CS Energy response to OFA Design and Testing

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Optional Firm Access, Design and Testing

CS Energy thanks AEMO for the opportunity to respond to the consultation on Optional Firm Access (OFA) – AEMO First Interim Report. We understand the task of AEMO is to work on the functional design of OFA and modelling of access settlements. We also understand AEMO's task is complicated by a requirement for AEMO to estimate the likely benefits of implementing OFA by testing market outcomes that would have occurred for a past period of time.

From reading the Interim Report we understand AEMO has taken this brief to be that it should consider past dispatch outcomes, then overlay the incentives under OFA and recalculate access settlement and determine the productive efficiency gains. It could then be possible to extrapolate these benefits over a longer term and then posit some dynamic or allocative efficiency that could ensue. CS Energy considers this approach to be sensible.

The problem as highlighted by AEMO is that it is improbable to assume dispatch outcomes will be guaranteed to be more efficient under OFA. CS Energy believes under OFA there may be incentives in dispatch for participants to optimise access and energy settlements. This will depend on the position of the generator, as to whether they are 'access long' (sufficient or greater access than they desire) or 'access short'. This will depend on the expected prices within a looped constraint, relative the Regional Reference Price (RRP) and whether the prices within a looped constraint are included in the setting of the RRP.

> Under OFA there may be incentives in dispatch for participants to optimise access and energy settlements.

Even under simple conditions, such as with a radial constraint, generators may offer volumes below cost to constrain the flowgate, generate returns under access settlement and benefit from a higher price of another generator not included in the flowgate setting the RRP. This is a clear behaviour that could arise under OFA.

> Example A: optimise access settlement by offering volumes away from marginal cost, constraining the flowgate and creating residues.

CS Energy notes that under the current arrangements, with hybrid flowgates, flowgate support offers can sometimes affect price if the interconnectors and other options for supply are also constrained, which can happen quite frequently if there are other constraints. Under such occasions, which were termed "constrained pricing" by the NGF[1], the RRP is a function of a change in dispatch of generators in the flowgate that produces 1MW at the regional reference node, but

[1]National Generators Forum, response to the, AEMC's consultation on the AER's ramp rate and FSIP rule change

zero across the flowgate. This RRP is paid to all generators and the price can include offers near the price cap and floor. Under OFA this "price signal" of fully constrained pricing may change, because the theory is that generators in the constraint will offer prices closer to marginal cost (although this is not guaranteed).

Within the NEM today the management of constraints, whereby generators can rebid prices and ramp rates, ameliorates the affect of the reduction in flowgate quantity, by rationing the flowgate quantity between participants and sometimes in lieu of interconnectors (to a certain extent). This change in dispatch of numerous generators means the change in flowgate quantity is not concentrated on one participant and risks are reduced. However the changing of dispatch of numerous generators results in some more volatile pricing outcomes, especially when 'disorderly' prices are included in the RRP calculation under constrained pricing. CS Energy believes the current arrangement leads to cycles of congestion, where increasing volumes of "disorderly" low prices depress prices after an initial higher price until eventually the constraint no longer binds. This was explained by the NGF in response to the Ramp Rate Rule change proposal whereby examples were given for January 2011 and 2013, where much evidence was provided on the effect of fully constrained pricing.

As AEMO points out in its interim report, the "disbenefit of a negative local price can be overwhelmed by the very high prices received in other parts of the loop". Because of this CS Energy expects generators will, if they are forced to subsidise the constraint, try to ensure the local prices in the loop affect the regional reference price so that access settlement is profitable.

If OFA stops generators pricing at the floor, CS Energy expects more stable pricing outcomes will accrue under constrained conditions and the cyclic nature of constrained pricing and dispatch may change. CS Energy suspects that the more stable pricing outcomes under OFA will result in generators being more able to optimise access settlement and energy settlement. In particular the removal of offers priced at the floor will create more stable local prices on the sending end of the constraint, reduce the chance of low or negative prices at the mode, and on the receiving end generators may still offer prices that result in high flowgate costs and a high RRP under fully constrained pricing.

In particular we believe the way AEMO formulates constraints, with most constraint equations including numerous terms that have negative coefficients[2], may lead to instances where these generators may reduce supply, pricing very high and increasing access settlement. These 'flowgate support' generators' offer prices can be included in the RRP under fully constrained pricing, even though these generators constrained on are not paid their local price. We suspect this may degrade flowgate volumes and increase access settlement.

[2] Where an increase in dispatch can alleviate the constraint, (in OFA language flowgate support generators)

We can imagine a dispatch scenario, rather than the congestion ‘cycles’ we have today, where a stable equilibrium emerges:

- flowgate support generators pricing high;
- flowgate volumes reducing, and
- RRP being set by an increase in supply of a flowgate support generator (pricing very high) and a reduction in supply by a constrained off generator (no longer pricing at the floor price of -$1,000/MWh).

Example B: flowgate support generators optimise access settlement in fully constrained pricing by maximising flowgate costs that affect the RRP. The flowgate costs may no longer be depressed by the offers at the floor price.

This would be when there is one more megawatt at the node to set the RRP but no change in the flow across the flowgate. The removal of the floor price offers could result in these no longer depressing flowgate costs and result in higher prices at the node.

It is for this reason that we recommended to the AEMC that the OFA design consider a way to include flowgate support generators. We have suggested that these are paid Long Run Incremental Costing (LRIC) prices and have negative access quantities in access settlement.

As requested by AEMO, CS Energy has considered a couple of examples to discuss the implications of OFA. We found a week that was heavily affected by constraints. The week of 17/06/2013 saw numerous outages in QLD. These constraints are good examples because they are real, short-lived events and included changes to the Left Hand Side (LHS) allocation and terms included in them as the network changed. They present some of the difficulties associated with the OFA model, yet should include the benefits in dispatch.

Example A: Incentives to maximise access settlement in a radial constraint

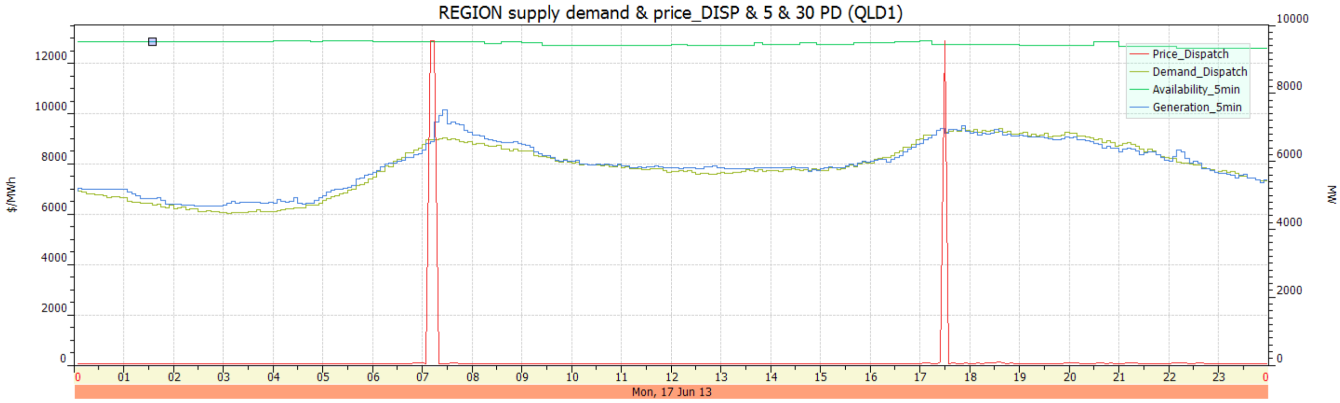
In this response we present a number of figures using the NEO 4.4 tool from Intelligent Energy Systems. The reports presented in each figure use data provided by AEMO.

In this example we consider constraint set Q-BRTR_8814_8815 in SWQ.

The system normal constraint, Q>>NIL_MRTX5_MRTX4[3], sometimes appears close to binding in the high demand summer period, but then Oakey or Swanbank E, (flowgate support generators) come on to relieve it. Q>>BRTR_MRTX5_MRTX4[4], is similar outage version. There are numerous generators not included in this flowgate that can set the price.

On the 17 June 2013 we had high prices when this constraint bound as shown in Figure 1.

Figure 1: Region supply, demand and price, 17 June 2013

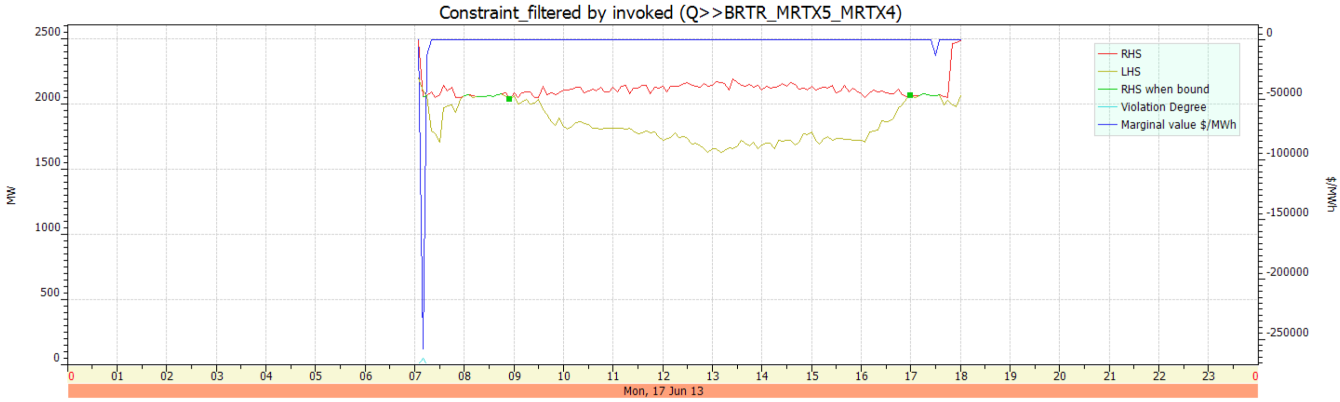


The high prices were reflected in the marginal values of the constraint equation, which were exacerbated because, when the outage was taken, AEMO introduced a constraint equation that could not be satisfied and therefore "violated". This can be seen in Figure 2.

[3] Q>>NIL_MRTX5_MRTX4: Out= Nil, avoid thermal O/L on remaining Middle Ridge 330/275 kV Tx #4, on trip of Middle Ridge 330/275 kV Tx #5, (or 9907 Millmerran to Middle Ridge 330kV line)

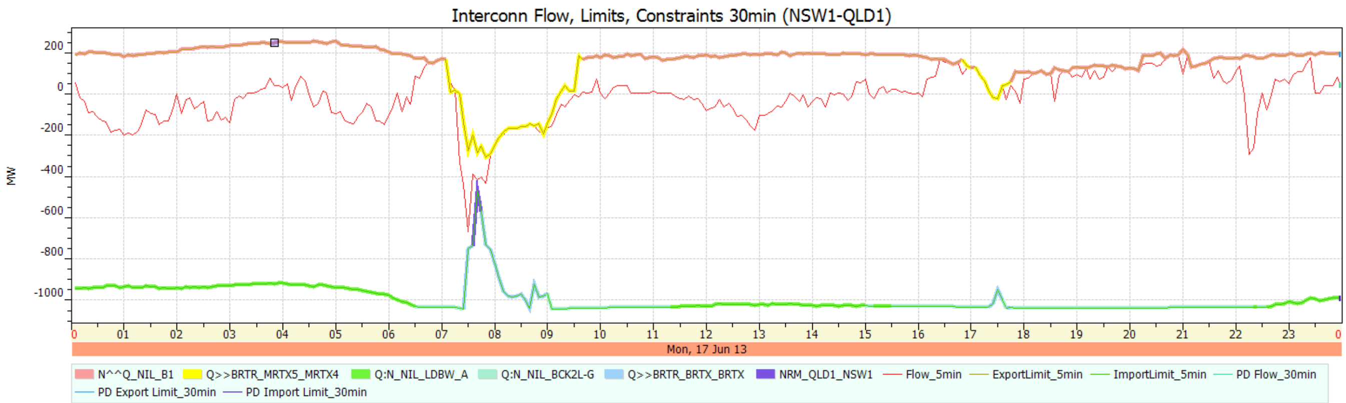
[4] Q>>BRTR_MRTX5_MRTX4: Out= 8814 or 8815 R2 Braemar to H18 Tarong 275kV line, avoid O/L on Middle Ridge 330/275 kV Tx #4, on trip of Middle Ridge 330/275 kV Tx #5 (or 9907)

Figure 2: Constraint Q>>BRTR_MRTX5_MRTX4: RHS, LHS, marginal value and violation degree



The period that is most interesting is the period leading up to 5pm. In this period the outage resulted in SWQ generation being constrained off as Braemar increased dispatch (Braemar adds to the flow through the flowgate), and displaced the QNI interconnector, resulting in SWQ generators and the interconnector no longer being able to set the RRP and the price plant not in the flowgate. This is shown in figure 3.

Figure 3: Interconnector flow, limits and constraints – Queensland-NSW interconnector



This example shows potential inefficient behaviour under OFA as generators in SWQ increased dispatch, constrained the flowgate and allowed others to set the RRP high. In effect Braemar and Darling Downs may have created congestion rents in access settlement by offering volumes away from marginal cost, constraining the line and creating residues. Under OFA, they could have the same incentive to do this; a difference could be that they may have been constrained off instead of the interconnector and saved the fuel cost of generating. Importantly the returns from doing this would depend on the access entitlements of the different participants in the flowgate and their electricity derivatives or retail load which are priced at the RRN.

In this flowgate example the generators would appear to have reasonable access entitlements because the rationing across the flowgate was not very aggressive, although we should note that only three of the six Braemar units were running therefore we would expect these participants to be access long, even after scaling back of access to the flowgate quantities.

Outage constraints may therefore represent an opportunity for peaking generators with significant available capacity (and therefore Transitional Access) to exploit their position of being access long even after access being scaled back to the flowgate volume. Therefore base-load generators may be access short when an outage constraint binds: as these generate far closer to their overall availability, far more frequently and at far lower prices. Hence in the example above Millmerran and Kogan Creek, upon *access scaling* could be access short and need to pay into access settlement.

We recommend AEMO investigate the incentives on fast-start plant, or other participants, under OFA to constrain flowgates in order to receive payments through access settlement. CS Energy considers the allocation of flowgate access could be significantly different than today (which is rationed by physical dispatch through the flowgate) and could lead to unexpected outcomes and or perverse behaviour.

Example B: Incentives to maximise settlement in a looped constraint

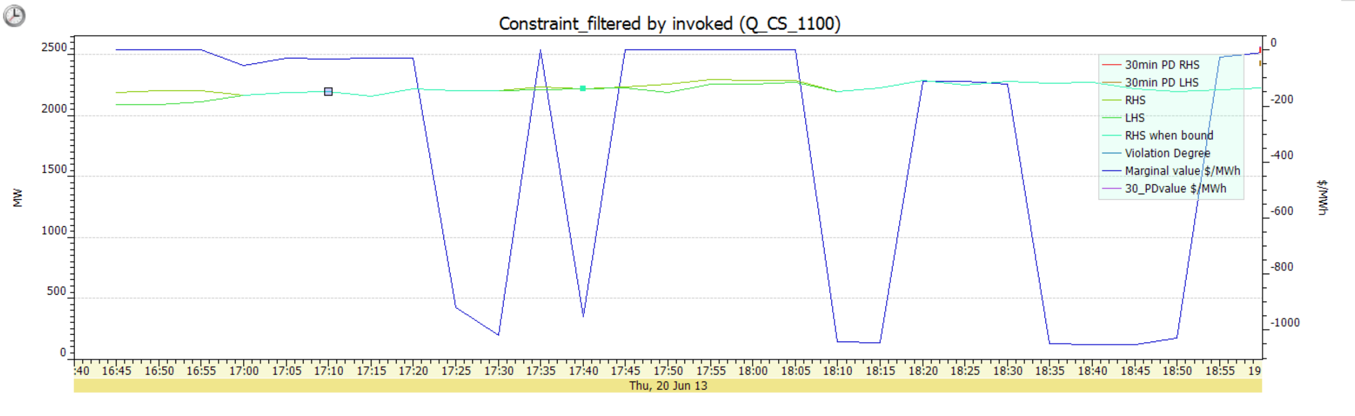
This example considers constraint Q_CS_1100 in CQ-SQ.

Q_CS_1100 was a radial constraint, which used to constrain off generators north of Tarong, limiting central to south intra-region power transfers. It has been reformulated after the reconfiguration of the system around Halys to include SWQ and the interconnectors, resulting in other terms with negative coefficients being included in the equation. It is now a 'looped' constraint.

On 20 June 2013, Q_CS_1100 required all generation north of Halys to be constrained off in QLD and below to be constrained up. In the morning, Millmerran repriced volume to the cap and this, coupled with an FCAS constraint due to an outage in northern NSW, affected the price (interconnector flows were made more costly by FCAS raise) creating a spike at the price cap.

Figure 4 shows the constraint equation Q_CS_1100's effect of constraining off generators that had priced to the market price floor of -$1,000/MWh. It was restricting supply of these offers through the flowgate and therefore ameliorating the constraint by 1MW would have reduced costs by -$1,000/MWh plus the RRP (to approximate).

Figure 4: Constraint Q_CS_1100: RHS, LHS, marginal value and violation degree



In order not to be constrained off those north on the sending end of the looped constraint could price down to -$1,000/MWh to maintain dispatch (see below), but this was complicated by a 'Feeder Bushing' constraint which principally constrains off Gladstone, but under the outage conditions of Calvale-Halys included all generation in Central-North QLD (as these generators had less flow allowed through the other flowgate and therefore had more flow through another flowgate).

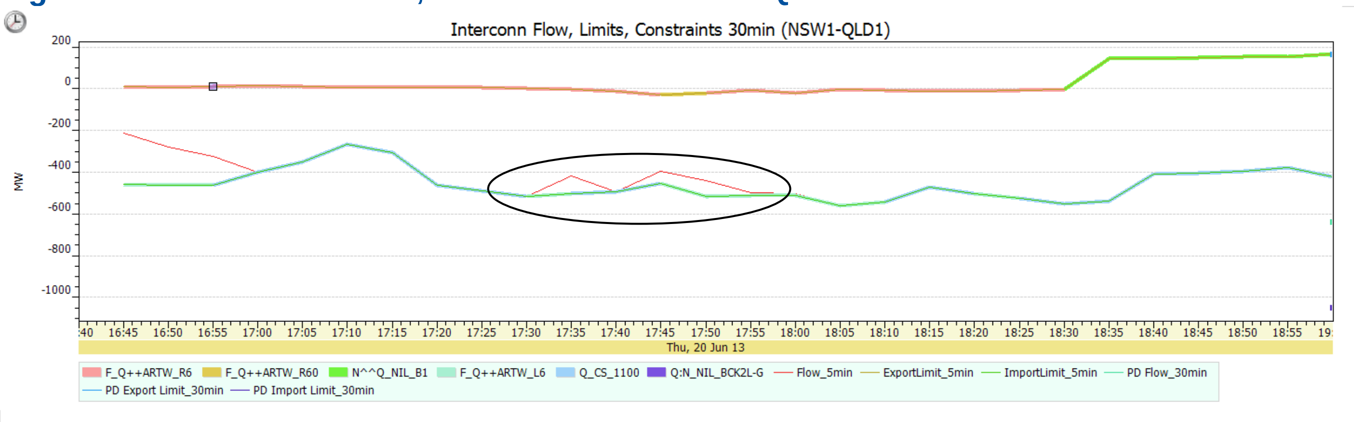
Generators and the QNI on the receiving end (south) of Q_CS_1100 were in a position whereby they would be constrained up. The QNI was quite expensive and with a low value coefficient, resulted in it outpricing some of the units constrained off – units 3 and 4 at Gladstone. Gladstone units were constrained off anyway, even if they priced down to -$1,000/MWh because of this.

Other suppliers were not caught out by Millmerran in the afternoon (as they were in the morning) because there was more supply from the Braemars, Oakey and Swan_E, which kept the price lower. The supply north of the Q-CS_1100 was, in time, able to set the price low as 'disorderly bids' affected the price, with negative values. This is under fully constrained pricing whereby the NEM Dispatch Engine (NEMDE) must resolve a looped constraint (usually only these result in fully constrained pricing) and calculate the RRP.

In this example an increment of a high priced offer (from a flowgate support generator) allowed some negatively priced offers to be dispatched across the flowgate. The RRP was a function of a change in dispatch of generators in the flowgate that produces 1MW at the regional reference node, but zero across the flowgate. This was only when we had NSW offers that were low enough to ‘open the flowgate’ for the constrained off generators.

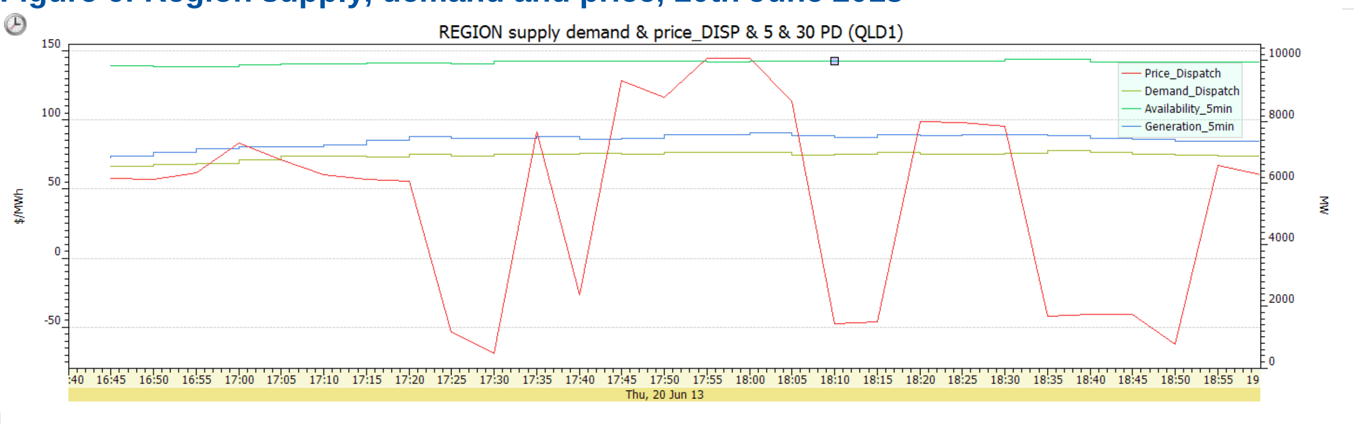
Figures 5 and 6 shows the instances whereby the interconnector was not constrained up (as it was too expensive) and the RRP in QLD was high.

Figure 5: Interconnector flow, limits and constraints – Queensland-NSW interconnector



The RRP in QLD cycled between low and high prices as the negative prices from the loop were included in the price, or whether the price was set with offers not in the loop.

Figure 6: Region supply, demand and price, 20th June 2013



The local prices for the constrained generators in Q_CS_1100 are shown in figure 7 below. Importantly the price for Gladstone is below the floor and so it was constrained off anyway. This allowed an increment of -$1,000/MWh offers within the loop to set the price.

Figure 7: Constraint equation Q_CS_1100 local price adjustment

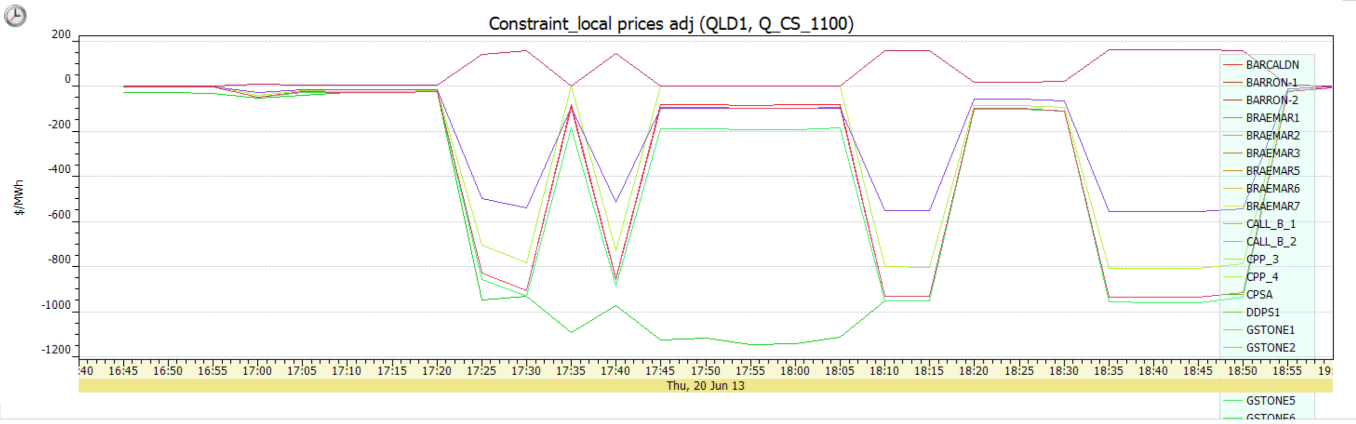
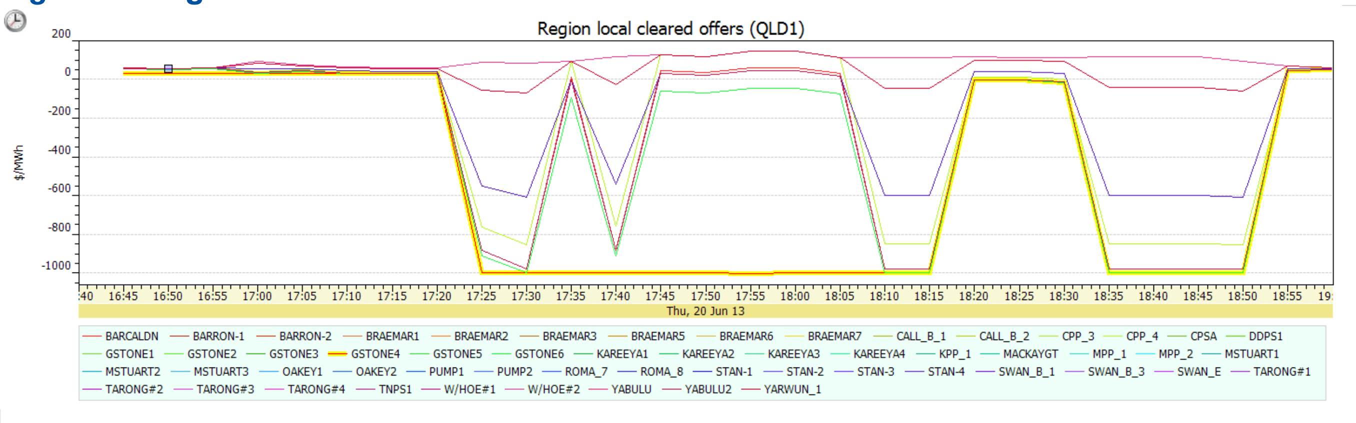


Figure 8 indicates where the constrained -$1,000/MWh offers of Gladstone affected price. This was when the QNI interconnector was constrained up (effectively a flowgate support offer) and the resultant RRP affected by the looped constraint is marginally negative. Figure 7 shows if a generator has set the price: this is done by calculating the locally cleared offer for that unit – by adding back the RRP. If, after doing this, the price is the floor or the cap (or in the case of your own plant your own offer price) you know that generator had this offer included in the RRP calculation.

Figure 8: Region "local cleared offers" 20th June 2013



It is our view that these outcomes are a result of the way the constraints are formulated and AEMO calculates price. Effectively the price in NSW was too high in some instances and the negatively priced offers, when accounting for the constraint coefficients, had to be constrained off (the flowgate closed). When the NSW price eased somewhat, it allowed the negatively priced generation to be dispatched at Gladstone. When the NSW RRP was too high, 15:45 to 18:05 at $120-$150/MWh the -$1,000/MWh offers from Gladstone could not compete, because the coefficient between the QNI and Gladstone units 3 and 4 were too great. However when the NSW price dropped, so QNI could compete, the negative offers form Gladstone could also be dispatched and affect the price as shown in Figure 9.

Figure 9: Example of fully constrained pricing with floor price under existing Rules

Q_CS_1100	Coeff	LHS change	Energy change	Affect on RRP QLD	Offered price
Flowgate support	-0.152	0.868	0.868	$98.09	$113
Gladstone	1	0.132	0.132	-$131.94	-$1,000
		0.000	1.000	-$33.85	
GLAD/QNI	-6.58				
Flowgate cost	$152.00		Actual RRP in QLD	-$47.00	

In Figure 9 the ratio between supply at Gladstone and supply on the interconnector is -6.58. This means that if Gladstone prices at -$1,000/MWh then supply from the interconnector can be dispatched if the price is lower than $152/MWh (-$1,000/MWh / -6.58). If the price at QNI in the looped constraint is below -$152/MWh (ignoring MLFs and interconnector losses) then the flowgate opens and Gladstone can be dispatched.

In Figure 9 an increment of a high priced offer (from a flowgate support generator) at $113/MWh allowed some negatively priced offers -$1,000/MWh to be dispatched across the flowgate. The RRP was a function of a change in dispatch of generators in the flowgate that produces 1MW at the regional reference node, but zero across the flowgate. This results in a price of -$33.58/MWh. This compares to the actual RRP for that interval which was -$47/MWh, which would have included losses, etc.

Figure 9 shows how 'disorderly' bids affect the price when the flowgate is subsidised by a constrained on offer (which is priced quite low and therefore constrained on). This is why negatively priced generation sometimes comes through a flowgate and we have cycles of high and then low prices. Typically the first high price is caused by a negative price being constrained down, or a high price being constrained up, and then other participants rebid offers to the floor price. Eventually prices in the other part of the loop increase until NEMDE constrains off -$1,000/MWh offers and these can affect the RRP. This can be expedited by AEMO imposing a negative residue 'clamp' on the interconnector. Eventually the change in dispatch and prices (which are now low or negative) resolves the constraint and dispatch settles, only for the next cycle to begin.

So far this example does not paint the current rules as efficient – it appears an inefficient process for setting dispatch volumes and prices. But this is not the point: what is important is <u>whether OFA is more efficient than the current rules?</u>

We believe there is the potential under fully constrained pricing, typically with lopped constraint equations that OFA would lead to more stable outcomes. This suggests OFA may be more efficient. However the more stable conditions will also allow for a stable dispatch equilibrium to emerge across the flowgate, rather than the 'cycles' of congestion caused by the way AEMO calculates the price under looped constraints.

We could imagine an equilibrium whereby the flowgate support generators have more control over flowgate residues and therefore the RRP under fully constrained pricing. Figure 10 uses the same example as in Figure 9, but the offer price of the flowgate support generator is changed to $1,000/MWh. The constrained off plant, Gladstone no longer prices to the floor under OFA and they are pricing at

$25/MWh. This is more of a stable equilibrium than under the existing arrangements and the price is high at $871.35/MWh.

Figure 10: Example of fully constrained pricing under OFA incentives

Q_CS_1100	Coeff	LHS change	Energy change	Affect on RRP QLD	Offered price
Flowgate support	-0.152	0.868	0.868	$868.06	$1,000
Gladstone	1	0.132	0.132	$3.30	$25
		0.000	1.000	$871.35	
GLAD/QNI	-6.58				
Flowgate cost	$152.00		Actual RRP in QLD	-$47.00	

It is obvious from this example that the RRP would not 'jump' to over $800/MWh because the interconnector could have increased its supply by 300MW, although with it already priced at over $113/MWh the price would probably have been higher under this scenario. In addition, the FCAS constraint limiting flows into QLD still sets the export limit on the interconnectors and would therefore have hampered it supplying more in NEMDE (this can be seen in figure 5 and was the cause of the price cap spike in the morning).

This example is quite a 'passive' example of fully constrained pricing in looped constraints. Due to the large number of -$1,000/MWh offers and relatively low demand conditions, CS Energy might have expected more orderly dispatch to identify the productive efficiency that OFA is expected to provide where the interconnector flows may well have been 'firmed' in dispatch under OFA.

This example shows the potential for generators within looped constraints to increase prices across the flowgate to a more stable equilibrium than today.

In our view, if more stable pricing outcomes had arisen in January 2013, particularly 9-14 January 2013, when dealing with congestion in central Queensland relating to constraints on circuits 855-871 and 855-871[5], (between Callide, Gladstone and Stanwell), the pricing outcomes could have been more reflective of the underlying supply competitive conditions at the time. Instead, under the current dispatch rules, the NGF noted: "*The price volatility under category C (fully constrained pricing) was the result of the price being set by "disorderly" rebids. This volatility served to* ***depress*** *prices over the period*[6]".

[5] These transmission constraints are no longer relevant as Powerlink has augmented the network between Calvale and Stanwell
[6] NGF, Response to the AEMC's consultation on the AER's Ramp Rate and FSIP Rule Change, March 2014

Other matters:

Access settlement using dispatch SCADA data

We understand that half hourly settlement is most likely for access settlement. This is going to result in difficulties related to flowgate quantities, prices and resultant settlement. In particular the implications of a constraint binding for one or two intervals of the six would present a problem. From CS Energy's perspective, access settlement using dispatch SCADA data would be more sensible as the flowgate quantities are rationed on the basis of dispatch targets, which are SCADA values. The adjustment to the flowgates for feed-back constraints is also on the basis of SCADA data. We also note that station auxiliary load is included in the RHS of the constraint, prior to allocating the flowgate quantity to generators included in the constraint.

Treatment of marginal loss factors

The consultation paper explains that access quantities should be scaled by marginal loss factors (MLFs). The reason for doing this is that dispatch figures are presently adjusted to account for marginal loss factors. CS Energy is unsure as to what the AEMC means by this statement. MLFs are applied to prices, not volumes. MLFs are not real volumes in any way and should not be applied so. Given generators are required by the Rules to offer prices that, when adjusted by the MLF, are no greater than the cap of the floor prices specified in the Rules the local offers for generators already consider MLFs. The AEMC and AEMO should elaborate on the need to include MLFs in access settlement. It is CS Energy's preliminary view, absent further information about the treatment of MLFs, that losses will already be incorporated in the difference in price and flowgate residues.