault on a major line.

Identifying the best location upon which to represent the resulting "pinch point" is challenging. It should be the point at which the separation would occur, however that is not a natural output of stability modelling. We have taken an approach that this separation is mostly likely to occur in the vicinity of the critical disturbance-which is known.

For example, for those related to critical faults on the Hazelwood to South Morang lines, we have described the current modelling as Vic-snowy *inter*-regional constraints as "OK", but noted that the Macquarie Generation proposal has boundaries electrically closer to the source of disturbance. We have listed the Snowy Hydro Proposal as "No" because it places the boundary further from the disturbance than status quo.

Voltage collapse limits are caused by an excessive reactive power flow across a reactance. This also has no specific element as its cause, however we can usually identify the source of the greatest voltage loss. For constraints 3,4&12 this is the Dederang-Murray 330kV line, and that is where this constraint should be represented.

Marginal Value

We have provided an accumulation of the marginal value of these constraints, i.e. the improvement in the objective function (cost of total dispatch) caused by a 1MW release of this constraint. This gives an indication of the economic value of the constraint when it bound and is thus more valuable than a simple time measure.

However, this should be read with some caution:

- The value is only the economic effect of a marginal MW. In some cases, a release of only a few MW's would have unbound the constraint whilst in others 100's of MW's would have been required. Therefore it is a fair indication of the impact upon price, but not on the total efficiency of dispatch.
- Where a constraint has caused the violation of another constraint, the marginal value is affected by the violation penalty of that constraint priced at many times VoLL. This has affected constraint #4, which absent this effect would have had a marginal value accumulation only of several tens of thousands.

The marginal value is published each 5 minutes so the number has been divided by 12 to get a $/MWh equivalent figure.

RRP Differential Between Nodes

As well as the marginal value weightings, we have also included the average of the dispatch prices in Victoria and Snowy in each dispatch interval where the constraint was binding, between 1-July-2005 and late March 2006.

This adds an additional dimension to the impact of each constraint, although again the reader should exercise some caution as the simple average may have hidden some of the picture of volatility and absent this constraint, the prices would still have diverged somewhat due to loss factors and potentially other constraints.

		Constraint Binding				*Regional Boundary Accurate Representation?*				
	CONSTRAINTID	**Avg Vic RRP**	**Avg Sn RRP**	**HRS**	**CONSTRAINT DESCRIPTION**	**Current**	**Current+ CSC/P trial**	**Snowy Hydro**	**Macgen**	**Marg value /12*** **
1	H>>H-64_B	$78	$244	86	Out= LowerTumutSS-UpperTumutSS(64), avoid MurraySS->LowerTumutSS(66) OL on MSS-UTSS(65) trip; Fb,CoOp	No	Yes	Yes	Yes	38,743
2	V>>H_NIL_2_R	$14	$19	78	Outage = Nil, limit Vic interconnectors and Vic generation to avoid pre-contingent overloading the South Morang 500/330kV (F2) transformer, radial mode at Hazelwood	No	No	No	Yes	347
3	H^V_LTUT	$38	$26	40	Outage = Lower Tumut to Upper Tumut 330kV line, limit Snowy to Vic to avoid voltage collapse for trip of the largest Vic generating unit (500 MW)	Yes	Yes	No	No	6,165
4	H^V_NIL1	$83	$21	20	Outage = Nil, limit Snowy to Vic to avoid voltage collapse for loss of the largest Vic generating unit, radial or 6/2 parallel modes	Yes	Yes	No	No	1,145
5	N>N-994_A	$1,282	$25	18	Out= Wagga-Yanco(994), avoid Wagga->Yanco(99F) OL on Wagga-DarlingtonPt(63) trip; Fb	No	No	No	No	268,285 ***
6	V::H_NILQC_R	$15	$21	18	Out = Nil, limit Vic interconnectors, NSW to Qld on QNI and Vic generation to avoid transient instability for fault and trip of a Hazelwood to South Morang 500 kV line, third linear segment, Radial	OK	OK	No	OK-better	79
7	VH>V1KTTX	$14	$15	13	Outage = Keilor 500/220kV transformer, limit Vic to Snowy and Vic to SA on Murraylink to avoid overloading the South Morang 500/330kV (F2) transformer, radial mode at Hazelwood	No	No	No	Yes	229
8	V::H_NILQE_BL_R	$16	$19	13	Outage = Nil, Basslink export to Tas, limit Vic interconnectors, NSW to Qld on QNI and Vic generation to avoid transient instability for fault and trip of a Hazelwood to Sth Morang 500kV line, radial mode at Hazelwood	OK	OK	No	OK-better	42
9	V:HHWROB_C	$11	$16	13	Outage = Hazelwood to Rowville No.4 500kV line, limit Vic to Snowy to avoid avoid transient instability for fault and trip of a Hazelwood to South Morang 500kV line, second linear segment of equations 27.1 & 28.1 from TLM-D, 3/5 Parallel	OK	OK	No	OK-better	147
10	H>>H-NIL_A	$20	$22	10	Outage=Nil, avoid overloading Murray to Upper Tumut (65) 330kV line on loss of Murray to Lower Tumut (66) 330kV line; FbRDF; Option 4	No	Yes	Yes	Yes	987
11	V:H2RPB_R	$10	$16	9	Outage = 2 dynamic reactive plant from Vic metro or SESS SVC's, limit Vic export to Snowy and SA for transient stability, system normal limit B - 40MW, Radial	OK	OK	No	Yes	43
12	HV_V2DDMS	$52	$22	9	Outage = Dederang to Murray 330kV line, limit Snowy to Vic to avoid voltage collapse for trip of a Dederang to Murray 330kV line	Yes	Yes	No	No	245

		Constraint Binding Stat's				*Regional Boundary Accurate Representation?*				
	CONSTRAINTID	**Avg Vic RRP**	**Avg Sn RRP**	**HRS**	**CONSTRAINT DESCRIPTION**	**Current**	**Current+ CSC/P trial**	**Snowy Hydro**	**Macgen**	**Margin al value/12**
13	V:HHWROC_C	$12	$19	9	Outage = Hazelwood to Rowville No.4 500kV line, limit Vic to Snowy to avoid avoid transient instability for fault and trip of a Hazelwood to South Morang 500kV line, third linear segment of equations 27.1 & 28.1 from TLM-D, 3/5 ParalleL	OK	OK	No	OK-better	116
14	N:Q_NIL_B9	$9	$15	9	Out = Nil, NSW to Qld Transient Stability Limit for: Vic to Snowy flows of 1000 to 1170 MW, 7 or less units in service at Bayswater and Liddell	OK	OK	No	OK-better	21
15	V::H_NILQF_BL_R	16	19	8	Outage = Nil, Basslink export to Tas, limit Vic interconnectors, NSW to Qld on QNI and Vic generation to avoid transient instability for fault and trip of a Hazelwood to Sth Morang 500kV line, radial mode at Hazelwood	OK	OK	No	OK-better	198
16	V::H_NILQB_R	13	17	8	Out = Nil, limit Vic interconnectors, NSW to Qld on QNI and Vic generation to avoid transient instability for fault and trip of a Hazelwood to South Morang 500 kV line, second linear segment, Radial	OK	OK	No	OK-better	267
17	V:H_BAHO	10	14	8	Out = Ballarat to Horsham line, limit Snowy to Vic to avoid transient instability for fault and trip of a Dederang to South Morang 330kV line, equation 1.2 from TLM-D minus 125MW	OK	OK	No	Yes	244
18	N>N-994_B	46	40	7	Out= Wagga-Yanco(994), avoid Wagga->Yanco(99F) OL on Wagga-DarlingtonPt(63) trip; TG advice	No	No	No	No	2,127
19	V:HHWRO3_R	10	15	7	Outage = Hazelwood to Rowville No.3 500kV line, limit Vic to Snowy to avoid avoid transient instability for fault and trip of a Hazelwood to South Morang 500kV line, equation 31.1q from TLM VE-Q, Radial	OK	OK	No	Yes	384
20	H>>H-64_D	218	229	7	Outage= Lower Tumut to Upper Tumut (64) 330kV line, avoid overloading Lower Tumut to Murray (66) on loss of Murray to Upper Tumut (65), FbRDF, Option 4	No	Yes	Yes	Yes	15,726
21	H>V_NIL1A	95	47	6	Outage = Nil, limit Snowy to Vic to avoid overloading a Dederang to Murray 330kV line for loss of one of the two parallel lines, 15 min line ratings	Yes	Yes	No	No	2,334
22	V::H_NILVF_BL_R	15	18	6	Outage = Nil, Basslink export to Tas, limit Vic interconnectors and Vic generation to avoid transient instability for fault and trip of a Hazelwood to Sth Morang 500kV line, radial mode at Hazelwood	OK	OK	No	OK-better	102
23	V:H_NILB_R	11	16	6	Outage = Nil, limit Vic to Snowy to avoid transient instability for fault and trip of a Hazelwood to South Morang 500kV line, second linear segment of equations 1+1q from TLM VE-D & VE-Q, Radial	OK	OK	No	OK-better	221

		Constraint Binding				*Regional Boundary Accurate Representation?*				
	CONSTRAINTID	**Avg Vic RRP**	**Avg Sn RRP**	**HRS**	**CONSTRAINT DESCRIPTION**	**Current**	**Current+ CSC/P trial**	**Snowy Hydro**	**Macgen**	**Marginal value/12**
24	VH_0000	445	2,392	5	Discretionary Victoria to Snowy transfer upper limit of 0 MW	N/A###	N/A	N/A	N/A	275,127
25	V:HDDMSB_R	15	18	4	Outage = Dederang to Murray 330kV line, limit Snowy to Vic to avoid transient instability for fault and trip of a Hazelwood to South Morang 500kV line, second linear segment of equations 1+1q from TLM VE-D & VE-Q minus 97MW, Radial	OK	OK	No	OK-better	117
26	V:H_NILC_R	11	16	4	Outage = Nil, limit Vic to Snowy to avoid transient instability for fault and trip of a Hazelwood to South Morang 500kV line, third linear segment of equations 1+1q from TLM VE-D & VE-Q, Radial	OK	OK	No	OK-better	133
27	VH_0050	48	3,601	4	Discretionary Victoria to Snowy transfer upper limit of 50 MW	N/A###	N/A	N/A	N/A	182,002
28	VH_0100	39	445	4	Discretionary Victoria to Snowy transfer upper limit of 100 MW	N/A###	N/A	N/A	N/A	39,251
29	V>>V_X_DD TX2_3_DBUSS	26	24	4	Outage = Dederang No.2 or No.3 330/220kV transformer and DBUSS transformer control scheme, limit Vic interconnectors and Southern Hydro generation to avoid overloading the Dederang No.1 transformer for loss of the other Dederang transformer	No	No	No	Yes	46

***See section explaining marginal value.

###This constraint was applied to the interconnector as NEMMCO's method to avert negative settlement residue and is not related to any physical limit-therefore accurate representation is not applicable. Refer to Appendix 1 of our submission for a thorough discussion of this matter.