



31 January 2006

Ken Kozlik
Chair of the Market Pricing Working Group
Independent Electricity System Operator
655 Bay Street, Suite 410, PO Box 1
Toronto, Ontario M5G 2K4

Re: Ramp rate

Dear Ken,

At AMPCO we have had extensive discussions following the January 20th meeting of the Market Pricing Working Group. AMPCO is concerned by the rush to end the 12X ramp rate assumption by the start of the Day Ahead Commitment Process. We do not see a connection between the two processes.

It is important that the solution to the ramp rate problem meet the needs of both loads and generators. Going to 1X ramp rate is not acceptable to AMPCO members. This would increase the market price to reflect ramp limits and would provide additional revenues to generators including those that do not respond by ramping up when needed. This is a windfall to these generators. Some of the generators receiving this windfall benefit will be the generators whose inability to ramp fast enough caused the ramp problems. It is unacceptable to impose these additional costs on loads. As enunciated by AMPCO representatives at the January 20th meeting, we need a solution which properly rewards generators that provide ramping service without providing a windfall benefit to generators that do not provide ramping service.

In the interests of being constructive, AMPCO asked Ken Snelson to look at the problem and suggest solutions. His work is included in the attached paper. This identifies two options for paying for ramping service without windfall benefits to the inflexible generation. These are Options 2 and 3 from his paper:

2. Defining a Ramping Ancillary Service
3. Using the 1X ramp rate price for incremental generation only

The paper suggests a high level design for Option 3, using the 1X ramp rate price for incremental generation only.

AMPCO strongly recommends that the IESO devote resources to flesh out both of these alternatives. It is only when a range of options have been evaluated that a reasonable decision can be made. This evaluation must include an assessment of the impacts on consumers, so that all participants can be assured that any changes are

consistent with the purpose of the IESO to protect the interests of consumers with respect to prices and the adequacy, reliability and quality of electricity service.

In the mean time there is no basis for moving away from the 12X ramp rate assumption.

I trust these comments are useful. We look forward to working constructively with you and all the staff at the IESO on these important issues.

Sincerely,

A handwritten signature in blue ink, appearing to read 'Adam S. White', with a long horizontal stroke extending to the right.

Adam S. White
President

cc. AMPCO Directors
Bruce Campbell, IESO
Dave Goulding, IESO
Glenna Carr, IESO

Dealing with Generator Ramp Limits in Ontario

Prepared for AMPCO by Ken Snelson Jan 21, 2006

Current Situation

In the existing electricity market the Market Schedule is calculated assuming that each unit has a ramp rate that is 12 times its actual ramp rate. This is an arbitrary assumption that removes most of the influence of ramp rate limitations from the Market Schedule. The Dispatch Schedule is managed to respect the actual ramp rate restrictions and differs from the Market Schedule for this reason, and a number of other reasons including transmission constraints. When the Dispatch Schedule requires more MW from a resource than indicated in the Market Schedule, the resource receives a "constrained-on" CMSC payment to ensure that the generator receives revenue equal to its bid for that quantity. When the Dispatch Schedule requires less MW from the resource than the Market Schedule there is a "constrained-off" CMSC payment to make up the profit to the level implied by the difference between the market revenue and the bid for the market quantity.

In summary, the existing system largely ignores ramp restrictions in the Market Schedule. Differences between the Dispatch Schedule and Market Schedule to respect ramp limits are compensated through the CMSC system.

Generator Perspective

Generators claim that suppressing the effects of ramp limitations in the Market Schedule depresses price and does not compensate them sufficiently for responding to ramp limited situations. CMSC is designed to avoid losses relative to bids but not to allow profits from a market price that might exceed the bid price. Generators have pushed hard to have the artificial 12X ramp rate assumption removed and replaced with a 1X ramp rate assumption that reflects the actual ramp rates.

Customer Perspective

Having generation available to respond to ramp limited situations is important for customers and customers should be prepared to pay appropriately for that service. However, removing the 12X ramp rate assumption has the effect of increasing the market price for all generation whether or not it contributes to responding to ramp limited situations. When the system is in a ramping-up situation and ramp rates are limiting, additional higher priced generation with the capability to ramp up will be brought on line because the lower cost generation cannot ramp fast enough. Raising prices for all generation to the level implied by the higher cost generation would increase revenues to generation that cannot ramp and is not responding to the ramp need. This can be generation with very low ramp rates or generation that is already at maximum output and so cannot increase further. Customers should be prepared to pay appropriately for the ramping service but should not be required to make payments for ramping service to generators who do not provide the service. Such payments would be a windfall benefit to those generators.

In principle a solution to this problem should only be acceptable to customers if:

- it provides sufficient compensation to generators to provide ramping service to ensure that the service is provided as needed
- It avoids making payments for ramping service to those generators who do not provide the service.

Alternative Methods of Compensating For Ramping Service

Four alternative methods are considered:

1. Compensation through CMSC payments – the current system
2. Defining a Ramping Ancillary Service
3. Using the 1X ramp rate price for incremental generation only
4. Using the 1X ramp rate price for all generation

Alternatives 1 and 4 have already been discussed. Alternative 1 is not acceptable to generators because it does not allow for profit relative to bids in providing ramping service. Alternative 4 is not acceptable to customers because it generates windfall payments to generators who do not provide ramping service.

Alternative 2 would define a Ramping Service (or Customer Following Service) similar to AGC which would be available to the IESO to manage ramp limited situations. The cost of such a service would be paid by customers through uplift. The new uplift to be paid by customers would tend to be offset by a reduced contribution of ramp limits to CMSC payments and associated uplifts. To the extent that the compensation to generators increases and assuming there are no additional efficiencies in scheduling ramp limited resources, there would be a net increase in cost to customers. However, this increase would be targeted to those resources providing the service and should be effective in ensuring that the ramp capability needed by customers is provided at a reasonable cost. This alternative requires further development to determine how generators would 'compete' to provide the service, how its use would be coordinated with the dispatch algorithm, how generators would be paid for the service. It is not discussed further in this paper although it should be considered as a viable alternative.

Alternative 3 allows incremental generation that responds to ramp limits during a ramp limited event to be paid a higher price while generation that is not responding to the ramp limits is paid a price that does not take into account ramp limits. This is a market-based solution that allows flexible units to compete to provide ramping service while avoiding additional ramping payments to units that do not ramp. There may be objections to this scheme that not all MWs are being treated equally. Normally all MWs have equal value and can be scheduled based on energy bids. If a lower cost MW is available it will be used to displace a higher cost MW. However, in a ramp limited situation the available ramp rate is a determinant of value in addition to the MWs bid for a given price. Another way of looking at this is that there are two different products – the units that can respond to ramp needs provide a quick response product which the other units do not. It is normal for speed of response to be a factor in determining the value of a product. Therefore it is appropriate to discriminate between resources that provide ramp and those that do not.

The rest of this paper discusses the high level design for one method for implementing Alternative 3. Others may have additional ideas as to how to design a market mechanism that respects the two basic requirements.

Market Price Calculations

Two market price calculations are done for each 5-minute dispatch interval. One calculation represents the market conditions ignoring ramp restrictions (this could be the current 12X ramp rate calculation) this is called the Base Price. The other market calculation is called the Ramp Price and includes the actual ramp restrictions i.e. a 1X ramp rate assumption. For times when ramp restrictions are not limiting

these calculations should be the same. Where the two calculations are different, the Market Schedule will be determined by the Ramp Price calculation and will account for ramp limits.

Ramp Limited Events

The incremental pricing is in effect during ramp limited events. A “ramp-up limited event” starts when the Ramp Price exceeds the Base Price. It ends when the Ramp Price returns to the same level as, or goes below, the Base Price. A “ramp-down limited event” is defined by the period that the Ramp Price is below the Base Price. Ramp-down limited events are less frequent than ramp-up limited events but must be accommodated. The following discussion is with respect to ramp-up limited events but comparable formulae can be developed for ramp-down limited events.

Scheduled Generation, Initial Generation and Incremental Generation

The Scheduled Generation for a resource is the generation in the five minute from the Market Schedule including ramp limits. During a ramp-up limited event the Initial Generation is the Scheduled Generation in the last interval before the start of the ramp-up limited event. This should be the same in the two pricing calculations. Incremental Generation is defined as the Scheduled Generation level less the Initial Generation.¹

Market Energy Payments

The payment to a generator is:

$$\text{Base Price} \times \text{Initial Generation}^2 \text{ plus} \\ \text{Ramp Price} \times \text{Incremental Generation}$$

An alternative but equivalent formula is:

$$\text{Base Price} \times \text{Scheduled Generation plus} \\ (\text{Ramp Price} - \text{Base Price}) \times \text{Incremental Generation}$$

With this formulation:

- A base load generator that does not increase its output during the ramp-up limited event is paid the Base Price which is not increased because of ramp limits. This is appropriate because this generator does not contribute to meeting the ramping need.
- A generator that is required solely because of the ramp limits will have zero Initial Generation and will be paid for the full Scheduled Generation at the higher Ramp Price. If this is the highest priced generation in the stack, it will set the Ramp Price and will be paid its bid price. If it is not the highest priced generation in the stack, the clearing price in the Ramp Price Calculation will be set by a higher bid priced unit. This is the same outcome as in the 1X ramp rate calculation proposed by the generators.

¹ It probably makes sense not to allow negative Incremental Generation quantities during ramp-up limited events. The result of allowing negative Incremental Generation would be to penalize generators who reduce generation during a ramp-up limited event. This could occur because of a failure or because the generator was dispatched down. Neither case is the result of a decision by the generator to deliberately ramp-down at a time when ramping up is needed.

² If the Incremental Generation is not allowed to go negative during a ramp-up limited event, this is the higher of the Initial Generation and the Scheduled Generation.

- A generator that can ramp to some degree will be paid for its Incremental Generation at the higher rate but at the lower rate for its Initial Generation. This gives the generator the incentive to maximize its ramping rate to get more generation at the higher rate.

This pricing scheme would be applied to all dispatchable generation with an equivalent formulation for dispatchable customers.

The two-tier pricing naturally ends at the end of the ramp-up event because the event ends when the Base Price and the Ramp Price become the same.

Hourly Ontario Energy Price

The Hourly Ontario Energy Price would be the weighted average of the generation bought at the Base and Ramp Prices. Since the Ramp Pricing is incorporated in HOEP, it would not be necessary to cover the cost of meeting ramp restrictions through uplift. This is not a necessary part of the scheme. The alternative is that HOEP be based on the Base Price only with the difference between Ramp price and Base Price for ramping generation being covered through uplift.

Constraint Payments

Constrained-on and constrained-off payments will still be required to manage differences between the Dispatch and Market Schedules. The principles will remain the same. Generators dispatched at a higher level in the Dispatch Schedule than the Market Schedule will be eligible for a constrained-on payment which holds him whole to his bid. A generator that is dispatched at a lower level than the Market Schedule will be eligible for a constrained-off payment to protect the profit implied by the Market Schedule. The detailed calculations will change because they will need to account for revenues at the Base Price and also revenues at the Ramp Price.

There should be less need for constraint payments than today because ramp constraints are accounted for in the Market Schedule. In the absence of transmission or other non-ramp constraints, a generator that has its schedule changed to accommodate ramp limits will not receive CMSC payments because the ramp limits are appropriately accounted for in the Market Schedule and market prices.

Including the effects of Multi-Interval Optimization

MIO has been implemented in the Dispatch Schedule to achieve a schedule that is closer to optimal in ramp limited events. This is done by looking forward over a number of intervals within the hour ahead. A ramp-limited unit may be ramped up early to reduce the use of a higher cost unit in later intervals. In this case the schedule in one time interval is a function of predicted conditions in future intervals and is no longer solely dependant on initial conditions, bids and customers in the specific interval.

The MPWG has had many presentations on how to calculate the incremental price with MIO. The above formulation will work with any of the definitions of incremental price in the Ramp Price calculation. However, its accuracy will be improved by using the most accurate formulation such as that proposed by IESO staff – MIO Modified Incremental Price.

Timing of Changes

Implementing this system could require significant changes to market tools. Experience suggests that the development and implementation time for such a change will be six months or more. This raises the question as to whether any changes should be made in the interim to better reflect ramp rates until a proper pricing scheme for ramp can be implemented.

The only feasible alternatives with minimal work are to retain the current 12X ramp rate or to change to a 1x ramp rate calculation. The proposed scheme that properly reflects ramp constraints is closer to the 12X ramp rate calculation than the 1X ramp rate calculation. The 12X ramp rate mechanism already provides some additional compensation to Incremental Generation through CMSC without paying the base generation for ramping service they do not provide. The base generation will be the larger proportion. It would be a move in the wrong direction to institute 1X ramp rate prices for all generation as an interim measure and then withdraw the ramp price component when new tools are developed.