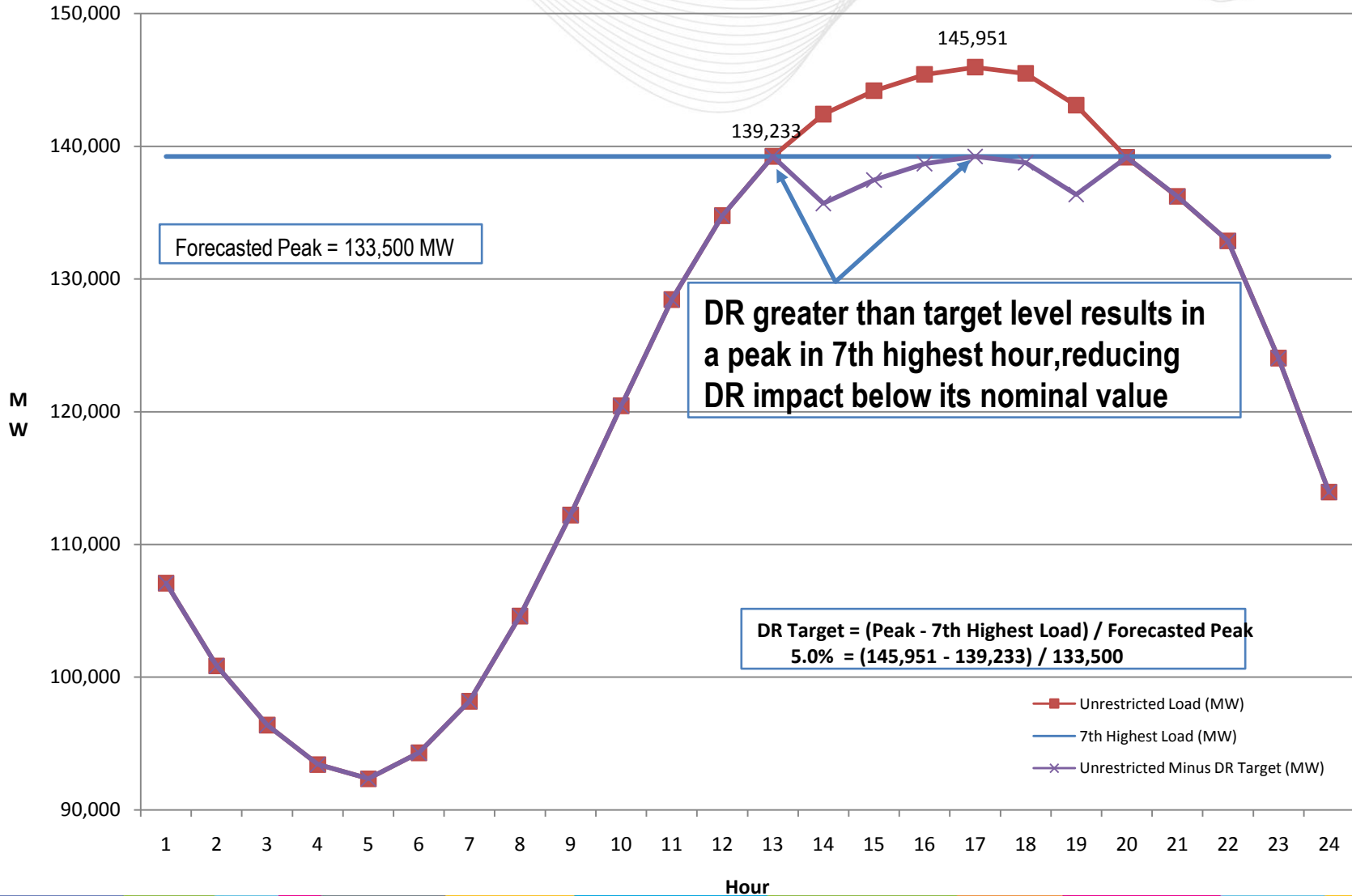


RPM Minimum Resource Requirement Determination

Planning Committee
December 15, 2011

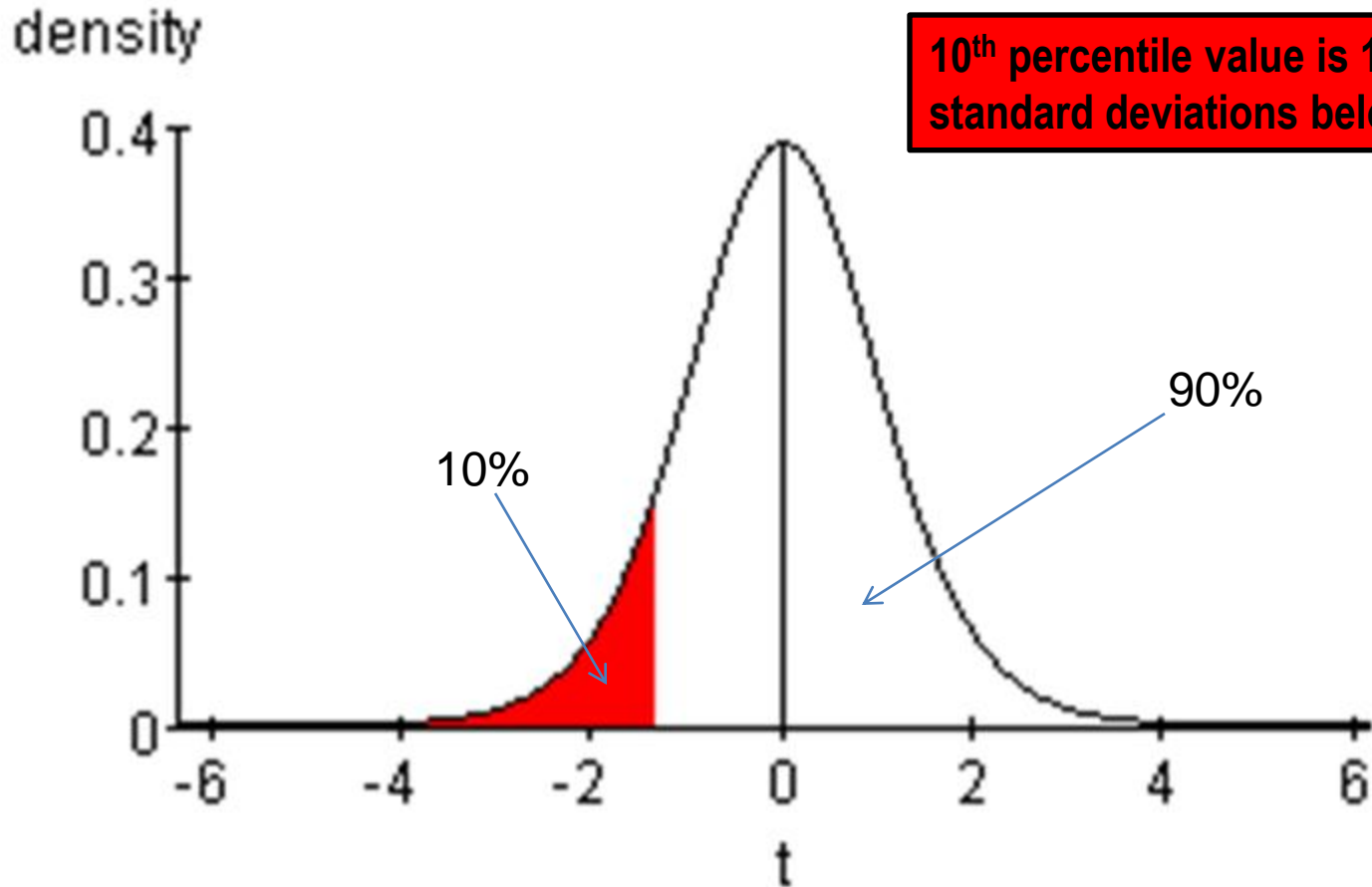
- **Limited DR** – Available for interruption up to ten times per year, with each interruption lasting no more than six hours (“10x6” Product)
- **Extended Summer DR** – Available for interruption an unlimited number of times from May 1 – October 31 but not interruptible from November 1 – April 30. Each interruption may last up to ten hours.
- **Annual DR** – Available any day of the year and for an unlimited number of interruptions during the year.
- **DR Reliability Targets** are established for the Limited DR and Extended Summer DR products per Section 5 of Manual 20.

DR Target Calculation: PJM RTO - August 2, 2006



PJM RTO			
DR TARGET FOR SELECTED LOAD DAYS			
2006-2011			
<u>Date</u>	<u>Load Management</u>	<u>Above 50/50 WN</u>	<u>Cap for 6 Hour Duration</u>
7/17/2006		X	4.5%
7/31/2006		X	4.5%
8/1/2006		X	5.0%
8/2/2006		X	5.0%
8/3/2006		X	3.6%
8/8/2007		X	5.1%
7/6/2010		X	5.2%
7/7/2010		X	6.0%
7/20/2011		X	4.6%
7/21/2011		X	4.3%
7/22/2011		X	4.5%
Average (2007 - 2011)			4.9%
Average (2006 - 2011)			4.8%
Standard Deviation			0.623%
10% Tail Probability			1.37
"10/90" DR Target			3.9%

- Over the 2006-2011 period, 6 of the 11 observations are below the mean value of 4.8%. This represents a greater than 50% probability that the target of 4.8% is too high (in 6 of the 11 days, the six hour interruption window is not sufficient to ensure the daily peak is reduced by the full amount of DR).
- PJM recommends that a “10/90” value be used rather than the mean value. This will ensure with 90% confidence that the target is sufficient.
- The 90% confidence factor is used in the two other DR Reliability Target procedures related to the 10 interruption limitation and the Extended Summer DR Product.
- The “10/90” value can be estimated by applying the Student t distribution to the 11 observations.



**10th percentile value is 1.372
standard deviations below the mean**

MAAC			
DR TARGET FOR SELECTED LOAD DAYS			
2006-2011			
<u>Date</u>	<u>Load Management</u>	<u>Above 50/50 WN</u>	<u>Cap for 6 Hour Duration</u>
8/2/2006	Y		4.3%
8/3/2006	Y		4.6%
8/8/2007	Y		7.0%
6/10/2008		Y	6.2%
7/6/2010		Y	5.5%
7/7/2010		Y	5.0%
5/31/2011	Y		6.6%
7/21/2011		Y	4.5%
7/22/2011		Y	6.0%
Average (2007 - 2011)			5.8%
Average (2006 - 2011)			5.5%
Standard Deviation			0.990%
10% Tail Probability			1.40
"10/90" DR Target			4.1%
"10/90" DR Target*			4.3%

*Value is converted to be coincident with the RTO

Eastern MAAC			
DR TARGET FOR SELECTED LOAD DAYS			
2006-2011			
<u>Date</u>	<u>Load Management</u>	<u>Above 50/50 WN</u>	<u>Cap for 6 Hour Duration</u>
8/2/2006	Y		4.4%
8/3/2006	Y		5.3%
8/8/2007	Y		7.3%
7/6/2010		Y	6.2%
7/7/2010	Y	Y	6.2%
5/31/2011	Y		7.2%
7/21/2011		Y	5.0%
7/22/2011		Y	4.6%
Average (2007 - 2011)			6.1%
Average (2006 - 2011)			5.8%
Standard Deviation			1.135%
10% Tail Probability			1.41
"10/90" DR Target			4.2%
"10/90" DR Target*			4.3%

*Value is converted to be coincident with the RTO

South-West MAAC			
DR TARGET FOR SELECTED LOAD DAYS			
2006-2011			
<u>Date</u>	<u>Load Management</u>	<u>Above 50/50 WN</u>	<u>Cap for 6 Hour Duration</u>
8/2/2006	Y		5.1%
8/3/2006	Y		5.8%
8/8/2007	Y		5.9%
7/7/2010	Y		5.2%
9/24/2010	Y		5.3%
5/31/2011	Y		6.2%
7/21/2011		Y	4.2%
7/22/2011		Y	8.5%
Average (2007 - 2011)			5.9%
Average (2006 - 2011)			5.8%
Standard Deviation			1.263%
10% Tail Probability			1.41
"10/90" DR Target			4.0%
"10/90" DR Target*			4.1%

*Value is converted to be coincident with the RTO

2014/2015 Minimum Resource Requirements				
Forecast Pool Requirement		1.0809		
Demand Resource Factor		0.956		
Quantities are in Unforced Capacity Megawatts	PJM Region	MAAC	EMAAC	SWMAAC
Reliability Requirement (without FRR)	148,323.1	72,187.0	39,995.0	17,358.0
Short-Term Resource Procurement Target (STRPT)	3,708.1	1,667.3	910.1	389.2
Reliability Requirement minus STRPT	144,615.0	70,519.7	39,084.9	16,968.8
CETL	NA	5,694.0	8,189.0	7,718.5
Reliability Requirement minus STRPT minus CETL	NA	64,825.7	30,895.9	9,250.3
Preliminary Peak Load Forecast	164,757.6	61,700.0	33,678.0	14,401.0
FRR Peak Load	27,535.8	0.0	0.0	0.0
Peak Load Forecast adjusted for FRR	137,221.8	61,700.0	33,678.0	14,401.0
Limited Demand Resource Reliability Target				
Percent of Preliminary Forecast Peak Load	4.8%	5.7%	5.9%	5.9%
Unforced Capacity, MW	6,806.2	3,634.2	2,053.2	878.0
Extended Summer Demand Resource Reliability Target				
Percent of Preliminary Forecast Peak Load	11.4%	11.1%	15.8%	14.1%
Unforced Capacity, MW	16,164.8	7,077.0	5,498.5	2,098.2
Minimum Resource Requirements for RPM, MW				
Minimum Extended Summer Resource Requirement	137,808.8	61,191.5	28,842.7	8,372.4
Minimum Annual Resource Requirement	128,450.2	57,748.7	25,397.4	7,152.1
Minimum Resource Requirements for FRR (% Obligation)				
Minimum Extended Summer Resource Requirement	95.4%	NA	NA	NA
Minimum Annual Resource Requirement	89.1%	NA	NA	NA

2014/2015 Minimum Resource Requirements				
Forecast Pool Requirement	1.0809			
Demand Resource Factor	0.956			
Quantities are in Unforced Capacity Megawatts	PJM Region	MAAC	EMAAC	SWMAAC
Reliability Requirement (without FRR)	148,323.1	72,187.0	39,995.0	17,358.0
Short-Term Resource Procurement Target (STRPT)	3,708.1	1,667.3	910.1	389.2
Reliability Requirement minus STRPT	144,615.0	70,519.7	39,084.9	16,968.8
CETL	NA	5,694.0	8,189.0	7,718.5
Reliability Requirement minus STRPT minus CETL	NA	64,825.7	30,895.9	9,250.3
Preliminary Peak Load Forecast	164,757.6	61,700.0	33,678.0	14,401.0
FRR Peak Load	27,535.8	0.0	0.0	0.0
Peak Load Forecast adjusted for FRR	137,221.8	61,700.0	33,678.0	14,401.0
Limited Demand Resource Reliability Target				
Percent of Preliminary Forecast Peak Load	3.9%	4.3%	4.3%	4.1%
Unforced Capacity, MW	5,530.1	2,741.6	1,496.4	610.1
Extended Summer Demand Resource Reliability Target				
Percent of Preliminary Forecast Peak Load	11.4%	11.1%	15.8%	14.1%
Unforced Capacity, MW	16,164.8	7,077.0	5,498.5	2,098.2
Minimum Resource Requirements for RPM, MW				
Minimum Extended Summer Resource Requirement	139,084.9	62,084.1	29,399.5	8,640.2
Minimum Annual Resource Requirement	128,450.2	57,748.7	25,397.4	7,152.1
Minimum Resource Requirements for FRR (% Obligation)				
Minimum Extended Summer Resource Requirement	96.3%	NA	NA	NA
Minimum Annual Resource Requirement	89.1%	NA	NA	NA

The determination of the 6-hour-based DR Reliability Target for Limited DR should be modified in two ways:

1. The load days examined should include all days beginning with January 1, 2006 through the most recent summer (rather than only days from the most recent 5 calendar years). This modification does not require a Tariff change.
2. The Target calculation should be based on the “10/90” value of the distribution resulting from all qualified load days (rather than the average of that distribution). Requires Tariff change.

These changes would be applied to both the RTO and the LDA procedures and would become effective with the 2014/2015 Incremental Auctions and the 2015/2016 Base Residual Auction.

Duration Requirement

1. PJM examines ~~the all days since January 1, 2006 through the most recent September 30~~last five calendar years and identifies any day which is an annual peak load day and/or a day with an unrestricted peak load greater than the 50/50 weather normalized peak and/or a day on which RTO-wide load management was implemented. These days would be most likely to require invocation of DR
2. The unrestricted hourly loads for each of the days identified in step 1 are ranked from highest to lowest. The MW difference between the day's unrestricted hourly peak load and its seventh highest unrestricted hourly load is computed.
3. For each day examined in step 2, the MW difference between the day's unrestricted hourly peak load and its seventh highest unrestricted hourly load is divided by the forecasted 50/50 peak load for that particular summer. The resulting percentages are tabulated for all days that qualify per step 1. ~~The average of these percentages is~~The DR Reliability Target based on the 6 hour duration requirement is the 10th percentile value from the distribution defined by these percentages. -Any day with a peak load well below the 50/50 peak may be excluded from this calculation as it is not representative of a day that would require implementation of DR.

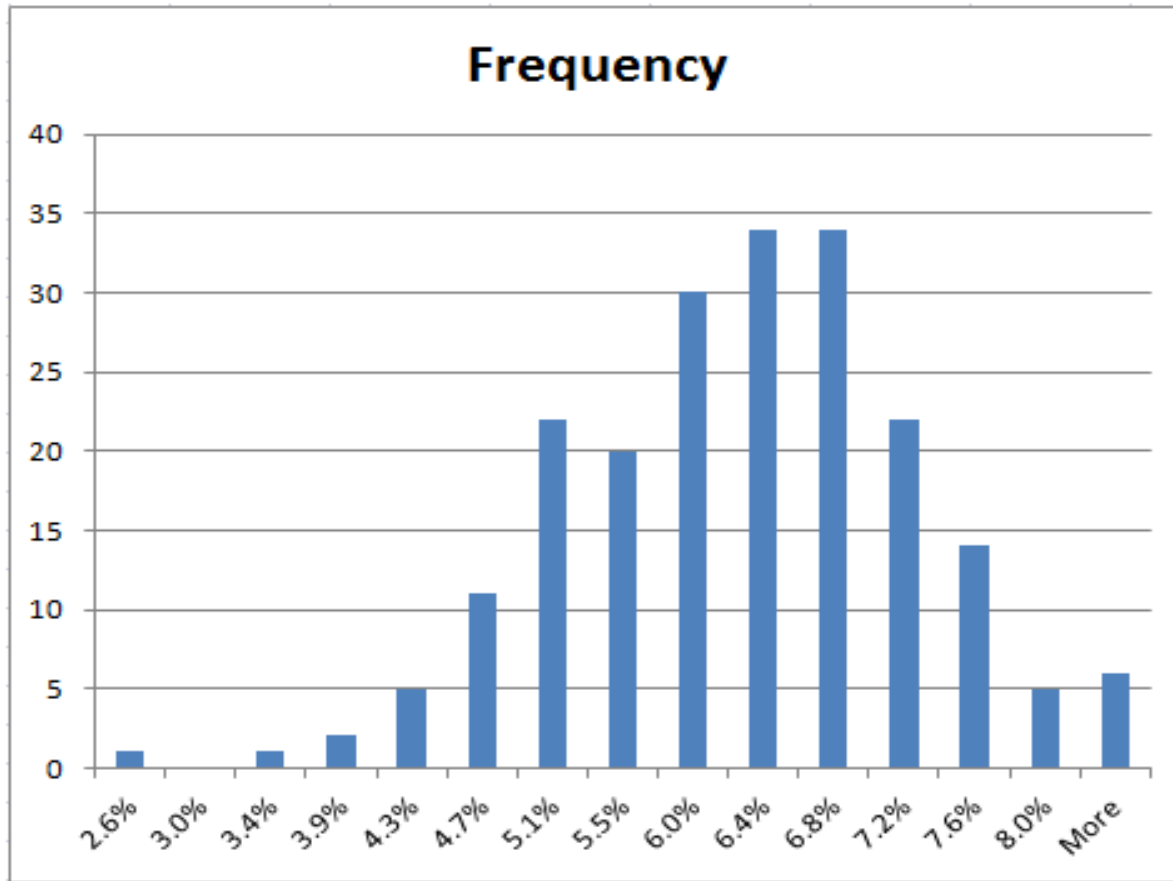
- Endorsement of revised language for OATT Section 2.36B.
- Endorsement of changes to Manual 20, Sections 5.2.1 and 5.2.2 as detailed on slide 13.

Student t Distribution Technical Information

- In situations when the sample size is small, we have imperfect knowledge of the population mean and variance. Under these circumstances, a Student t distribution dependent on sample size is appropriately used to replace the normal distribution.
- The primary difference between a Student t distribution and a normal distribution is that the Student t has “fatter” tails. This means that observations further away from the sample mean have a greater probability of occurrence in the Student t distribution than in the normal distribution. This reflects the greater uncertainty about the sample mean because of the relatively few observations.
- As the number of observations increases, the Student t distribution gradually approaches the normal distribution. Once the number of observations reaches 30, the two distributions are roughly equivalent.

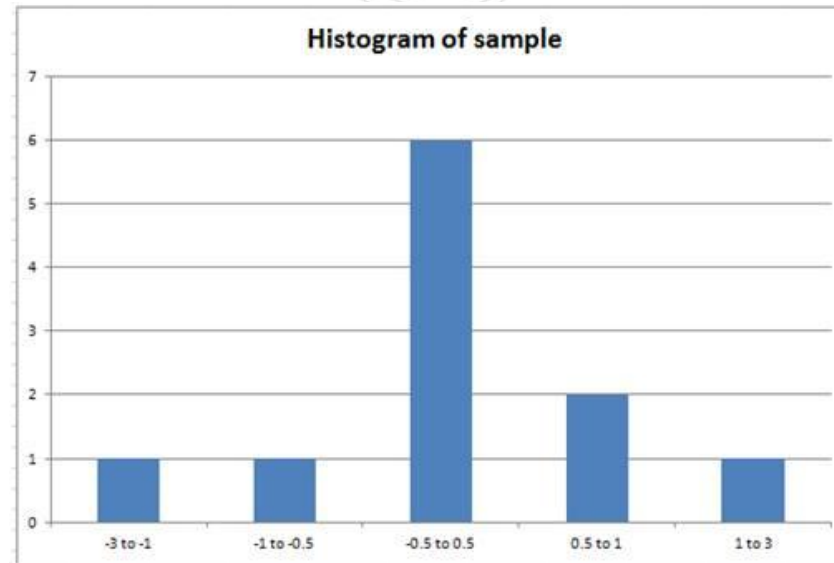
- To obtain the “10/90” value, PJM needs to determine the appropriate statistical distribution to be applied in calculating the sample statistics (mean and standard deviation).
- The distribution of the data of % diff of peak to 7th highest daily load needed to be verified for a small sample of data (only 11 data points). PJM can simulate the underlying population being sampled.
- PJM determined all summer weekday peaks since 2006 and retained the top 50% for each summer. PJM took the difference of each daily peak and the 7th highest daily load, and divided by the median summer daily peak for each year. This calculation approximated the cap for six hour duration. Histogram of results is on next slide.

- A histogram of the data appears to be normally distributed.



Distribution of Sample High Load Days

Plot of 11 High Load Days (number of stdev about the mean)



PJM also used a statistical test (the Shapiro-Wilk test) to verify that the 11 sample points to be used were normally distributed. Under the test, the null hypothesis is that the data is normally distributed. The test fails to reject this assertion.

Test of Normality on 11 High Load Days

