

Two Examples to compare ramp rate effects on prices

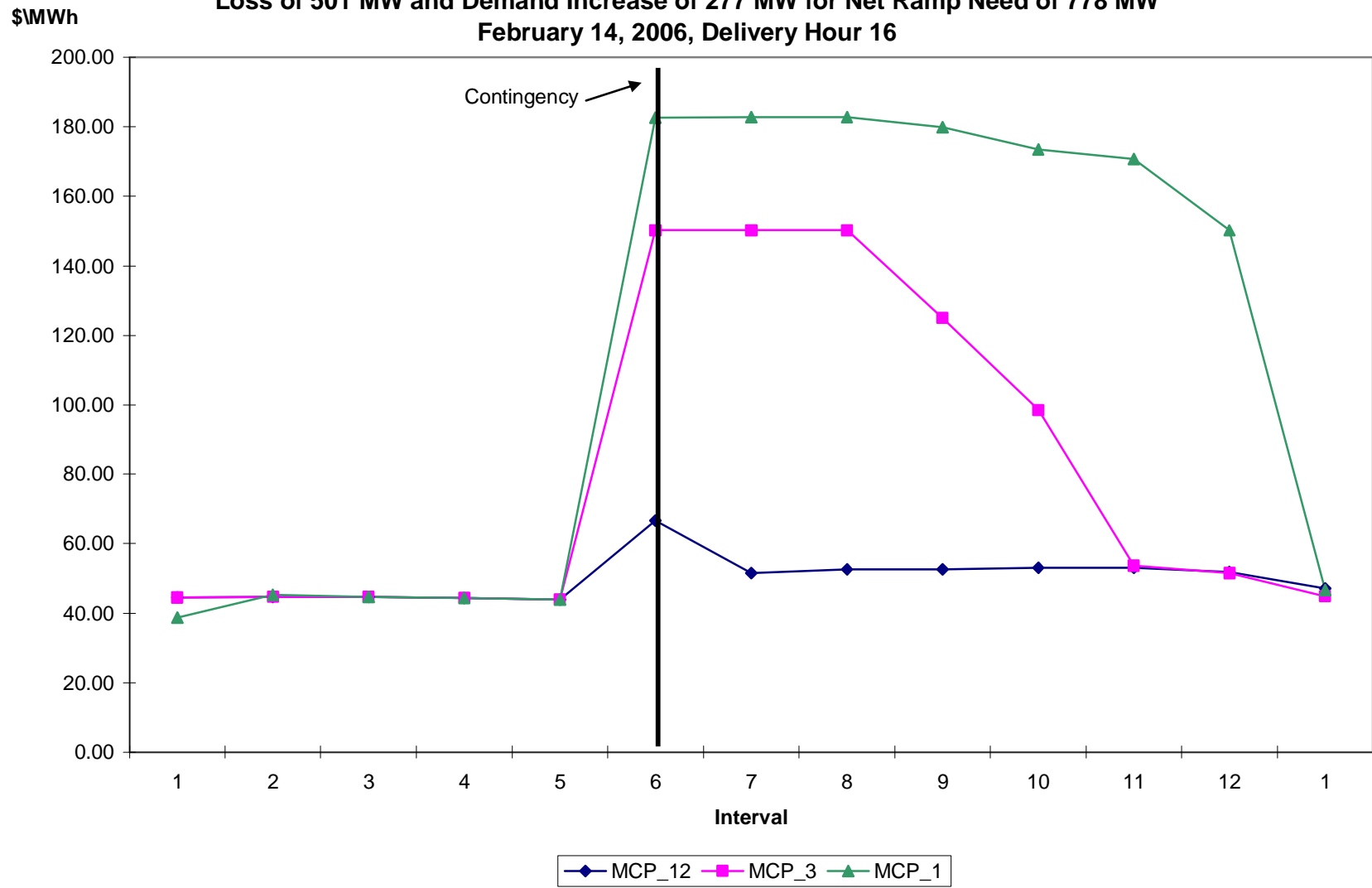
1. February 14, 2006 Hour 16

This is an illustration of a how a large contingency would create a divergence between the prices under different ramp rate assumptions. In short, prices under the different ramp rate assumptions diverge more when the market is clearing on a point of the offer curve where there is considerable unused fossil generation.

Market Facts:

- In interval 6, two things occur: (i) loss of a unit (501 MW) and (ii) demand increases by 277 MW. In net there is a ramp need of 778 MW.
- Operating reserve was not activated to replace the loss generation.
- In interval 5, just prior to the contingency, there are two fossil generation facilities that are on line with a total of 870 MW of energy offered but not scheduled in the unconstrained sequence. The ramp rates for both of the units increases as the offered quantities increases – from 2MW per minute for the initial quantities offered (first 150 to 100 MW offered) to 10 MW per minute on the next 200 MW of output.
- Under 12 times pricing, these two units can increase their output by a total of 320 MW from interval 5 to 6. Additional supply comes from other fossil plants through the conversion of operating reserve to energy. A gas fired unit sets the price in interval 6 at \$66.66. After that, demand remains relatively stable. The two fossil units provide the additional supply to replace the contingency. They set the price for the rest of the hour.
- Under 3-times pricing, the two fossil units can increase their output from interval 5 to 6 by a total of 60 MW. With less ramp available, the price spikes to \$150 (set by a higher priced hydro unit). With three times pricing, the two fossil units provide an additional 60 MW of energy in interval 7 and prices remain stable. For the next few intervals more supply becomes available from the two fossil units and prices converge to the 12 times price level within the hour.
- Under 1-times pricing, the two fossil units can provide only 20 MW from interval 5 to interval 6. As a result the price is \$187 and set by even higher prices hydro facility. With 1 times ramp rate, the two fossil units can only provide 60 MW across the hour. Prices do not converge to the 12-times price level within the hour.

Large Contingency with Spare Fossil Generation On Line
Loss of 501 MW and Demand Increase of 277 MW for Net Ramp Need of 778 MW
February 14, 2006, Delivery Hour 16



2. December 14, 2005 Hour 8

This is an illustration of where contingency would create little divergence between the prices under different ramp rate assumptions. In short, prices under the different ramp rate assumptions diverge very little when the market is clearing on a point of the offer curve where there all available fossil generation is already scheduled.

Market Facts:

- The Pre-dispatch price was \$199 signalling tight supply conditions. All of the provinces available fossil generation was scheduled in pre-dispatch.
- Prior to the start of the hour there were 216 MW of failed imports, causing the supply situation to be further strained.
- At the same time, just prior to the start of the hour, a gas fired generation unit which was scheduled full capacity in pre-dispatch, had difficulty ramping up to full capacity. The unit was run at minimum for the hour until interval 10 in which it was lost fully. This resulted in a derating of roughly 480 MW across the hour.
- The demand increased by over 1000 MW from the start to the end of the hour with interval by interval demand increases of 150 MW in a few intervals.
- In this example, there is virtually no difference between the prices as produced under 12 times and 3 times. The prices are typically set by higher priced Hydro-electric generation which is not ramp limited.

**Large Contingency with No Spare Fossil Generation On Line
Loss of 216 MW of Imports and 480 MW Derating of Gas-Unit
December 14, 2005, Delivery Hour 8**

