REGIONAL SETTLEMENT PRICES DURING ADMINISTERED PRICING

A Report to the AEMC

29 May 2008

Final Report

IES Intelligent Energy Systems

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Executive Summary

This report provides the AEMC with IES' technical analysis and advice on two issues.

First, it explains how the application of an Administered Price Cap (APC) in one region can indirectly cap settlement prices in other regions, via the APC price scaling mechanism specified in Clause 3.14.2(e)(2) of the National Electricity Rules (the Rules).

Second, it assesses whether market participants, in regions whose spot prices are *indirectly* capped following an Administered Pricing Period (APP), could be eligible to claim compensation.

The report provides answers to the three questions put by the AEMC:

Q1

How does the application of clause 3.14.2(e)(2) within the NEM Dispatch Engine (NEMDE) affect the calculation of the spot market settlement prices in regions which have energy flows towards a region where the APC has been applied? Specifically, does direct application of an APC in one region lead to the indirect application of Administered Prices in other regions via the price scaling effects of clause 3.14.2 (e)(2)?

A1

The application of the administered price cap, clause 3.14.2(e)(2), is not done within NEMDE but is done afterwards in the settlement process by adjusting the final pricing outputs of NEMDE. How this is done is outlined in sections 3 to 5. The direct application of an APC in one region can lead to the indirect application of administered prices in other regions via price scaling using inter-regional average loss factors.

Q2

When power is flowing away from a region that is subject to an APC, what, if any, effect is there on the prices of adjoining regions to which the power is flowing?

A2

There should be no effects on prices in these adjoining regions if there are no inter-regional loops. On the other hand if there are any inter-regional loops then there could be a situation where one of these regions is affected.

Q3

Would market participants in regions whose spot prices are *indirectly* capped to the APC via the impact of clause 3.14.2 (e)(2) be eligible to claim compensation under clause 3.14.6 of the Rules?

A3

Clause 3.14.6 is quite clear that market participants in regions whose spot prices are *indirectly* capped to the APC could be eligible for compensation as long as they have a dispatched offer or bid whose price is higher or lower than the capped price due to the operation of the price cap.

Our answers to these questions have been informed by the following.

- An assessment of the Rules, the 2000 application by NECA to the ACCC to amend the National Electricity Code by introducing VoLL price cap scaling,[1] and the ACCC's reasons for deciding to approve that application.[2]

  The ACCC's decision is relevant because the ACCC, as one of its conditions of authorisation, stated that clauses associated with setting prices during administered price periods and market suspension should be made consistent with the proposed changes to the VoLL scaling methodology. Consequently the methodology the ACCC approved for VoLL price scaling between regions (clause 3.9.5(c) of the Rules) is also used for APC price scaling (clause 3.14.2 (e)(2)).

- An analysis of NEMMCO's published procedures on its methodology for implementing the Rules concerning the adjustment of settlement prices during administered pricing periods. These adjustments include the imposition of the APC in a region where the CPT is breached and the consequential scaling of prices in other regions;
- Analysis of the results of a spreadsheet model that mimics the APC settlement price adjustments and can simulate a range of interconnector flow and inter-regional price scaling scenarios; and
- An examination of the settlement pricing outcomes arising from the breach of the CPT in South Australia (SA) on 17 March 2008.

From the brief analysis in this report and the actual application of the administered price cap on the 17th March 2008, it is quite clear that capping prices in one region during an administered price period can cause price capping to ripple through the market to other regions.

Consequently, there is the potential for many market participants to claim compensation and this could result in a large, un-hedged liability for customers.

Concern about large, un-hedged liabilities for retailers and end-use customers, arising from APC compensation claims, is the basis for Energy Australia's Rule change proposal.[3] EA's proposal seeks to address the financial risk arising from

[1] NECA Code Change Panel, 2000, *VoLL scaling report*, NECA, Adelaide, March, p.2. Available at: http://www.neca.com.au/Files/C_VOLL_scaling_ACCC_March_2000.doc
[2] ACCC 2000, *Applications for Authorisation: Amendments to the National Electricity Code — Rebidding, VoLL scaling and settlements statements*, Determination, (Authorisation nos. A90730, A90731, A90732), ACCC, Melbourne, 6 December 2000. (Available at http://www.accc.gov.au/content/index.phtml/itemId/744438/fromItemId/401858)
[3] EnergyAustralia 2007, "Compensation Arrangements Under Administered Pricing - Rule change proposal", 10 December 2007. Available at http://www.aemc.gov.au/electricity.php?r=20071106.104606

these potentially large compensation claims by capping the value of compensation payable to a generator to be no more than its “direct operating costs” (i.e. short-run marginal costs), rather than the difference between its offer price and the APC.

However, Energy Australia’s proposal may not be the best way to manage this problem.

An alternative option exists for reducing the magnitude of these compensation payments and the financial risks arising from them. We suggest that it might be preferable to only apply the cap in the region which is subject to the administered price period, allow the interconnectors to have negative residues and compensate Inter Regional Settlement Residue (IRSR) unit holders for any reduction in residue payments arising from the APC in a region. This option may result in overall compensation amounts that are smaller than those under the existing Rules or the Rules proposed by Energy Australia. The compensation to IRSR holders could be funded using the existing settlement Rules for recovering APC-related compensation.

It is understood that the Commission has the power (under Section 91A of the National Electricity Law) to make a more preferable Rule, and consequently may wish to further assess this alternative option.

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1 Introduction

1.1 Background

On 10 December 2007, the Commission received a Rule change proposal from Energy Australia (EA), seeking to modify clause 3.14.6 of the Rules, which relates to how compensation is calculated following the application of administered price cap (APC), market suspension event, value of lost load (VoLL), or market floor price. EA's proposal seeks to change the criteria and process for the determination of compensation, in order to clarify the compensation process and ensure that compensation to generators is based on "direct generating costs" rather than on their offer prices.

The Commission is currently preparing a draft Rule determination on this Rule change proposal.

A joint first round submission received from TRUenergy and AGL Hydro Partnership, outlined the complexities of forecasting the operation of the APC when it is affected by inter-regional flow direction, as a source of risk and uncertainty for Market Participants during administered price periods (APP)[4]. Specifically, this submission referred to the impact that clause 3.14.2 (e)(2) of the Rules has on prices in regions connected to a region in which an APC has been applied.

Under clause 3.14.2 (e)(2) of the Rules, the dispatch price of regions is affected when those regions have energy flowing (over a regulated interconnector or regulated interconnectors) to a region where the APC has been applied.

The operation of the APC under clause 3.14.2(e)(2) and the effect it may have on the settlement prices of regions where the APC has not been directly applied, is material to EA's Rule change proposal as it has the potential to broaden the scope of eligibility for compensation following administered pricing to market participants beyond the region in which an APC is directly applied.

NEMMCO's publication "Operation of the Administered Price Provisions in the NEM" gives its views on how the APC is applied and how the application of an APC in one region affects spot prices in other regions across the NEM.[5]

The Commission has sought independent advice on this matter from IES.

1.2 Terms of Reference

The terms of reference set out by the AEMC were as follows.

[4] http://www.aemc.gov.au/pdfs/reviews/Compensation%20Arrangements%20Under%20Administered%20Pricing/submissions1/000AGL%20Hydro%20Partnership%20and%20TRUenergy.pdf

[5] NEMMCO 2007, "Operation of the Administered Price Provisions in the National Electricity Market", NEMMCO Briefing Paper, 27 June 2007, NEMMCO, Sydney. (URL http://www.nemmco.com.au/dispatchandpricing/150-0014.pdf)

FINAL REPORT

The consultant is to provide the Commission with a written report addressing the following questions:

(a.) How does the application of clause 3.14.2(e)(2) within NEMDE affect the calculation of the spot market settlement prices in regions which have energy flows towards a region where the APC has been applied? Specifically, does direct application of an APC in one region lead to the indirect application of Administered Prices in other regions via the price scaling effects of clause 3.14.2 (e)(2)?

(b.) When power is flowing away from a region that is subject to an APC, what, if any, effect is there on the prices of adjoining regions to which the power is flowing?

(c.) Would market participants in regions whose spot prices are *indirectly* capped to the APC via the impact of clause 3.14.2 (e)(2) be eligible to claim compensation under clause 3.14.6 of the Rules?

The report should include an explanation of how NEMDE calculates the settlement price for regions which have energy flows to a region where the APC has been applied, including worked examples.

2 Overview of the Administered Price Cap

This section provides a brief overview of administered price periods (APPs) and the administered price cap (APC), which are set out in Section 3.14 of the Rules.

The APC sets a price cap for spot prices in a region when it is applied. Similarly, the administered floor price sets a floor price to spot prices in a region. Currently, the price cap is $100/MWh during peak periods (i.e. from 07:00 to 23:00 hours) on NEM business days and $50/MWh at all other times.[6] The value of the administered floor price is always the negative of the value of the APC.

The administered price cap and floor price are used to adjust prices in a region when there is an administered pricing period (APP). An APP is triggered in a region when the spot prices in that region exceed the cumulative price threshold (CPT) over a seven day period (336 trading intervals) or when the ancillary service prices for any frequency control ancillary service (FCAS) exceed six times the CPT over a seven day period (i.e. 2016 dispatch intervals). Currently, the value of the CPT is $150,000/MWh; which, over a period of seven days, represents an average spot price of $446.43/MWh.

Once the CPT has been exceeded, NEMMCO is to publish a market notice advising that an APP has commenced. The APP remains in force from the start of the next trading interval after the CPT was exceeded until the end of the current trading day (04:00). The APP can be extended by NEMMCO if in NEMMCO's opinion one or more trading periods in the next business day will be an APP.

If one region has its energy dispatch spot price capped (or floored) due to the application of an APP, then other regional reference node prices may also be adjusted to the cap price (or floor price) adjusted for an average loss factor. How this is done is outlined in the next section.

[6] The AEMC is reviewing the level of the APC, and its draft decision is that the APC should be increased to $300/MWh at all times during an APC (see http://www.aemc.gov.au/electricity.php?r=20071105.151356). Throughout this report, the APC values of $100/MWh peak periods and $50/MWh off-peak are used.

3 Administered Price Cap and Settlement Prices in Other Regions

Clause 3.14.2(e)(2) of the Rules states:

If during an administered price period the dispatch price:

(1) [Deleted]

(2) at any regional reference node is set to the administered price cap under clause 3.14.2, the dispatch prices at all other regional reference nodes connected by a regulated interconnector or regulated interconnectors that have an energy flow towards that regional reference node must not exceed the product of the administered price cap multiplied by the average loss factor for that dispatch interval between that regional reference node and the regional reference node at which dispatch prices have been set to the administered price cap determined in accordance with clause 3.14.2(e)(5).

Clearly, this Rule is intended to scale down the regional reference prices in regions exporting to a region whose dispatch price is capped during an administered price period. Further, this scaling of regional references prices can extend to other regions which are not adjacent to the region whose dispatch price is being capped as long as they are connected to the region via a sequence of regulated interconnectors.

This concept of scaling the regional reference prices in other regions which are connected by regulated interconnectors to a region whose price has been set by the APC is based on the concept of 'VoLL scaling' found in clause 3.9.5 of the Rules.

Sub-clauses 3.9.5 (c) and 3.9.5 (d) define the way a VoLL price in one region is to be scaled down in regions exporting to this region via regulated interconnectors. The original intent of these arrangements was to scale back dispatch prices in other regions by the smallest amounts which would ensure that there were no negative settlement residues on the regulated interconnectors connecting regions to one or more regions which had VoLL prices. This rationale for the Rules can be seen in NECA's Code Change Panel paper 'VoLL Scaling Report' which was published in 2000. In the paper the Code Change Panel indicate that the reason why the price is adjusted in regions which export energy to an APC affected region, is to limit large negative settlement residues.[7] Elsewhere in the report it states that NECA's Code Change Panel deliberated on a number of options for managing the VoLL price cap and VoLL scaling to other regions. They finally settled on a proposal 'which would reduce VOLL scaling to the minimum necessary to prevent inter-regional settlement deficits arising but

[7] NECA Code Change Panel, 2000, *VoLL scaling report*, NECA, Adelaide, March 2000, p.2. Available at: http://www.neca.com.au/Files/C_VOLL_scaling_ACCC_March_2000.doc

which would, importantly, provide for scaling in real time (based on average, rather than marginal, losses) and safeguard the position of entrepreneurial interconnectors.'[8]

NECA submitted this paper to the ACCC when seeking to amend the Code to introduce VoLL price scaling.[9]

In the ACCC's determination concerning the amendments to the National Electricity Code, which changed the provisions for inter-regional scaling for VoLL and administered price caps to what are in the Rules now, the Commission wrote:

> *"Presently price scaling provisions within the Code allow compensation to be paid for the impact of inter-regional settlements due to the application of price caps in the electricity market. However the application of a price cap tends to remove inter-regional price differences and can have the effect of causing inter-regional settlements residues to become negative. Scaling is introduced to compensate for this impact as well as reducing the price paid to upstream generators to a value less than the price cap.*
>
> *The proposed Code changes:*
>
> - *provide for scaling based on capping to scaled prices in all circumstances when the VoLL price cap applies in one or more regions;*
> - *base scaled prices on the average loss equations for regulated interconnectors (rather than marginal losses); and*
> - *allow entrepreneurial interconnectors access to the compensation provisions under parallel provisions to those that already exist for administered prices."*[10]

Avoiding negative settlement residues is the reason the Rules refer to average loss factors as the price scaling factors rather than marginal loss factors which are generally used for dispatch and pricing.

The Rules do not explicitly state how the average loss factors are to be calculated. However, if the intention of the Rules to avoid negative settlement residues is used, then the average loss factor for an interconnector can be calculated in a relatively straight forward way.

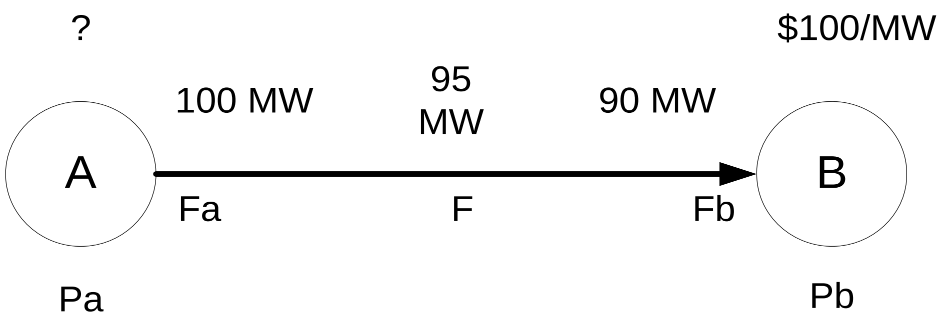
3.1 Price Scaling using the average loss factor

When seeking to avoid negative settlement residues, the average loss factor on an interconnector can be readily calculated by dividing the flow, measured at the sending end, by the flow measured at the receiving end. For example, suppose

[8] NECA Code Change Panel, 2000, *VoLL scaling report*, NECA, Adelaide, March 2000, p.52.
[9] The NEC changes regarding VoLL and price cap scaling were put forward by NECA to the ACCC for authorisation on 15 March 2000
[10] ACCC 2000, *Applications for Authorisation: Amendments to the National Electricity Code — Rebidding, VoLL scaling and settlements statements*, Determination, (Authorisation nos. A90730, A90731, A90732), ACCC, Melbourne, 6 December 2000, p.11. (Available at http://www.accc.gov.au/content/index.phtml/itemId/744438/fromItemId/401858)

that there are two regions: A and B, connected by a regulated interconnector and that region A is exporting to region B. Also suppose that region B has had its price capped to $100/MWh due to it being in an APP. This situation is illustrated in Figure 1.

Figure 1 Simple Example of Inter-regional impact of APC



For this example, we assume that there is a flow of 95MW from A to B at the border. There is also 10MW of losses which corresponds to a flow of 100MW at A's regional reference node (Fa) and a flow of 90MW at B's regional reference node (Fb). What value to use as the average loss factor to calculate region A's price (Pa) is not obvious. However, in order to avoid negative settlement residues and keep Pa as high as possible then the following must hold:

$$
\begin{aligned}
Fa \times Pa &= Fb \times Pb \\
Pa &= (Fb/Fa) \times Pb \\
&= (90\text{ MW} / 100\text{ MW}) \times \$100/\text{MWh} \\
&= \$90/\text{MWh}
\end{aligned}
$$

In this case the average loss factor is (Fb/Fa), which equals 0.9. This is the approach that NEMMCO adopts to calculating the average loss factors

The way NEMMCO calculates the prices in regions exporting to a region whose price has been capped is described in:

(a) a NEMMCO publication, "Operation of the Administered Price Provisions in the National Electricity Market - Briefing Paper'";[11] and

(b) settlement system design specifications, internal to NEMMCO, which NEMMCO provided to the AEMC.

NEMMCO calculates the prices in regions exporting to a region whose price has been capped by making price adjustments in its settlements system. Price

[11] NEMMCO 2007, 'Operation of the Administered Price Provisions in the National Electricity Market - Briefing Paper', NEMMCO, Sydney, 27 June 2007. http://www.nemmco.com.au/dispatchandpricing/150-0014.pdf

scaling, arising from the application of the APC in one region, is the last adjustment made to the raw settlement prices calculated by NEMDE that are fed into the settlements system. Any price limit scaling that NEMMCO undertakes is only done after all other dispatch and pricing processing for violated constraints, non physical losses, etc. have been undertaken.

The price capping used by NEMMCO is a quite complicated heuristic algorithm to account for parallel interconnectors. This process is not carried out by NEMDE itself. Rather, the price capping is done outside of NEMDE, as an adjustment to the original settlement prices calculated by NEMDE. It is done as a post processing adjustment of the regional prices calculated by NEMDE.[12]

[12] It is interesting to note that the same results could be achieved by formulating the problem as a simple optimization, which aims to make the prices in all regions as close to their original dispatch price values as possible, subject to making sure that there are no negative settlement residues on regulated interconnectors.

4 Examples

To illustrate the application of the APC to multiple regions, a simple example of an economic dispatch is provided. In this case there are four regions: A, B, C and D, (see figure 2). Regions A and B both connect to C, and C connects with D. Each region (node) has two generators. The demands at each node and their dispatch prices are presented in Table 1. The generator offers and dispatches and the interconnector flows are presented in Table 2 and Table 3 respectively.

Table 1 Nodal demands and prices

Node	Demand	Price
a	0.00	114.00
b	110.00	160.00
c	110.00	140.00
d	110.00	117.76

Table 2 Generator Offers

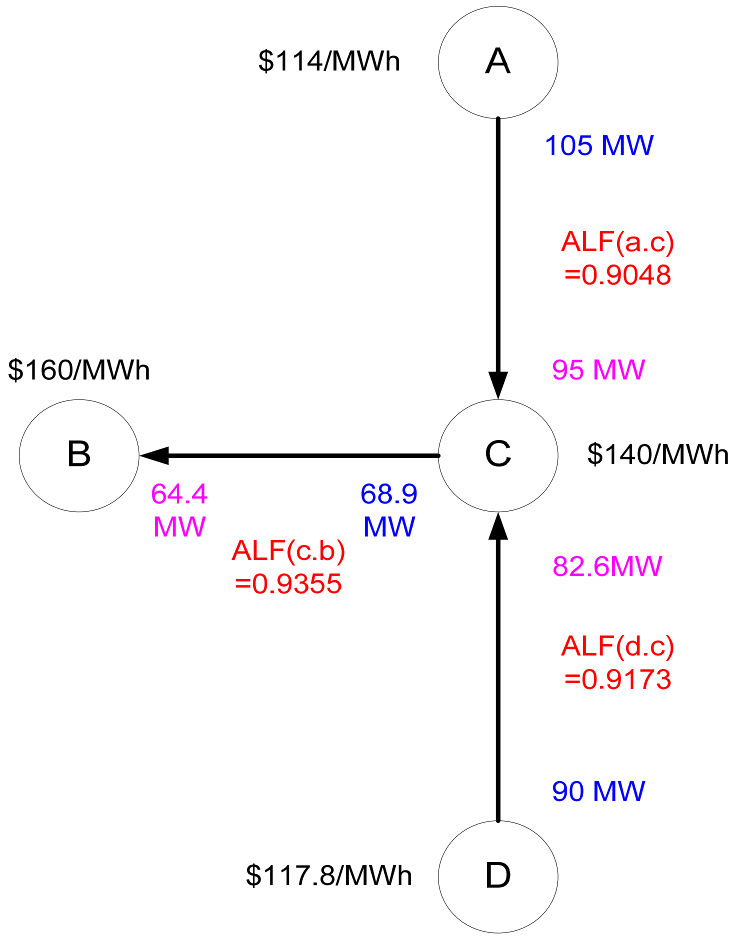
Generators	Node	Price	Quantity	Dispatch
Ga1	a	90.00	100.00	100.00
Ga2	a	114.00	100.00	5.00
Gb1	b	160.00	100.00	45.56
Gb2	b	220.00	100.00	0.00
Gc1	c	140.00	100.00	1.33
Gc2	c	250.00	100.00	0.00
Gd1	d	55.00	100.00	100.00
Gd2	d	110.00	100.00	100.00

Table 3 Interconnector Flows

Line	Start	End	Start	Mid point	End	Losses
1	a	c	105.00	100.00	95.00	10.00
2	b	c	-64.44	-66.66	-68.88	4.44
3	c	d	-82.56	-86.28	-90.00	7.44

A diagram of the network and flows arising from this dispatch is presented in Figure 2. The arrows indicate the direction of inter-regional power flows, with the power flow at the sending RRN end of each interconnector shown in blue and the power at the receiving end shown in pink. The average loss factor along each interconnector is shown in red and is the ratio of power flow at the receiving end of an interconnector to the flow at its sending end.

Figure 2 Network Flows



For this dispatch and pricing situation, we will examine three administered pricing scenarios.

4.1 Scenario 1

In this scenario, region C is in an APP and the interconnector between C and D is a Market Network Service Provider (MNSP).

The administered prices under this scenario are presented in Table 4.

Table 4 Administered Prices for Scenario 1

Node	Price	Admin. Price
a	114.00	90.48
b	160.00	160.00
c	140.00	100.00
d	117.76	117.76

In this case, the price in region C is capped at $100/MWh, prices at B and D are unaffected, and the price at A is scaled down. Prices region D are unaffected because it is connected to the rest of the market via an MNSP, and hence is not subject to price scaling. The region B price is not scaled because there are no negative residues on flows from C to B.

4.2 Scenario 2

In this scenario, region B is in an APP and the interconnector between C and D is a regulated interconnector. The resulting administered prices are presented in Table 5. All the prices are scaled down because regions C, D, and A all have power flowing towards region B, where the APC is applied, and these flows are on regulated interconnectors. The administered price for region D is the result of the capped price in region B being multiplied by the average loss factor from region D to region B. The average loss factor from region D to B is calculated by multiplying the average loss factor from C to B by the average loss factor from D to C. Thus the price in D is

$100/MWh x ALF(c,b) x ALF(d,c) = $100/MWh x 0.9355 x 0.9173

= Scaled price in C x 0.9173

= $93.55/MWh x 0.9173

= $85.81/MWh

The price for region A is calculated similarly to what was done for D.

Table 5 Administered Prices for Scenario 2

Node	Price	Admin. Price
a	114.00	84.64
b	160.00	100.00
c	140.00	93.55
d	117.76	85.81

4.3 Scenario 3

In this scenario two regions, B and C, are in an APP and the interconnector between C and D is a regulated interconnector. The resulting administered prices are presented in Table 6. All the prices are scaled down and are exactly the same as for scenario 2. What is particularly important to note is that even though region C is in an APP, its price is not being set by the cap but by the price scaling resulting from region B's price being capped as this gives a lower price.

Table 6 Administered Prices for Scenario 3

Node	Price	APC Price
a	114.00	84.64
b	160.00	100.00
c	140.00	93.55
d	117.76	85.81

4.4 Administered Prices versus Offer Prices

Under the administered pricing (in scenarios 1 to 3), generators Ga1, Ga2, Gb1, Gc1 and Gd2 receive prices which are less than their offer prices (see Table 2), except Ga1, Gb1 and Gd2 in scenario 1. That is, these generators are constrained-on relative to the administered (settlement) prices, and are consequently eligible to claim compensation under clause 3.14.6(a) of the Rules (see Section 5 below for further discussion).

4.5 Administered Price Scaling When There are Loops

The implied algorithm behind the Rules for VoLL scaling and administered price scaling is really not designed for inter-regional loops. In the Code Change Panel's submission and the ACCC's authorisation there is no discussion of how VoLL scaling or APC scaling would work in the presence of inter-regional loops.

The change in registration of Murraylink to that of regulated interconnector on 9th October 2003 created the situation of a parallel set of interconnectors between two NEM regions. To address this situation NEMMCO changed their price scaling software to only scale the price in a region if there was a net power flow towards the price capped region and to use an average loss factor based on the net inter-regional flow. From NEMMCO's documentation it is not always clear what scaled prices would result from the application of the APC in some inter-regional loop scenarios. Though, it is quite clear that NEMMCO is aware of the potential for endless price limit scaling around interconnector loops.

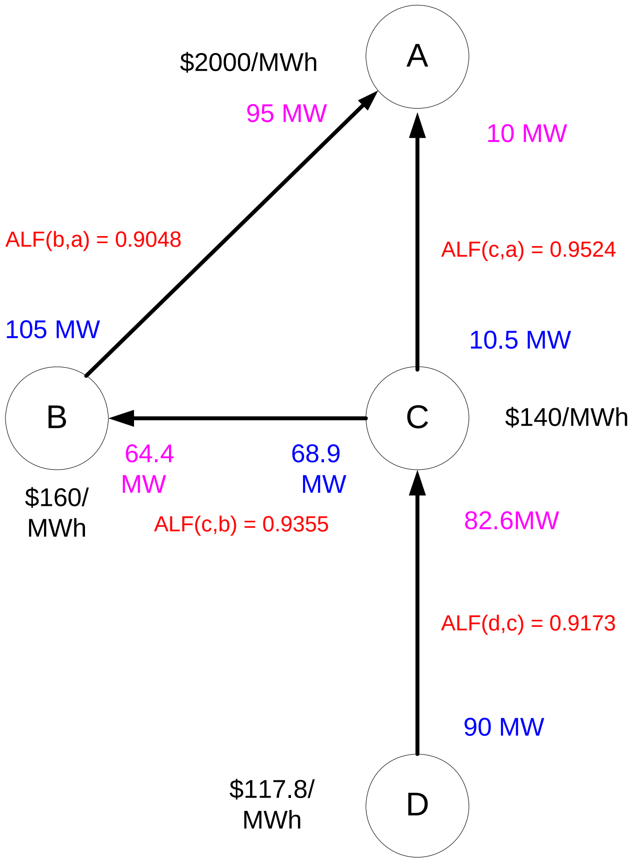
The next two sections illustrate price scaling around loops and the potential issues associated with it.

4.6 Scenario 4: An Inter-regional Loop Affected by A Price Cap

To illustrate how a region could be affected by price scaling when it has power flowing around a loop to a region whose price is capped, we will use a fourth scenario in which there is now an additional AC interconnector between Region A and Region B. This additional interconnector creates a loop (circuit) from A to B to C and back to A. In this scenario, region A is in an APP and all interconnectors are regulated interconnectors.

Figure 3 presents the dispatched flows on the interconnectors and the regional dispatch prices before the APC is applied in region A and other regional prices are scaled. Power flows from C directly to A and indirectly from C to A via B. The arrows indicate the direction of inter-regional power flows, with the power flow at the sending RRN end of each interconnector shown in blue and the power at the receiving end shown in pink. The average loss factor along each interconnector is shown in red and is the ratio of power flow at the receiving end of an interconnector to the flow at its sending end, as discussed in Section 4 above. For example, ALF(c.a) is the average loss factor for the flow from region C to region A on the interconnector joining these regions.

Figure 3 Scenario 4: Loop Network Flows and Dispatch Prices



The resulting administered prices are presented in Table 7. In this case region C's price is affected by two price cap scalings. C's price can not exceed A's capped price times the average loss factor for flows from C to A. As well C's price can not exceed A's capped price times the average loss factor for flows from C to B times the average loss factor for flows from B to A. That is the price in C is capped as follows:

Price C	<=	$100/MWh x ALF(c,a)
	=	$100/MWh x 0.9524
	=	$95.24/MWh
and		
Price C	<=	$100/MWh x ALF(b,a) x ALF(c,b)
	=	$90.48/MWh x 0.9355
	=	$84.64/MWh

Thus

Price C	=	min($95.24/MWh, $84.64/MWh)
	=	$84.64/MWh

Consequently region D's price is:

Price D	=	Price C x ALF(d,c)
	=	$84.64/MWh x ALF(d,c)
	=	$77.64/MWh

Table 7 Administered Prices for Scenario 4

Node	Price	Admin. Price
a	2000.00	100.00
b	160.00	90.48
c	140.00	84.64
d	117.80	77.64

4.7 Scenario 5: Importing Region Affected by a Price Cap

A region which has power flowing to it from a region whose price is capped could be affected by price scaling if it is part of an inter-regional loop. This could easily occur if there are counter price flows. That is, if there are interconnector flows from a high priced region, which is in an APP, to lower priced region. Counter-price flows can result from the dispatch process minimising dispatch costs due to:

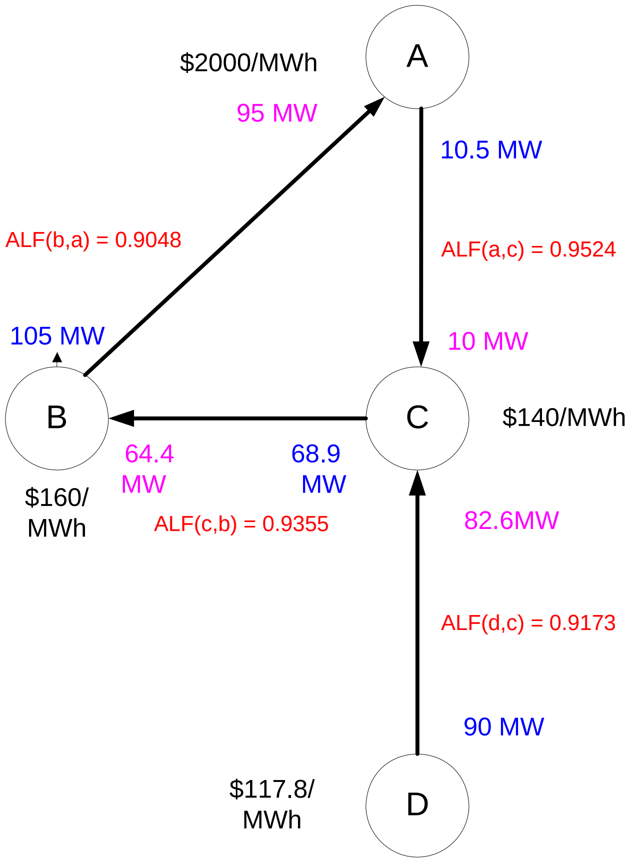
- intra-regional network constraints;
- the presence of an inter-regional AC loop, as would have been the case if the SA-NSW Interconnector (SNI) had been built;
- regional frequency control requirements; or
- power system testing.

Inter-regional loops can create significant counter price flows and persistent negative settlement residues on an affected interconnector even if there are no intra-regional constraints. In such cases the sum of residues across all interconnectors in the loop will be positive. These negative residues arise because power flows around the loop must obey the laws of physics (i.e. Kirchhoff's laws), and this can result in counter-price flows on one of the interconnectors in a loop.[13]

To illustrate how a region could be affected by price scaling when it has power flowing to it from a region whose price is capped, we will use a fifth scenario. This scenario is exactly the same as the fourth scenario except that there is a counter price flow from region A to region C. Figure 4 presents the dispatched flows on the interconnectors and the regional dispatch prices prior to the application of the APC and any regional price scaling.

[13] Such counter-price flows can be economically efficient. Counter-price flows on a loop can arise as a result of binding network constraint or as the result of minimising the economic costs of electrical losses on the network. In such cases, a pattern of prices can arise around the loop, which is referred to as the "spring washer effect".

Figure 4 Scenario 5: Counter Price Flow and Dispatch Prices Prior Application of APC



In this scenario, it is assumed that without the application of the APC in region A, the dispatch results in power flowing from the higher priced region A to region C; due to binding intra-regional constraints in region A, and generators in region A making low priced offers in order to achieve their desired dispatch volumes at the RRP of $2000/MWh. In this case, the application of the price cap in region A causes the price in region B to be adjusted; which in turn causes the prices in regions C and D to be adjusted. However, region A is exporting to region C which means that region A's price could be adjusted again and so the process could continue. Under this scenario there are two equations that must hold simultaneously:

Price C	=	Price A x ALF(b,a) x ALF (c,b)
And		
Price A	=	Price C x ALF(a,c)

For average loss factors less than one, the solution of these two equations can only lead to prices in A and C being 0 and, consequently, the price in B also being 0. This is not a sensible outcome. The only way to break the cycle is not to use the interconnector with the counter price flow to scale A's price based on C's price and the ALF(a,c). If this is done then prices obtained are those administered prices presented in Table 8. This solution will result in a negative settlement residue for the interconnector between regions A and C[14]. As discussed earlier, the Rules are not really clear as to what should happen with price scaling in loop situations similar to the one outlined in this example, though it would be reasonable to assume the second method of calculating the scaled prices is probably much closer to their intent than the approach which results in zero prices.

Table 8 Administered Prices for Scenario 5

Node	Price ($/MWh)	Admin. Price ($/MWh)
a	2000.00	100.00
b	160.00	90.48
c	140.00	84.64
d	117.80	77.68

[14] A slightly more sophisticated optimisation could be used which would cap the negative settlement residue on the interconnector between regions A and C should this be desired.

5 Compensation

As a result of the application of the APC in one region and of the price scaling effect in other parts of the network offers can be dispatched which are priced above the relevant regional reference prices.[15] This was illustrated in the examples in Section 4.

These constrained-on generators would be eligible for compensation under the Rules. Specifically Clause 3.14.6 (a) of the Rules states:

> *(a) Scheduled Generators may claim compensation from NEMMCO in respect of generating units if, due to the application of an administered price cap during either an administered price period or market suspension, the resultant spot price payable to dispatched generating units in any trading interval is less than the price specified in their dispatch offer for that trading interval.*

Other market participants can also claim compensation following an APC, including:

- Scheduled Network Service Providers (Clause 3.14.6 (a1) of Rules);
- Market Participants (3.14.6 (a2)); and
- ancillary service generating units and loads(3.14.6 (a3)).

An eligible market participant must notify NEMMCO and the AEMC of its intent to claim within two business days of the event and the AEMC must determine an appropriate amount of compensation.

In the five scenarios illustrated above:

- Claims for compensation could arise from generators across the NEM.
  - The value of compensation claimed by these generators could be up to the difference between their offer prices and their region's administered price.
- Scheduled network service providers, Market participants and ancillary service generating units or loads could also claim compensation.
  - Scheduled NSP's might claim the difference in the value of interconnector residues before and after price capping, or the difference between their offer prices times the dispatched flows and the actual out turned settlement residues.

[15] That is, the generators appear to be constrained-on relative to their RRP as a consequence of the settlement adjustments (APC and/or price scaling) to the initial RRP values calculated by NEMDE.

6 Other Observations

Four additional, interesting, observations from our investigations of the APC are:

(a.) Price scaling can sometime make an exporting region's price higher than the downstream importing region's price;

(b.) Price scaling could increase the price in an exporting region above the original unscaled price;

(c.) It is questionable whether the APC price scaling methodology needs to be same as that used for VoLL price scaling; and

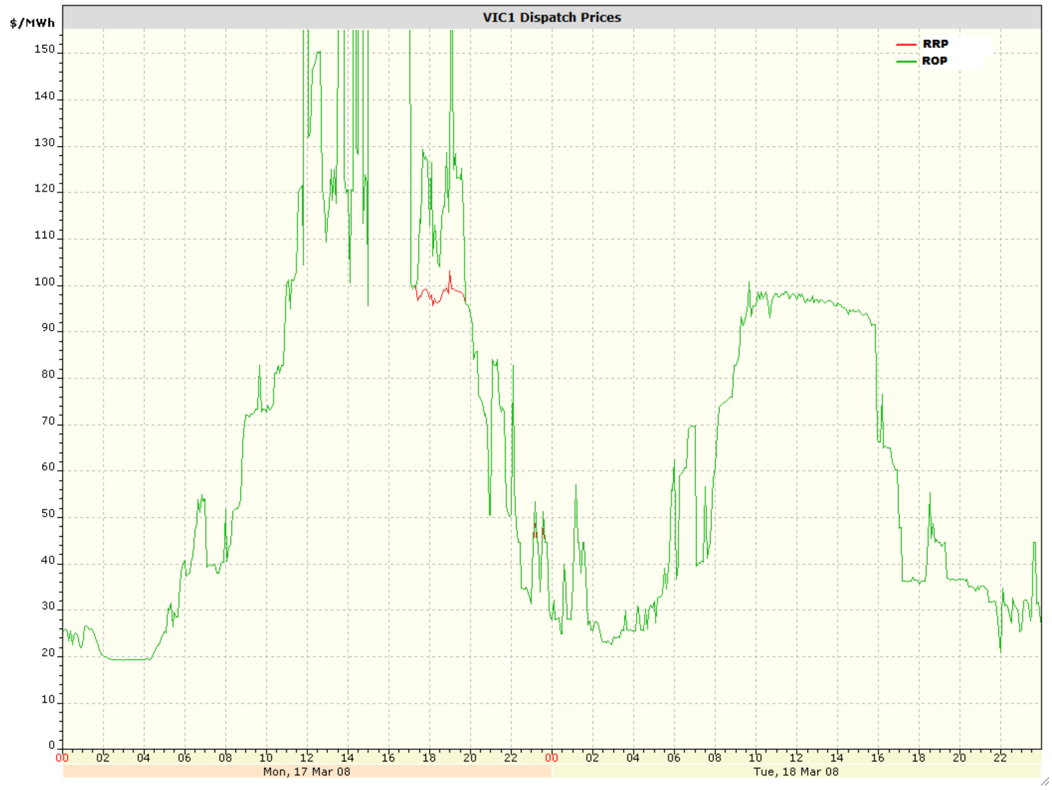
(d.) An alternative to the current APC price scaling method, which limits compensation payments, exists. This alternative might be a preferable means of addressing the financial risks (to individual participants and the market as whole) of large, unhedged, compensation payment liabilities, than that proposed by EnergyAustralia.

6.1 Administrative Prices Higher In Exporting Regions

The application of the price scaling method can result in an administered price in an exporting region being higher than the importing region's administered price. This can occur when there are negative losses for the flow on the interconnector.

This actually occurred for a dispatch interval on the 17th March 2008 in Victoria shortly after 17:00, when the scaled price in red is above $100/MWh (see Figure 3). The green line shows the Victorian settlement price without any price scaling arising from the APP in South Australia.

Figure 5 Victorian Dispatch Prices Before and After Price Scaling Due to the Application of the APC in SA, 17 March 2008



6.2 Administrative Prices Higher Than the Original Price

When developing the spreadsheet model that mimics the APC and price scaling, we realised that the application of a price cap in a region and price scaling in other regions did not clearly define what should be the price in a region exporting to another region whose price is capped. All that Clause 3.14.2(e) of the Rules states is that the price in the exporting region should not exceed the APC multiplied by the average loss factor. The clause does not actually state that the price should be the minimum of the original price and the APC multiplied by the average loss factor. Consequently, if the Rule were applied naively to determine an administered price, rather than a price cap, this could result in a scaled dispatch price in an exporting region being higher than the original dispatch price.

For example, assume that power is flowing from VIC to SA, with an uncapped dispatch price in SA of $101/MWh and a price in Victoria of $90.90, due to roughly 10% marginal loss factor on the VIC-SA interconnector. Now assume that this price of $101 in SA breaches the CPT in SA, triggering the application of a $100/MWh APC in SA. The price in VIC has to be scaled back using the average loss factor, which is assumed to be 5%. This results in the Victorian price rising to $95/MWh after scaling from its original level of $90.90. The increase in the VIC price after APC price scaling is due to the use of the average loss factor instead of the marginal loss factor.

Clearly, this sort of outcome was not the intention of the price scaling algorithm. As discussed earlier, the aim of the price scaling Rules is to ensure that the application of a price cap does not create negative settlement residues.

Suggestions

To address this issue, we therefore suggest that:

(a.) The Rules should clearly specify that any price scaling due to a price cap should aim to reduce prices in an exporting region by the smallest amount whilst ensuring that any negative settlement residues are minimised. This may result in no changes in prices in some exporting regions;

(b.) It would be desirable for the Rules to be changed to more clearly reflect this objective of minimizing/eliminating negative residues and leave the details of the algorithm to NEMMCO.

6.3 Same Method for APC and VoLL Scaling?

Following IES's investigations of the APC process, we have come to a view that there is no compelling reason for the APC price scaling methodology to be the same at that used for VoLL price scaling.

It appears from reviewing the ACCC's determination in 2000 on VoLL scaling that the only reason why the VoLL price scaling algorithm was used for APC price scaling was to avoid negative settlement residues.

However, since under the APC related Rules generators and market network service providers are eligible for compensation, and there is a funding mechanism for such compensation, the reason for using the VOLL price scaling method for APC price scaling can be questioned.

With the price scaling approach, there is the potential for many market participants to claim compensation, and this could result in a large, un-hedged liability for customers. Concern about these potential liabilities is the basis for Energy Australia's Rule change proposal. EA's proposal seeks to address the financial risk arising from potentially large compensation payments by capping the value of compensation payable to a generator to be no more than its "direct operating costs" (i.e. short-run marginal costs), rather than the difference between its offer price and the APC.

However EA's proposal may not be the best way to manage this problem.

6.4 An Alternative to APC Scaling that Limits Compensation

Rather than continuing with APC price scaling and seeking to limit the value of compensation using the approach suggested by EA, it may be better to:

(a.) only apply the cap in the region which is the subject to the administered price period;

(b.) allow the interconnectors to have negative residues; and (c.) compensate IRSR unit holders for any reduction in residue payments arising from the APC in a region.

This may result in overall smaller compensation amounts and less problems for the market in terms of un-hedged liabilities.

For example, under this method, if South Australia had an APC applied and this created negative residues on the VIC-SA interconnectors (Heywood and Murraylink, whose combined capacity is around 700MW), compensation might be claimed by generators in SA (some fraction of the approximately 4000MW of installed capacity in SA) and the 700MW of IRSR units. The volume of compensation payable (and most likely its value) using this approach would be substantially less than if price scaling was applied and this forced down settlement prices across other NEM regions (excluding Tasmania, since it is connected by an MNSP), triggering claims for compensation by some proportion of the NEM's 40,000MW installed generating capacity and claims by other eligible parties across the NEM.

If such an approach were adopted, then a mechanism for funding compensation to IRSR holders would have to be determined. Some possible funding options are:

(a) To use existing recovery mechanisms for APC-related compensation

(b) For customers in the importing region to fund any negative residues arising from the imposition of the APC. Such an approach has been used in the past. For example, in January and February 2000 there was an industrial dispute in Victoria's generation sector, which resulted in the Victorian prices being capped under a Victoria jurisdictional derogation relating to Industrial Relations Force Majeure (IRFM) events, while prices in regions exporting power to Victoria were not capped or scaled. In this case, the Victorian retailers had to pay NEMMCO the negative settlement residues resulting from the difference between the capped prices in Victoria and the uncapped prices in the regions exporting to Victoria (the 'white hole' money).

7 Conclusions

The questions that the AEMC asked can now be readily answered.

Q1

How does the application of clause 3.14.2(e)(2) within NEMDE affect the calculation of the spot market settlement prices in regions which have energy flows towards a region where the APC has been applied? Specifically, does direct application of an APC in one region lead to the indirect application of administered prices in other regions via the price scaling effects of clause 3.14.2 (e)(2)?

A1

The application of the APC, clause 3.14.2(e)(2), is not done within NEMDE but is done afterwards in the settlement process by adjusting the final pricing outputs of NEMDE. How this is done is outlined in sections 3 to 5. The direct application of an APC in one region can lead to the indirect application of administered prices in other regions via price scaling using inter-regional average loss factors.

Q2

When power is flowing away from a region that is subject to an APC, what, if any, effect is there on the prices of adjoining regions to which the power is flowing?

A2

There should be no effects on prices in these adjoining regions if there are no inter-regional loops. On the other hand if there are any inter-regional loops then there could be a situation where one of these regions is affected.

Q3

Would market participants in regions whose spot prices are *indirectly* capped to the APC via the impact of clause 3.14.2 (e)(2) be eligible to claim compensation under clause 3.14.6 of the Rules?

A3

Clause 3.14.6 is quite clear that market participants in regions whose spot prices are *indirectly* capped to the APC could be eligible for compensation as long as they have a dispatched offer or bid whose price is higher or lower than the capped price due to the operation of the price cap.

From the brief analysis in this report and the actual application of the administered price cap on the 17th March 2008, it is quite clear that capping prices in one region during an APP can cause price capping to ripple through the market to other regions.

Consequently, there is the potential for many market participants to claim compensation and this could result in a large, un-hedged liability for customers.

This concern is the basis for EA's proposal. EA's proposal seeks to address the financial risk arising from these potentially large compensation claims by capping the value of compensation payable to a generator to be no more than its "direct operating costs" (i.e. short-run marginal costs), rather than the difference between its offer price and the APC.

However, EA's proposal may not be the best way to manage this problem.

It may be better to only apply the cap in the region which is subject to the administered price period, allow the interconnectors to have negative residues and compensate IRSR unit holders for any reduction in residue payments arising from the APC in a region. This may result in overall smaller compensation amounts.