



PJM Load Model Selection for 2016 RRS

Resource Adequacy
Analysis Subcommittee
06/24/2016

1. Background
2. Comparing Load forecast and PLOTS/ PRISM modeling approach
3. Load Model selection approaches for PJM RTO
4. Assessment of World models relative to PJM RTO
5. Recommendation of Load Model for 2016 RRS

- Analysis based on method approved at June 9, 2016 PC meeting (Appendix V in 2016 RRS Assumptions Letter)
- Based on 2016 Load Forecast Report. Focus is on 2020/21 Delivery Year.

2016 RRS Assumptions Letter: <http://www.pjm.com/~media/committees-groups/committees/pc/20160609/20160609-item-05b-rrs-assumptions-letter-2016.ashx>

2016 Load Forecast Report: <http://www.pjm.com/~media/documents/reports/2016-load-report.ashx>

PJM Load Forecast

- Load history from 1998 -2015 used to develop daily peak load forecast regression models
- Uses 21 years of weather history to develop a range of forecasted loads
- Model based on Calendar Year
- Produces a median (50/50) load and seasonal distribution of daily peaks
- Relationship between 12 monthly peaks

PLOTS/ PRISM

- Uses 7+ years of historic hourly loads
- 12 monthly forecasted loads to obtain forecast monthly load shape of DY 2020/21
- Model based on Delivery Year (DY)
- Produces magnitude-ordered daily peak load distributions for each week

Criteria

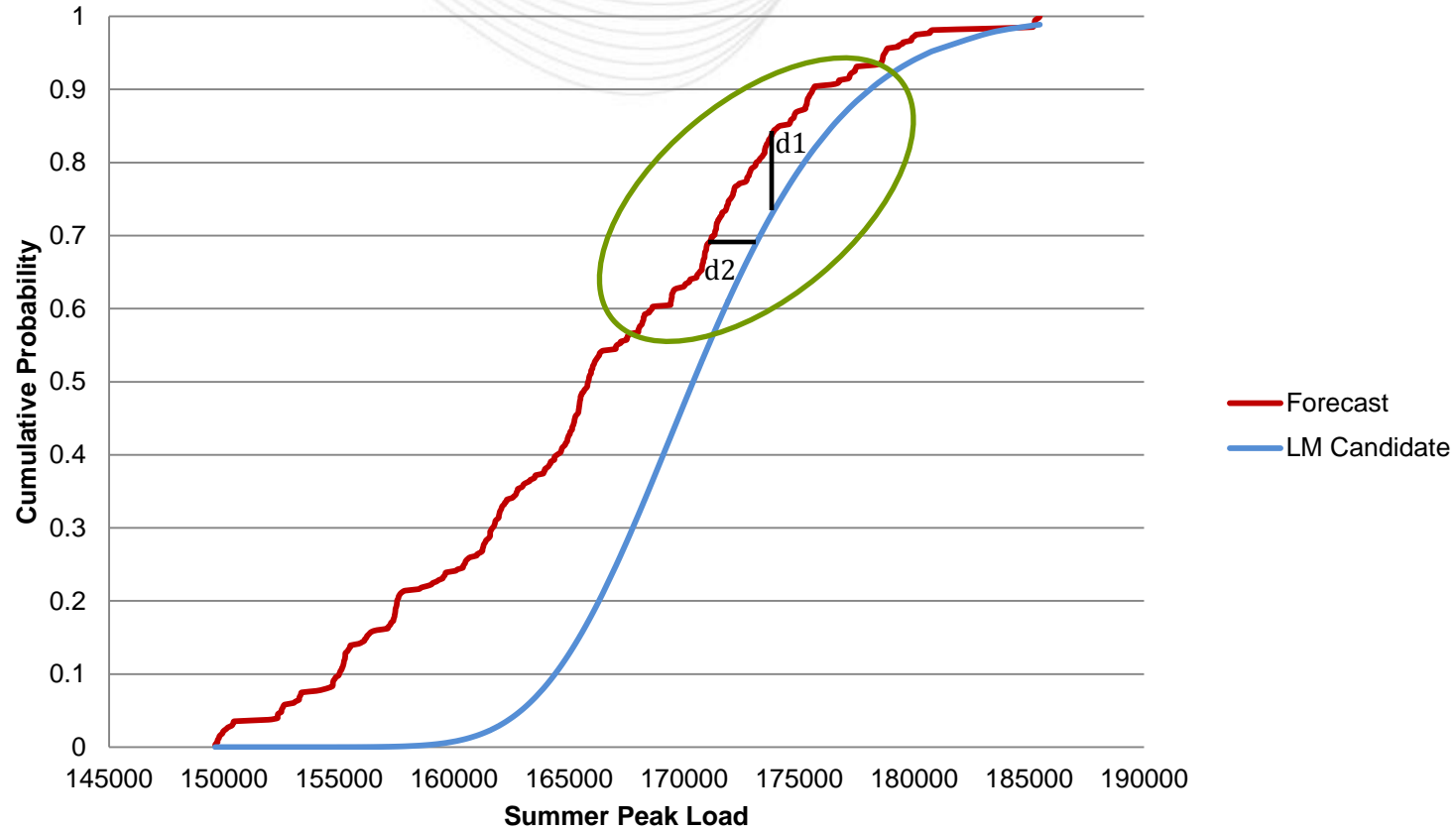
- Include most recent data to capture load patterns
- Include more historical years to reduce sensitivity from abnormal years (e.g.: 2006)
- Choose IRM Study load models that are consistent with the Load Forecast Model distributions.
- Consider historical PJM/World load diversity



PJM Load Model Combinations to Assess

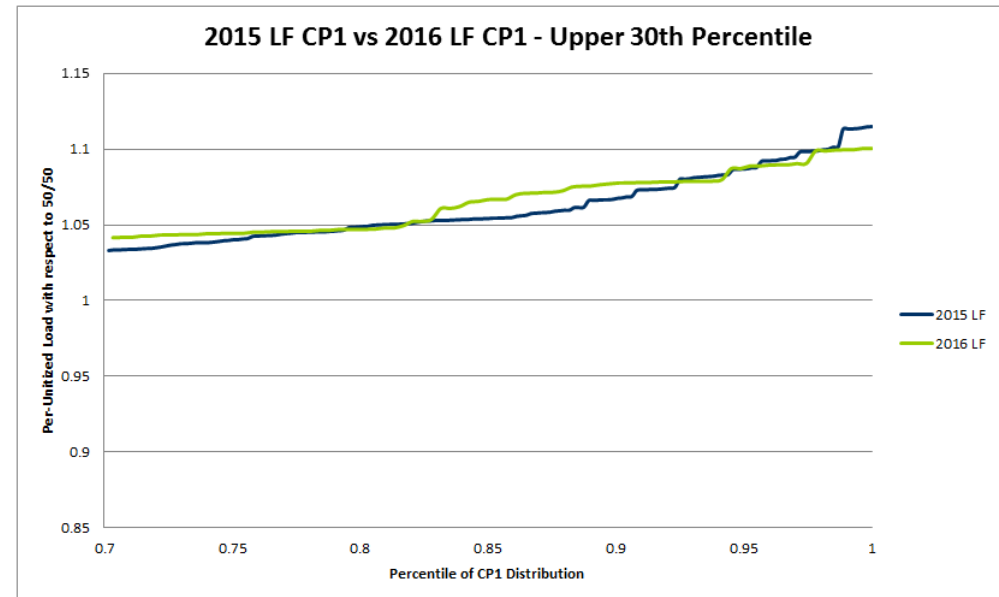
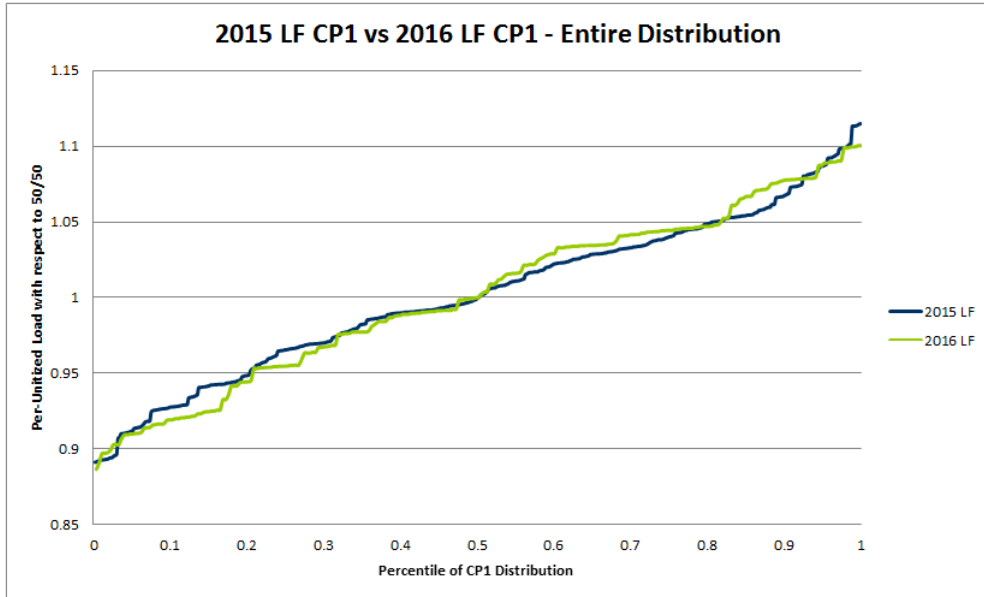
Load Model #	Description	Load Model #	Description
50972	1998-2013 16 Year LM	51004	1998-2006 9 Year LM
50973	1998-2012 15 Year LM	51005	1999-2007 9 Year LM
50974	1999-2013 15 Year LM	51006	2000-2008 9 Year LM
50975	1998-2011 14 Year LM	51007	2001-2009 9 Year LM
50976	1999-2012 14 Year LM	51008	2002-2010 9 Year LM
50977	2000-2013 14 Year LM	51009	2003-2011 9 Year LM
50978	1998-2010 13 Year LM	51010	2004-2012 9 Year LM
50979	1999-2011 13 Year LM	51012	2005-2013 9 Year LM
50980	2000-2012 13 Year LM	51013	1998-2005 8 Year LM
50981	2001-2013 13 Year LM	51014	1999-2006 8 Year LM
50982	1998-2009 12 Year LM	51015	2000-2007 8 Year LM
50983	1999-2010 12 Year LM	51017	2001-2008 8 Year LM
50984	2000-2011 12 Year LM	51018	2002-2009 8 Year LM
50987	2001-2012 12 Year LM	51019	2003-2010 8 Year LM
50988	2002-2013 12 Year LM	51020	2004-2011 8 Year LM
50989	1998-2008 11 Year LM	51021	2005-2012 8 Year LM
50990	1999-2009 11 Year LM	51022	2006-2013 8 Year LM
50991	2000-2010 11 Year LM	51023	1998-2004 7 Year LM
50992	2001-2011 11 Year LM	51024	1999-2005 7 Year LM
50993	2002-2012 11 Year LM	51025	2000-2006 7 Year LM
50994	2003-2013 11 Year LM	51026	2001-2007 7 Year LM
50995	1998-2007 10 Year LM	51027	2002-2008 7 Year LM
50996	1999-2008 10 Year LM	51028	2003-2009 7 Year LM
50997	2000-2009 10 Year LM	51029	2004-2010 7 Year LM
50998	2001-2010 10 Year LM	51030	2005-2011 7 Year LM
50999	2002-2011 10 Year LM	51031	2006-2012 7 Year LM
51002	2003-2012 10 Year LM	51032	2007-2013 7 Year LM
51003	2004-2013 10 Year LM		

Peak Day (CP1) Cumulative Distribution



- For each PLOTS load model:
 - Calculate weekly parameters using:
 - PLOTS mean and std. deviations
 - PJM forecasted monthly loads for 20/21 DY
 - Forecast Error Factor (FEF)= 0.01

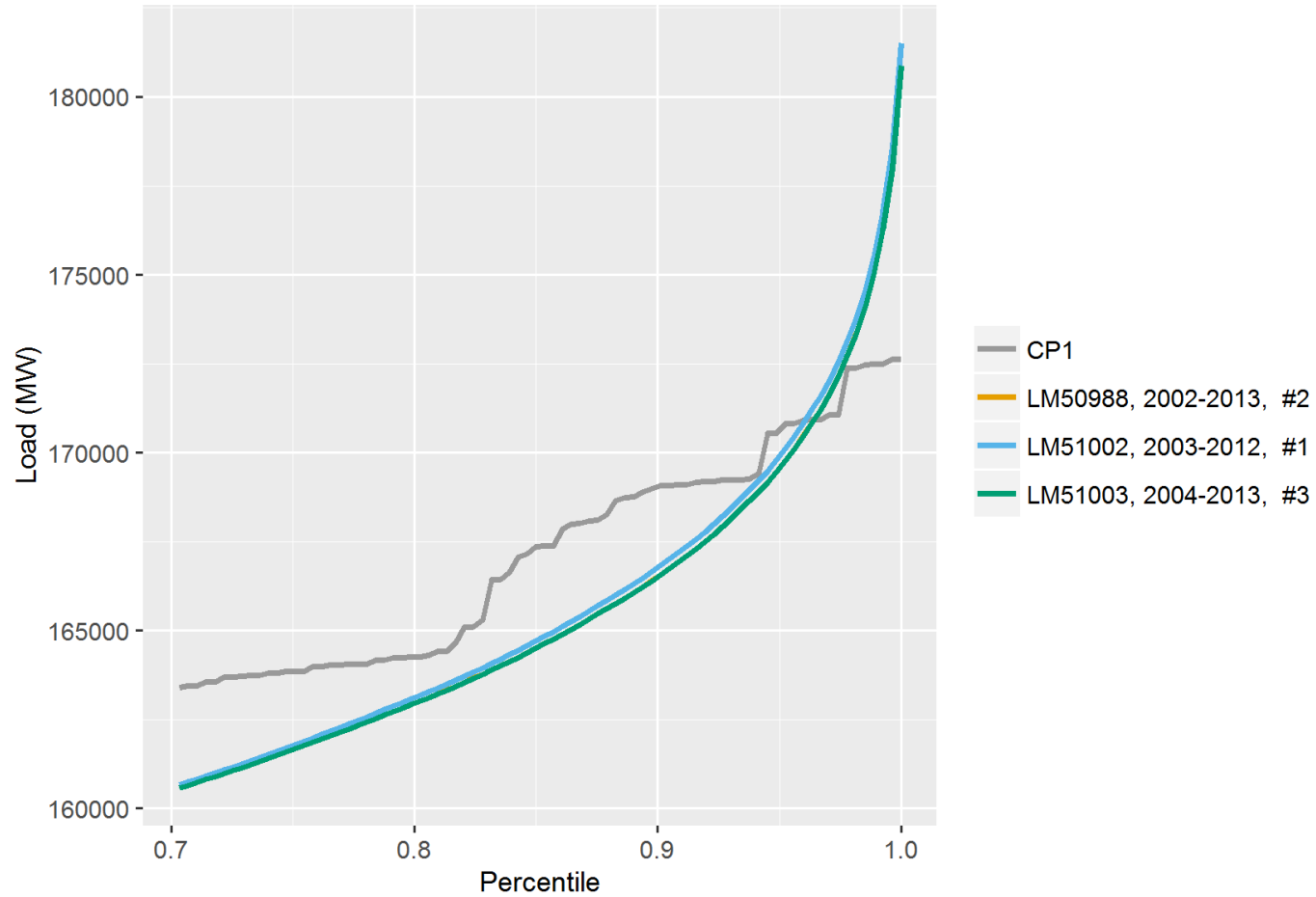
Load Forecast Model Distribution - 2015 vs 2016



Approach 1 – Summer Seasonal Peak CDF

- 5 random draws from peak week to represent weekday daily peaks
- Calculate highest load from 5 weekdays - Seasonal Peak
- Generate 273 scenarios and develop CDF

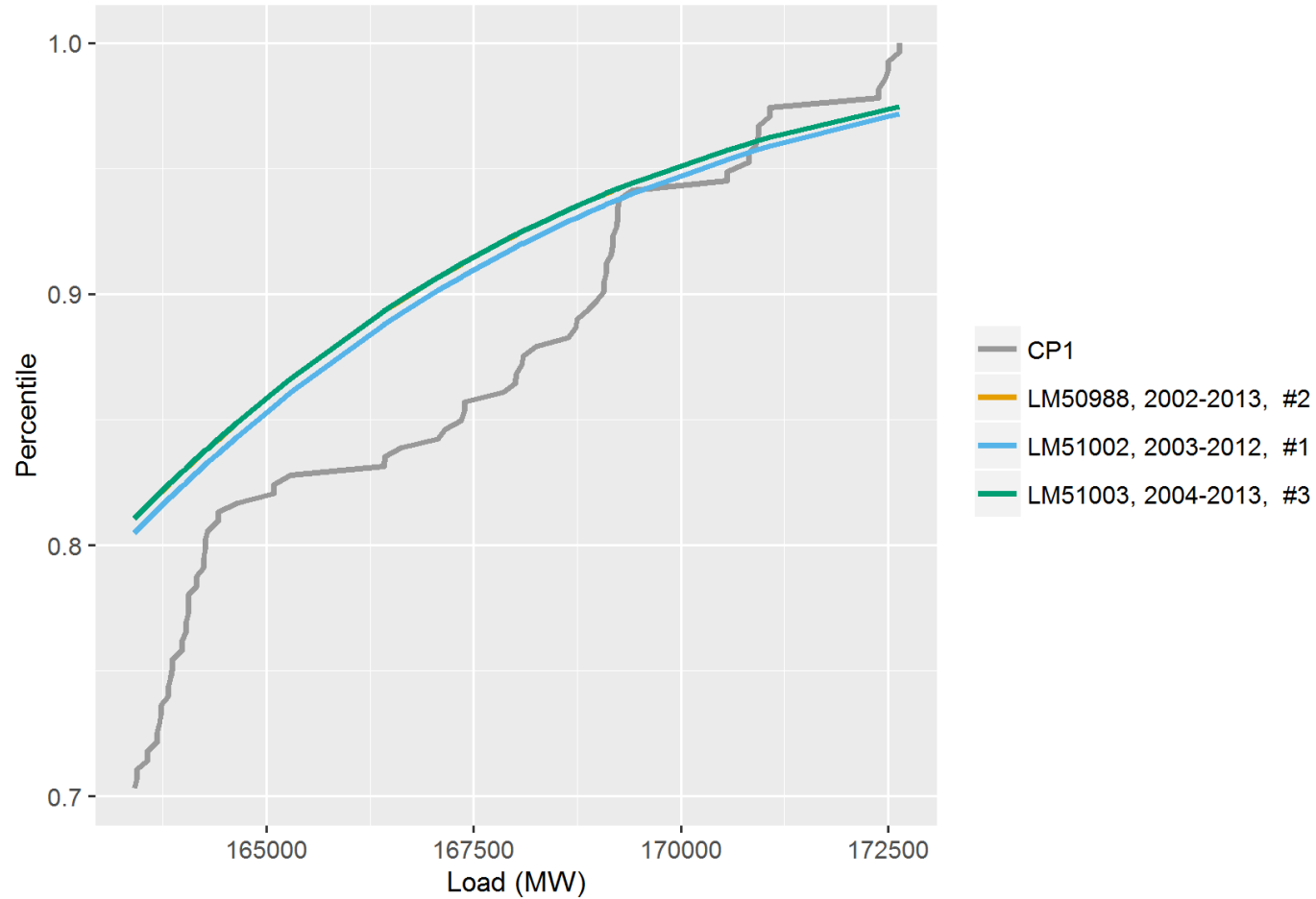
Approach #1 Results



Approach 2

- Use 273 summer seasonal peak loads from load forecast and associated cumulative probability (CDF of CP1)
- For each PLOTS load model
 - Use peak week distribution
 - Calculate probability of drawing a value less than or equal to each of the 273 seasonal peaks from the peak week distributions
 - Calculate absolute error between the above computed probability and the respective probability in the CP1 CDF

Approach #2 Results



- Load Model (LM) Choices
 - 50988: 2002-2013 12 YR LM
 - 51002: 2003-2012 10 YR LM
 - 51003: 2004-2013 10 YR LM
- Last year's selected LM (2003 – 2012) is also a top candidate this year.

- World Load Models were created using PLOTS program, observing the same historic time periods. In so doing, we consider the PJM/World diversity.
 - Uses historic Coincident Peak pattern
 - World defined as MISO, NY, TVA, VACAR, and NE*.
- Recent exchanges with Operations Department and other PJM staff suggest that NE should not be part of the World
 - PJM has no direct transmission ties with NE
 - More importantly, PJM does not have an agreement with NE to share emergency capacity (as it does with its other neighbors)



LM #51002 - Two area pattern assessment

		PJM RTO LM #51002 10 Yr Load Model - 2003 - 2012			World Region LM #51053		
Month	WK #	PLOTS Mean	PLOTS STD	EWM	PLOTS Mean	PLOTS STD	EWM
June	5	0.8033	0.0553	0.8336	0.8429	0.0483	0.8720
June	6	0.9057	0.0636	0.9484	0.8834	0.0503	0.9159
June	7	0.8774	0.0422	0.8975	0.9296	0.0470	0.9603
July	8	0.9079	0.0434	0.8735	0.9159	0.0416	0.9220
July	9	0.9084	0.0723	0.9019	0.9405	0.0463	0.9517
July	10	1.0000	0.0791	1.0000	0.9968	0.0385	1.0000
July	11	0.9399	0.0710	0.9318	0.9546	0.0499	0.9697
August	12	0.9765	0.0637	0.9691	1.0000	0.0603	0.9995
August	13	0.9415	0.0738	0.9447	0.9690	0.0465	0.9540
August	14	0.8801	0.0580	0.8680	0.9123	0.0311	0.8828
August	15	0.8323	0.0754	0.8366	0.8897	0.0381	0.8678



Historical Peak Load Coincidence PJM / World

Year	PJM Peak - Actual Date	World Peak - Actual Date	Peak Coincidence?
1998	21-Jul-98	21-Jul-98	Yes
1999	30-Jul-99	28-Jul-99	No
2000	9-Aug-00	31-Aug-00	No
2001	9-Aug-01	8-Aug-01	No
2002	1-Aug-02	1-Aug-02	Yes
2003	21-Aug-03	14-Aug-03	No
2004	3-Aug-04	2-Aug-04	No
2005	26-Jul-05	3-Aug-05	No
2006	2-Aug-06	1-Aug-06	No
2007	8-Aug-07	8-Aug-07	Yes
2008	9-Jun-08	21-Jul-08	No
2009	10-Aug-09	10-Aug-09	Yes
2010	7-Jul-10	4-Aug-10	No
2011	21-Jul-11	20-Jul-11	No
2012	17-Jul-12	17-Jul-12	Yes
2013	18-Jul-13	18-Jul-13	Yes
2014	7-Jan-14	7-Jan-14	Yes

World excludes ISO New England

In the last 17 years, PJM and the World **have not peaked** on the same day 10 times.



LM #51002 - Switching of World peak week

		PJM RTO LM #51002 10 Yr Load Model - 2003 - 2012			World Region LM #51053		
Month	WK #	PLOTS Mean	PLOTS STD	EWM	PLOTS Mean	PLOTS STD	EWM
July	8	0.9079	0.0434	0.8735	0.9159	0.0416	0.9220
July	9	0.9084	0.0723	0.9019	0.9405	0.0463	0.9517
July	10	1.0000	0.0791	1.0000	0.9546	0.0499	0.9697
July	11	0.9399	0.0710	0.9318	0.9968	0.0385	1.0000

World peak week is now on Week 11

- PJM recommendation to RAAS on selection of historical time period for load model:
 - **Use 10yr (2003-2012, #51002) Load Model for 2016 RRS Base Case and switch World peak to a different July week so that PJM and World peak on the same month but not on the same week.**
 - LM #51002 is best ranked in Approaches 1 and 2.
 - Switch in World peak week is performed to match historical diversity observed between PJM and World

- Endorsement of PJM recommendation to use the **10yr (2003-2012, #51002) Load Model including switch in World peak week for the 2016 RRS Base Case.**