



## **Problem Statement: Payments to tier 1 synchronized reserves when the non-synchronized reserve price is greater than zero**

### ***Introduction***

Primary reserve is to ensure reliability in the event of contingencies. Primary reserve is PJM's implementation of the NERC 15-minute contingency reserve requirement. The NERC requirement is to carry sufficient contingency reserves to meet load requirements reliably and economically and provide reasonable protection against instantaneous load variations due to load forecasting error or loss of system capability due to generation malfunction. PJM implements the NERC requirement conservatively as primary reserve available within ten minutes.

PJM's primary reserve requirement is satisfied by synchronized tier 1 reserves, synchronized tier 2 reserves and non-synchronized reserves (NSR), subject to the requirement that synchronized reserves equal 100 percent of the largest contingency.

Tier 1 synchronized reserve is a component of primary reserve comprised of all on-line resources following economic dispatch and able to ramp up from their current output in response to a synchronized reserve event. The tier 1 synchronized reserve for a unit is measured as the lower of the available ten minute ramp and the difference between the economic dispatch point and the economic maximum output. Tier 1 resources are identified by the market solution and the sum of their ten minute availability equals available tier 1 synchronized reserve. Tier 1 Synchronized Reserve is the first element of primary reserve identified by the market software and the availability of tier 1 has zero incremental cost. As a result, the cost for the availability of tier 1 has been zero.

However, the shortage pricing tariff (October 1, 2012) states that tier 1 synchronized reserve is to be paid the tier 2 synchronized reserve market clearing price whenever the non-synchronized reserve market clearing price (NSRMCP) rises above zero. The quantity of tier 1 to be paid this price is not clearly defined. The rationale for this change was and is unclear but it has had a significant impact on the cost of tier 1 synchronized reserves. The additional payments are not for availability. The additional payments are not for performance.

### ***Pricing variations***

During hours when the NSRMCP = \$0 and there is no spinning event, tier 1 synchronized reserve credits are not compensated.

During hours when the NSRMCP = \$0 and there is a spinning event, tier 1 resources are compensated at the Synchronized Energy Premium Price for the actual amount of tier 1 Synchronized Reserve provided.<sup>1</sup>

During hours when the NSRMCP > \$0 and there is no spinning event, tier 1 resources are compensated using the tier 2 price. The quantity of tier 1 to be paid this price is not clearly defined in the tariff, but PJM Settlements appears to calculate the quantity as the estimate of available ten minute ramp within the operating hour, which is substantially greater than the amount of tier 1 MW accounted for when the Synchronized Reserve Market is cleared in the hour prior to the operating hour.<sup>2</sup>

During hours when the NSRMCP > \$0 and there is a spinning event, tier 1 resources are compensated at the tier 2 price for the actual amount of tier 1 Synchronized Reserve provided.

The non-synchronized reserve market clearing price was above \$0.00 in 406 hours during the first eight months of 2014, in 15 of which there was a spinning event. For those 406 hours, tier 1 synchronized reserve resources were paid the tier 2 synchronized reserve market clearing price, which resulted in total payments of \$87,813,810 in credits. (Table 0-1). The tier 1 MW weighted average SRMCP for the full RTO in the 406 hours when the NSRMCP was greater than \$0.00 was \$64.59 for the first eight months of 2014.

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<sup>1</sup> The Synchronized Energy Premium Price is defined as the average of the five-minute LMPs calculated during the synchronized reserve event plus \$50/MWh. If the hourly integrated LMP is greater than the Synchronized Energy Premium Price, the Tier 1 credit is zero.

<sup>2</sup> See Tariff, 02/22/2013 p.1762. "i) Credits for Synchronized Reserve provided by generation resources that are then subject to the energy dispatch signals and instructions of the Office of the Interconnection and that increase their current output or Demand Resources that reduce their load in response to a Synchronized Reserve Event ("Tier 1 Synchronized Reserve") shall be at the Synchronized Energy Premium Price, with the exception of those hours in which the Non-Synchronized Reserve Market Clearing Price for the applicable Reserve Zone or Reserve Sub-zone is not equal to zero. During such hours, Tier 1 Synchronized Reserve resources shall be compensated at the Synchronized Reserve Market Clearing Price for the applicable Reserve Zone or Reserve Sub-zone for the lesser of the hourly integrated amount of Tier 1 Synchronized Reserve attributed to the resource as calculated by the Office of the Interconnection, or the actual amount of Tier 1 Synchronized Reserve provided should a Synchronized Reserve Event occur."

**Table 0-1 Price and cost of tier 1 synchronized reserve attributable to a non-synchronized reserve price above zero; January through August, 2014. last updated 09/26/2014 - tab**

Year	Month	Tier 1 MW Weighted Synchronized Reserve Market Clearing Price When NSRMCP>\$0	Tier 1 MW Weighted Non Synchronized Reserve Market Clearing Price When NSRMCP>\$0	T1 Credits	T1 Actual MW
2014	Jan	\$109.81	\$64.58	\$65,068,493	747,961
2014	Feb	\$42.57	\$20.22	\$2,587,477	60,769
2014	Mar	\$46.49	\$23.63	\$10,578,718	246,401
2014	Apr	\$16.36	\$7.53	\$4,954,385	312,419
2014	May	\$15.85	\$4.58	\$3,977,385	252,363
2014	Jun	\$35.46	\$11.98	\$531,432	15,354
2014	Jul	\$14.20	\$5.98	\$67,579	6,600
2014	Aug	\$27.57	\$23.96	\$53,305	1,933
2014 Total		\$64.59	\$36.04	\$87,813,810	1,643,692

The tariff is clear about the price to be paid to tier 1 reserves when the NSRMCP is greater than zero, but it is not clear about the quantity to which the price applies. The tariff states that the quantity is “the hourly integrated amount of Tier 1 Synchronized Reserve attributed to the resource as calculated by the Office of the Interconnection.” There are at least two interpretations of the quantity. One interpretation is the amount of tier 1 MW estimated by PJM when PJM runs the hour ahead market for tier 2. That tier 1 estimate directly results in defining the MW amount of tier 2 that PJM purchases in the synchronized reserve market. Another interpretation is the amount of tier 1 estimated to be simultaneously available in the operating hour. PJM Settlements appears to be using the latter interpretation. The amount of tier 1 calculated by PJM Settlements is substantially higher than the amount of tier 1 estimated by the market solution.

The additional payments to tier 1 synchronized reserves do not create an incentive to provide more tier 1 synchronized reserves. The additional payment is not a payment for performance as all estimated tier 1 reserves receive the payment regardless of whether they provided any response. Thus, 73.0 percent of tier 1 resources do not respond but are paid when the non-synchronized reserve price is greater than zero. Tier 2 synchronized reserve resources are paid the market clearing price for tier 2 because they stand ready to respond and incur costs to do so, have an obligation to perform and pay penalties for nonperformance. The MMU recommends that the additional payments to tier 1 be eliminated.

**Problems:**

The issues relevant to tier 1 payments are:

1. There is no logical reason to pay tier 1 resources the tier 2 price when the non-synchronized reserve price is greater than zero and there is a spinning event. The Synchronized Energy Premium Price provides appropriate incentives and compensation for tier 1 resources when they respond to a spinning event.
2. There is no logical reason to pay tier 1 resources the tier 2 price when the non-synchronized reserve price is greater than zero and there is no spinning event. Tier 1 resources are doing nothing.
  - a. The MW of tier 1 paid the tier 2 price when there is no spinning event is overstated and not required by the tariff. The MW of tier 1 is not clearly defined in the tariff, but PJM Settlements appears to calculate the quantity as the estimate of available ten minute ramp within the operating hour, which is substantially greater than the amount of tier 1 MW accounted for when the Synchronized Reserve Market is cleared in the hour prior to the operating hour.

The rule implies a performance obligation where none exists. Tier 1 synchronized reserve is a reserve called by dispatch during spinning events. But tier 1 resources are not obligated to respond to spinning events. Tier 2 and non-synchronized reserves are assigned, obligated to respond to a spinning event, and penalized for non-response.

Tier 1 synchronized reserve is paid the Synchronized Energy Premium Price when a spinning event occurs and it responds. These spinning event response credits for tier 1 response are independent of the tier 1 estimated MW, independent of the synchronized reserve market clearing price, and independent of the non-synchronized reserve market clearing price.

### ***Example***

Paying tier 1 MW is inconsistent with the calculation of the market solution price. The market solution considers tier 1 MW to have a zero cost. If the synchronized reserve requirement can be satisfied entirely by tier 1 MW then the SRMCP=\$0. If there is not enough tier 1 to satisfy the SR requirement the remainder of the synchronized reserve requirement is supposed to be filled by tier 2, optimized across tier 2 and energy. But, under PJM's current implementation, when the next MW of NSR required to satisfy the primary reserve requirement increases the NSR price from \$0.00 to \$0.01, all tier 1 MW are paid the tier 2 price. This causes a sharp discontinuity in the supply curve price when there is a significant amount of tier 1.

**Example:** June 26 Hour 17: SRMCP=\$98.01. NSRMCP=\$4.85. No spinning event. Total Tier 1 cost = \$393,383. Total Tier 2 cost = \$56,758.

The market solution must first satisfy the SR requirement of 1,375 MW. The market solution saw 828 MW of tier 1 available hour ahead towards the required 1,375 MW) and PJM purchased the remaining 579 MW of the SR requirement as tier 2. After the SR constraint is satisfied NSR is added initially at a cost of \$0 until an LOC for staying off-line is incurred

which causes the NSR price to exceed \$0.00. The NSR price becomes \$4.85. The first MW of NSR at a price above \$0 has a cost \$4.85 plus (total cost of tier 1, or \$393,383). This is unlikely to be the optimal solution.

The example also illustrates the issue with the calculation of the quantity of tier 1 that PJM Settlements paid for. The market solution saw 828 MW of tier 1 available hour ahead. But Settlements paid 4,012 MW of tier 1.