

# Shortage Pricing Timeline Example

20100412 SPWG – ITEM 5

- The purpose of this example is to illustrate at a high-level how the PJM-proposed shortage pricing mechanism will function
- The timing for the example uses the emergency declarations made on 8/8/07

- 11:44 – Long lead time emergency DR in BC, PEP is deployed
- 12:08 – Long lead time emergency DR in Mid-Atlantic and Dominion is deployed
- 12:20 – Short lead time emergency DR in BC, PEP is deployed
- 12:33 – Loading of maximum emergency generation in the BC/PEP zones to relieve contingency overloading on the Conastone #3 500/230 kV transformer for Conastone #2 500/230 kV transformer

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- **14:44 – Primary Reserve warning in Mid-Atlantic**
- 15:05 – Loaded maximum emergency generation in the DOM zone in addition to BC/PEP to relieve the BED-BLA reactive transfer interface
- 15:30 – Short lead time emergency DR in Mid-Atlantic is deployed

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- **15:55 – 5% voltage reduction in the Mid-Atlantic region**
- 15:57 – Loaded maximum emergency generation in Mid-Atlantic

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- **17:09 – 5% voltage reduction in the Mid-Atlantic region is terminated**
- 17:33 - PJM cancelled the maximum generation in the Mid-Atlantic with the exception of the BC/PEP zones.
- 17:50 – Long and short lead time emergency DR in Mid-Atlantic (except BC, PEP) is restored
- 18:12 – Maximum generation in the BC, PEP zones is restored
- 18:35 – All emergency DR in Dominion and BC, PEP is restored

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- **18:53 – Primary Reserve warning in Mid-Atlantic is terminated**

(1)

(2)

(3)

(4)

- No reserve shortage and no penalty factors impacting LMP
- All events prior to 14:44 are the deployment of emergency capacity
- PJM's opinion is that this capacity should be eligible to set price at up to its offer price
- The existing \$1,000/MWh offer cap will remain in place and therefore any resource setting LMP will do so at a price less than or equal to the offer cap
- Reserve and regulation prices will be calculated every 5-minutes commensurate with system conditions

- During the period prior to a reserve shortage it is imperative that emergency capacity (generation and DR) be permitted to set LMP if it is marginal
- Not allowing this will essentially treat these high-priced resources as “self-schedules” in the energy market resulting in a fall in LMP as the system approaches the reserve shortage
- This would be a counter-intuitive market result given that emergency capacity is being depleted and reserves are going to go short in the near future

- Issuance of a Primary Reserve warning indicates a shortage of Primary Reserve in the Mid-Atlantic
- From a dispatch perspective, resources previously being held back to provide Primary Reserves are now beginning to be dispatched for energy
- This causes:
  - The NSRMCP in the Mid-Atlantic+DOM to be set to the penalty factor
  - The Primary Reserve penalty factor to impact LMP in the Mid-Atlantic+DOM
  - A shift in the marginal resource from what was likely a high cost resource that was marginal for energy while reserve requirements could be met to a lower cost resource that was previously providing reserves that are now being converted to energy
  - The LMP will be the primary reserve penalty factor plus the marginal cost of energy

- Similar to the first step, the emergency DR and generation deployed at this time should be eligible to set LMP at its offer price
- The emergency capacity that is eligible to set LMP is subject to the \$1,000/MWh offer cap
- In the Mid-Atlantic+Dominion
  - Assuming penalty factors after transition
  - If emergency capacity eliminates the reserve shortage, energy prices could be up to the \$1000/MWh offer cap
  - If shortage is not eliminated, LMPs will range between \$850 and \$1850 depending on the marginal resource for energy
  - SRMCP between \$850 and \$1700
  - NSRMCP = \$850

- All emergency DR in the Mid-Atlantic and Dominion has been deployed and is eligible to set LMP
- Emergency generation has been loaded in Dominion, BC and PEP and is eligible to set LMP
- Primary Reserves are short in the Mid-Atlantic+Dominion region and the NSRMCP is set to the penalty factor (\$850)
- Synchronized Reserves are not short in the Mid-Atlantic+Dominion. The SRMCP is greater than or equal to the Primary Reserve penalty factor (\$850 - \$1700)
- LMPs in the Mid-Atlantic+Dominion are equal to the Primary Reserve penalty factor plus the marginal cost of energy (\$850 - \$1850)

- Initiation of a voltage reduction means Synch Reserves are short
- At this point, both Synch and Primary Reserves are short in the Mid-Atlantic
- From a dispatch perspective, the non-synchronized portion of Primary Reserves have been fully converted into energy and now synchronized reserves are being dispatched for energy
- This causes:
  - The SRMCP in the Mid-Atlantic+DOM to be set to the sum of the Primary and Synch Reserve penalty factors
  - The Primary and Synch penalty factors now both impact LMP in the Mid-Atlantic+DOM
  - A shift in the marginal resource from what was likely a high cost resource that was marginal for energy while primary reserve requirement could be met to a lower cost resource that was previously providing synchronized reserves that are now being converted to energy
  - The LMP will be the primary reserve penalty factor plus the synchronized reserve penalty factor plus the marginal cost of energy

- Remaining emergency generating capacity in the Mid-Atlantic is deployed
- This generating capacity will be eligible to set LMP
- In the Mid-Atlantic+Dominion
  - Assuming penalty factors after transition
  - If remaining emergency capacity deployed had eliminated the synchronized reserve shortage, LMPs would range from \$850-\$1700
  - LMPs will range between \$1700 and \$2700 depending on the marginal resource for energy as the reserve shortages remain
  - SRMCP = \$1700
  - NSRMCP = \$850

## (4) Termination of Voltage Reduction and Restoration of Most Emergency Capacity -- 17:09 – 18:53

- Termination of the voltage reduction now assumes Synch Reserve requirement can be met
  - Assuming penalty factors after transition
  - SRMCP between \$850 and \$1700
  - LMP between \$850 and \$1850
  - NSRMCP still \$850 as Primary is still short
- In the dispatch, higher cost resources are now marginal for energy as DR and dispatchable generation are used to restore reserves
- The LMP and SRMCP will be dependant on the marginal cost of energy and which resource is marginal for SR
- Prices during this period are still high given that Primary Reserves are still short but are declining as load decreases and emergency capacity is restored

- Termination of the Primary Reserve warning means that the Primary Reserve requirement can now be met and the system is no longer in any reserve shortage
- In the Mid-Atlantic+Dominion
  - Assuming penalty factors after transition
  - NSRMCP < \$850
  - SRMCP < \$1700
  - LMP will now likely fall to \$1,000/MWh or less depending on local congestion and losses. Penalty factors are no longer influencing LMP.