

# Intermittent Resource (“IR”) Study Work Plan

## Estimate of Wind/Hydro Generation During Hours of System Peak Load

**Objective:** To develop a methodology for establishing values for winter and summer Qualified Capacity (MW) for Intermittent Resources in the Forward Capacity Auction. This study will attempt to determine the optimum sample size (set of Reliability Hours) that yields the most reliable estimator of median generation during system peak load hours for wind turbines and hydroelectric resources.

### ***Method of Study:***

Each monthly system peak load is expected to occur during one of the following hours:

Season	Hour Ending	Months
Summer	1400 through 1800	June, July, August, and September
Winter	1800 through 1900 1600 through 1800	December and January, October, November, February, March, and April.

**Initial Procedure.** To meet the objectives of this study, historical wind speed will be used to model the output of three types of hypothetical wind turbines. Observed output for ten existing daily cycle hydroelectric resources will be analyzed. The study will test data for a varying number of years.

**Hydroelectric Resources.** The actual generation of these resources during the hours specified above over all days in the designated months will constitute the initial dataset.

**Wind Turbines.** The study will use observed wind speed data from three different locations in New England typical of coastal, offshore, and inland sites. Technical characteristics of the types of turbines that are the most likely candidates for installation at such sites will be combined with the wind speed data to derive hypothetical generation at each location.

**Analysis.** The best possible estimator of generation is defined as the sample median. If generation is normally distributed, then the median and mean (average) are equivalent, and the statistical tests involving the sample mean are more robust and less complex.

Therefore, if analysis reveals a normally distributed sample, the mean will replace the median.

For each IR, the monthly median KW generation will be calculated for each peak load hour over specified years. The sample set of hours will then be expanded iteratively, in order to determine the optimal sample size (“Reliability Hours”) to use to establish the IR’s Qualified Capacity (MW).

Example 1 illustrates the proposed summary results from the datasets for the first year:

**Example 1: Initial Set of Reliability Hours**

JULY	Hour					Total
Day	1400	1500	1600	1700	1800	
<b>1</b>	1,000	800	900	780	1,000	X
<b>2</b>	900	750	875	600	900	
<b>3</b>	1,000	700	850 (July Peak)	500	1,000	
** ** ** **	*	*	*	*	*	
<b>31</b>	800	600	1,000	0	800	
<b>Sample Size</b>						
Total Sample Size	31	31	31	31	31	155
Number of Observations within Criteria	31	31	31	31	31	155
Observations within Criteria: % of Sample Observations	100%	100%	100%	100%	100%	155
Median KW Across Days	Med HE 1400	Med HE1500	Med HE 1600	Med HE 1700	Med HE 1800	<b>Grand Median July 1 – July 31 Hours 1400-1800</b>

The following steps outline the format of the study:

**Step 1: Initial Sample**

- Collect Data for the peak hours listed above, which define the initial set of Reliability Hours for each seasonal period.
- Calculate median output during the Reliability Hours for each IR for each year of the study.

**Step 2 Iterative Process**

- Expand the sample Reliability Hours iteratively, adding one hour before and then one hour after the peak period.
- Determine if the median is similar to the initial sample value, within the chosen confidence level.
- If the statistical tests show that the median of the additional hour is not significantly different from the median calculated for the initial set of Reliability hours, expand the range of Reliability Hours further by adding one hour before and/or one hour after the re-defined peak period.
- This process will continue until the median of an additional contiguous hour differs significantly from that calculated for the previous sample.
- The set of contiguous hours that are statistically similar to the initial set of Reliability Hours will comprise the final set of Reliability Hours.
- Example 2 illustrates this iterative process, where hours 1300 to 1800 are selected as the final set of Reliability Hours for July:

**Example 2: Final Set of Reliability Hours**

	Hour Ending						
JULY	Initial Reliability Hours						
	1st Hour Added: Not Stat. Diff. from Initial Median						2 <sup>nd</sup> Hour Added Stat. Diff. from Initial Median: Fails Test
	Final Set of Reliability Hours						
Day	1300	1400	1500	1600	1700	1800	1900
1	900	1,000	800	900	780	1,000	X
2	850	900	750	875	600	900	
3	700	1,000	700	(July Pk) 850	500	1,000	
*****	*	*	*	*	*	*	
31	975	800	600	1,000	0	800	
Sample Size	31	31	31	31	31	31	
Observations within Criteria	31	31	31	31	31	31	0
Observations within Criteria: % of Sample	100	100	100	100	100	100	--
Median KW Across Days	Med HE 1300	Med HE 1400	Med HE 1500	Med HE 1600	Med HE 1700	Med HE 1800	Med HE 2000

***Step 3 Evaluation:***

A methodology for calculating Qualified Capacity (MW) for the FCM will be developed from the results of this analysis, according to the following steps:

- Analyze generation data for the Reliability Hours over a rolling period of years for each type of IR.
- Determine the most representative set of contiguous years between 2000 and 2005.
- Calculate the rolling average median hourly generation over this set of years for each IR, for the summer and winter seasons.
- Calculate the winter and summer Qualified Capacity (MW) value for each category of IR studied.
- If time permits, additional years may be evaluated for a subset of the hydroelectric resources to explore the significance of:
  - Using a longer time horizon to calculate the rolling average;
  - Comparing wet, dry, and normal years; or
  - The relationship between precipitation and generation.