



4 May 2006

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Dear Russell

OPTION 4 CONSTRAINT FORMULATION

Thank you for your letter of the 12 April 2006, in which you sought clarification of your understanding and invited comments on your observations concerning NEM constraint formulation. In response to the observations you raised NEMMCO is pleased to respond as below.

In summary, NEMMCO is of the view that the experience to date has demonstrated that the implementation of "Option 4" or the fully co-optimised constraint form has:

- been more effective in managing power system security than those constraint forms which constrain only interconnectors or only intraregional generation,
- lead to improved utilisation of the network,
- been consistently applied as outlined in policy documents and in accordance with the technical envelopes provided by TNSPs, and
- reduced the level of manual intervention by NEMMCO.

NEMMCO agrees that the improvement in power system management by the introduction of Option 4 constraints has tended to increase the complexity of the price setting process, although complexity in price setting (meaning cases where dispatch price is determined as linear combination of a number of offer prices) existed prior to introduction of the Option 4 formulation. The MCE recognised this complexity in making their policy decision to use Option 4 formulations. To address this increased complexity NEMMCO has:

- increased the detail published relating to how price was set in each period, and
- developed and executed training courses specifically designed to increase understanding in NEM constraints.



Network Utilisation

Under the programme commenced in July 2005, NEMMCO has now implemented over 700 Option 4 constraint equations. Around 200 of these equations include safety margins.

Safety margins are generally only changed in response to observed power system performance. In the specific cases mentioned in your letter (N>>N-LDTM_14 and N>>N-LDTM _15) these increases were necessary due to the fact that there were unusual differences between the SCADA or operational measurements for particular line power flows and the values calculated under the state estimation process indicating greater than normal SCADA measurement inaccuracies. An increase in operating margin would have been required in these cases irrespective of the constraint formulation approach adopted.

There have also been cases where implementing Option 4 constraints has resulted in reduced safety margins, less reliance on discretionary constraints, or increased power system security. For example, the 40 MW safety margin that applied to the N>N-81__1T constraint was removed following conversion to Option 4.

Implementation of Option 4 constraints in the Snowy region meant that NEMMCO was no longer required to use discretionary constraints to maintain system security, resulting in more efficient operation of the power system. The improved power system control afforded by the introduction of Option 4 constraints in the Snowy region also enabled NEMMCO to move from 30-minute to 15-minute line ratings for the Snowy circuits, as advised in NEM Communication No. 1321 issued on 14 November 2003.

Prior to the implementation of Option 4 constraints, Dederang transformer outages were managed by applying discretionary constraints on the Snowy to Victoria power transfers. The development of Option 4 constraints for these outages has resulted in an average increase in Snowy to Victoria transfer of around 250 MW due to improved power system control.

In the case of the N>>N-NIL_28 constraint the incidence of the constraint violating has fallen from 55 times out of 74 binding/violating dispatch intervals during 2004/05 when it was formulated as an Option 1 type, to once out of 30 binding/violating dispatch intervals since being formulated as an Option 4 type in July 2005, again due to improved power system control.

Consistency of constraint formulations

In order to ensure consistency of constraint formulation NEMMCO established a policy for constraint formulation "Network and FCAS Constraint Formulation Policy" which is published on the NEMMCO Website – refer:

<http://www.nemmco.com.au/dispatchandpricing/170-0030.htm>

Setting Coefficients

Regarding the issue of the reason for the change from the "5 to 1" rule to "10 to 1" rule, the reason for this change is set out in the above policy document as follows:

"In case of any of the following relevant scheduled terms:

- Regulated interconnectors; or
- Scheduled Network Services

If the absolute value of its coefficient is less than one tenth of the absolute value of the coefficient of any other term on the left hand side then this term with the small absolute value coefficient should be moved to the right hand side of the constraint equation. This is to minimise the risk of significant fluctuations in dispatch and pricing outcomes when the dominant variable becomes constrained by a different constraint equation. This rule relaxes the previous "1 to 5" rule which was determined for joint interconnector constraints as a result of a review of a market incident that occurred on 2 March 2000. The Market was advised of this rule via NEM Communication No. 562 in March 2001. This rule has now been relaxed in order to better meet the requirements set down in the above jurisdictional policy based upon a judgment by NEMMCO that there are unlikely to be significant issues for constraints with coefficients with ratios in range 5 to 10. NEMMCO will monitor the performance of constraints affected by this relaxation closely and may impose a tighter limit for this rule for groups of constraints with the same interconnector terms on the left hand side if potential issues are identified with any of the constraints in the same group."

As you pointed out in your letter there are still some joint interconnector constraint equations which follow the "5 to 1" rule rather than the "10 to 1" rule. However these older joint interconnector constraint equations are scheduled to be modified under the transition programme which is currently being undertaken. This program has also been published on the NEMMCO Website refer:

<http://www.nemmco.com.au/dispatchandpricing/170-0030.htm>

Also, as described in NEMMCO's "Network and FCAS Constraint Formulation Policy" document, while the "1 to 10" rule has been applied to interconnectors and scheduled network services, it was considered that generating units need not be covered by this rule as the change in output possible within a small period of time would be smaller. Left hand side generating unit coefficients are instead restricted to being greater than 0.07. This avoids the possibility of NEMDE violating the constraint rather than dispatching high priced generation.

Consistency between Regions

Regarding the observation which you made on the formulation of the Tarong constraints, it should be noted that there is an important difference between these constraints and the normal constraints within NSW. The Tarong constraints are designed to manage voltage stability issues whereas the typical constraints within the NSW region are designed to ensure that post contingent line loadings do not exceed the thermal rating of the circuit. The more heavily enmeshed network configuration in NSW combined with the different method used to determine thermal limit equations tends to result in more generator terms being included in the NSW thermal equations.

In accordance with the announced program for conversion of constraints to Option 4, the Option 3 Tarong constraints have been converted to Option 4. At that time consideration was given to transfer of the Swanbank and Wivenhoe terms to the left hand side of the constraint equation. However this was not done as the review highlighted some special difficulties related to this particular limit. Accordingly NEMMCO has approached Powerlink with a suggestion that the manner in which the technical envelope is specified for management of voltage stability in south east Queensland be changed. If Powerlink agrees with this then the formulation of these constraints would be fundamentally altered.

Application of new Option 4 equations

As regards the observation you made on formulation of constraints in southern NSW, the reference you quote is from June 2003 prior to the general policy decision made by the MCE. At that time the Option 4 formulation was not an option which was generally available to NEMMCO and so the choices available to NEMMCO in this case were Option 1 (ie constrain intraregional generating units only) or Option 8 (ie constrain the interconnector only). Because both the interconnector and the intra-regional generating units can influence the flows in southern NSW neither is a perfect solution. In 2005 these constraints were reformulated as Option 4 (ie constraining both intra-regional generating units and interconnector flow) in accordance with the policy decision by the MCE. Current evidence is that these new Option 4 constraints are performing more effectively than either the Option 1 or Option 8 alternatives.

Level of Manual Intervention in the Market

NEMMCO agrees that the adoption of the Option 4 constraint formulation will tend to reduce the number of interventions required to maintain power system security but will tend to increase the incidence of interventions to manage excessive accumulation of negative residues. As NEMMCO stated in its Final Determination on "Management of Network Limitations in the Snowy Region & Constraint Formulation in the NEM – Interim Actions" published in July 2003:

"Under Option 1 constraints, NEMMCO currently has to manually constrain interconnector flow and generation to manage the system security issues caused by these constraints. This manual process is, in itself, heavy handed to a higher degree than the proposed process under Option 4 constraints, and, in addition, has a high risk of error that could lead to system security problems. The process of constraining interconnectors (or using alternative constraint orientations) to curtail negative residues is less likely to lead to security problems while at the same time addressing many of the issues raised by participants in relation to the accumulation of negative residues."

It should also be noted that the number of interventions has tended to decline.

Prior to the introduction of Option 4 constraints in the Snowy Region NEMMCO intervened by applying discretionary constraints to maintain power system security in the Snowy region for a total 146 hours in the period 1 November 2002 to 16 February 2003 (refer Appendix 4 of the NEMMCO Draft Report "Management of Network Limitations in the Snowy Region & Constraint Formulation in the NEM – Interim Actions" of March 2003).

In a similar period after the introduction of Option 4 constraints (1 November 2005 to 16 February 2006) NEMMCO intervened for 54 hours to minimise the accumulation of negative residues on interconnectors associated with the Snowy Region.

Price Setting Processes

NEMMCO agrees that the introduction of Option 4 constraints has tended to increase the complexity of the price setting process, although complexity in price setting (meaning cases where dispatch price is determined as linear combination of a number of offer prices) existed prior to introduction of the Option 4 formulation due to:

- multiple terms of the left hand side of a constraint equation (applies even for Option 1 constraints); and
- co-optimisation between energy market and FCAS market

Introduction of Option 4 formulation has resulted in an increase in the instances when prices will be determined in this manner. The MCE recognised this complexity in making their policy decision to use Option 4 formulations.

To assist Participants in understanding this complexity NEMMCO is now publishing on the day after price setting information which demonstrates how each dispatch price in each region has been set. Further details on this data is available on the NEMMCO Website refer:

<http://www.nemmco.com.au/dispatchandpricing/140-0036.htm>

In addition NEMMCO offers to Participants on a regular basis a market education course entitled "Network and FCAS Constraints" to assist Participants in understanding the impacts of constraints.

As regards your comment on the increased incidence of over-constrained dispatch periods, NEMMCO believes that any such increase is not due to the introduction of Option 4 constraints since by their nature these constraints are less likely to violate than Option 1 constraints since they provide greater degrees of freedom. NEMMCO believes that any increase in over constrained dispatch periods would be due to:

- introduction of Tasmania into the NEM in mid 2005; and
- changes to the over -constrained dispatch process introduced in 2005 that extended its scope to cover violation of intra-regional constraints and adjustment of ancillary service prices.



NEMMCO believes that the use of Option 4 constraints has improved the secure operation of the power system and is pleased to work with the AEMC, AER and the industry so that any market issues can be appropriately addressed.

Please contact me on (02) 9239 9103 if you would like to discuss these issues further.

Yours sincerely


Brian Spalding
Chief Operating Officer

Enc.

cc. Dr John Tamblyn Chairman AEMC
Mr Steve Edwell Chairman AER