



CAOR Discussion Paper

Market Pricing Working Group January 2006

Table of Contents

- 1.0 INTRODUCTION.....3**
- 2.0 CURRENT IMPLEMENTATION OF CONTROL ACTION OPERATING RESERVE (CAOR) IN THE REAL TIME MARKETS5**
 - Table 1. CAOR Offers Originally Recommended by IESO5
 - Table 2. CAOR Offers in the Real Time Markets6
 - Issues Raised by the Market Pricing Working Group7
 - Why does the IESO continue to include CAOR as a reserve source even after the control action counted on to provide the reserve has been implemented?7
 - Why does the IESO permit all 800 MW of CAOR to be considered as 10N when one of the CAOR sources is the ability to disregard the 30R requirement?8
- 3.0 FREQUENCY OF CAOR USAGE.....9**
 - Figure 3: Frequency CAOR is Scheduled in Peak and Off Peak Hours..... 10
 - Figure 4: Predispatch Constrained and Unconstrained Average Frequency and Average MW for 30R and 10N..... 10
 - Figure 5: Frequency of CAOR Usage in the 30 Minute Reserve Market 11
 - Issues with CAOR being scheduled in Pre-Dispatch 11
- 4.0 OPTIONS AVAILABLE TO ADDRESS THE RELIABILITY CONCERNS CAUSED BY CAOR12**
 - Increase Price(s) of CAOR offer 12
 - Remove or reduce Existing CAOR offer quantities from predispatch 12
 - Constrain on Additional Resources when CAOR is scheduled in predispatch 13
- 5.0 APPENDIX..... 14**
 - Figure 5: Real time Constrained and Unconstrained Average Frequency and Average MW for 30R and 10N 14
 - Figure 6: Frequency of CAOR Usage in the 30 Minute Reserve Market in Real Time 14
 - Figure 7: Frequency of CAOR Usage in the 10N Reserve Market..... 15

1.0 INTRODUCTION

The IESO has a number of emergency control actions that it may utilize to ensure the reliability of the IESO controlled grid. A subset of these control actions (CA) are disregarding the thirty minute operating reserve requirement and voltage reductions of 3 and 5 %¹. During the first year of market operations, control room operators at the IESO used these control actions as they were required to manage the reliability of the IESO controlled grid. In most circumstances where these control actions were used they were counted towards the operating reserve requirement in periods where there were not enough market based operating reserve (OR) offers. If a shortage of market based OR offers were identified the control room operators at the IESO would lower the OR requirement (in accordance with relevant NERC, and NPCC reliability standards) by the amount of the market shortfall. They would lower the reserve requirement knowing that if a real time contingency were to occur, and the full OR requirement was required to respond to the contingency, they would have both the market based OR, and the control actions to respond to the contingency.

When the above situation occurs the control room is using control actions to satisfy its OR requirements. For example, if there were a 250 MW shortage of market based OR offers for HE 13, identified in the one hour ahead predispach, the control room operators would have lowered the OR requirements for HE 13 knowing that if a contingency were to occur they would have the ability to implement a 3 % voltage reduction which would lower demand by approximately 250 MW. These control actions would only be utilized if there were a contingency in real time that required these actions. This could be seen as the IESO control room operators implicitly scheduling control actions as a source of operating reserve.

These actions had unintended implications on the OR, and energy market clearing prices. When the reserve requirement was lowered the reserve price would fall as the amount of supply remained constant and the amount of OR 'demand' had decreased². A decrease in demand with steady supply will almost always lead to a drop in price. This price decrease was not providing the market with the correct price signal. As a control action was being utilized to meet the reserve requirement due to a shortfall in market based OR offers one would expect the OR prices to be increasing to indicate the shortage of OR offers to attract new offers to the market, not decreasing as was observed.

These counter-intuitive price drops³ were identified as an issue early in the operation of the IESO administered markets by the Market Pricing team and the solution of Control Action Operating Reserve (CAOR) was proposed and finally implemented in the real time markets on August 6, 2003.

CAOR is the implementation of standing offers in the IESO reserve markets⁴ for certain control actions that are available to the IESO control room operators. The offers installed in 2003 were for 400 MW at \$30.00 for 30 minute OR and \$30.10 for 10 minute non-synchronized (10N) OR. These offers were intended to decrease or eliminate the instances of counter intuitive pricing as the control actions that the operators were using now had a market price applied to them. With this addition, if a control action was

¹ For a listing of all control actions available to the IESO control room operators please refer to Appendix E of Market Manual 7.4; Emergency Operating State Control Actions. http://www.ieso.ca/imoweb/pubs/systemOps/so_GridOpPolicies.pdf

² Lowering the OR requirement is a drop in OR demand, and is equivalent to a decrease in demand in the energy market

³ These price decreases are considered counter-intuitive as the price would be expected to increase in these scenarios as opposed to dropping as a result of instituting a control action.

⁴ CAOR offers may include the amount of demand reduction available from 3 and 5 percent voltage reductions and disregarding the 30 minute operating reserve requirement. CAOR is only offered in the 30 minute and 10 minute non-synchronized operating reserve markets.

scheduled the OR market would clear at \$30 or \$30.10 reducing the potential for a counter intuitive price drop.

An issue identified with the implementation of CAOR, expressed by the IESO control room, is the way in which CAOR is used in pre-dispatch during the spring season. It is thought that scheduling CAOR in pre-dispatch during this season is placing the IESO controlled grid at undue risk as an operator now has one less control action available to utilize when responding to a real time contingency as a control action has already been scheduled in the market. It is thought that without CAOR in pre-dispatch additional resources would be scheduled in place of the control actions leaving a larger set of control actions for the operators to utilize when responding to a contingency. This paper will describe the frequency CAOR is scheduled in pre dispatch in Section 3.0, and propose a number of options to address the reliability concerns in section 4.0.

In November 2005 the IESO board approved an additional 400 MW of standing offers for CAOR and a change to control room procedures on how to manage OR shortages and shortfalls. The control room procedures were changed to eliminate the previous practice of reducing the OR requirement in times of OR shortfalls. The previous practice of reducing the OR requirement when a shortfall was identified was seen as a direct and identifiable cause of counter intuitive pricing. The procedure now instructs the control room operators to not reduce the OR requirement when a shortfall is identified allowing the pricing algorithm to calculate a shortage price in times when there is a shortage of OR offers. This is the intuitive outcome, shortage pricing at times of OR shortfalls. Section 2.0 (Issues Identified by MPWG) will discuss the impacts of this procedure change and Section 2.0 (Current Implementation of Control Action Operating Reserve (CAOR) in the real time markets) will describe the implementation of the second CAOR offer and address issues that have been identified specifically with that portion of the offer.

When the IESO Board approved the additional 400 MW and the corresponding procedure change a commitment was made to provide the board with a review of the frequency of use and the resultant market and reliability impacts of CAOR at its February 2006 meeting. This paper, and stakeholder feedback on this paper, will form the basis of that Board report.

2.0 CURRENT IMPLEMENTATION OF CONTROL ACTION OPERATING RESERVE (CAOR) IN THE REAL TIME MARKETS

At the October, 2005 meeting of the IESO Board, IESO management recommended that the standing offer for CAOR be increased by an additional 400 MW and it be incorporated in the real-time dispatch and pricing algorithms. In this recommendation the offers for CAOR were structured as depicted in Table 1.

Table 1. CAOR Offers Originally Recommended by IESO

MW's offered in Pre-Dispatch	MW's offered in Real Time	30 Minute OR Offer Price (\$)	10 N OR Offer Price (\$)
400	400	30.00	30.10
0	200	75.00	75.10
0	200	100.00	100.10
All CAOR offers to have an associated energy offer price of \$2000 /MW			

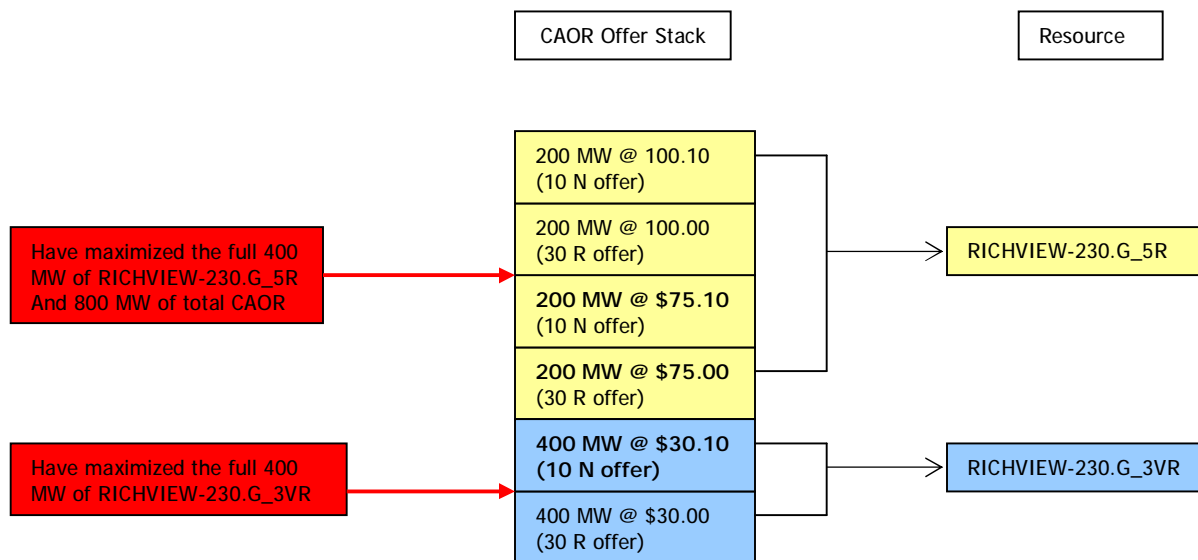
However, at the time of implementation testing, it was discovered that the offers as planned were not achieving the results that were expected. Specifically, the (\$100, \$100.10) portions of the offer were not being scheduled in the most common scenarios, a shortage of 30 minute or total reserve.

The reasons the most expensive lamination would not be scheduled arise from the manner in which the original CAOR was implemented in 2003. When the original CAOR was implemented in the market two virtual generation resources were created at the Richview bus, each with the capacity of 400 MW. One resource, RICHVIEW-230.G_3VR, was utilized for the original offer of (\$30, \$30.10) and the second resource, RICHVIEW-230.G_5R, was implemented at the same time to allow for the future expansion of CAOR. This second resource is being utilized for the additional 400 MW of CAOR.

When the Dispatch Scheduling Optimizer (DSO) schedules operating reserve (OR) it attempts to calculate the lowest cost solution that will fulfill the total OR and energy requirement⁵. The DSO has been programmed with the ability to 'cascade' the 10N offers into 30R (10N can be used to satisfy the 30R requirement since 30R is a less restrictive criteria than 10N) if that will result in a more efficient, lower cost, outcome. Given these requirements of the DSO, when it attempts to schedule CAOR it will do so according to Figure 1. For example, assume the full complement of CAOR (800 MW) is required to meet the total reserve requirements and assume all other market based offers are at less than \$30. The DSO will schedule the original 400 MW as 10N @ \$30.10, exhausting the capability of that resource. The DSO will then move to the next lowest offer and schedule 200 MW of CAOR @ \$75 then schedule the next lowest offer, 200 MW @ \$75.10. It can be seen from this example that the \$100 lamination of the offers will never be scheduled as it is more economical for the DSO to schedule RICHVIEW-230.G_5R to its full capability using the lower two laminations (\$75, \$75.10) than to schedule OR at the \$100 lamination. This is not the desired outcome of the original CAOR offers, which is to have multiple offers available to the 10N and 30R markets at escalating prices, up to \$100.

⁵ The DSO will attempt to find the co-optimized efficient solution for all four markets (energy, 10S, 10N, 30R). In other words, the DSO will attempt to find the solution for all four markets that will result in the lowest total (or combined) cost, not the lowest cost for each individual market.

Figure 1: CAOR Offers Available to the DSO to Schedule in 30 R



After discovering the (\$100, \$100.10) portion of the offers were never being utilized the decision was made to alter the OR offers before they were implemented in the real time market. The OR offers were altered in a way that would achieve the intent of the original offers, which was to have multiple laminations available to the 10N and 30R reserve markets at escalating prices. By structuring the offers as 10N offers only, the DSO has the ability to ‘cascade’ the 10 N operating reserve offers into the 30R OR market to satisfy the overall OR requirement. This would not be possible if the offers were placed into the 30R market only, as 10N reserve can be used to satisfy the 30 minute requirement, but 30R cannot be used to satisfy the 10N requirement.

On November 23, 2005, the offers were placed into the real time markets. The structure of the existing OR offers can be seen in Table 2⁶.

Table 2. CAOR Offers in the Real Time Markets

MW’s offered in Pre-Dispatch	MW’s offered in Real Time	30 Minute OR Offer Price (\$)	10 N OR Offer Price (\$)
400	400	30.00	30.10
0	200	N/A	75.00
0	200	N/A	100.00
All CAOR offers have an associated energy offer of \$2000 /MW			

Using the example from above, with the OR offers as they exist in the real time market (no 30R offers for the highest two laminations), if there existed a shortfall in total OR, or a shortfall in 10N OR, the DSO

⁶ The IESO posts the state of the current CAOR offers on the market data pages of its public website at this link: <http://www.ieso.ca/imoweb/marketdata/ControlActionOR.asp>

would schedule 400 MW as 10N @ \$30.10, 200 MW as 10N @ \$75 and 200 MW as 10N and 30 R @ \$100.00. This would provide the market with the proper, intuitive price signal; the OR price would be increasing as the OR demand-supply balance was becoming tighter.

ISSUES RAISED BY THE MARKET PRICING WORKING GROUP

There are two issues concerning CAOR that have been raised by the MPWG that require further explanation. One is the way IESO treats CAOR offers once a control action has already been used and the other is the amount of CAOR offers that should be available to the 10N market.

Why does the IESO continue to include CAOR as a reserve source even after the control action counted on to provide the reserve has been implemented?

There was concern expressed by some MPWG members that it was inappropriate to continue to offer the full 800 MW of CAOR when one or more of the control actions associated with CAOR had been implemented. In other words, once the IESO has reduced voltage by 3 or 5% or disregarded a portion of the 30 R requirement, it would seem logical that the quantity of CAOR offers should be reduced by the equivalent amount of demand reduced as that control action is no longer available.

Prior to July 2005, CAOR offers were reduced as would be expected when a voltage reduction was implemented. When a voltage reduction was implemented the demand would decrease as a result of the control action and the CAOR offers would be reduced. In most circumstances lowering the demand through a control action would lead to a drop in price in a situation where the price would be expected to be increasing. To decrease the possibility of this happening MR-296⁷ directed changes to the pricing algorithm. This market rule amendment resulted in a procedure change where CAOR offers are no longer reduced when a voltage reduction is implemented. Changes under MR296 require the IESO to increase demand in the pricing algorithm by an amount equivalent to that reduced by the control action. With this change the DSO is calculating prices in the unconstrained sequence as if the control action had not been taken, reducing or eliminating the likelihood of counter-intuitive prices. The CAOR offers should reflect that same view and not be reduced. Reducing the CAOR offers in this instance would be lowering the supply while not having a corresponding decrease in demand

The situation is slightly different when reducing the 30R requirement, however the outcome is equivalent. When the 30R requirement is reduced there are no changes made to the input parameters of the DSO. The tool is still attempting to schedule the full energy and OR components. The only action as a result of a 30R shortage is an entry in the control room log to indicate the details of the 30R shortage. Since there are no input changes to the DSO and the tool is still attempting to schedule the full OR requirement the CAOR offers should not be reduced when a 30R shortage is identified. Reducing the CAOR offers in this instance would be lowering the supply while not having a corresponding decrease in demand (lowering the OR requirement).

⁷ MR296 is a set of market rule amendments that defines pricing procedures during emergency situations. These market rule amendments were implemented to reduce (or eliminate) the frequency of counter intuitive pricing during emergency situations. For more information on these amendments please visit: http://www.ieso.ca/imoweb/pubs/mr/MR_00296-R00_BA.pdf

In the constrained schedule of the DSO where the dispatch instructions are formulated, the demand the DSO attempts to satisfy is the actual demand as measured, not the 'adjusted' demand as in the market schedule discussed above. Given this fact, when a control action is utilized to reduce demand and maintain reliability it would seem intuitive that the CAOR offers would be reduced in the constrained schedule by an amount equivalent to the demand reduction as that control action is no longer available. This does not happen as CAOR is a pricing tool and the constrained schedule has no impact on prices as it is primarily concerned with reliability. Maintaining the CAOR offers in the constrained schedule does not constitute a reliability concern as the control room operators are always aware of the control actions available to them. When a control action has been implemented and CAOR is scheduled in the constrained schedule the operators know they have implemented a control action and are well aware of the control actions remaining to them, regardless of the state of the CAOR offers.

Why does the IESO permit all 800 MW of CAOR to be considered as 10N when one of the CAOR sources is the ability to disregard the 30R requirement?

The Market Rules define only two control actions as contributing towards CAOR offers - voltage reductions, and disregarding 30 minute operating reserve⁸. Some MPWG members have expressed concern that CAOR 10N offers should be limited to the amount that voltage reductions can contribute. It does not seem intuitive to allow disregarding the 30R requirement to count towards satisfying the 10N reserve requirement. As will be explained below, even with this apparent anomaly, the appropriate pricing outcomes are still achieved in all reasonably expected circumstances with the CAOR change as shortage pricing still occurs when appropriate. This occurs despite the fact that we are allowing 800 MW of CAOR to be used in 10N and 30R.

Consider the most common scenario where the total OR requirement is 1350 MW⁹; composed of requirements for 225 MW of 10 minute synchronized, 675 MW of 10N and 450 MW of 30R, and suppose there is 400 MW of reserve available from voltage reductions. Since the concern being addressed is one of using 30R relief as a source of 10-minute OR, we must consider the scenario where the market has less than 275 MW of 10N reserve offers (275 MW = 675 MW 10N requirement – 400 MW available from voltage reductions). Suppose, there were only 274 MW of 10N reserve offers. The total available OR, including CAOR, would be 1299 MW (225 MW of 10 S, 274 MW of 10N, and 800 MW of CAOR). With 1299 MW being less than the total OR requirement of 1350 MW, shortage pricing will occur¹⁰. Before the recent CAOR change, shortage pricing would not have been triggered in this circumstance; the control room operators would have reduced the OR requirement to prevent or eliminate the shortage which could have resulted in a counter intuitive price signal.

⁸ According to NERC and NPCC standards an ISO may disregard the 30R requirement provided it can foresee returning it to normal levels within 4 hours.

⁹ These requirements can increase during certain outage conditions on the Ontario power system. 1350 MW is the total OR requirement the vast majority of the time.

¹⁰ If the DSO detects that there are insufficient energy and operating reserve offers (including the CAOR offers) in the market to fully meet energy demand and the various operating reserve requirements, the DSO will first determine the magnitude of the shortage(s). The DSO will then automatically rerun with the reserve requirements lowered by the amount of the identified shortfall(s) and an additional 2 MW buffer to ensure that the DSO can find a solution. The market clearing prices (unconstrained sequence) will be set with the energy price reflecting the value of the last MW of energy that is dispatchable and the operating reserve price being the higher of the energy price or the highest operating reserve offer. When this happens, the amount of the shortfall in market supplied operating reserve is determined and assessed against available control actions that may qualify as operating reserve. In order to meet its NPCC and NERC requirements, the IESO is implicitly carrying control action(s) as operating reserve in such instances.

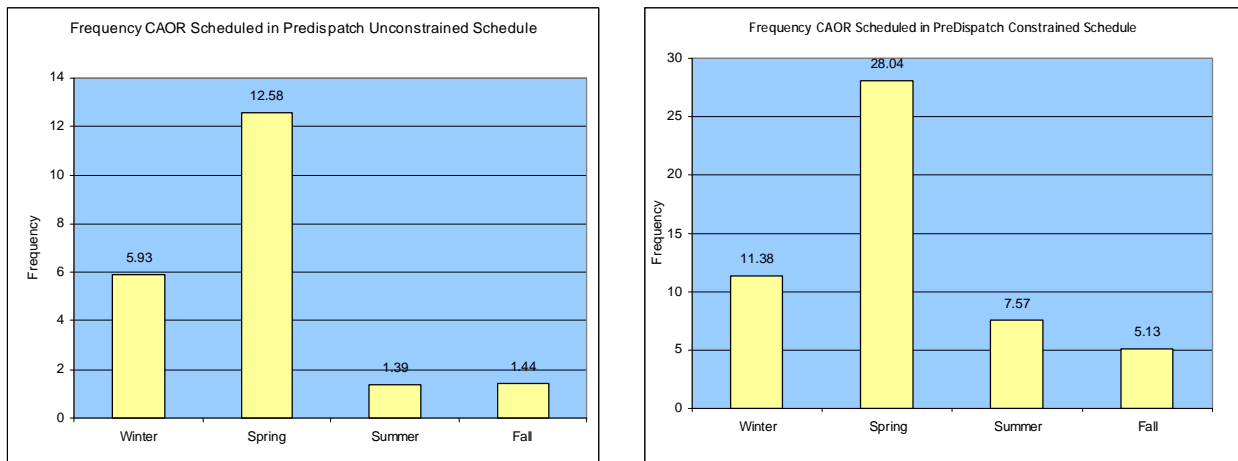
A situation when shortage pricing would not occur is one in which participants have provided 30R offers that are not also offered as 10N or 10N offers that are not available for 10N but can be used as 30R¹¹. In this case, it is possible that more than 400 MW of CAOR could be used to augment the 10N, and adequate 30R offers would exist to provide adequate total reserve, without the shortage pricing algorithm being triggered. The 10N requirement of 675 MW would be satisfied by CAOR and the OR market clearing price would be \$75 or \$100, the CAOR offer price. In this scenario the control room would classify as recallable as many MWs of exports as possible as possible, up to the amount of CAOR scheduled according to the normal control room procedures¹².

While shortage pricing would not occur in this instance, OR prices will be increasing (due to the increasing CAOR offer prices) as the amount of OR available is decreasing. This is a strong signal of the tightness of the OR market, which would not have existed prior to the control room procedure change.

3.0 FREQUENCY OF CAOR USAGE

As can be seen from Figure 2 there is a large seasonal component to the scheduling of CAOR offers in the spring and fall seasons.

Figure 2: Average 2003-2004-2005 Seasonal Frequency of CAOR Usage in Predispatch



During the spring months the river systems of Ontario are running at high water levels due to the melting of the winter snow and ice pack and high levels of seasonal precipitation. As a result the hydroelectric generating stations in the province are being run at or near full capability, and they can not store the volume of water that is running through the river systems. It is clearly preferable for them to

¹¹ This situation will happen with a slow moving generator offering OR. Assume a generator has a ramp rate of 5 MW/min, then that unit can be scheduled for 50 MW in 10N and 100 MW in 30R concurrently.

¹² According to internal procedures when CAOR is scheduled in the final predispach run, an equivalent amount of exports are classified as recallable. This is in essence tying the CAOR to recalling exports (if enough exports exist). For example, if 200 MW of CAOR have been scheduled in the constrained schedule, the control room operators will classify 200 MW of exports as recallable. In the event of a real time contingency, exports will be recalled before performing voltage reductions as specified in the Emergency Control Actions List. This gives the operators the flexibility to enact voltage reductions later if the situation deteriorates.

use this water to produce energy instead of spilling excess water to offer operating reserve. Since the hydroelectric generators are running at, or near, 100 % capacity they have little excess capability to offer into the OR market. As runoff decreases heading into the drier summer months, hydroelectric facilities can typically resume offering OR in hours when they are not generating.

An exacerbating characteristic of the spring season is the small difference between the peak and off peak demand for energy. At times other than the spring the higher off peak demand requires more fossil units online during more hours of the day which increases the likelihood there will be capacity available to the OR market, especially in the peak hours. During the spring, demand is lower during all hours requiring less fossil units operating to satisfy the demand and hence less fossil units available to offer OR. As can be seen from Figure 3, CAOR is only being scheduled during peak hours during the spring where in other seasons the available fossil generators, and excess hydro capacity, would have been offering sufficient reserve to eliminate the need to schedule CAOR.

Figure 3: Frequency CAOR is Scheduled in Peak and Off Peak Hours

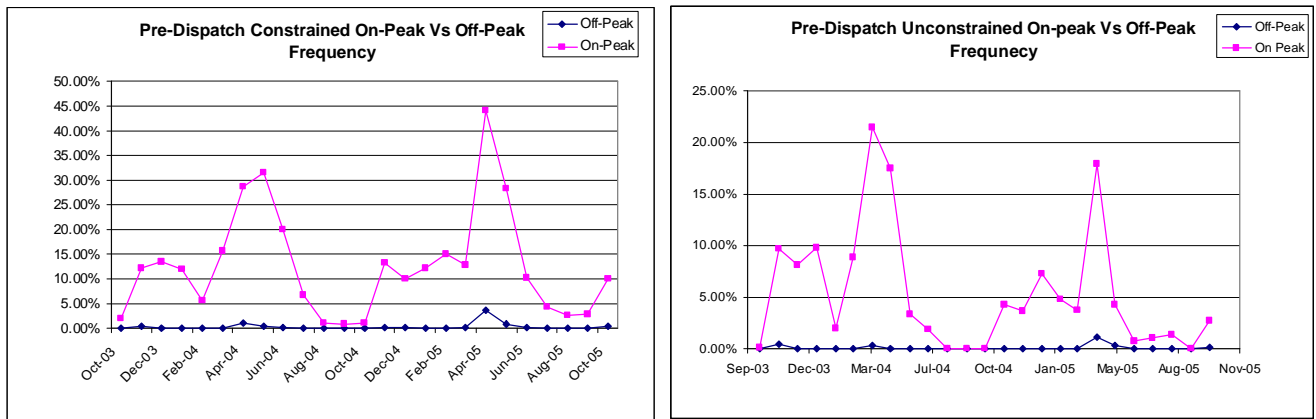
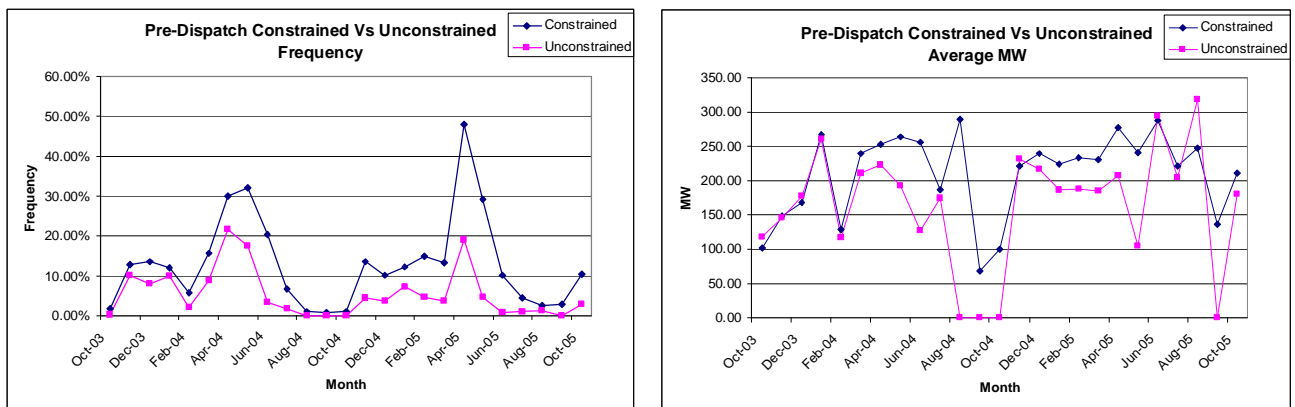


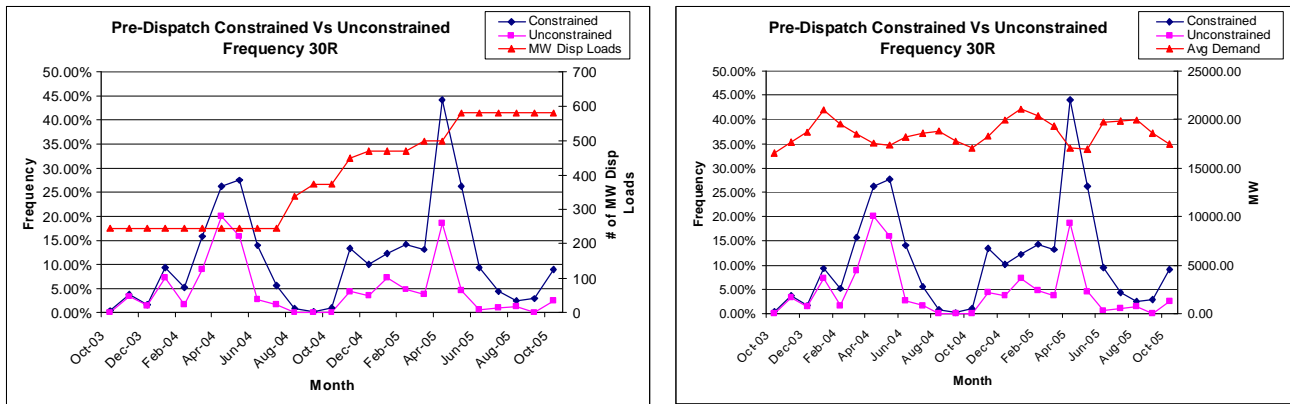
Figure 4: Predispach Constrained and Unconstrained Average Frequency and Average MW¹³ for 30R and 10N



¹³ The Average MW graph depicts the average number of MW of CAOR used when it is scheduled.

This seasonal effect is the single largest determinant of CAOR usage and is a trend that has existed from the time CAOR was introduced. A question that was examined was whether the increase in dispatchable loads has caused a reduction in the reliance on CAOR. As can be seen from Figure 5, the quantity of dispatchable load¹⁴ has had little effect on the frequency of CAOR scheduling. This shows that with 400 MW of CAOR and up to 600 MW of dispatchable loads available to offer OR the potential of the IESO running short of OR in the spring is still high. The frequent reliance on CAOR results in a reliability concern for the IESO.

Figure 5: Frequency of CAOR Usage in the 30 Minute Reserve Market¹⁵



ISSUES WITH CAOR BEING SCHEDULED IN PRE-DISPATCH

The IESO is concerned with the frequency that CAOR is being scheduled in pre-dispatch. The IESO asserts that at times such as the spring season, including CAOR in the pre-dispatch process effectively causes the market to plan itself into situations where Emergency Control Actions are relied upon for reserve in real time far too frequently. By including CAOR in the pre-dispatch sequence the proper signals about operational opportunities are not being sent to domestic generators and otherwise viable imports are not being scheduled, thereby creating reduced real time supply.

If these resources were available in real time (increased imports and domestic generation) the operators would have more flexibility in their response to a contingency. If a fossil generator was started in place of scheduling CAOR this would have an immediate and obvious positive impact on reliability. If an import was scheduled in place of CAOR that would free up domestic generation that the operators would be able to call upon in real time. These resource changes (less fossil starts, decreased imports) represent reductions in resources that the control room could have drawn upon in the event of a contingency. The IESO control room operators believe that not having these resources available is decreasing their flexibility in responding to contingencies.

¹⁴ Dispatchable loads are capable of offering into the reserve market and it would be expected that as the amount of dispatchable loads available to the OR market increase that the frequency of usage of CAOR would decrease.

¹⁵ The number of MW's of dispatchable load shown in this diagram is total MW's of dispatchable load and does not indicate the number of MW's actually being offered into the OR market. It is assumed that the dispatchable loads offer into the OR market during most hours. Note also, 30R CAOR frequency is shown as dispatchable loads were not able to offer into the 10N market during the period shown in the figure.

For these reliability reasons the IESO would like to discuss options and formulate a recommendation to address this concern.

4.0 OPTIONS AVAILABLE TO ADDRESS THE RELIABILITY CONCERNS CAUSED BY CAOR

There are two possible ways to change the CAOR in predispach. The offer price can be increased, reducing the frequency that CAOR is being scheduled, or the amount of CAOR offered in predispach can be reduced.

INCREASE PRICE(S) OF CAOR OFFER

One way to decrease the frequency of CAOR being scheduled in predispach is to increase the offer price. This would place the CAOR higher in the offer stack and reduce the potential of it being scheduled in the predispach sequence. This will have consequences in the real time markets as the higher offer price would result in higher prices in the real time energy and operating reserve markets.

REMOVE OR REDUCE EXISTING CAOR OFFER QUANTITIES FROM PREDISPATCH

Removing or reducing the CAOR offers available for scheduling in predispach would resolve the IESO's reliability concerns. A problem with this approach is the increased discrepancy this would introduce between the predispach and real-time pricing sequences. The current implementation of CAOR has already introduced a discrepancy between predispach and real-time in which the real-time sequence has 400 MW more CAOR offers available to it than does predispach¹⁶. The only way to ensure price fidelity between the predispach and real time sequences is to ensure they are provided with equivalent inputs. This change could potentially introduce greater discrepancies between the predispach and real time energy market clearing prices.

A likely consequence of the greater discrepancy between the pre-dispatch and dispatch prices will be an increase to the Intertie Offer Guarantee (IOG) payments. Without CAOR offers in predispach, the DSO will schedule the next economic resource, likely an import¹⁷, to meet the required pre-dispatch demand for energy and OR. When real time scheduling occurs, with the CAOR offers present, the real time price will fall as there would be more supply available to the real time sequence than the predispach sequence. An increase in supply will systematically lead to a decrease in price, all else being equal. This would lead to systematically higher predispach prices relative to real time prices in periods when CAOR would have been scheduled. The predispach-real time price discrepancy is the trigger for IOG payments.

¹⁶ Due to NERC and NPCC requirements the IESO cannot increase the amount of CAOR offered in pre-dispatch, this is the rationale for adding the second set of 400 MW of CAOR to the real time market only. According to the NERC and NPCC requirements an ISO cannot schedule or plan the reduction of 30 minute operating reserve, which is how increasing the quantity of the offer in predispach would be seen. This explains why the maximum available in predispach is 400 MW (250 MW demand reduction from a 3% voltage reduction and 150 MW from a 5% voltage reduction).

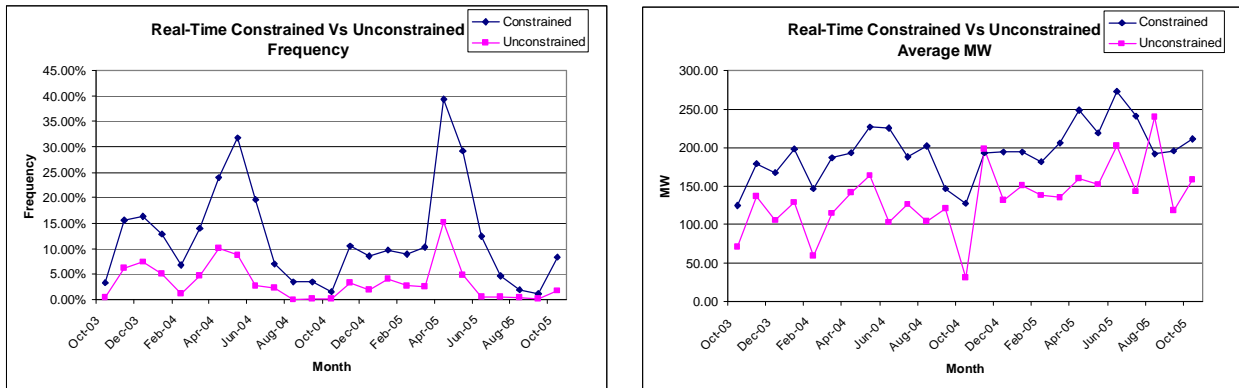
¹⁷ The next economic resource during the spring, the season the IESO is concerned with, is highly likely to be an import as excess domestic generation is not usually running during this period, please see Section 3.0 for an explanation of this scenario.

CONSTRAIN ON ADDITIONAL RESOURCES WHEN CAOR IS SCHEDULED IN PREDISPATCH

An option to address the reliability concerns with scheduling CAOR in predispach is to commit additional resources whenever CAOR is scheduled with great frequency. Constraining on a domestic generator or an additional import, whichever is cheaper, will provide more MW available on line to mitigate any reliability risks associated with scheduling CAOR. This option has the advantage of not increasing the level of pre-dispatch to real time price discrepancy as the inputs to the pre-dispatch and real time sequence will remain as they currently are.

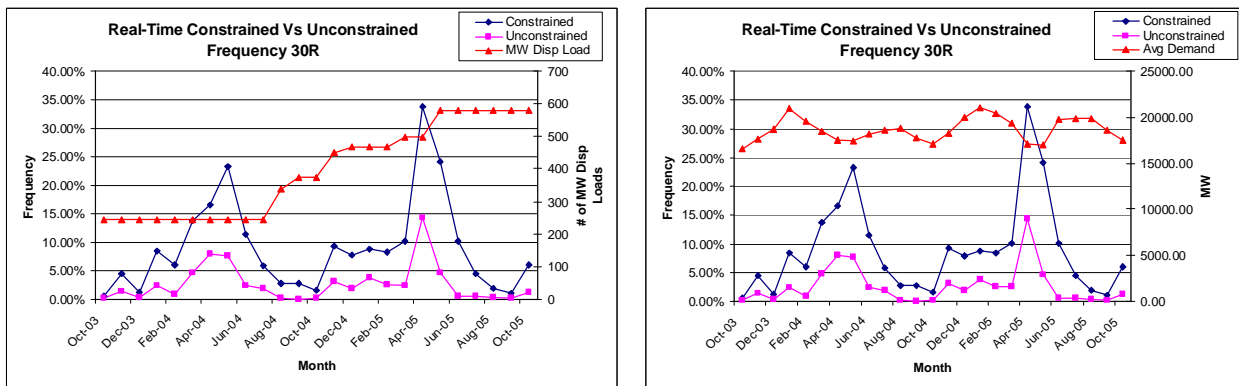
This option will obviously result in a slight increase to uplifts as a generator, or import, that was not originally economically selected will be constrained on and receive a congestion management settlement credit (CMSC) for the specified period. A procedure to determine when it is appropriate to constrain a generator on, and for how long would need to be developed.

Figure 5: Real time Constrained and Unconstrained Average Frequency and Average MW¹⁸ for 30R and 10N



Note: Figure 5 is the real time equivalent to Figure 2.

Figure 6: Frequency of CAOR Usage in the 30 Minute Reserve Market in Real Time



Note: Figure 6 is the real time equivalent of Figure 4. These show the frequency CAOR is scheduled in real time with MW's of dispatchable load and the monthly average demand. As can be seen in the charts, MW's of dispatchable load and average demand have no obvious impact on the frequency CAOR is scheduled in real time, the same conclusion of pre-dispatch.

¹⁸ The Average MW graph depicts the average number of MW of CAOR used when it is scheduled.

Figure 7: Frequency of CAOR Usage in the 10N Reserve Market

