5-Minute Settlements Roadmap

As of February, 2018
• Proposed implementation date now April 1, 2018
• FERC Order 825 – Sub-Hourly Settlements
  – Align settlement and dispatch intervals by:
    • Settling energy transactions in its real-time markets at the same time interval it dispatches energy
    • Settling operating reserves transactions in its real-time markets at the same time interval it prices operating reserves
    • Settling intertie transactions in the same time interval it schedules intertie transactions
  – Final Rule issued June 16, 2016
  – Compliance Filing submitted January 11, 2017
• Align prices with resource dispatch instructions and operating needs, providing appropriate incentives for resource performance
## 5-Minute Settlements Roadmap for 2018

<table>
<thead>
<tr>
<th>Training Implementation</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Member Education Session</td>
<td>🟢 January 8, 2018</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production Implementation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>🟢 Implementation Date: April 1, 2018</td>
</tr>
</tbody>
</table>

**Legend**
- 🟢 Start Date
- ⚫ End Date
- Market Settlement Calculation System (MSCS)
- Market Settlement Reporting System (MSRS)
  - New 5 Minute reports
  - Minimize changes to current hourly reports
- Power Meter
  - Accept 5 minute meter data (though not required)
- Emergency Procedures application changes
  - User Interface changes
  - XML file changes
The following MSRS reports containing static test data for the operating days of 11/13 and 12/15 have been released in the MSRS training environment.

- Spot Market Energy Charge Summary
- Energy Market & Congestion Loss Charges Details
- Generator LMP Charge Summary
- Balancing Generator LMP Charges
- Explicit Loss Charges
- Explicit Congestion Charges
- Real-Time Daily Energy Transactions*
- Day-Ahead Daily Energy Transactions*

* Denotes new
Ancillary Services / Operating Reserves Market Trials

- Ancillary Services and Operating Reserves data available in MSRS Training environment
  - Utilize the same operating days as the Day-ahead and Balancing market trials
    - 11/13/2017 and 12/15/2017
  - Regulation, Sync Reserve, and Non-Sync Reserve data on 2/20
  - Load Response and Operating Reserve data on 2/26
  - Communication will be sent out to identify specific reports

- 3rd Market Trial date - TBD

- Questions/Comments?
  - mss@pjm.com
Generation Resource
• Sends email to PJM Market Settlements at least 3 business days prior to Operating Day for which 5-minute revenue meter data is effective

PJM Market Settlements
• Performs verification
• Notifies Generation Resource that resource is set-up in Power Meter

Generation Resource
• Submits five minute revenue meter data on effective Operating Day
Availability of 5 Minute LMP Data in Data Miner 2

• Based on member requests, the following data will be available beginning March 6 for testing purposes for the operating day of March 5
  – Five Minute Real-Time LMPs – Daily only
  – Five Minute Ancillary Services Prices – Daily only
• Data Miner 2 beta environment will provide UI and API interface to access this data
• These Real-Time LMPs will be considered test data and will not be used for any settlement calculations

Note 1: PJM is publishing the LMP data solely for member testing purposes only. These LMPs will be available on Data Miner 2 train environment until April 1. After April 1, the verified LMP data will be available in Data Miner 2 production

Note 2: This data will be available on Data Miner 2 only. The csv files will be posted on pjm.com will remain the hourly LMP values
### Existing Hourly Data: Where will data exist for an Operating Day?

<table>
<thead>
<tr>
<th>Operating Days &lt; 4/1/2018</th>
<th>Operating Days &gt;= 4/1/2018</th>
</tr>
</thead>
</table>
| **Hourly RT LMP & Ancillary Service LMP (Daily and Monthly files)** | **Flat files on pjm.com**<sup>**</sup>  
**Data Miner 2** | **Data Miner 2** |
| **Hourly DA LMP (Daily and Monthly Files)** | **Flat files on pjm.com**<sup>**</sup>  
**Data Miner 2** | **Data Miner 2** |
| **Operational Data Page** | **pjm.com**<sup>**</sup> |
| **RT Marginal Value** | **Flat files on pjm.com**<sup>**</sup>  
**Data Miner 2** | **Data Miner 2**  
**Consolidated into 1 data feed**  
**5-minute version only** |
| **RT Transmission Constraints** | **Flat files on pjm.com**<sup>**</sup>  
**Data Miner 2** | **Flat files on pjm.com**<sup>**</sup>  
**Data Miner 2** |
| **Preliminary Billing Data** | **Flat files on pjm.com**<sup>**</sup>  
**Data Miner 2** |
|  
- Operating Reserve Rates  
- Regulation  
- Sync & Non-Sync Reserves  
- DASR |  
| **3Q 2018 pjm.com flat files retirement plan and Operational Data Page changes will continue to be discussed at Tech Change Forum** |
## 5-Minute Settlements Public Data Availability

### Operating Days >= 4/1/2018

<table>
<thead>
<tr>
<th>5-minute RT LMPs</th>
<th>Data Miner 2 only</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-minute Ancillary Service LMPs</td>
<td></td>
</tr>
<tr>
<td>5-minute RT Marginal Value and Transmission Constraints</td>
<td></td>
</tr>
<tr>
<td>RT Settlement LMPs in eDataFeed</td>
<td>Data Miner 2 only</td>
</tr>
</tbody>
</table>

- Preliminary and Final load weighted average transmission zone LMPs and residual aggregate LMPs will be available.
Appendix – Previously Communicated Information
Day-ahead and Real-time LMP Postings

Hourly RT and DA LMP CSV files
Available through March 31, 2018
Will no longer be published effective April 1, 2018

Production Data Miner
Hourly RT LMPs, Ancillary Service Clearing Prices, and DA LMPs available in August 2017
Hourly values will continue to be published in Data Miner after April 1, 2018
5 Minute RT LMPs and Ancillary Service Clearing Prices published on April 1, 2018
5-Minute Settlements Report Changes

- PJM will be implementing the following:
  - Transpose the data label column into numerous report columns and add in EPT Interval Ending and GMT Interval Ending columns
    - Conserves report width, but adds more rows to report
    - Removes “Total” column
### Operating Reserve Generator Credit Details

**Customer Account: Report Creation Timestamp (EFT):**

<table>
<thead>
<tr>
<th>Start Date:</th>
<th>End Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000.01</td>
<td>5000.8</td>
</tr>
</tbody>
</table>

#### Option Implemented: Transposed Data Labels

| E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

<table>
<thead>
<tr>
<th>Custom er ID</th>
<th>Custom er Code</th>
<th>Data</th>
<th>CPT Interval Ending</th>
<th>GMT Interval Ending</th>
<th>Unit ID</th>
<th>Unit Name</th>
<th>Unit Ownership Share</th>
<th>DA Generator Unit (MW)</th>
<th>DA Scheduled MWh</th>
<th>Dispatch Rate ($/MWh)</th>
<th>RT Generator (MWh)</th>
<th>RT Schedule ID</th>
<th>DA Energy Offer ($/MWh)</th>
<th>Sched Rate</th>
<th>DA Net Revenue ($)</th>
<th>RT Schedule ID</th>
<th>BDR Region ID</th>
<th>BDR Reason ID</th>
<th>Sched Rate</th>
<th>BDR Region ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>122 ABC</td>
<td>2/1/2018 005</td>
<td>2/2/2018 005 5</td>
<td>22941243 ABC</td>
<td>1</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>123 ABC</td>
<td>2/1/2018 015</td>
<td>2/2/2018 015 5</td>
<td>22941243 ABC</td>
<td>1</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>124 ABC</td>
<td>2/1/2018 020</td>
<td>2/2/2018 020 5</td>
<td>22941243 ABC</td>
<td>1</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>125 ABC</td>
<td>2/1/2018 025</td>
<td>2/2/2018 025 5</td>
<td>22941243 ABC</td>
<td>1</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>126 ABC</td>
<td>2/1/2018 030</td>
<td>2/2/2018 030 5</td>
<td>22941243 ABC</td>
<td>1</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>127 ABC</td>
<td>2/1/2018 035</td>
<td>2/2/2018 035 5</td>
<td>22941243 ABC</td>
<td>1</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>128 ABC</td>
<td>2/1/2018 040</td>
<td>2/2/2018 040 5</td>
<td>22941243 ABC</td>
<td>1</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>129 ABC</td>
<td>2/1/2018 045</td>
<td>2/2/2018 045 5</td>
<td>22941243 ABC</td>
<td>1</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>130 ABC</td>
<td>2/1/2018 050</td>
<td>2/2/2018 050 5</td>
<td>22941243 ABC</td>
<td>1</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>131 ABC</td>
<td>2/1/2018 055</td>
<td>2/2/2018 055 5</td>
<td>22941243 ABC</td>
<td>1</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>1.128</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

---

**Z**  **AA**  **AB**  **AC**  **AD**  **AE**  **AF**  **AG**  **AH**  **AI**  **AJ**  **AL**  **AM**  **AN**  **AO**

<table>
<thead>
<tr>
<th>Economic Min (MW)</th>
<th>Economic Max (MW)</th>
<th>RT Dispatched Declared Type</th>
<th>RT Dispatched Declared MWh Used</th>
<th>RT Dispatched Declared MWh</th>
<th>RT Energy Offer ($/MWh)</th>
<th>RT No-Load Cost ($)</th>
<th>RT Startup Cost ($)</th>
<th>RT Additional Startup Cost ($)</th>
<th>RT Additional Synchronous Reserve Revenue ($)</th>
<th>RT Additional Non-Synchronous Reserve Revenue ($)</th>
<th>RT Bal Net Revenue ($)</th>
<th>Economic Min (MW)</th>
<th>Economic Max (MW)</th>
<th>RT Dispatched Declared Type</th>
<th>RT Dispatched Declared MWh Used</th>
<th>RT Dispatched Declared MWh</th>
<th>RT Energy Offer ($/MWh)</th>
<th>RT No-Load Cost ($)</th>
<th>RT Startup Cost ($)</th>
<th>RT Additional Startup Cost ($)</th>
<th>RT Additional Synchronous Reserve Revenue ($)</th>
<th>RT Additional Non-Synchronous Reserve Revenue ($)</th>
<th>RT Bal Net Revenue ($)</th>
</tr>
</thead>
</table>