Use of Penalty Factor for the ORDC

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Use of $2,000/MWh as the Penalty Factor

- PJM is proposing a penalty factor of $2,000/MWh for all reserve products
- PJM will commit and dispatch all economic generation to maintain 10- and 30-minute reserves products
- Energy offers from these resources can be up-to $2,000/MWh
- When LMPs are in the range of $2,000/MWh, the lost opportunity costs for resources with lower offers will be high.
- PJM's dispatch systems must be able take these actions so that operators do not need to manually dispatch resources.
- Prices must reflect these actions.

Quick Example

- No congestion, no losses

- Marginal unit offer = $1,900/MWh
- LMP at Generator A = $1,900/MWh
- Energy Offer of Generator A = $50/MWh

- Lost Opportunity Cost = LMP – Offer = $1,900/MWh - $50/MWh = $1,850/MWh

Pre-Emergency and Emergency Demand Response

- Pre-Emergency and Emergency Demand Response can also submit offers close to $2,000/MWh (~$1,850/MWh)

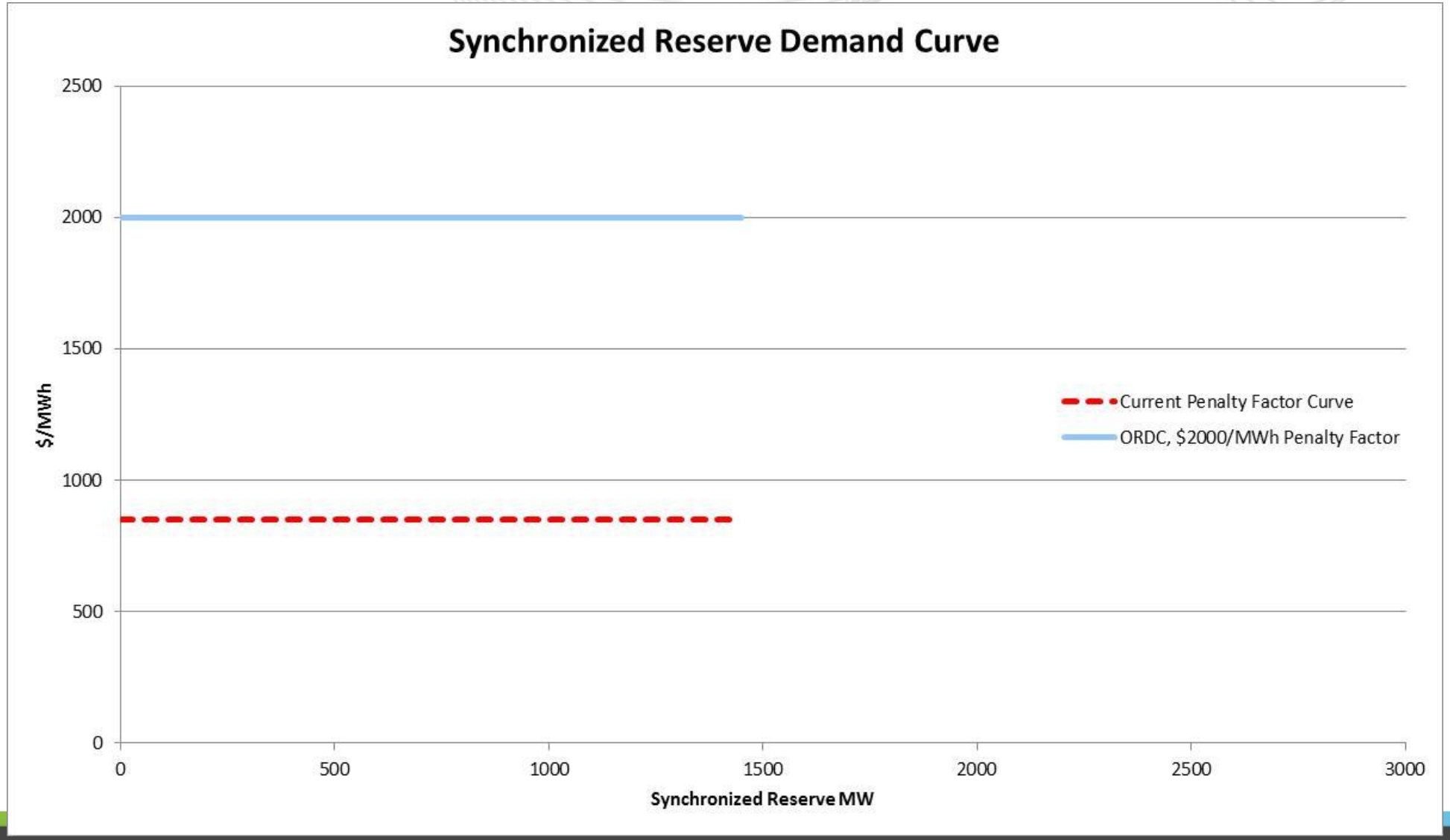
- These offers are submitted everyday and are an action that operators will take to maintain 10-minute reserves everyday
  - Section 2.3, PJM Manual 13

Other Emergency Procedures

- Voltage Reduction Action and Manual Load Dump Action
  - Voltage Reduction Action will be done to maintain Synchronized Reserves but not Primary Reserves
  - Manual Load Dump Action will be done as a reserve deployment but not to maintain a minimum level of reserves

- These are the most extreme actions.
- Should the system operators ever take these actions, prices should be at or near their peak.
- When in either of these conditions today, PJM's rules force a simultaneous shortage of all reserve products.
  - PJM believes this process should continue.

Flat Portion of the ORDC

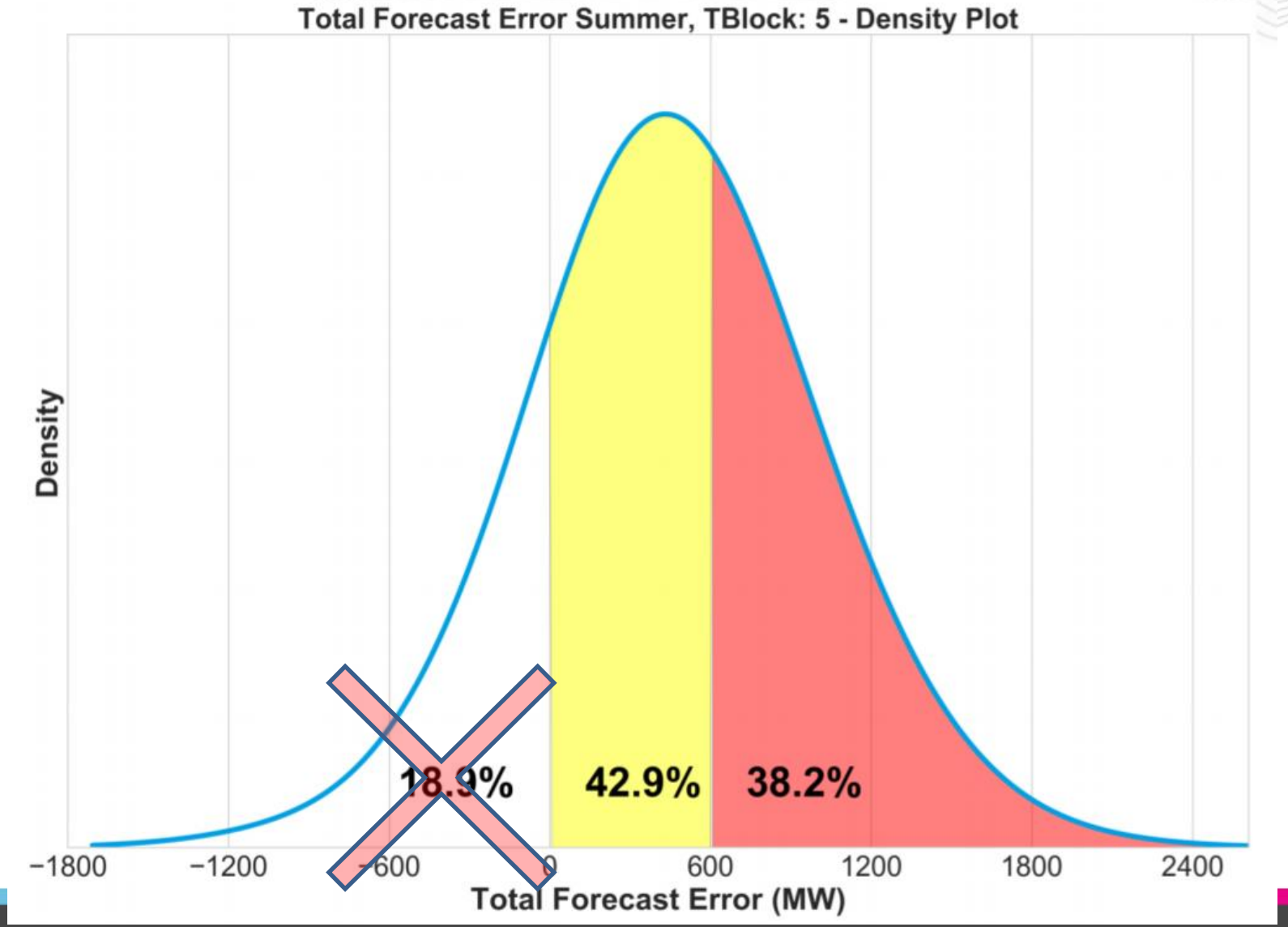


Probability of Not Meeting the Minimum Requirement

- Probabilities are determined using uncertainties
- This is a two-tailed distribution
  - Uncertainty can result in more reserves or less
  - This can happen under various conditions

- PJM will not rely on the benefit of forecast error to meet its minimum reserve requirements.
- This results in the removal of one tail of the distribution and the block shape to all the curves.

Removal of Tail



PBMRR * Penalty Factor

- Downward-sloping section of the curve
- Based on the PBMRR * Penalty Factor for various levels of reserves
  - Regulation requirement is subtracted from the MW levels

- At its core, the ORDC intended to reflect demand bids for reserves at various levels that do not exist in any markets today

  What would a consumer be willing to pay to procure another MW of reserves given the incremental benefit to reliability?
- The incremental benefit to reliability is the reduction in probability of not meeting the MRR.
- The maximum willingness to pay has already been established at $2,000/MWh
  - $850/MWh in today's model

PBMRR * Penalty Factor

- If the cost of a reserve shortage is $2,000/MWh, and procuring another MW of reserves would result in a 40% chance of that shortage occurring, a rational demand bid for those reserves would be $800/MWh ($2,000/MWh * 40%).

- More generically, “willingness to pay” is:

marginal cost of a reserve shortage * probability of that shortage occurring

or

Penalty Factor * PBMRR

Synchronized Reserve Demand Curve