

2011 IRM Study

Status Report and Load Model Selection

Planning Committee
August 4, 2011

- Study results will re-set IRM for 2012/13, 2013/14, 2014/15 and establish initial IRM for 2015/16.
- Generation Owner review of PJM capacity model has concluded.
- PJM and World capacity models are being finalized.
- PJM and World load models to be finalized at August 4 PC meeting.
- ATSI and Duke will be modeled in PJM for all Delivery Years.
- On target to send preliminary study results to PC for September 8 meeting. PC will vote on IRM in October.

PJM Load Model Selection

- Analysis based on method approved at July 2009 PC meeting (Appendix E of 2009 IRM Study Report)
- Based on 2011 Load Forecast Report. Focus is on 2015/16 Delivery Year.

2009 RRS Report: <http://www.pjm.com/planning/resource-adequacy-planning/~media/documents/reports/2009-pjm-reserve-requirement-study.ashx>

2011 Load Forecast Report: <http://www.pjm.com/planning/resource-adequacy-planning/~media/documents/reports/2011-pjm-load-report.ashx>

- **Criteria**
 - Include most recent data to capture load patterns
 - Include greater number of historical years to reduce sensitivity due to a few abnormal years (e.g.: 2006)
 - Choose IRM Study load models that are consistent with the Load Forecast Model distributions. (The red line on the graphs below.)
 - Select time period that reflects historical PJM/World load diversity

| S No: | Load Model # | Load Model Years |
|-------|-----------------|---------------------------------|
| 1 | 2175 | 1997-2006 10 Year LM |
| 2 | 2156 | 1998-2007 10 Year LM |
| 3 | 2157 | 1999-2008 10 Year LM |
| 4 | 2158 | 2000-2009 10 Year LM |
| 5 | 2176 | 1997-2005 9 Year LM |
| 6 | 2159 | 1998-2006 9 Year LM |
| 7 | 2160 | 1999-2007 9 Year LM |
| 8 | 2161 | 2000-2008 9 Year LM |
| 9 | 2162 | 2001-2009 9 Year LM |
| 10 | 2177 | 1997-2004 8 Year LM |
| 11 | 2163 | 1998-2005 8 Year LM |
| 12 | 2164 | 1999-2006 8 Year LM |
| 13 | 2165 | 2000-2007 8 Year LM |
| 14 | 2166 | 2001-2008 8 Year LM |
| 15 | 2167 | 2002-2009 8 Year LM |
| 16 | 2178 | 1997-2003 7 Year LM |
| 17 | 2168 | 1998-2004 7 Year LM |
| 18 | 2169 | 1999-2005 7 Year LM |
| 19 | 2170 | 2000-2006 7 Year LM |
| 20 | 2171 | 2001-2007 7 Year LM |
| 21 | 2172 | 2002-2008 7 Year LM |
| 22 | 2173 | 2003-2009 7 Year LM |
| 23 | 2174 | 1998-2008 11 Year LM |

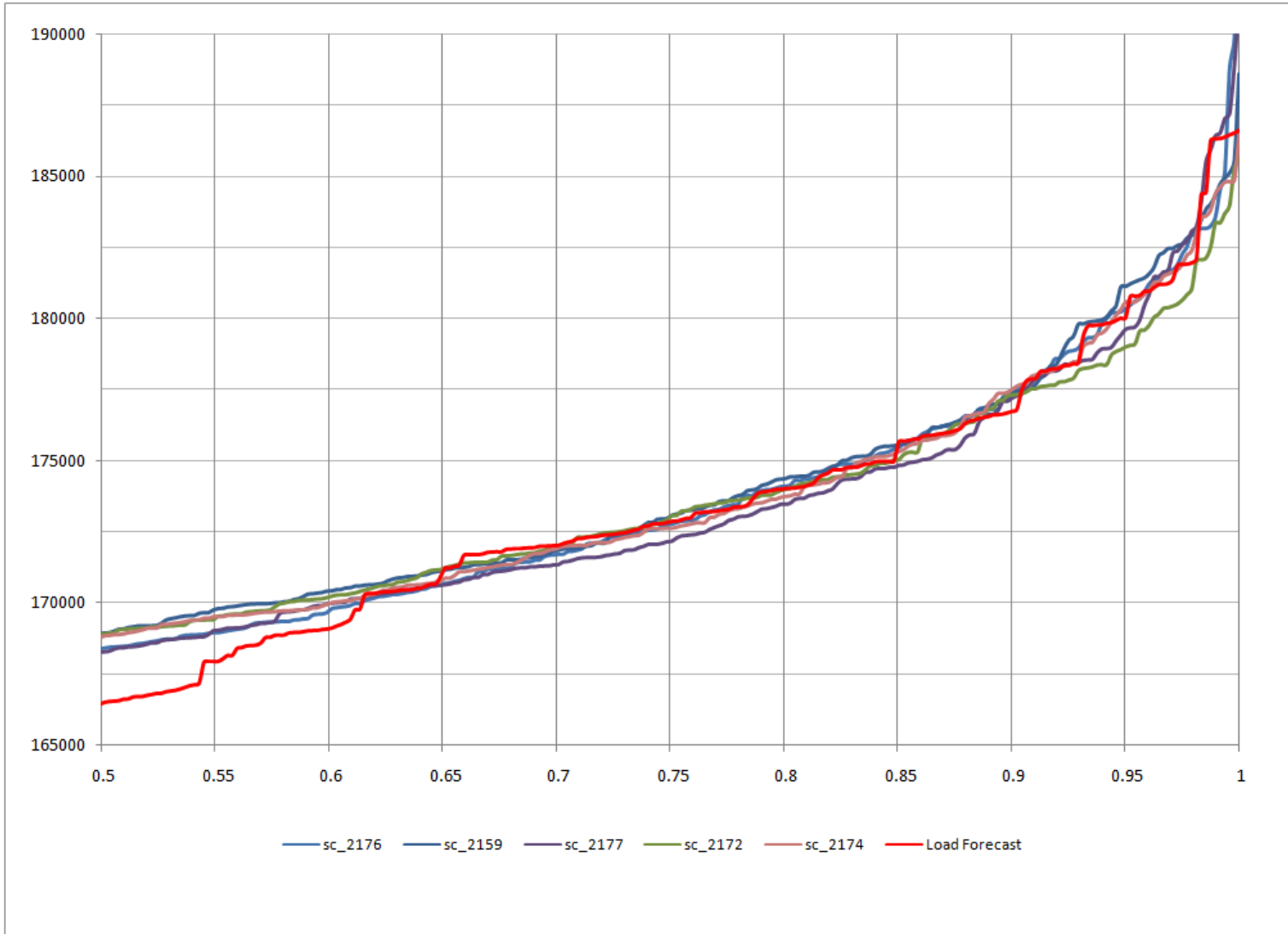
| | LM# | Ranking (All) | Ranking (25% +) | Ranking (50% +) | Ranking (75% +) | Ranking (90% +) |
|---------|------|---------------|-----------------|-----------------|-----------------|-----------------|
| Ranking | 2175 | 1 | 2 | 6 | 6 | 9 |
| | 2156 | 16 | 18 | 19 | 21 | 21 |
| | 2157 | 15 | 16 | 17 | 17 | 13 |
| | 2158 | 14 | 14 | 15 | 16 | 14 |
| | 2176 | 5 | 3 | 2 | 4 | 4 |
| | 2159 | 4 | 4 | 4 | 2 | 2 |
| | 2160 | 23 | 23 | 23 | 23 | 23 |
| | 2161 | 11 | 11 | 10 | 8 | 6 |
| | 2162 | 13 | 13 | 12 | 9 | 8 |
| | 2177 | 2 | 1 | 1 | 3 | 3 |
| | 2163 | 9 | 9 | 9 | 13 | 16 |
| | 2164 | 18 | 19 | 16 | 19 | 22 |
| | 2165 | 21 | 22 | 22 | 22 | 20 |
| | 2166 | 17 | 17 | 18 | 15 | 17 |
| | 2167 | 10 | 10 | 11 | 12 | 11 |
| | 2178 | 3 | 5 | 8 | 14 | 18 |
| | 2168 | 8 | 8 | 7 | 7 | 10 |
| | 2169 | 19 | 15 | 14 | 10 | 7 |
| | 2170 | 22 | 21 | 21 | 18 | 15 |
| | 2171 | 20 | 20 | 20 | 20 | 19 |
| 2172 | 7 | 7 | 5 | 5 | 5 | |
| 2173 | 12 | 12 | 13 | 11 | 12 | |
| 2174 | 6 | 6 | 3 | 1 | 1 | |

Best Statistical Fit Models – Ranking Method 2

| Load Model # | Rank (All Points) | Rank (1st Quartile +) | Rank (Median +) | Rank (3rd Quartile +) | Rank (Top 10%) |
|--------------|-------------------|-----------------------|-----------------|-----------------------|----------------|
| 2156 | 16 | 16 | 18 | 19 | 19 |
| 2157 | 19 | 19 | 19 | 21 | 20 |
| 2158 | 14 | 14 | 14 | 14 | 13 |
| 2159 | 4 | 4 | 2 | 1 | 2 |
| 2160 | 23 | 23 | 23 | 23 | 23 |
| 2161 | 15 | 15 | 16 | 17 | 18 |
| 2162 | 11 | 11 | 11 | 10 | 9 |
| 2163 | 9 | 9 | 9 | 8 | 8 |
| 2164 | 21 | 21 | 21 | 18 | 17 |
| 2165 | 22 | 22 | 22 | 22 | 22 |
| 2166 | 13 | 13 | 13 | 15 | 15 |
| 2167 | 12 | 12 | 12 | 11 | 10 |
| 2168 | 8 | 8 | 7 | 7 | 1 |
| 2169 | 18 | 18 | 15 | 13 | 11 |
| 2170 | 20 | 20 | 20 | 16 | 14 |
| 2171 | 17 | 17 | 17 | 20 | 21 |
| 2172 | 7 | 7 | 5 | 4 | 7 |
| 2173 | 10 | 10 | 10 | 12 | 12 |
| 2174 | 6 | 6 | 6 | 2 | 3 |
| 2175 | 3 | 3 | 4 | 6 | 6 |
| 2176 | 2 | 2 | 3 | 3 | 5 |
| 2177 | 1 | 1 | 1 | 5 | 4 |
| 2178 | 5 | 5 | 8 | 9 | 16 |

- Load Model Choices
 - 2159: 1998-2006 9 Year LM - Rank 1*
 - 2172: 2002-2008 7 Year LM - Rank 2
 - 2174: 1998-2008 11 Year LM- Rank 3
 - 2176: 1997-2005 9 Year LM - Rank 4
 - 2177: 1997-2004 8 Year LM - Rank 5

* Load Model used in 2010 IRM Study





World Load Model Assessment

| ZONE | MONTH | Average Diversity using August Peak years only |
|-------|-------|--|
| World | 1 | 83.76% |
| World | 2 | 82.06% |
| World | 3 | 75.52% |
| World | 4 | 70.08% |
| World | 5 | 79.08% |
| World | 6 | 91.16% |
| World | 7 | 95.42% |
| World | 8 | 100.00% |
| World | 9 | 86.41% |
| World | 10 | 73.31% |
| World | 11 | 73.95% |
| World | 12 | 81.86% |

| year | zone name | season | 2011 Study avg_div | 2010 Study Values | 2009 Study Values |
|------|-----------|--------|---------------------------|-------------------|-------------------|
| 2010 | WORLD | Winter | 7.29% | 7.03% | 6.63% |
| 2010 | WORLD | Summer | 4.60% | 4.25% | 4.04% |
| 2010 | WORLD | Spring | 8.02% | 6.50% | 5.79% |
| 2010 | WORLD | Fall | 5.10% | 4.87% | 4.68% |

Diversity Calculation: $(NCP - CP) / NCP$

| | NCP | | | CP | LM | LM as | NCP- LM | CAP | CP- LM | Reserves | Reserves |
|--------------------------|--------|--------|-----------|--------|-------|-------|---------|--------|--------|----------|-------------|
| | 2011 | IRM | Diversity | 2011 | 2011 | % NCP | (NID) | based | | as | as |
| | | | | | | | | on NID | | % of CP | % of CP- LM |
| NY | 33182 | 15.50% | 0.9540 | 31656 | 2498 | 7.53% | 30684 | 35440 | 29158 | | |
| NE | 27550 | 14.40% | 0.9540 | 26283 | 1774 | 6.44% | 25776 | 29488 | 24509 | | |
| MISO | 78104 | 17.40% | 0.9540 | 74511 | 4421 | 5.66% | 73683 | 86504 | 70090 | | |
| TVA | 33586 | 15.00% | 0.9540 | 32041 | 1286 | 3.83% | 32300 | 37145 | 30755 | | |
| VACAR | 64956 | 15.30% | 0.9540 | 61968 | 2202 | 3.39% | 62754 | 72355 | | | |
| Dominion | 21796 | | | | 616 | 2.83% | 21180 | | | | |
| VACAR | | | | | | | | | | | |
| Other | 43160 | 15.30% | 0.9540 | 41175 | 1586 | 3.67% | 41574 | 47935 | 39589 | | |
| Total Composite Region = | 215582 | | | 205665 | 11565 | 5.36% | 204017 | 236512 | 194100 | 15.00% | 21.85% |

World Reserve Range in 2010 RRS: 15.7% - 21.8%

Data Sources

NY and NE - NPCC Reliability Assessment for Summer 2011 (published April 2011 - Appendix VIII Table 3a- page 13)

http://www.npcc.org/viewDoc.aspx?name=CO-12_2011_Summer+Reliability+Assessment+Final+Report.pdf&cat=repSeasonal

Midwest Independent Transmission System Operator, Inc.Planning Year 2011 LOLE Study Report (published December 10, 2010 - page 3)

Using Old NERC Boundaries "MAIN Other" Plus "ECAR Other"(Excludes ATSI and Duke) - The word "Other" indicates that any PJM footprint model is removed.
Figure 2-1 Page 10 and Figure 5-6 page 31(calculations on rows 37-44)

TVA and VACAR - 2010 NERC ES&D Report, assuming zero load diversity between DomVP and rest of VACAR

Total Internal Demand(Code=S02) 2nd Yr column. TVA=Central X Factor Table

NY, and MISO are modeled at their approved IRMs for 2011. TVA and VACAR are modeled at the assessed soft target IRM of 15% and 15.3% respectively.

<https://www.midwestiso.org/Library/Repository/Study/LOLE/2011%20LOLE%20Study%20Report.pdf>

[http://www.nysrc.org/pdf/Reports/2011%20IRM%20Final%20Report%2012-10-10\[1\].pdf](http://www.nysrc.org/pdf/Reports/2011%20IRM%20Final%20Report%2012-10-10[1].pdf)

NE is modeled per the approved 2015 IRM, shown on slide 6

http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/mtrls/2011/jul212011/icr_values.pdf

Dominion NCP and LM are per the PJM Load Forecast Report, January 2011 (pages 36 and 52)

LM => Load Management

NCP => Non Coincident Peak load

PJM/World Load Model Assessment

- Load Model Choices
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 - 2176: 1997-2005 9 Year LM - Rank 4
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* Load Model used in 2010 IRM Study

| Load Model Time Period Assessment Checks | | Load Model # | | | | |
|--|---|---------------------------|---------------------------|----------------------------|---------------------------|---------------------------|
| Check No. | Description of assessment | 2159 9 Year (98-06) | 2172 7 Year (02-08) | 2174 11 Year (98-08) | 2176 9 Year (97-05) | 2177 8 Year (97-04) |
| 1 | Using most recent 7-10 year period ? | Pass | Pass | Pass | Pass | Pass |
| 2 | Do we have hourly loads for entire time period, both areas | Pass | Pass | Pass | Pass | Pass |
| 3 | Does PJM forecast LM peak in the same month as PLOTS historic data? | Pass | Fail | Fail | Pass | Pass |
| 4 | Compare to Forecast load model, Approach 1 | Pass Best Match | Pass | Pass | Pass | Pass |
| 5 | Compare to Forecast load model, Approach 2 | Pass Best Match | Pass | Pass | Pass | Pass |
| 6 | Is LM a candidate for assessment of two area correlation? | Pass | Pass | Pass | Pass | Pass |
| 7 | Does World forecast LM peak in the same month as PLOTS historic data? | Pass | Pass | Pass Best Match | Pass | Fail |
| 8 | Pattern assessment between World and PJM RTO | Pass | Pass | Pass | Pass | Pass |
| Passes all checks - No exceptions | | X | | | X | |

PJM and RAAS unanimous recommendation:

- **Use 9 year (1998-2006) Load Model for 2011 IRM Study Base Case.**
- **Same Load Model that was used in 2010 IRM Study Base Case**

Request PC endorsement of this recommendation.