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Dear John

Congestion Management Review Draft Report

Thank you for the opportunity to provide a written submission on the Congestion Management Review Draft Report (**Draft Report**). The Congestion Management Review has served as a constructive examination of the link between transmission congestion, power system and market operation.

The use of fully co-optimised network constraints is important to ensure effective control of power system flows. NEMMCO expresses its support for the Draft Report's recommendation of including within Chapter 3 of the Rules the requirement for NEMMCO to use the fully co-optimised network constraint formulation to the extent practicable.

The following comments are made on the Draft Report's recommendations:

- NEMMCO can see merit in expanding the Rules constraint information requirements in the form of a guideline. The constraint documentation currently published by NEMMCO is likely to go a long way to meeting information needs;

- It would be appropriate for an assessment of the real-time flow of constraint information to include the information published by NEMMCO's Market Systems in the PASA, Pre-dispatch and Dispatch time frames and acknowledge the risk of unavoidable events that are difficult to forecast;

- NEMMCO would welcome the opportunity to discuss potential implementation issues as part of any further development and consultation the Commission may wish to undertake on Positive Flow Clamping (**PFC**). Further areas to consider for PFC could be:
    - the possibility that the magnitude and frequency of PFC intervention may be greater than reducing a counter-price flow by no more than zero, as is the current practice for managing negative residues; and
    - that the PFC trigger is based on forecasting counter price events that are caused by generators' incentives to bid below avoidable costs, being a certain form of strategic bidding. Strategic bidding is difficult to confirm, let alone forecast.

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- NEMMCO would be able to accommodate measures such as: ceasing the practice of netting off negative residues against positive residues in a billing week; increasing the threshold trigger for managing negative residues from a forecast of $6,000 to $100,000; and to extend the time-table for auctioning SRA units;

- Some data from which measures of network capability can be constructed is already available. NEMMCO would be pleased to discuss the further use and application of this data.

NEMMCO is currently planning the recommencement of the Network Control Ancillary Services (**NCAS**) review. Once this planning has progressed NEMMCO will lodge a supplementary submission to convey the high level steps intended for the recommencement of the NCAS review.

Detailed responses to the recommendations are provided in the attachment.

Yours faithfully,

Brian Spalding

Brian Spalding
Chief Operating Officer

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Response to the Draft Congestion Management Report recommendations

Recommendation 1:

The Commission has reached a draft recommendation that implementing a form of localised spot pricing arrangements based on either:

- **Negotiated allocation of transmission rental rights; or**
- **Auctioned allocation of transmission rental rights,**

would be undesirable for the following reasons:

- **would be likely to raise significant implementation issues and competition concerns and have significant wealth transfer implications;**
- **It would constitute a disproportionate response to the problems created by the present levels and impacts of congestion, based on currently available evidence; and**
- **Depending on the extent of its application, it could go beyond the scope of the MCE's ToR for the CMR.**

NEMMCO acknowledges the above recommendation and the supporting reasons.

Recommendation 2:

The Commission has reached a draft recommendation that implementing a regime of constrained-on payments through changes to the Rules to settlement of the spot market would not represent a proportionate means of improving the management of physical and financial trading risk from network congestion.

NEMMCO acknowledges the above recommendation.

Recommendation 3:

- **That negative settlement residues no longer be netted-off against positive residues within a billing week; and**
- **That negative residues be funded by directly billing the importing region's TNSP.**

The ceasing of the netting off arrangement can be accommodated by NEMMCO. This would require a modification to the Market Management Systems and would be implemented in accordance with NEMMCO's Change Management Procedures.

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Negative residues remaining after netting off against positive residues, in the same week, are funded by netting against auction proceeds of the subsequent quarter in accordance with the Negative Inter-Regional Settlements Rule, prior to allocating the auction proceeds to the importing TNSP.

It would be appreciated if more detail could be provided for the recommendation on:

directly billing the importing region's TNSP

Does this recommendation mean that when the practice of netting negative residues against positive residues in a billing week is ceased, that negative residues will be funded on a billing week basis through the TNSP's settlement statement?

Recommendation 4:

- **That the threshold at which NEMMCO intervenes to limit the accumulation of negative settlement residue be lifted from $6,000 to $100,000;**
- **That the need for physical intervention as a means of managing negative settlement residues, and the level of the threshold for invoking such an intervention should be reassessed in three years with a view to complete removal if possible; and**
- **That NEMMCO should be obliged to outline how it interprets and applies those provisions of the Rules that enable it to effect clamping in the constraint guidelines recommended in Chapter 6.**

NEMMCO can accommodate an increase in the lifting of the threshold. This would be implemented through a change in NEMMCO's Dispatch Operating Procedure.

NEMMCO supports the concept of a guideline that would include how NEMMCO interprets and applies those provisions of the Rules that enable it to intervene.

The Draft Report has introduced Positive Flow Clamping ("**PFC**") as an alternate approach to managing negative settlement residues. The Draft Report states that PFC works by clamping the relevant interconnector to a positive flow, rather than reducing a counter-price flow by no more than zero, as is the current practice for managing negative residues. Some of the major elements of PFC are:

- PFC would not be applied to all cases where negative residues were forecast to accumulate to $6,000, but only for events that would be pre-defined and identified by constraint equations;
- the interconnector would be clamped to the flow at which that interconnector was dispatched in the dispatch interval just prior to the PFC invocation;
- PFC would not be invoked if this compromised system security.

NEMMCO currently publishes its approach to the Management of the Negative Residue process in the Dispatch Operating procedure[1]. If a situation is identified where negative residue management will be necessary for a binding network constraint, the current practice is to begin to constrain the

[1] NEMMCO Operating Procedure: Dispatch ,21 September 2007, page 32-34, located at http://www.nemmco.com.au/powersystemops/so_op3705v047.pdf

interconnector flow at a rate no greater than that which applies for a planned outage. This ramping would cease at the point at which counter price flows were halted. From that point on periodic adjustment of the level of the constraint might be necessary due to changing market conditions by:

- increasing the level of constraint if counter-price flows re-emerged ; or
- relaxing the level of constraint if significant positive inter-regional settlements accumulations indicated that current level of constraint was excessive.

Consider the example of a negative residue forecast to accumulate to $6,000 in over four hours. The current practice would be for NEMMCO to respond by constraining the interconnector flow. If the forecast accumulation was revised to below $6,000 in the first hour of constraining or ramping the interconnector flow, NEMMCO would be able to relax the constraint and cease intervention without impacting the interconnector flow. The revision in the forecast of the negative residue may:

- have been a result of the early stages of reducing the counter-price flow, or
- be a response to more accurate information becoming available closer to the time of the forecast accumulation, or
- arise from other changes in market conditions.

The reason for the revised forecast is probably irrelevant, as the example demonstrates that ramping allows NEMMCO to apply a proportionate approach to reducing the interconnector flow. Ramping allows intervention to be calibrated to prevailing market conditions.

A similar proportionate approach does not seem to be afforded by PFC. Take the scenario of the negative residue accumulating to $6,000 in over four hours. The approach seems to be that PFC would be immediately invoked to the flow of the dispatch interval just prior to the PFC invocation.

In contrast to the existing ramping approach to managing negative residues, PFC seems to be "all or nothing" requiring:

- greater reliance on forecasting;
- higher magnitudes of intervention; and
- greater frequency of intervention.

The Draft Report makes the two points as below:

- PFC is only to be considered for counter-priced flow events caused by generator's incentives to bid below avoidable costs due to pre-defined binding constraints; and
- PFC would be invoked when negative residue caused by one of the defined constraints were forecast to accumulated above $6,000.

The PFC trigger seems to be dependent on the likelihood of a certain form of strategic bidding by generators. Strategic bidding is difficult to confirm, let alone forecast. This is because strategic bidding is likely to be implemented through the rebidding process as close to dispatch as possible to deny competitors time to organise a response. On this basis it seems unlikely that a forecast of strategic bidding would be an effective PFC trigger.

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Part of the high level PFC design is that PFC events would be pre-defined and identified by constraint equations. Composing the pre-defined list could be contentious in light of the Draft Report's statement:

PFC would result in a different dispatch outcome to the current clamping regime. Intra-regional generators would be backed off to a greater extent, while interregional generators would be allowed to generate more.

The assumption that when a certain constraint binds it will always result in strategic bidding, may need to be tested. Under certain market conditions when the constraint binds there may be incentives for strategic bidding, while under different market conditions when the same constraint binds, there maybe incentives for generators to bid competitively. For the latter case it would be inappropriate for PFC to be invoked.

NEMMCO would welcome the opportunity to discuss potential implementation issues as part of any further development and consultation the Commission way wish to undertake on PFC.

Recommendation 5:

That several tranches of IRSR units be made available for auction up to 3 years in advance of the relevant IRSR quarter, with the detailed development of release profile being established through the SRC.

NEMMCO can accommodate extending the timetable for auctioning, and would implement through Settlement Residue Committee procedures.

Recommendation 6:

Include within Chapter 3 of the Rules the requirement for NEMMCO to use fully co-optimised network constraint formulation to the extent practicable, except where NEMMCO reasonably determines that an alternative constraint formulation is necessary to meet system security requirements or to manage negative settlement residues provided that NEMMCO's use of an alternative constraint formulation is consistent with the guidelines referred to in Section 6.2.2.

NEMMCO supports transferring the substance of the Part 8 derogation relating to fully co-optimised constraint formulation into Chapter 3 of the Rules. The use of fully co-optimised network constraints is important to ensure effective control of power system flows.

The second part of the recommendation on conditions for NEMMCO to apply the alternate constraint formulation to meet system security requirements is consistent with NEMMCO's Network and FCAS constraint formulation paper[2], which defines alternate constraint formulation situations as:

- when very small coefficients interact mathematically with other aspects of the optimization process to reduce the physical effectiveness of the constraint; and
- when a very broad range of coefficients result in large short term movement in some plant, delivering questionably small benefit, and potentially negative net benefit to power system security.

[2] Network and FCAS constraint formulation , 4 July 2005 located at http://www.nemmco.com.au/dispatchandpricing/170-0040.pdf

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Deviations from the general rule will only be made where it can be demonstrated that the deviation is in the interest of delivering greater security to the power system.

As a point of clarification, when NEMMCO constrains the interconnector flow to manage negative residues, NEMMCO maintains the use of the fully optimised constraint for power system security, but overlays a second constraint containing an interconnector term to limit the interconnector flow.

Recommendation 7:

That NEMMCO be obliged to:

- **Develop constraint guidelines outlining the methodology and process to be followed when developing, formulating and implementing constraint equations to assist participants to assess the impact of constraints on dispatch and pricing;**
- **Comply with its published constraint guidelines; and**
- **Consult with stakeholders when developing or modifying those guidelines.**

NEMMCO recognises that elements of NEM design and many of the NEM processes are technical and highly complex. Efficient participation in the NEM can be promoted by a greater understanding of how the market operates, and so NEMMCO supports the concept of a guideline that could build on Participant understanding of constraint operation.

A review of the existing NEMMCO publications against the minimum information that the Commission has suggested for inclusion in the guideline is outlined below:

1. Constraint Equation Development – NEMMCO's Network Limits Procedure[3] states that Transmission line and other network ratings are provided to NEMMCO by each TNSP for use in constraints and network study applications.

2. Constraint Equation Formulation – NEMMCO has published the document Network and FCAS constraint formulation[4] which explains how the rules for constraint formulation has been developed on the basis of the Statement on NEM Electricity Transmission issued by the Ministerial Council on Energy on 20 May 2005. The document deals with decisions regarding whether terms should be on the left or right hand sides of the constraint equation.

3. Constraint Equation Implementation - NEMMCO's Network Limits Procedure [5] provide details on the publication of generic constraint data, NEMMCO actions when a constraint equation becomes binding, Constraint testing and Constraint Change Management. NEMMCO's Dispatch Procedures[6] provide details on how constraints are applied to prevent negative residues from accumulating provided that system security can be maintained.

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[3] NEMMCO Operating Procedure: Generic Constraints Due to Network Limitations, 11 December 2006, page 8, located at http://www.nemmco.com.au/powersystemops/so_op3704v008.pdf

[4] Network and FCAS constraint formulation , 4 July 2005 located at http://www.nemmco.com.au/dispatchandpricing/170-0040.pdf

[5] NEMMCO Operating Procedure: Generic Constraints Due to Network Limitations, 11 December 2006, page 45-50, located at http://www.nemmco.com.au/powersystemops/so_op3704v008.pdf

[6] NEMMCO Operating Procedure: Dispatch ,21 September 2007, page 32-34, located at http://www.nemmco.com.au/powersystemops/so_op3705v047.pdf

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NEMMCO's Network Limits Procedure also provides numerous worked examples at different levels of complexity, demonstrating how a binding constraint can affect the spot price calculation. As acknowledged in the Draft Report, NEMMCO has a number of additional constraint based publications ranging across: Constraint Naming Guideline; FCAS constraints guide; Basslink Energy and FCAS equations document; Confidence levels, offsets and operating margins policy document.

A two day Network and FCAS course is also run by NEMMCO on a cost recovery basis that includes topics on power system limitations, formulation of network constraints and network constraints and dispatch.

Rules clause 3.8.10(c) obliges NEMMCO to document the process used to derive constraints. NEMMCO can also see merit in expanding constraint information Rules requirements in the form of a guideline.

NEMMCO views that the existing documents, such as the Networks Limit Procedure, would go a long way to fulfilling the likely guideline requirements. The guidelines consultation process could serve as a valuable process to clarify if Participants are being given the appropriate information to understand NEMMCO's approach to constraint equation development, formulation and implementation.

Recommendation 8:

That the Rules be amended to:

- **Require NEMMCO to develop and publish an information resource that assists Market Participants to understand and predict the nature and timing of events that are likely to materially affect constraints in the dispatch process. NEMMCO must develop this information resource in consultation with industry;**
- **The "events" referred to above should include at a minimum, network outages, commissioning (or decommissioning) of new generating units, loads or network assets and new or modified network support constraints;**
- **NEMMCO must publish the information required above on a timely basis and must publish updates to that information provided under this Rule as soon as practicable;**
- **The information resource must be transparent and give Market Participants confidence that all relevant information is published in a timely manner;**
- **In developing or changing this information resource, NEMMCO must consult with industry; and**
- **Oblige TNSPs and other Registered Participants to provide that information required by NEMMCO to develop this information source.**

The recommendation raises a number of issues. Firstly, there is scope for clarification on the recommendation's first dot point on publishing an information resource that assists *Market Participants to understand and predict the nature and timing of events that are likely to materially affect constraints in the dispatch process*

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Clearer terms of reference would assist NEMMCO when using a consultation to satisfy potentially diverse stakeholder expectations, on what it takes to understand and predict the nature and timing of constraint events.

The Draft Report discussion on constraint flow information identified the role of the Network Outage Scheduler ("**NOS**") and also suggested that NEMMCO should be required to publish information about events other than outages. However no mention was made in the Draft Report of the existing constraint data published via NEMMCO's Market Management Systems (MMS) to Participants.

NEMMCO's Operating Procedure[7] lists the MMS Data Model tables associated with constraint data, as:

- Generic Constraint Set – which is the grouping of a number of constraint equations prepared for system normal or outage conditions;
- Generic Constraint Data – being Left Hand Side(LHS), Operator and Right Hand Side(RHS) for each constraint equation;
- Invocations – identifying any constraint that has been invoked in the MTPASA, STPASA, Pre dispatch or Dispatch time frames;
- Market Results – being the MTPASA, STPASA, Pre dispatch, Dispatch time frame constraint results.

NEMMCO has also developed a constraint naming guideline to identify the purpose, system condition and the regional location of the constraint.

Constraint data published through NEMMCO's MMS should enable Participants to answer questions on identifying:

1. existing constraint sets, including all components of constraints;
2. which constraints were binding in the Dispatch, Pre-Dispatch or PASA time-frames;
3. the interconnectors and generating units that were affected by binding constraints.

The Draft Report conveyed Participant concerns on lack of real-time information on network outages, and last minute changes to the timing of outages. TNSPs will give verbal advice to NEMMCO on-line staff as soon as practical if a TNSP is aware that the starting time or the completion time of a given outage is likely to differ significantly from the advised times and provide an estimate of the revised starting time and/or the completion time of the outage. This advice will be required if the actual starting or completion time of a given outage is likely to differ by 30 minutes or more from the scheduled times. NEMMCO on-line staff then modify the invoke time and/or the revoke time of the constraint set associated with the outage as appropriate and log the details. On this point it is expected that Participants could stay informed of these outage changes through the Pre-dispatch process.

NEMMCO's Operating Procedure[8] also states there can be variances between Pre-dispatch and Dispatch owing to:

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[7] NEMMCO Operating Procedure: Generic Constraints Due to Network Limitations, 21 September 2007, page 45 and 46, located at http://www.nemmco.com.au/powersystemops/so_op3704v008.pdf

- demand forecast accuracy that is highly dependent on weather forecasts;
- short notice outages;
- unplanned outages; and
- re-bidding by generators.

While NOS is a key information source, it is important that any assessment of the existing constraint information flow to participants, recognise the extent of constraint data published via the MMS in the PASA, Predispatch and Dispatch time-frames, and acknowledge the risk of unavoidable events that are difficult to forecast.

Finally, the Draft Report mentions that participants potentially face uncertainty over the timing and methodology of the constraint development process, and there is a gap between the TNSP's Annual Planning Report and the time when NEMMCO implements the revised constraint formulation.

The arrangement between NEMMCO and TNSPs is that Transfer Limit advice is to be provided no less than five business days[9] prior to the outage. With the exception of VENCorp[10] this advice remains confidential between NEMMCO and the TNSP. There is a similar understanding for events other than network outages that may result in different constraint equations being formulated. On receiving the advice NEMMCO will formulate, test and then implement the constraint set in the MMS.

NEMMCO has interpreted the Draft Report's statement on Participant uncertainty over timing and methodology, as indicating that Participants are not given forward notice on implementation of new constraint sets until these are available for invocation in the MMS. Initial thoughts on how the constraint development process could be addressed to give participants forewarning of new constraint sets, may require:

- making Transfer Limit advice publicly available; and
- extending time-frames on TNSPs providing advice to NEMMCO, to give Participants the opportunity for reviewing constraint sets prior to implementation to the MMS.

Further analysis may be required on how practical it would be to apply longer time-frames, and whether the loss of flexibility in timing could require additional resources for NEMMCO.

The practice of advising Transfer Limits has evolved over the years of NEM operation, and from NEMMCO's view is efficient and smooth. Even though NEMMCO is satisfied with the current approach, NEMMCO would have no objection to the principle of making the constraint development process more structured and visible.

Recommendation 9:

- **That NEMMCO develops a methodology in consultation with participants for the production of mis-pricing information that covers all material congestion in**

[8] NEMMCO Operating Procedure : Pre-dispatch, 1 May 2007,on page 10, http://www.nemmco.com.au/powersystemops/so_op3704v008.pdf

[9] The five business day requirement is to give NEMMCO's staff time to: complete due diligence, to formulate, test and then implement the constraint set to the MMS.

[10] Located at http://www.vencorp.com.au/index.php?action=filemanager&folder_id=367&pageID=7767&sectionID=7766

the NEM;

- **That NEMMCO publishes mis-pricing information on a quarterly basis; and**
- **That NEMMCO's other resource commitments be taken into account when establishing a commencement date for this requirement.**

NEMMCO's general policy is to automate processes as a way of increasing reliability and transparency of information. NEMMCO would look to automate the publication of quarterly mis-pricing information that may be required from this recommendation. NEMMCO's experience from preparing mis-pricing information for the Commission is that classifying constraints as caused by outage or system normal events, is not practical to automate for all cases.

Usually the classification could be based on the constraint name, however there are some constraints such as Q_CS_1300[11], that can be caused by either system normal or an outage. There can also be instances where an outage in one line can cause system normal constraints protecting an associated line (for a different contingency) to bind.

Requirement for manual analysis for classifying system normal and outage events on an ongoing basis could significantly increase the level of resourcing for publishing mis-pricing information, compared to a fully automated process.

Recommendation 10:

No amendments to the current transmission pricing Rules should be implemented in order to improve location signals on new generators.

NEMMCO has no comment on this recommendation.

In any event, the Commission would welcome views on:

- **Whether there is a need for more sophisticated measures of transmission capability, and what purpose such measures would serve;**
- **How such measures should be specified; and**
- **Who should have responsibility for developing, producing and publishing such measures.**

The Commission has sought feedback on the potential development of measures for network capability. This is a relatively complex area in which limited work has been done to date. To further develop this area NEMMCO provides some material in the following areas:

- a contextual comment to clarify the environment in which measures of network capability are produced;
- an outline of a measure of network capability currently produced for the NEM;

[11] Constraint that limits flow from Central Queensland to South Queensland to less than 1300 MW. Being discretionary it could be potentially invoked for both system normal and outage conditions.

- an alternative representation of existing data that aligns with the example provided in the CMR Draft report; and
- outlines some caveats and opportunities in the production and use of network capability measures.

Contextual comment

In discussing measures of network capability, it is crucial to recognise that there is a broad range of factors that can impact the MW transfer capability of any set of network elements. For example, the flow limit on a set of transmission lines might be limited by any combination of:

- infrastructure ratings and availability – transmission elements in or out of service;
- ambient conditions – temperature and wind speed;
- available static or dynamic reactive capability:
  - provided by TNSPs through SVCs and capacitor banks; or
  - contracted by either NEMMCO or TNSPs via: NCAS; connection agreements with generators; or network support agreements;
- availability of customer load management or generation support; and
- load & generation patterns.

Given that the network constraints used in the NEM dispatch process to account for these limitations can bind at a range of power flow levels, network capability cannot be adequately described by a single number and would need to be expressed as some form of a range of values.

Existing representations of network capability

NEMMCO already produces at least one form of information on network capability that reflects the range of factors that limit power flow over a cut-set. The most illustrative type of information can be found in Appendix F of the 2007 Statement of Opportunities (SOO). For example, Figure F.8 from the SOO (reproduced below) focuses on the level of flow over the Vic-Snowy interconnector that was achieved when (at least) one of the many constraint equations controlling flow over that interconnector happened to bind.

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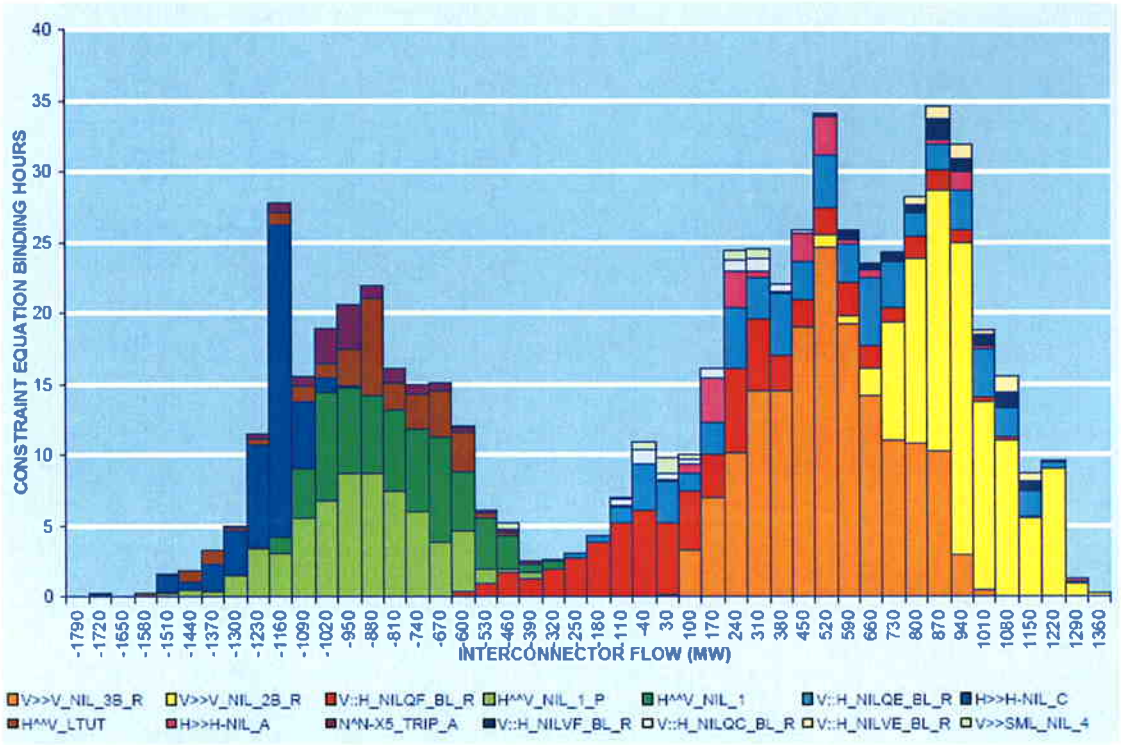
Figure F.8 Binding Constraint Equation Distribution: Victoria-Snowy Interconnector for the 2006/07 Financial Year (Positive Flow is VIC to SNOWY)



[Note: Refer to the text on p. F-18 of the SOO for further information on how to read the above histogram.]

Some of Figure F.8's notable features are:

- the interconnector can be, and is, constrained at every power flow level – not just at the maximum or minimum;
- at some times the interconnector is forced to flow in a particular direction – that is, the 'upper limit' (which is normally positive) can be negative;
- it is not unusual for constraint equations to constrain the interconnector over a very wide range – for example, V::H_NILQF_BL_R constrains VIC - SNOWY over the range of -600MW to +1,080MW (and the actual level at which the interconnector is constrained is determined in a large part by bids and interactions with other constraints).

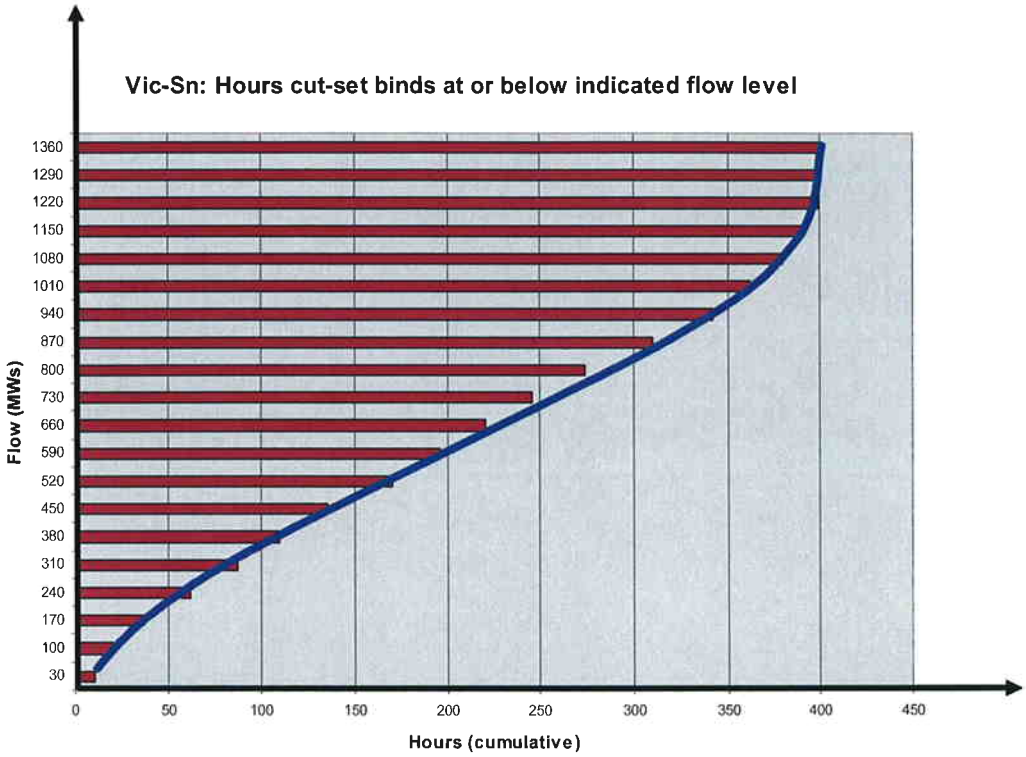
It is important to recognise that the data currently available has been developed for information and planning purposes, and different approaches may need to be developed to the assessment of network capability for specific applications.

Alternative representations of existing data

As an indication that there are possible alternative presentations that could be applied to the information published in the SOO, the following Chart 1 shows a relatively straightforward transformation of a subset of the Figure F.8. This transformation can yield a single curve as shown below. However, it is important to keep in mind the number of factors that can impact the capability

shown, and that other ways of presenting the information may be equally or more appropriate for different circumstances.

Chart 1: Transformation of SOO Figure F.8



[Notes to the interpretation of Chart 1:

- Chart 1 uses a subset of the flows from 30 MW to 1360 MW depicted on the right hand side of Figure F.8 – that is from the Victorian Region towards the Snowy Region.
- The bars in Chart 1 are the transposed columns from SOO Figure F.8, with binding hours cumulated as cut-set flow increases.
- With the axes transposed from SOO Figure F.8, the solid curved line in Chart 1 (an approximation to the ends of the bars) is directly analogous to the example of a constrained flow duration curve presented as Figure 7.1 on p.135 of the CMR Draft report.]

Caveats and opportunities in production and use of capability data

The example representations of network capability above are currently available for interconnectors only, as existing NEMMCO systems only facilitate the production of such information on interconnector cut-sets. It should also be noted that development of this information is, at present, not necessarily a straightforward exercise. Further, the more aggregated the representation of the information – for example, transforming SOO Figure F.8 into Chart 1 – the more information is hidden

and the greater is the risk that inexpert interpretation of the data could lead to misleading conclusions[12].

NEMMCO has not yet made any assessment as to the level of resource that would be necessary to produce similar representations for intra-regional cut-sets – that is, for flow paths that are not interconnectors. NEMMCO would be pleased to discuss the development of measures of network capability that either draws on the examples provide above; or other forms of network capability that could be drawn from data within NEMMCO systems.

12 Specifically, Figure F.8 identifies the constraint equations responsible for limiting the interconnector power flow. However, in most cases these constraint equations are associated with network elements within the region rather than the lines that form the interconnector. Aggregating the constrained hours (as in Chart 1) removes the information of which parts of the network or which system limitations were most significantly affecting interconnector limits. Therefore, transformations such as this might be counterproductive for some applications – if it is important to identify the cause of the constrained operation.