Electric Reliability Council of Texas

# Final Report: January 6 2014 EEA

Prepared by: Operations Support Engineering

Event Date: January 6, 2014

Report Date: March 7, 2014

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## Incident Classifications

| | |
|---|---|
| **Date and time of incident** | 6 January 2014 0652 |
| **Region of incident** | System wide |
| **Affected regions** | All |
| **Event type** | EEA Level 2 |
| **Primary cause** | Winter Weather & Generation Trip/Derating |

## Abbreviations and Symbols

| Abbreviation | Term |
|---|---|
| AS | Ancillary Services |
| DRUC | Day-Ahead Reliability Unit Commitment |
| EEA | Energy Emergency Alert |
| ERCOT | Electric Reliability Council of Texas |
| ERS | Emergency Reserve Service |
| HE | Hour Ending |
| HRUC | Hour-Ahead Reliability Unit Commitment |
| HSL | High Sustainable Limit |
| kV | Kilovolt |
| LF | Load Forecast |
| MAPE | Mean Absolute Percent Error |
| MIS | Market Information System |
| MW | Megawatt |
| PRC | Physical Responsive Capability |
| QSE | Qualified Scheduling Entity |
| QSGR | Quick Start Generation Resource |
| RGV | Rio Grande Valley |
| RRS | Responsive Reserve Service |
| RUC | Reliability Unit Commitment |
| SARA | Seasonal Assessment of Resource Adequacy |
| SCED | Security Constrained Economic Dispatch |

# Contents

# 1 Event Summary

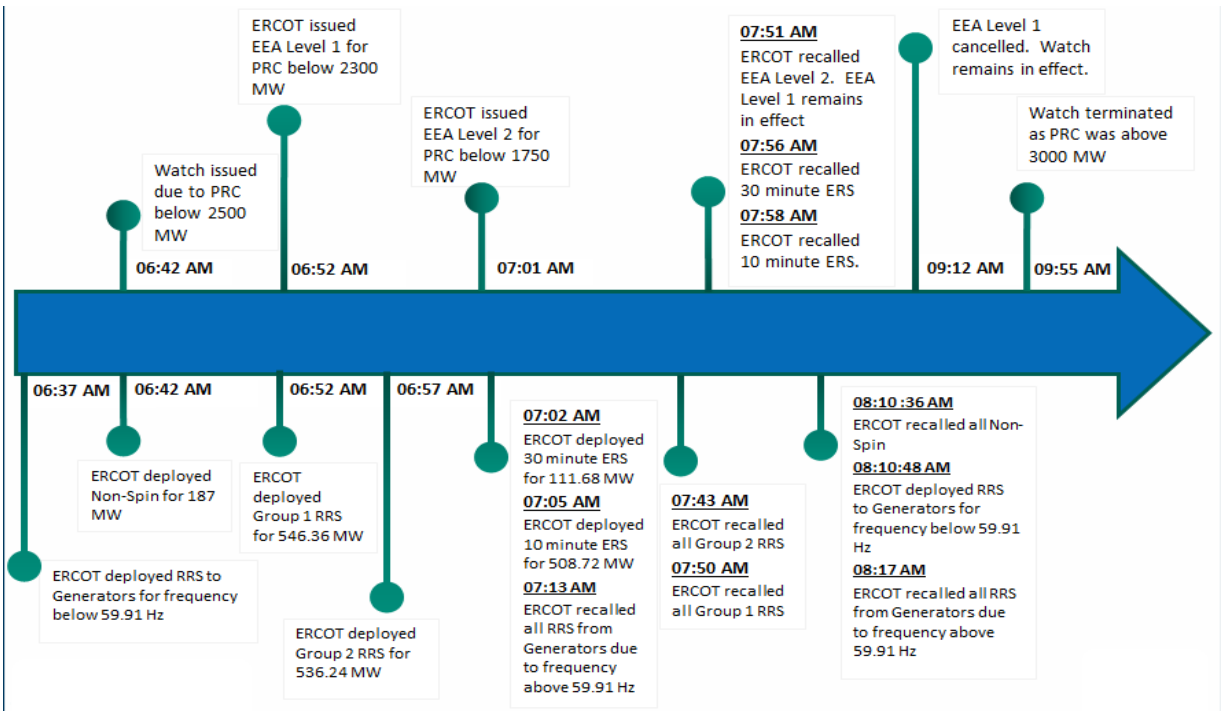
The morning of January 6, 2014, ERCOT entered into emergency operations. The unavailability of generation resources due to outages, derates, and failures to start in conjunction with freezing conditions contributed to the event. As the load increased due to the morning ramp and generation resource unavailability continued to increase, reserves declined. At 06:52 ERCOT entered level 1 of its Energy Emergency Alert (EEA) plan. EEA level 2 was declared at 07:01 during which Non-Spin, Load Resources (LR) and Emergency Reserve Service (ERS) were deployed. At 07:51 ERCOT exited EEA level 2 and reentered back into EEA level 1 due to improving conditions, and at 09:12 ERCOT exited EEA level 1 and resumed normal operations. Media appeals were issued and no firm load shed actions were taken.

# 2 Pre-Event Conditions

On January 5, 2014, a cold weather front swept across the ERCOT region, bringing with it freezing conditions across much of the Interconnection the evening of the 5th and into the 6th. An Advisory was issued at 10:00 on January 5 for the impending cold weather. Peak load was forecasted to be 54,442 MWs and adequate resources were forecasted to be online to serve peak load for HE08 on the 6th. Between midnight on January 6 and the time EEA was issued at 06:52, significant generation became unavailable due to trips, derates, or failures to start, causing Physical Responsive Capability (PRC) to degrade over the morning hours.

# 3 Incident Event Log

An illustrated timeline is provided below. On the following page is the sequence of events in tabular form. The majority of the information in the table has been retrieved from system operator log entries. Formal discussion of the event and the conditions leading up to it are provided in Section 5.



| Time | Event |
|---|---|
| **05 Jan 2014 10:00** | **ERCOT issued an Advisory due to the hard freeze expected across much of the state Monday morning.** |
| 05 Jan 2014 23:56 | Unit tripped while loaded at 25 MW due to bag house issues. |
| 06 Jan 2014 00:00 | Unit derated 154 MW due to emissions limitations. |
| 06 Jan 2014 00:16 | 2 Units derated due to gas restrictions. Total derate of 832 MW to the plant.<br>Unit derated 70 MW due to emissions |
| 06 Jan 2014 00:30 | Unit tripped with loss of 472 MW. Cause of the trip to be an auxiliary ground on the transformer |
| 06 Jan 2014 00:49 | Unit derated 15 MWs due to weather related issues |
| 06 Jan 2014 01:48 | Unit tripped with a loss of approximately 467 MW of generation. Cause of the trip to be Unit had frozen LP drum lines. |
| 06 Jan 2014 02:50 | Unit derated 30 MW; Another Unit derated 6 MW. |
| 06 Jan 2014 03:10 | Unit experienced valve problems and came offline, losing 30 MW of generation. Total consequential loss of capacity due to trip is 337 MW |
| 06 Jan 2014 03:55 | Unit derated 110 MW due to a frozen transmitter on the steamer |
| 06 Jan 2014 04:05 | Unit derated 18 MW due to temperature related faults |
| 06 Jan 2014 04:43 | Unit tripped on startup due to blade path temperature. Loss of capacity 110 MW. |
| 06 Jan 2014 04:46 | Unit failed to start due to burner issues. Total loss of capacity 435 MW |
| 06 Jan 2014 04:54 | Unit tripped with 20 MW due to high drum level issues.<br>Unit derated 125 MW due to emissions |
| 06 Jan 2014 04:54 | Unit tripped with 74 MW of generation due to frozen high pressure steam flow transmitters. Total consequential loss of capacity due to trip is 198 MW. |
| 06 Jan 2014 05:02 | Unit failed to start due to exhaust vacuum issues. Loss of capacity 395 MW. |
| 06 Jan 2014 05:52 | Unit tripped with 10 MW of generation lost. Manual trip to stay within air permit requirements. |
| 06 Jan 2014 05:53 | Unit derated 300 MW due to an issue with boiler feed pump. |
| 06 Jan 2014 05:59 | Unit tripped with loss of 194 MW of generation due to freezing. Total consequential loss of capacity is 369 MW. |
| 06 Jan 2014 06:00 | Unit derated 105 MW due to emissions limitations |
| 06 Jan 2014 06:05 | Unit derated by 500 MW due to an issue with the heater drain pump. |
| 06 Jan 2014 06:27 | Unit forced out for 4 hour lock out with loss of 47 MW of generation. |
| 06 Jan 2014 06:35 | Unit reported having freezing problems with instrumentation. Unit was initially derated from 400 MW. |
| **06 Jan 2014 06:42** | **ERCOT deployed 187 MW of Non-Spin.**<br>**ERCOT issued a Watch due to PRC below 2500 MW.** |
| 06 Jan 2014 06:45 | Unit tripped off its remaining 500 MW. |
| 06 Jan 2014 06:47 | Unit tripped off due to emission problem while generating 138 MW. Total consequential loss of capacity is 214 MW. |
| 06 Jan 2014 06:50 | Unit derated by 150 MW due to loss of fan. |
| **06 Jan 2014 06:52** | **ERCOT issued EEA Level 1 for PRC below 2300 MW**<br>**ERCOT deployed Group 1 Load Resources RRS for 546.36 MW.** |
| **06 Jan 2014 06:57** | **ERCOT deployed Group 2 Load Resources RRS for 536.24 MW.** |
| **06 Jan 2014 7:01** | **ERCOT issued EEA Level 2 for PRC below 1750 MW.** |
| 06 Jan 2014 06:59 | Unit tripped while loaded at 310 MW due to exhaust temperature spread. |
| 06 Jan 2014 07:00 | ERCOT requested Transmission Operator contact CFE about emergency energy across the CFE DC ties. |

| | |
|---|---|
| **06 Jan 2014 07:02** | **ERCOT deployed 30 minute ERS for 111.68 MW.** |
| **06 Jan 2014 07:05** | **ERCOT deployed 10 minute ERS for 508.72 MW.** |
| 06 Jan 2014 07:12 | Unit returned to service. Unit was derated by 32 MW due to heater problems. |
| 06 Jan 2014 07:24 | Unit derated by 26 MW due to emissions issues |
| 06 Jan 2014 07:25 | ERCOT requested emergency transmission service across the SPP DC ties. SPP stated none was available for HE 8 and 9. |
| 06 Jan 2014 07:27 | Unit derated by 65 MW due to an issue with the pulverizer |
| 06 Jan 2014 07:30 | ERCOT received emergency energy across the South DC tie for 20 MW and 50 MW across the Laredo DC tie. |
| 06 Jan 2014 07:34 | ERCOT received emergency energy across the Railroad DC tie for 150 MW. |
| 06 Jan 2014 07:36 | Unit tripped with 155 MW due to exhaust spread. |
| **06 Jan 2014 07:43** | **ERCOT recalled all RRS Group 2 Load Resources.** ERCOT curtailed two export schedules across the North DC Tie for 134 MW. |
| **06 Jan 2014 07:50** | **ERCOT recalled all RRS Group 1 Load Resources.** |
| **06 Jan 2014 07:51** | **ERCOT recalled EEA Level 2. EEA level 1 remained in effect.** |
| **06 Jan 2014 07:56** | **ERCOT recalled 30 minute ERS.** |
| **06 Jan 2014 07:58** | **ERCOT recalled 10 minute ERS.** |
| 06 Jan 2014 07:59 | Unit tripped off due to emissions problems with loss of 114 MW of generation. |
| 06 Jan 2014 07:59 | Unit tripped off due to vibration alarm with loss of 20 MW. |
| 06 Jan 2014 08:09 | Unit derated by 30 MW due to mill issues |
| **06 Jan 2014 08:10** | **All non-spin reserves recalled.** |
| 06 Jan 2014 08:11 | Unit tripped with approximately 900 MW of generation due to freezing conditions |
| 06 Jan 2014 08:12 | Unit tripped 118 MW. Manual trip due to NOx emissions. |
| 06 Jan 2014 08:22 | Emergency energy across the Railroad DC tie limited to 100 MW from 150 MW due to contingency on CFE grid. |
| 06 Jan 2014 08:24 | Unit tripped while loaded at 11 MW. The turbine inlet pressure sensor froze which sent a false signal to the DCS. |
| 06 Jan 2014 08:29 | Unit derated from 165MW due to a boiler feed pump issue. |
| 06 Jan 2014 08:31 | Unit tripped with approximately 65 MW of generation due to Intermittent GND in 24VDC Control Circuit. |
| 06 Jan 2014 08:50 | Unit tripped with 215 MW generation due to CTG Master Trip Relay failure. |
| 06 Jan 2014 09:05 | Emergency energy from CFE to ERCOT was terminated. A total of 300 MW was received. |
| **06 Jan 2014 09:12** | **EEA terminated. Watch remained in effect.** |
| **06 Jan 2014 09:55** | **ERCOT terminated Watch, PRC was above 3000 MW.** |

## 4 Notable Facts

- Prior to the operating day, during the 19:00 HRUC execution on January 5 2014, ERCOT committed 1 unit (319 MW capacity) for HE06-2200. This commitment was for local congestion.
- Prior to the morning peak on the January 6, three (3) 345kV, sixteen (16) 138kV, and four (4) 69kV transmission outages were cancelled or ended early. One resource delayed its outage.
- Prior to issuing the EEA at 06:52 AM on January 6 2014, ERCOT lost 9355 MW of generation capacity due to generator trips, failure to starts, or derates.
- Of the 9355 MW of generation lost, 3541 MW of that was due to weather related issues.
- 2468 MW of capacity was on planned outage and 2938 MW of capacity was on forced outage going into the operating day (00:00 on 1/6/14).
- Wind generation ramping does not appear to have contributed to the event.

- ERCOT deployed 187 MW of non-Spin from 06:42 to 08:10
- ERCOT deployed 1082 MW of Load Resources between 06:52 and 07:50
- ERCOT deployed 112 MW of ERS 30 minute service between 07:02 and 07:56
- ERCOT deployed 508 MW of ERS 10 minute service between 07:05 and 07:58
- PRC reached its lowest point of 1344 MW at 07:09
- Instantaneous Peak Load was 56,478 MW at 07:08:24. The forecast peak was 54,442 MW for HE09, and the peak integrated load was 55,487 MW for HE08
- ERCOT obtained 300 MW of emergency power across its DC Ties with Mexico; none was available with SPP.
- The actual load for HE08 was 2,500 MW higher than the day-ahead forecast, and 1,200 MW higher than the current-day forecast. For HE09 the approximate differences are 2,400 MW and 900 MW respectively.
- The Department of Energy (DOE) OE-417 form was issued at 11:53 for the public appeal issued during the EEA. The Final OE-417 form was submitted on January 7 2014 at 13:03.
- No firm load was shed during this EEA event.

# 5 Detailed Discussion

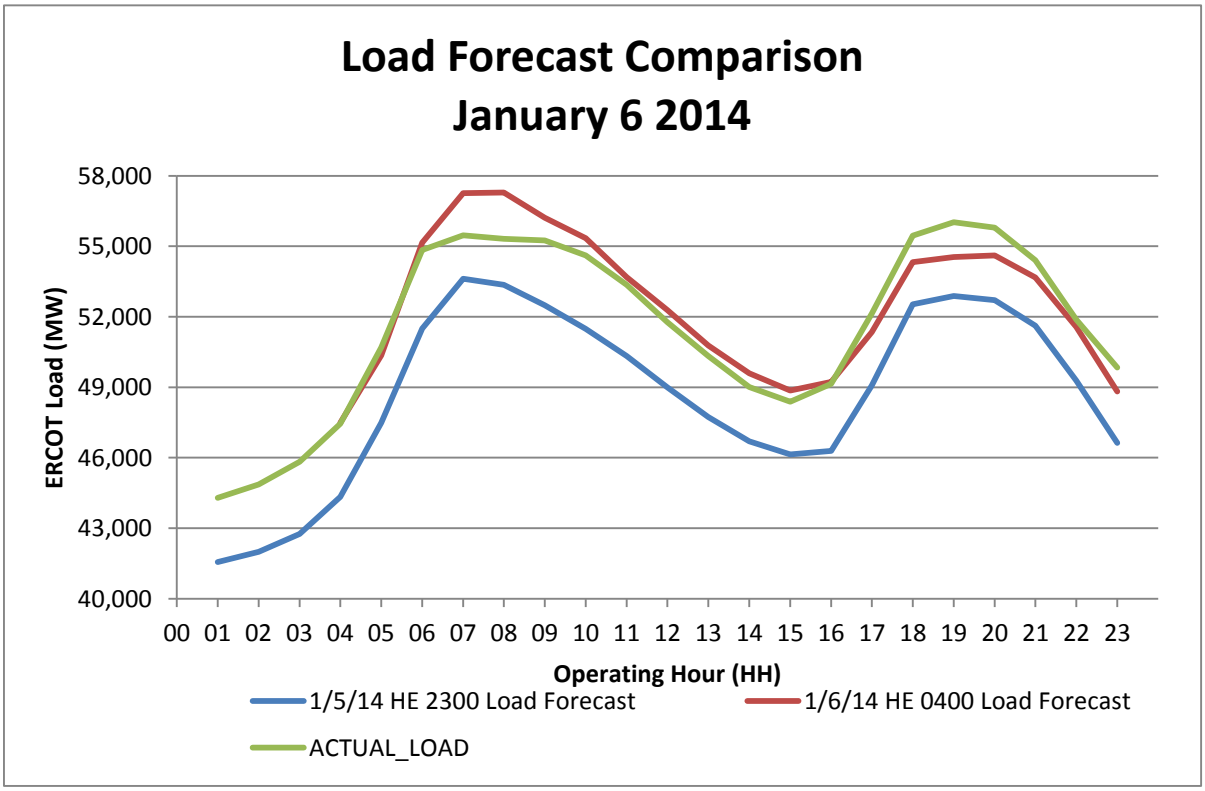
Meteorological Assessment

The table below is a comparison between temperatures and wind for similar cold weather events in recent history to that of the February 2, 2011 cold weather event. In most cases the temperatures were warmer than that of February 2 2011, and wind speeds were generally higher. This table highlights the fact that while the weather on January 6 2014 was very cold, it was not the same magnitude of that experienced on February 2, 2011. The actual temperatures and wind speeds for February 2 2011 are provided below, and then the remaining information is the comparison to those numbers.

| | | Dallas | | Houston | | Austin | | San Antonio | | Brownsville | | Midland | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Temp | Wind | Temp | Wind | Temp | Wind | Temp | Wind | Temp | Wind | Temp | Wind |
| *2-Feb-11* | 5AM | 14 | 17 | 22 | 10 | 18 | 20 | 20 | 13 | 34 | 18 | 9 | 17 |
| | 6AM | 14 | 15 | 21 | 14 | 19 | 17 | 20 | 20 | 33 | 13 | 8 | 15 |
| | 7AM | 14 | 20 | 21 | 16 | 19 | 18 | 20 | 17 | 33 | 20 | 7 | 16 |
| | 8AM | 13 | 20 | 22 | 18 | 19 | 18 | 20 | 16 | 33 | 16 | 7 | 16 |
| 10-Feb-11 | 5AM | 2 | 9 | 4 | -3 | 3 | 8 | 2 | 3 | 1 | 3 | -4 | 13 |
| *10/11 Winter Peak* | 6AM | 2 | 9 | 4 | -1 | 2 | 1 | 1 | 10 | 1 | -3 | -3 | 11 |
| 57,334 MW Load HE08 | 7AM | 2 | 14 | 4 | 4 | 1 | 6 | 0 | 13 | -1 | 2 | -1 | 16 |
| | 8AM | 4 | 13 | 3 | 9 | 3 | 8 | 2 | 6 | 0 | 3 | 1 | 10 |
| 16-Jan-13 | 5AM | 14 | 8 | 17 | 0 | 14 | 14 | 12 | 4 | 10 | 2 | 13 | 8 |
| *12/13 Winter Peak* | 6AM | 13 | 7 | 16 | 5 | 13 | 9 | 12 | 14 | 11 | -1 | 13 | 7 |
| 50,686 MW Load HE08 | 7AM | 14 | 12 | 17 | 4 | 12 | 13 | 10 | 12 | 10 | 4 | 15 | 7 |
| | 8AM | 15 | 13 | 15 | 10 | 13 | 11 | 12 | 9 | 10 | -2 | 16 | 7 |
| 10-Dec-13 | 5AM | 7 | 9 | 12 | -3 | 12 | 11 | 13 | 8 | 10 | 4 | 15 | 10 |
| *13/14 Peak Prior to Jan* | 6AM | 7 | 6 | 12 | 4 | 10 | 10 | 11 | 13 | 9 | -1 | 16 | 8 |
| 53,690 MW Load HE08 | 7AM | 6 | 10 | 11 | 6 | 7 | 12 | 11 | 12 | 9 | 8 | 18 | 9 |
| | 8AM | 7 | 13 | 11 | 8 | 10 | 11 | 12 | 12 | 9 | 3 | 17 | 8 |
| 6-Jan-14 | 5AM | 2 | 7 | 6 | -8 | 7 | 3 | 11 | -2 | 10 | 3 | 7 | 4 |
| *EEA2* | 6AM | 2 | 2 | 7 | 1 | 5 | 2 | 10 | 4 | 10 | -2 | 8 | 2 |
| 56,031 MW Load HE20 | 7AM | 1 | 12 | 6 | 0 | 3 | 3 | 8 | 3 | 9 | 6 | 7 | 3 |
| | 8AM | 4 | 11 | 5 | 9 | 3 | 5 | 7 | 1 | 9 | -1 | 7 | 4 |
| 7-Jan-14 | 5AM | 8 | 8 | 1 | 5 | 0 | 20 | 5 | 13 | 5 | 9 | 11 | 17 |
| *13/14 Winter Peak* | 6AM | 8 | 6 | 3 | 14 | -4 | 13 | 4 | 20 | 7 | 5 | 12 | 9 |
| 57,277 MW Load HE08 | 7AM | 7 | 11 | 3 | 16 | -3 | 18 | 4 | 17 | 8 | 12 | 14 | 9 |
| | 8AM | 8 | 11 | 1 | 14 | -4 | 18 | 4 | 16 | 9 | 9 | 14 | 10 |
| | | | | | | | | | | | | | |
| Temperature values shown indicate degrees warmer at this time than same time on 2/2/2011 | | | | | | | | | | | | | |
| Wind values shown indicate MPH higher wind on 2/1/2011 than at this time | | | | | | | | | | | | | |

Load and Wind Forecast Performance

The January 5 2014 23:00 load forecast for snapshot January 6, 2014 predicted load levels much lower than what were experienced in real-time. As can be seen from the graph below, the actual load on average was 2,400 MW higher than the January 5 2014 23:00 forecasted load for Operating Hours 7-10. The current day Load Forecast snapshot taken at 04:00 on January 6, 2014 was closer to the actual load for most of the day. Contributing factors to the discrepancy across the 08 Operating Hour between the current day Load Forecast snapshot and real-time can be attributed to deployment of Load Resources (1082 MW) and ERS (620 MW) as well as public response to media appeals to conserve energy and voltage reduction measures. Adding the Load Resource and ERS deployment numbers back into the load, brings the load forecast error for HE08 to less than 300 MW. Regarding the difference between the January 5 2014 23:00 load forecast snapshot and the January 6 2014 04:00 snapshot, this difference can be attributed in part to updated temperature forecasts in the five hours between these two snapshots. Additionally, the load forecast tool is able to adjust its forecast based on the differences it observes between the past several hours' forecasts compared to the actual load that occurred.

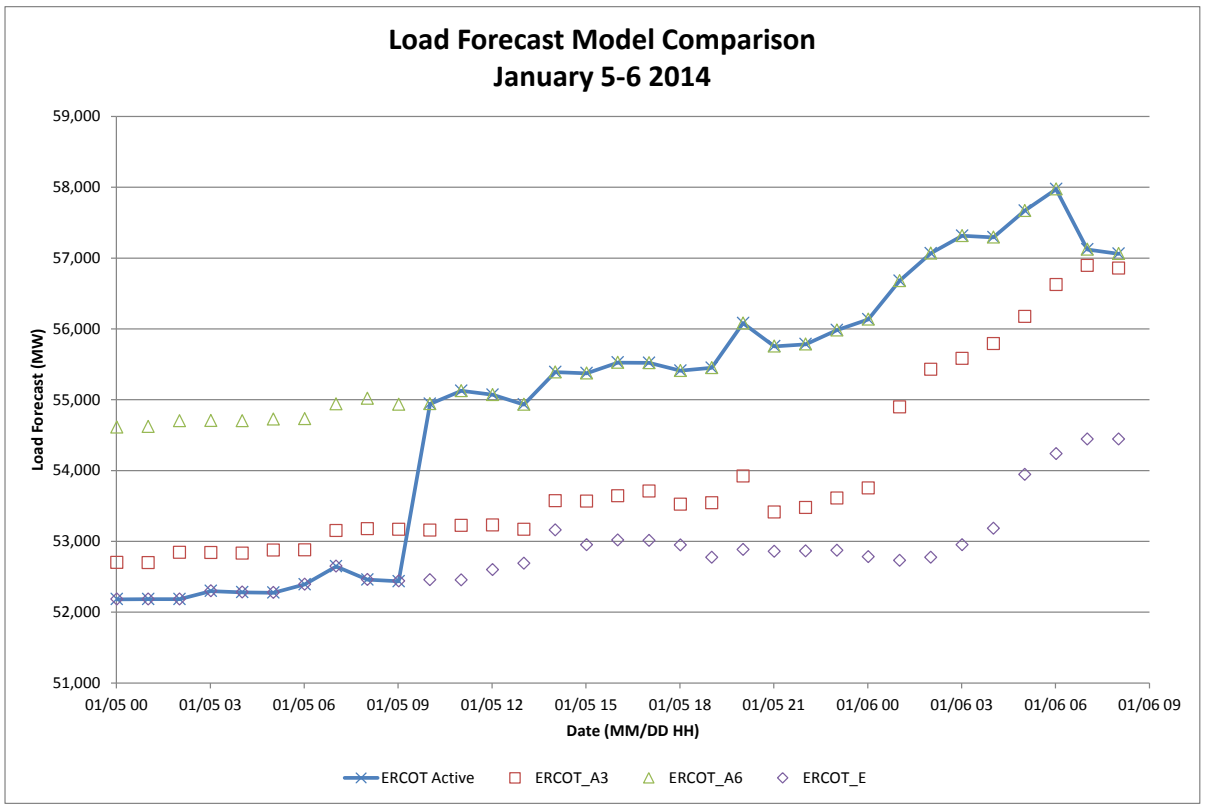



In terms of load forecast accuracy, ERCOT calculates a Mean Absolute Percentage Error (MAPE) that evaluates the accuracy of the various forecasting models available. MAPE is calculated daily and monthly for all forecast models. On January 6 2014, the daily MAPE for the forecast model being used (Areva 2006) was 2.29%, and the monthly MAPE for January-to-date was 3.17 %. The monthly MAPE for January-to-date is consistent with historical trends of load forecast performance. A monthly MAPE of 3.5 – 4.0 % is considered acceptable performance. As can be seen from the table on the next page, of all the available forecast models, this model was the most accurate.

| MAPE | | |
|---|---|---|
| Forecast Model | Jan 6 Daily | Jan-To-Date Monthly |
| ERCOT Active | 2.29 % | 3.17 % |
| Areva 2003 (A3) | 5.23 % | 3.58 % |
| Areva 2006 (A6) | 2.29 % | 2.56 % |
| MextrixIDR Total (E) | 6.04 % | 3.80 % |

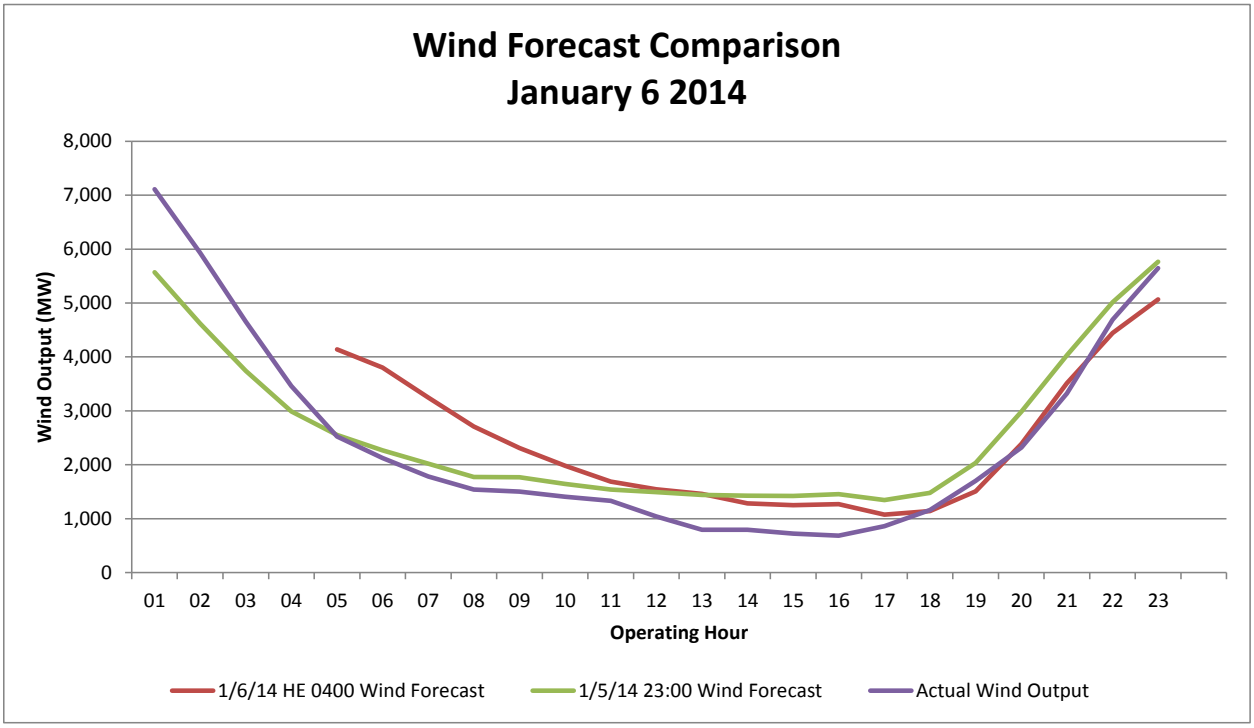
*Note: The ERCOT Active model can be a single model or combination of any of the forecast models

The graph below illustrates which of the three load forecast models was being used on January 5 and 6. On January 5 around HE09, the active forecast was changed to the Areva 2006 model, and remained during the event on January 6.




The January 5 2014 23:00 wind forecast for January 6 2014 predicted wind output fairly consistent to the actual wind output observed. As can be seen from the graph below, the actual wind output, on average, was 240 MW below the January 5 2014 23:00 forecast for Operating Hours 7-10. The current day wind forecast snapshot taken at 04:00 predicted a much higher wind output, resulting in a forecast on average 1000 MW above the actual wind output for Operating Hours 7-10. It is important to note that the current wind forecast model does not take into account ambient temperature impacts or icing impacts on wind turbine availability. Wind farm generation companies are required, per Sections 3.15 (12) and 6.5.5.2 (4) of the ERCOT Nodal Protocols, to provide ERCOT with a telemetered value corresponding to the number of turbines available based on local weather conditions. This information is provided back to ERCOT's wind forecast vendor, however the typical operating conditions of the wind farms are not known to the vendor in advance. In absence of the information, the forecast is unable to adjust to reflect those conditions specific to each wind farm. ERCOT is working with the wind farm generation

companies to collect this information. ERCOT observed 618 MW of derated MWs at 07:00 from wind generators due to weather limiting turbine availability which is also accounted for in the Resource Outages section below.




In terms of wind forecast accuracy, ERCOT calculates system-wide and regional assessments of wind forecast performance on a daily and monthly basis. On January 6 2014, the forecast error percentages were 8.1 % for the day-ahead forecast error, and 4.8 % for the hour-ahead forecast error. These numbers are consistent with historical trends of wind forecast performance, if not slightly better. In 2013, the annual day-ahead forecast error was 8.3 % and the annual hour-ahead forecast error was 5.3 %. The table below provides additional details.

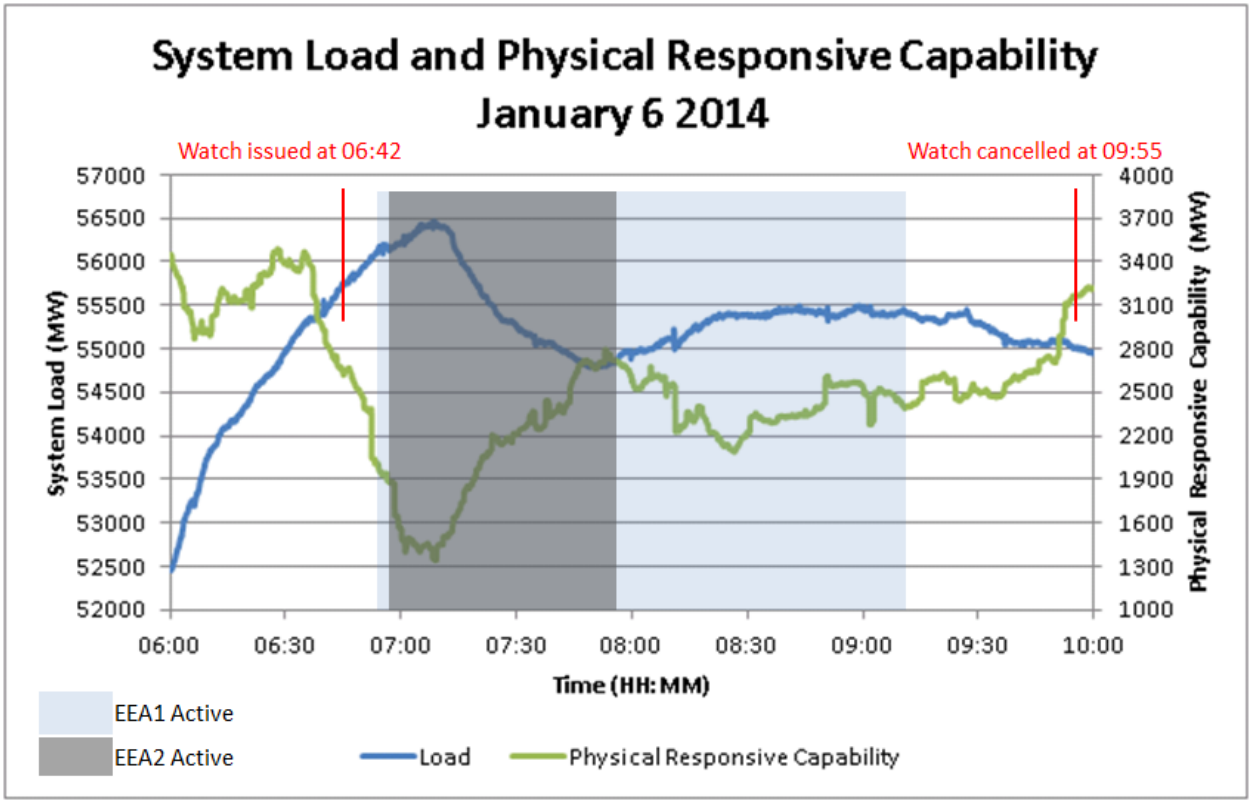
| | | FORECAST ERROR | | | |
|---|---|---|---|---|---|
| | | JAN 6 DAILY MEAN | | JAN-TO-DATE MONTHLY MEAN | |
| | | Absolute MW Error (using Estimated Uncurtailed Output) [MW] | Absolute Percent Error of Installed Capacity [%] | Absolute MW Error (using Estimated Uncurtailed Output) [MW] | Absolute Percent Error of Installed Capacity [%] |
| Day-Ahead | Forecast | 893.3 | 8.1% | 1022.1 | 9.2% |
| | COP HSL | 890.2 | 8.1% | 1099.9 | 10.0% |
| Hour-Ahead | Forecast | 532.6 | 4.8% | 620.7 | 5.6% |
| | COP HSL | 521.5 | 4.7% | 686.5 | 6.2% |

Reserves

ERCOT monitors PRC as an indicator of available reserves that can respond to a disturbance. PRC is a percentage of the High Sustainable Limits (HSL) of all on-line resources in addition to synchronous condensers and Load Resources. Per ERCOT System Operation' procedures, an Advisory is declared when PRC is below 3000 MW, and a

Watch is declared when PRC is below 2500 MW. EEA level 1 is declared when PRC is below 2300 MW and EEA level 2 when below 1750 MW. ERCOT's NERC Contingency Reserve is 1375 MW.

The graph below plots PRC and the system load between 06:00 and 10:00. Notice the inverse relationship between PRC and system load during the ramp. PRC gradually decreased throughout the morning of the 6th as load increased and resource trips and derates continued to occur. The rapid decrease of PRC around 06:30 was the result of the morning load ramp coupled with sudden resource trips and derates across the short period of time. PRC reached its lowest point of 1344 MW at 07:09, and by 07:51 was 2709 MW when ERCOT exited out of EEA level 2. PRC crossed above 2400 MW by 09:11 when ERCOT exited out of EEA level 1. ERCOT was only below its NERC Contingency Reserve of 1375 MW for one minute.

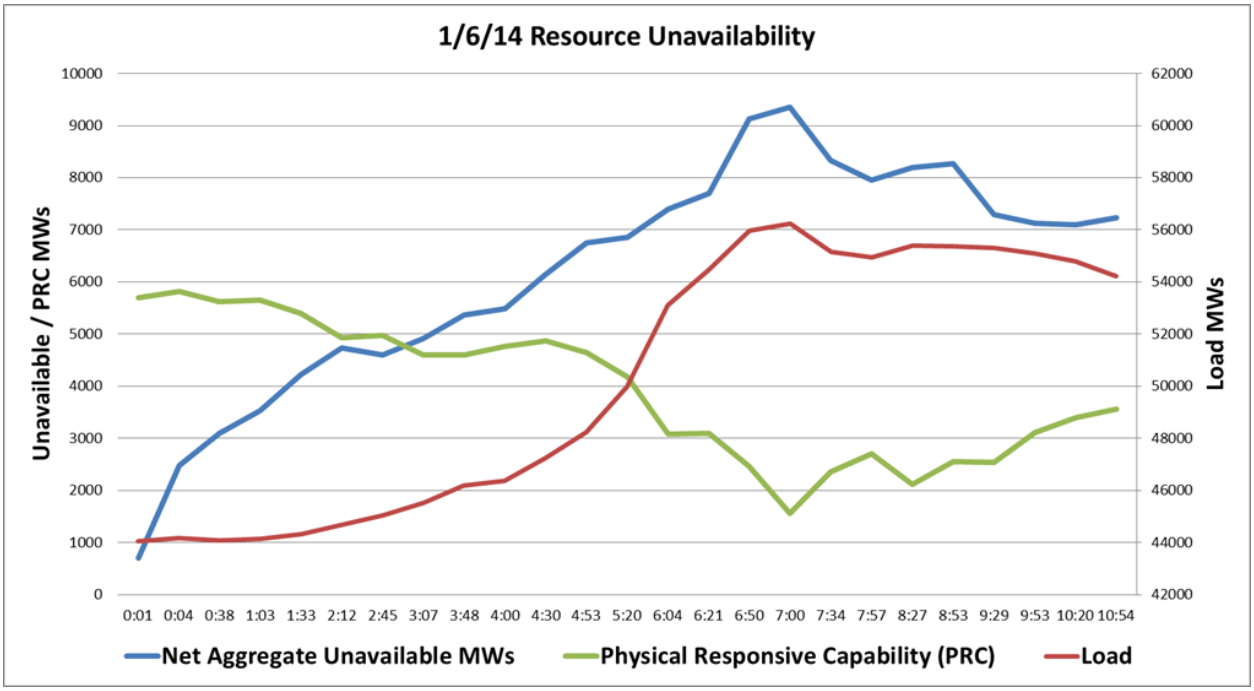


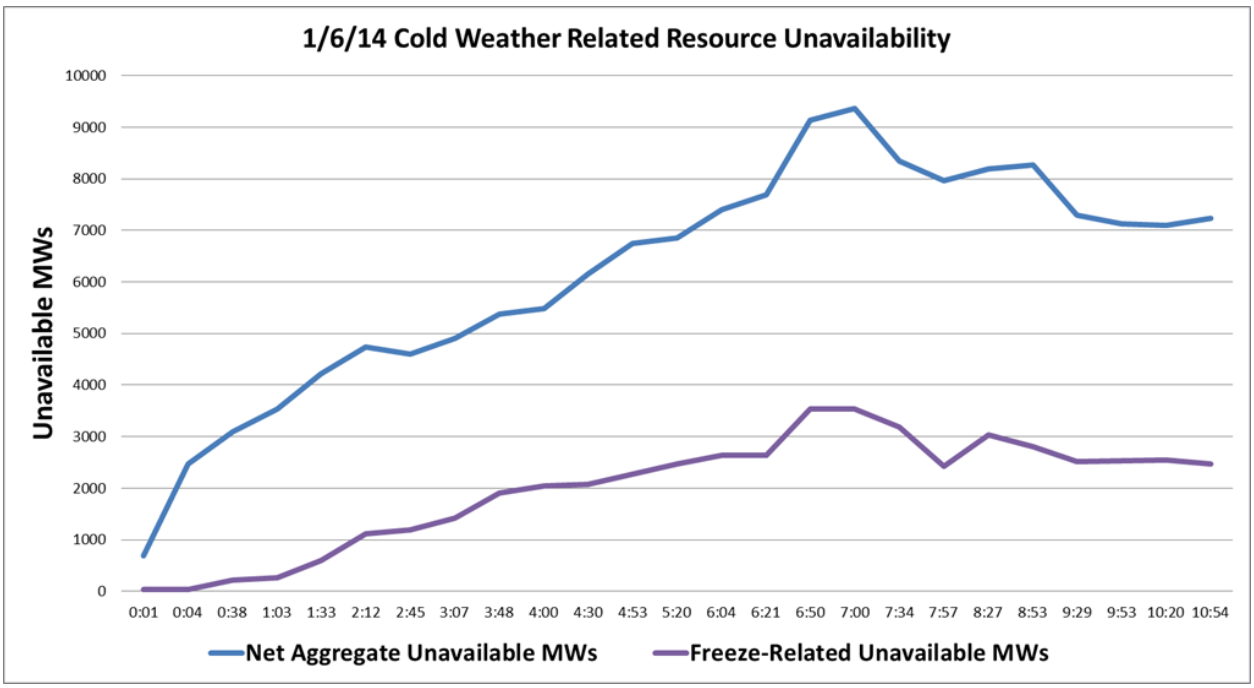

Resource Outages

As can be seen from the graphs on the next two pages, at the peak loss of MWs, 9355 MW was unavailable. 3541 MW were related to issues encountered due to weather. From a cumulative perspective, 97 units tripped, derated, or failed to start during 1/6/14 from 00:00 to 23:59. While not expressed in the graph below, ERCOT also had 2468 MW of capacity on planned outage and 2938 MW of capacity on forced outage leading into the operating day. This would indicate a cumulative peak impact of 14,761 MW of generation that was unavailable entering the EEA.

These values represent an increase from previously reported values due to responses received from Requests For Information (RFIs) sent to Qualified Scheduling Entities (QSEs) as well as additional analysis. A majority of the difference can be accounted for by wind derates that were not entered in Outage Scheduler or captured in ERCOT ISO operator logs. Additional information is provided in Appendix A.

There are a couple of important issues to consider with regard to resource outages. The first issue is that while ERCOT does perform loss of generation contingencies in its Reliability Unit Commitment (RUC) and real-time systems, it is beyond standard "N-1" criteria to perform loss of multiple generation contingencies. The situation on January 6 2014 was well beyond "N-1" criteria. The second issue is that even though ERCOT observed generators tripping and being derated in real-time, given the nature of the RUC tool requiring a two hour lead time (i.e. the 06:00 Hour-Ahead RUC (HRUC) cannot commit generation before HE 09), it was not possible for the operators to react within the timelines of RUC. This timing limits RUC from providing additional unit commitments for events such as this event with a significant amount of generation becoming unavailable over a short period of time.

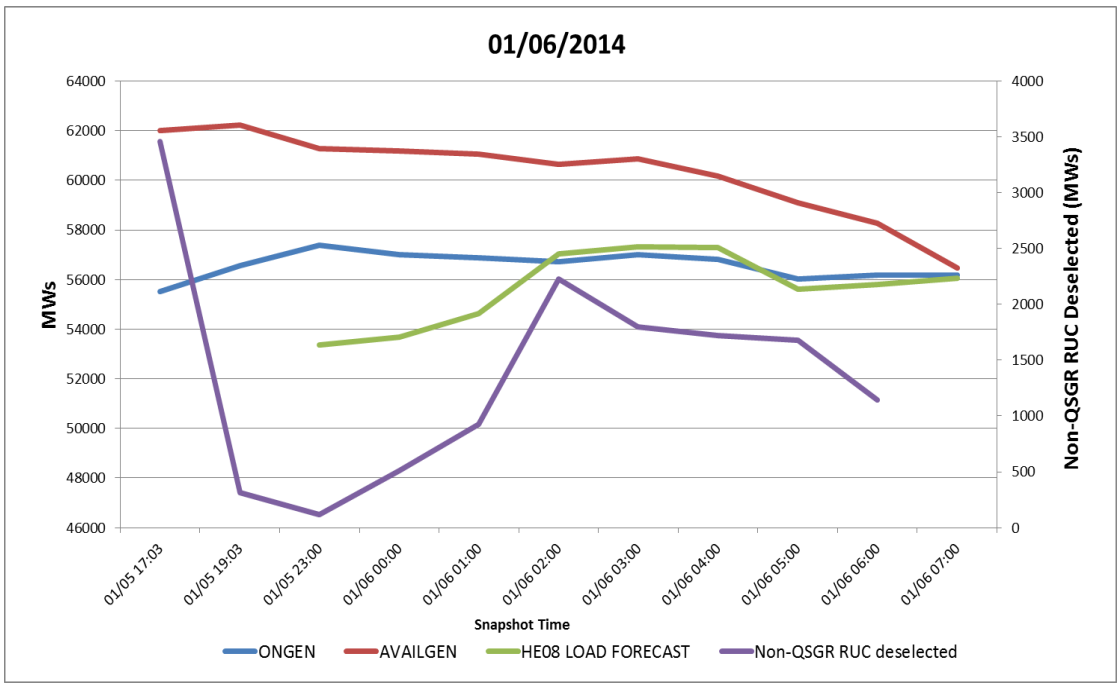





Reliability Unit Commitment (RUC)

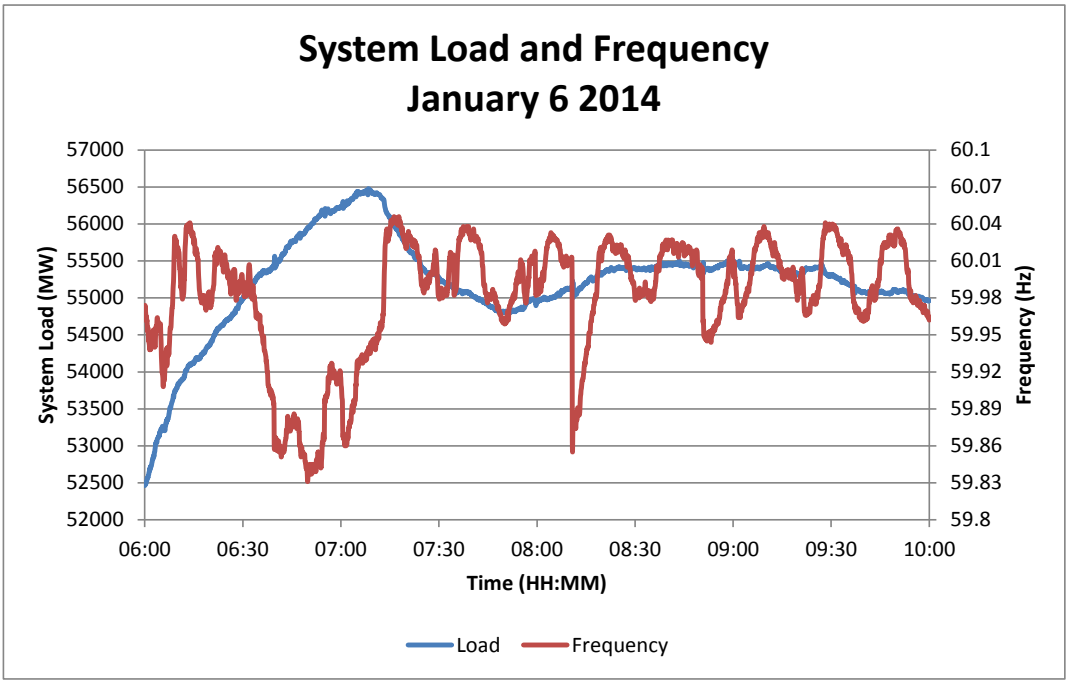
ERCOT committed one resource in the HRUC which executed at 19:00 the evening of January 5 for HE06-22. The HSL for this unit is 319 MW. HRUC recommended several additional resources, most of which were for local congestion, and were not committed by the system operator. Many of those resources were Quick Start Generation Resources (QSGR), or had lead times short enough that the system operator could wait closer to the Operating Hour to issue the commitment. QSGRs are not committed in HRUC because QSGRs are expected to be available within the operating hour and come on-line on their own in response to system needs. Additional resources were not committed based on the expected on-line capacity indicating sufficient resources were available to meet the forecasted load.

ERCOT performed additional analysis into HE08 for January 6 2014 with regards to available off-line capacity. The graph on the next page illustrates available capacity for HE08 as a function of time, beginning at 17:00 on January 5, through 07:00 on January 6. The graph indicates that during this time, the amount of off-line capacity available to come online to serve load diminished as the operating hour approached. In other words, even though there may have been off-line, non-outaged capacity on the system, that capacity's temporal limitations (e.g. minimum off-line time, minimum start time) prevented that capacity from being utilized in real-time. This graph also indicates the amount of non-QSGR capacity which was deselected for commitment over time. Note that while this indicates that as much as 1500 MW of capacity was available for commitment in the hours leading up to the event, many of the resources contributing to this number were on-line during HE08 or experienced issues in coming online. Additional details of the RUC process are discussed in the "Resource Outages" section of this report.



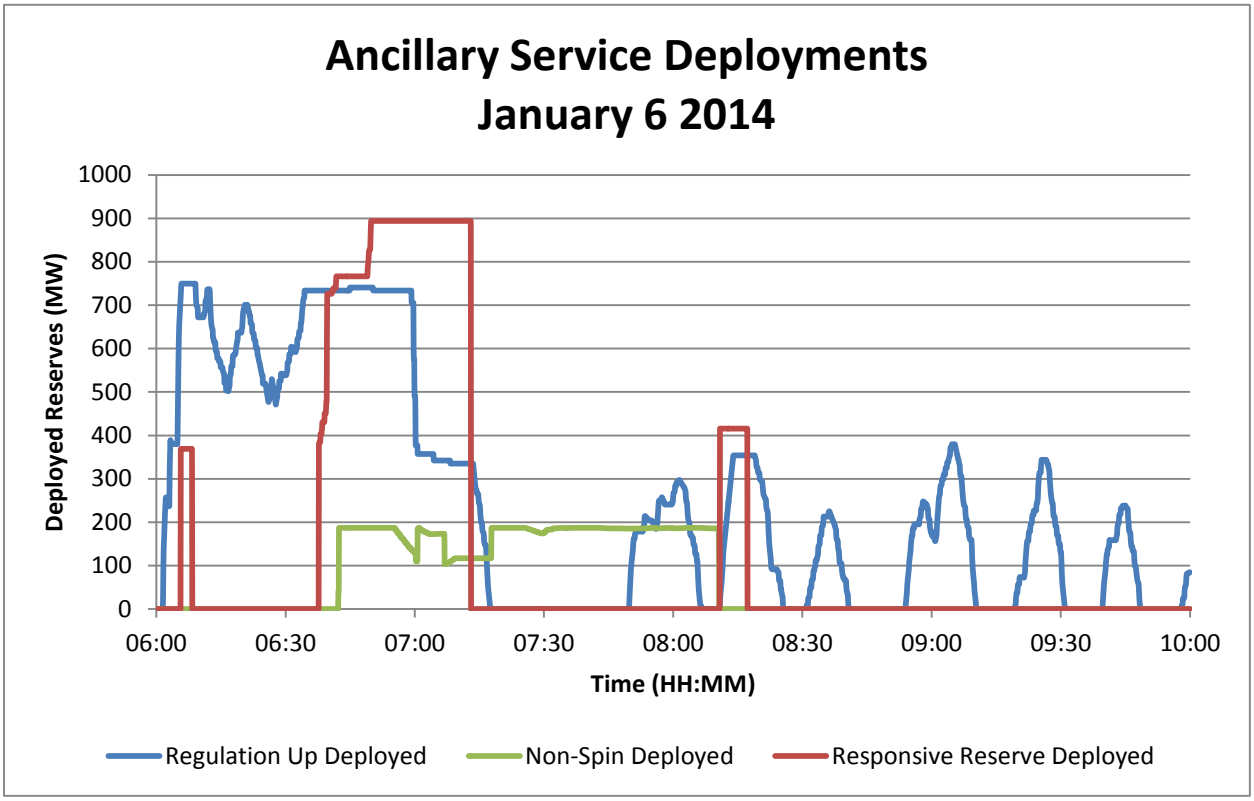

Frequency and Ancillary Services

Frequency began decaying at 06:32, and continued declining until 06:49, with a brief period of recovery around 06:44. Frequency reached its lowest point of 59.831 Hz at 06:49:48. Frequency then recovered, crossing 60 Hz at 07:13. There was a frequency spike at 08:10, attributed to the large unit trip (900 MW), and frequency quickly was restored. The graph below illustrates the system frequency during the event.



The graph below illustrates the deployment of Ancillary Services during this event. Note that ERCOT had 1500 MW of Non-Spin available during this event. A large percentage of Non-Spin comes from quick-start resources whose capacity is always released to the Security Constrained Economic Dispatch (SCED) application for dispatch subject to price floors. The amount of Non-Spin deployed in this graph is only for that portion of Non-Spin (187 MW) which was provided by off-line resources which ERCOT manually instructed to be deployed. The 187 MW of off-line Non-Spin was deployed to three units. All three units responded to the Non-Spin deployment as required within the required time.

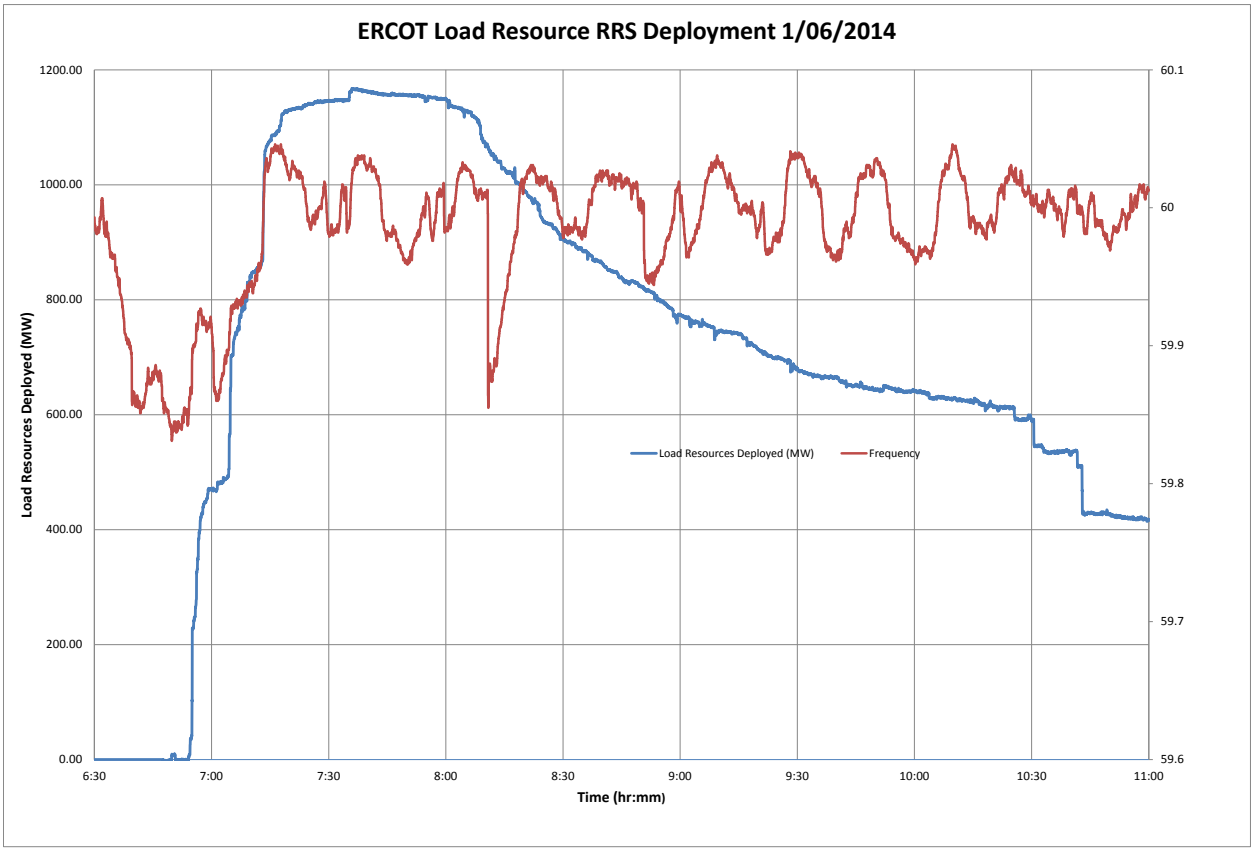
The Responsive Reserve Deployed only indicates those MWs deployed to generators. Note that the Responsive Reserve deployment to generators follows a similar pattern to that of Non-Spin. An RRS deployment is a release of capacity to SCED for dispatch subject to administrative price floors. Details on the Responsive Reserve performance from Load Resources are provided in the section below.



Load Resources providing Responsive Reserve Service (RRS) were also deployed during this event. Of the 1085.5 MW of Load Resources deployed, 1018.3 MW responded, for a 94 % performance overall. Section 8.1.1.4.2 Responsive Reserve Service Energy Deployment Criteria, of the ERCOT Nodal Protocols requires energy deployment performance of Load Resources to be between 95% and 150 % of the requested MWs within ten (10) minutes of the deployment instruction. Overall, the Load Resources were very close to meeting the 95 % requirement. The table below indicates the performance by each Qualified Scheduling Entity (QSE) providing Load Resource RRS.

| QSE Name | Total LR RRS Responsibility (MW) Based on Telemetry at time of Frequency Spike | LR Response (MW) |
|---|---|---|
| QSE A | 0.0 | 0.0 |
| QSE B | 55.6 | 52.3 |
| QSE C | 143.4 | 120.2 |
| QSE D | 174.6 | 175.2 |
| QSE E | 0.0 | 0.0 |
| QSE F | 19.0 | 19.1 |
| QSE G | 59.6 | 49.4 |
| QSE H | 88.8 | 44.8 |
| QSE I | 397.5 | 397.2 |
| QSE J | 89.0 | 91.7 |
| QSE K | 58.0 | 68.4 |
| System Totals | 1085.5 | 1018.3 |

The graph below illustrates the deployment of Load Resources providing RRS between 06:30 and 11:00 on January 6 2014.



The deployment performance of Emergency Reserve Service (ERS) was unavailable at the time this report was created.

Congestion

For the duration of January 6 2014 ERCOT utilized SCED to balance load and manage congestion, including the entire duration of the EEA event. SCED executed every five minutes during the EEA, and between 06:00 and 09:00, there were only three SCED executions manually initiated, all of which were in response to unit trips or derates. The ERCOT State Estimator and Real-Time Contingency Analysis (RTCA) applications did not experience any performance issues during the event, and no Interconnection Reliability Operating Limit (IROL) exceedances or violations occurred. There was one base case constraint that exceeded its limit, the Mountain Top 138/69 kV Autotransformer, and that was only for one five-minute execution of RTCA. There were as many as seventeen post-contingency constraints active in SCED between 05:00 and 12:00. Those active constraints are indicated in the table on the next page. Transmission constraints were not a cause of this event.

| Operating Day January 6 2014 | | |
|---|---|---|
| Constraint | Contingency Description | Constrained Element |
| D_NBCBY5 : HB_TWG66_A | Northbelt - King / Cedar Bayou 345 kV Double-Circiut | Humble - Treaschwig 138 kV Line |
| DNAVLEG5 : 40__A | Navarro - Limestone 345 kV Double-Circuit | Big Brown - Jewett 345 KV Line |
| DSAMTHS5 : WHTNY_FMR2 | Sam Switch - Tradinghouse 345 kV Double-Circuit | Whitney 138/69 kV Autotransformer # 2 |
| DTRSTRC5 : TRSES_MR6L | Trinidad - Watermill / Tricorner 345 kV Double-Circuit | Trinidad 345/138 kV Autotransformer |
| DWH_STP5 : BONIVI_RINCON1_1 | White Point - Lon Hill / STP 345 kV Double-Circuit | Bonnieview - Rincon 69 kV Line |
| DWLV89N8 : 3410__A | West Levee - 800/900 Network 138 kV Double-Circuit | East Levee Switch - Reagan Street 138 kV Line |
| SCOLPAW5 : COLETO_KENEDS1_1 | Coleto Creek - Pawnee 345 kV Single-Circuit | Coleto Creek - Kenedy Switch 138 kV Line |
| SDQNB8 : HB_TWG66_A | Drilco - Northbelt 138 kV Single-Circuit | Humble - Treaschwig 138 kV Line |
| SI_DI_38 : I_DUPP_I_DUPS1_1 | Ingleside Dupont Switch - Dupont PP1 138 kV Single-Circuit | Ingleside Dupont Switch - Dupont PP1 Ingleside 138 kV Line |
| SKOCNU28 : GILA_HIWAY_2_1 | Gila - Koch Up River 138 kV Single-Circuit | Gila - Hiway 9 138 kV Line |
| SLAQLOB8 : BRUNI_69_1 | Lobo - La Quinta 138 kV Single-Circuit | Bruni 138/69 kV Autotransformer |
| SORNLON8 : LON_HI_SMITH1_1 | Lon Hill - Orange Grove 138 kV Single-Circuit | Lon Hill - Smith 69 kV Line |
| SPAWCAL5 : COLETO_KENEDS1_1 | Calaveras - Pawnee 345 kV Single-Circuit | Coleto Creek - Kenedy Switch 138 kV Line |
| SSALSK28 : 6146__A | Skywest - Salt Flat 138 kV Single-Circuit | East Midland - Midland East 138 kV Line |
| SSHBMLS5 : ELKTN_SD1_1 | Martin Lake - Shamburger Switch 345 kV Single-Circuit | Elkton Series Reactor 138 kV # 1 |
| STRSWTR5 : TRSES_MR6L | Watermill Switch - Trinidad 345 kV Single-Circuit | Trinidad 345/138 kV Autotransformer |
| XLY2T58 : LYTTON_S_AT1H | Lytton Springs 345/138 kV Autotransformer # 2 | Lytton Springs 345/138 kV Autotransformer # 1 |

# 6. Conclusions

The overall conclusion for the event is that the ERCOT System Operators handled a difficult situation well and prevented firm load shed in the ERCOT Interconnection. The prompt and decisive actions taken resulted in mitigation of degrading systems and appropriate use of Ancillary Services and emergency procedures. The main contributing cause was the substantial amount of resource capacity lost through trips and derates. While lost capacity can typically be replaced with other resources when the capacity loss is distributed over a long time frame, loss of significant capacity over a short period of time coupled with a large load ramp up to a daily peak will strain reserves and typically call for emergency operations such as the EEA that occurred on January 6th, 2014. The fact that a similar high peak was observed on January 7th, 2014 with sufficient reserves and no EEA, supports that the main contributing cause was the substantial amount of resource capacity lost through trips, derates, and failure to starts. While the overall large number of unavailable capacity is still high, it is noted that there was less unavailable capacity due to cold weather that in February 2, 2011 indicating improvement relative to cold weather preparedness.

The above detailed analysis yielded several conclusions. An assessment of meteorological data indicates that temperatures on this day were warmer than that of the severe cold weather event which occurred on February 2, 2011. The load forecast MAPE for the day was 2.29 % for the active forecast model, which was the most accurate of the forecast models available to ERCOT. The wind forecast performance was consistent, if not better, than historical trends, and the day-ahead wind forecast was very close to the actual output observed over the hours in which the EEA was active. The hour-ahead wind forecast models may need some additional training, and ERCOT is working with QSEs and its wind forecast vendor to improve this forecast through the update of wind farm models regarding icing and ambient temperature operations limits.

ERCOT did commit one resource in DRUC, and kept close watch on the HRUC suggestions as well as available on-line resources leading into the event. Frequency did decline as available reserves declined, and eventually increased back to 60 Hz after 40 minutes. ERCOT deployed its RRS and Non-Spin reserves with no systematic issues. Load Resources responded to manual deployments, and were very close to meeting the 95 % deployment performance criteria outlined in the ERCOT Nodal Protocols. SCED was able to dispatch resources to meet load subject to several transmission constraints during the event, as no constraints were relaxed during the EEA.

## 7. Next Steps (or Immediate Actions)

- ERCOT has already (re)visited generation sites who immediately indicated performance issues related to the weather, and has scheduled to visit the others.
- ERCOT has worked with the Texas Reliability Entity (TRE) to issue a Request for Information (RFI) to generation companies to gain additional details pertinent to the event. The results of that RFI are included where possible in this report with a few additional forthcoming.
- ERCOT will utilize RFI results from Wind resources to work on improving short term forecast with updating wind farm models regarding icing and ambient temperature operations limits.
- ERCOT will review and enhance procedures to directly consider increased generating capacity unavailability for unit commitment during severe cold weather events.

## 8. Lessons Learned

Event Analysis

- ERCOT is placing more formal processes around more advanced communications in preparation of events. This discussion includes, but not limited to, discussing expected weather, transmission & generation outages, and need for early RUC commitments. This process includes a scheduled meeting between operations, outage coordination, meteorology and other support staff.

Seasonal Planning

- ERCOT should reassess outage calculations used for future SARA reports to ensure derates are appropriately included.
- ERCOT should continue its winterization site visits and early indications are that the increased focus of resources and ERCOT concerning winterization of units are yielding improvements in the number of units that experienced issues related to the cold weather.
- ERCOT and TRE should consider continuing an annual Winter Preparation seminar to share lessons learned and best practices.

Operations Planning

- ERCOT should continue to review forecasted cold weather with multiple departments including internal meteorologist in advance of approaching severe cold weather to support operational readiness. This review should include weather "heat maps" similar to that which was provided in the "Meteorological Assessment" section of this report that compares the expected cold weather event to that of previous cold weather events.
- ERCOT should consider formalizing the process of committing units with longer than DRUC startup times and units that notified ERCOT of fuel restriction to switch to alternate fuel in advance of severe cold weather.
- ERCOT outage coordination should continue to provide additional support staff to conduct and support studies with increased loads that exceeded load forecasts to help identify any short term outage concerns in advance of severe cold weather.

Operations

- ERCOT is working with the TCEQ to update procedures to notify QSEs that they may generate past their permits and need only to notify TCEQ that they are doing so (notification of action instead of requesting permission to act). A market notice indicating as such is forthcoming as of the generation of this report.
- ERCOT is reviewing procedure modifications to deploy (release to SCED) all RRS generation resources during EEA2 to ensure SCED has all possible capacity to deploy.
- ERCOT should continue to give advanced notice to market participants when cold weather approaches as the advanced notice resulted in transmission outage delays and one resource outage delay.

## 9. Appendix A: Tripped and Derated Units

The table below indicates the units which experienced a trip, failure to start, or derate during January 6 2014 (in time sequence). The Pie charts provide a breakdown of the types of units and cause of trips.

| RESOURCE ENTITY NAME | Unit Name | Type | Trip Time | Lost MWs | Cause Category |
|---|---|---|---|---|---|
| SWEETWATER WIND 4 LLC | SWEET_WATER_4 | De-Rate | 1/5/14 18:47 | 34 | Low Temperature Limit |
| CALPINE CORP | PSG GT3 | Trip | 1/5/14 20:05 | 176 | Failed equipment |
| CPS ENERGY | Calaveras JTD1 | Trip | 1/5/14 23:56 | 420 | Failed equipment |
| BUFFALO GAP WIND FARM 2 LLC | BUFF_GAP UNIT2_1 | De-Rate | 1/6/14 0:00 | 30 | Low Temperature Limit |
| BUFFALO GAP WIND FARM 2 LLC | BUFF_GAP UNIT2_2 | De-Rate | 1/6/14 0:00 | 30 | Low Temperature Limit |
| SCURRY COUNTY WIND LP | CAMP SPRINGS CSEC_G1 | De-Rate | 1/6/14 0:01 | 5 | Low Temperature Limit |
| EXTEX LAPORTE LP 2 | HLSES_UNIT4 | De-Rate | 1/6/14 0:01 | 120 | Fuel restriction |
| EXTEX LAPORTE LP 2 | HLSES_UNIT3 | De-Rate | 1/6/14 0:01 | 395 | Fuel restriction |
| LUMINANT GENERATION COMPANY LLC | LHSES_UNIT1 | De-Rate | 1/6/14 0:01 | 355 | Fuel restriction |
| LUMINANT GENERATION COMPANY LLC | LHSES_UNIT2 | De-Rate | 1/6/14 0:01 | 475 | Fuel restriction |
| EXTEX LAPORTE LP 2 | MCSES_UNIT6 | De-Rate | 1/6/14 0:01 | 122 | Fuel restriction |
| EXTEX LAPORTE LP 2 | MCSES_UNIT7 | De-Rate | 1/6/14 0:01 | 118 | Fuel restriction |
| EXTEX LAPORTE LP 2 | MCSES_UNIT8 | De-Rate | 1/6/14 0:01 | 42 | Fuel restriction |
| GEUS | STEAM_ENGINE_1 | De-Rate | 1/6/14 0:01 | 8 | Fuel restriction |

| RESOURCE ENTITY NAME | Unit Name | Type | Trip Time | Lost MWs | Cause Category |
|---|---|---|---|---|---|
| GEUS | STEAM_ENGINE_2 | De-Rate | 1/6/14 0:01 | 8 | Fuel restriction |
| BIG BROWN POWER COMPANY LLC | BBSES_UNIT1 | De-Rate | 1/6/14 0:04 | 136 | Emissions |
| LUMINANT GENERATION COMPANY LLC | MNSES_UNIT3 | De-Rate | 1/6/14 0:12 | 70 | Emissions |
| BIG BROWN POWER COMPANY LLC | BBSES_UNIT1 | Trip | 1/6/14 0:30 | 606 | Failed equipment |
| LAMAR POWER PARTNERS LLC | LPCCS_CC2 | De-Rate | 1/6/14 0:38 | 73 | Other |
| BULL CREEK WIND LLC | BULLCRK_WND1 | De-Rate | 1/6/14 0:43 | 91 | Low Temperature Limit |
| BULL CREEK WIND LLC | BULLCRK_WND2 | De-Rate | 1/6/14 0:43 | 89 | Low Temperature Limit |
| LUMINANT GENERATION COMPANY LLC | GRSES_UNIT1 | Trip | 1/6/14 0:55 | 225 | Failed equipment |
| FPL ENERGY CALLAHAN WIND LP | CALLAHAN | De-Rate | 1/6/14 1:03 | 43.5 | Low Temperature Limit |
| POST OAK WIND LLC | LNCRK_G871 | De-Rate | 1/6/14 1:05 | 2 | Low Temperature Limit |
| FPL ENERGY HORSE HOLLOW WIND LLC | HORSE_HOLLOW_3 | De-Rate | 1/6/14 1:11 | 54 | Low Temperature Limit |
| SCURRY COUNTY WIND LP | CAMP SPRINGS CSEC_G2 | De-Rate | 1/6/14 1:12 | 4.5 | Low Temperature Limit |
| ROSCOE WIND FARM LLC | TKSW1_ROSCOE | De-Rate | 1/6/14 1:19 | 2 | Low Temperature Limit |
| NRG TEXAS POWER LLC | WAP_WAP_G2 | Failed to Start | 1/6/14 1:20 | 169 | Failed equipment |
| INDIAN MESA WIND FARM LLC | INDIAN_MESA | De-Rate | 1/6/14 1:21 | 11.2 | Low Temperature Limit |
| SENATE WIND LLC | SENATE | De-Rate | 1/6/14 1:27 | 4 | Low Temperature Limit |
| WISE COUNTY POWER COMPANY LLC | WCPP_CC1 (ST1) | Trip | 1/6/14 1:30 | 270 | Frozen instrumentation |

| RESOURCE ENTITY NAME | Unit Name | Type | Trip Time | Lost MWs | Cause Category |
|---|---|---|---|---|---|
| NRG TEXAS POWER LLC | WAP_WAP_G1 | Failed to Start | 1/6/14 1:33 | 169 | Failed equipment |
| WISE COUNTY POWER COMPANY LLC | WCPP_CC1 (CT1 ) | Trip | 1/6/14 1:47 | 240 | Frozen instrumentation |
| WISE COUNTY POWER COMPANY LLC | WCPP_CC1 (CT2 ) | Trip | 1/6/14 1:47 | 240 | Frozen instrumentation |
| INADALE WIND FARM LLC | INADALE1 | De-Rate | 1/6/14 1:57 | 1 | Low Temperature Limit |
| FPL ENERGY HORSE HOLLOW WIND LLC | HORSE_HOLLOW_1 | De-Rate | 1/6/14 2:12 | 34.5 | Low Temperature Limit |
| CALPINE CORP | FREC_CC1 | De-Rate | 1/6/14 2:18 | 25 | Emissions |
| STANTON WIND ENERGY LLC | SWEC | De-Rate | 1/6/14 2:24 | 9 | Low Temperature Limit |
| FPL ENERGY UPTON WIND IV LLC | KING_SE | De-Rate | 1/6/14 2:26 | 3.9 | Low Temperature Limit |
| GOAT WIND LP | GOATWIN2 | De-Rate | 1/6/14 2:45 | 55 | Low Temperature Limit |
| GOAT WIND LP | GOATWIND | De-Rate | 1/6/14 2:45 | 55 | Low Temperature Limit |
| LUMINANT GENERATION COMPANY LLC | MLSES_UNIT2 | De-Rate | 1/6/14 3:03 | 140 | Emissions |
| TENASKA FRONTIER PARTNERS LTD | FTR_G4 | De-Rate | 1/6/14 3:07 | 110 | Other |
| KIOWA POWER PARTNERS LLC | KMCHI_CC1 (CT101) | Failed to Start | 1/6/14 3:07 | 178 | Frozen instrumentation |
| KIOWA POWER PARTNERS LLC | KMCHI_CC1 (CT201) | Failed to Start | 1/6/14 3:08 | 180 | Frozen instrumentation |
| KIOWA POWER PARTNERS LLC | KMCHI_CC1 (ST1) | Failed to Start | 1/6/14 3:08 | 307 | Frozen instrumentation |
| FPL ENERGY UPTON WIND II LLC | KING_NW | De-Rate | 1/6/14 3:47 | 7.8 | Low Temperature Limit |
| CAPRICORN RIDGE WIND LLC | CAPRIDG_CR1 | De-Rate | 1/6/14 3:50 | 18 | Low Temperature Limit |

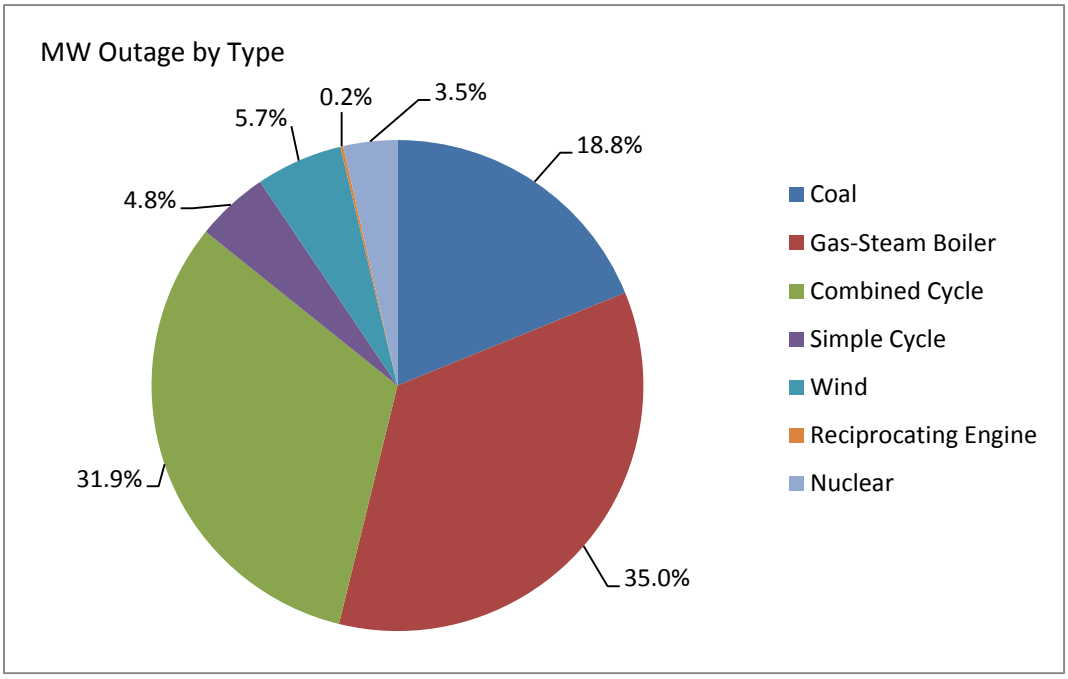
| RESOURCE ENTITY NAME | Unit Name | Type | Trip Time | Lost MWs | Cause Category |
|---|---|---|---|---|---|
| BRAZOS ELECTRIC POWER CO OP INC | JACK_CNTY CC1 (ST1) | De-Rate | 1/6/14 3:55 | 110 | Frozen instrumentation |
| LUMINANT GENERATION COMPANY LLC | MNSES_UNIT3 | De-Rate | 1/6/14 3:57 | 95 | Emissions |
| EXTEX LAPORTE LP 2 | HLSES_UNIT4 | Failed to Start | 1/6/14 4:00 | 120 | Failed equipment |
| FPL ENERGY UPTON WIND III LLC | KING_NE | De-Rate | 1/6/14 4:05 | 3.9 | Low Temperature Limit |
| LUMINANT GENERATION COMPANY LLC | MLSES_UNIT2 | De-Rate | 1/6/14 4:29 | 80 | Emissions |
| NRG TEXAS POWER LLC | Cedar Bayou (CBY_G1) | De-Rate | 1/6/14 4:30 | 580 | Failed equipment |
| WEST TEXAS WIND ENERGY PARTNERS LP | SW_MESA | De-Rate | 1/6/14 4:31 | 23.3 | Low Temperature Limit |
| BRAZOS ELECTRIC POWER CO OP INC | MIL_MILLERG4 | Failed to Start | 1/6/14 4:38 | 115 | Other |
| CAPRICORN RIDGE WIND II LLC | CAPRIDG_CR4 | De-Rate | 1/6/14 4:41 | 9 | Low Temperature Limit |
| LUMINANT GENERATION COMPANY LLC | SCSES_UNIT2 | Failed to Start | 1/6/14 4:49 | 502 | Failed equipment |
| FPL ENERGY UPTON WIND I LLC | KING_SW | De-Rate | 1/6/14 4:52 | 5.2 | Low Temperature Limit |
| BRAZOS ELECTRIC POWER CO OP INC | TEN_CC1 (CT1) | De-Rate | 1/6/14 4:53 | 75 | Frozen instrumentation |
| BRAZOS ELECTRIC POWER CO OP INC | TEN_CC1 (STG) | Trip | 1/6/14 4:53 | 106 | Frozen instrumentation |
| WOLF RIDGE WIND LLC | WOLF_RIDGE | De-Rate | 1/6/14 5:20 | 7.5 | Low Temperature Limit |
| NRG TEXAS POWER LLC | WAP_WAP_G4 | De-Rate | 1/6/14 5:50 | 290 | Failed equipment |
| LAMAR POWER PARTNERS LLC | LPCCS_CC1 (CT11) | De-Rate | 1/6/14 5:54 | 80 | Frozen instrumentation |
| LAMAR POWER PARTNERS LLC | LPCCS_CC1 (CT12) | De-Rate | 1/6/14 5:54 | 90 | Frozen instrumentation |

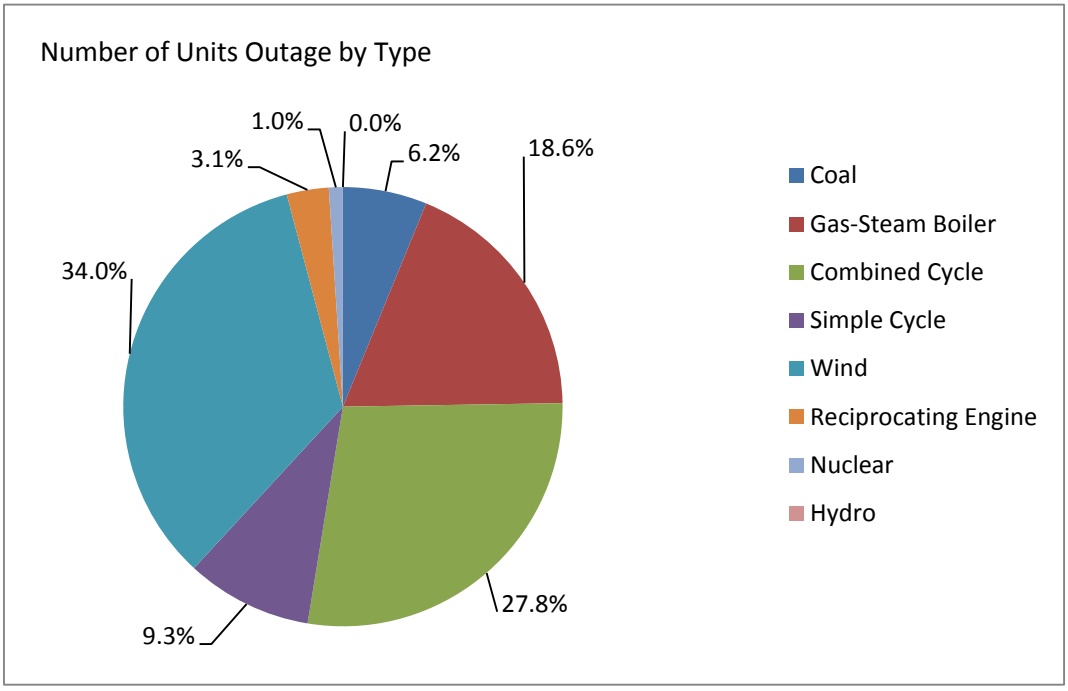
| RESOURCE ENTITY NAME | Unit Name | Type | Trip Time | Lost MWs | Cause Category |
|---|---|---|---|---|---|
| LAMAR POWER PARTNERS LLC | LPCCS_CC1 (ST10) | Trip | 1/6/14 5:54 | 195 | Frozen instrumentation |
| LUMINANT GENERATION COMPANY LLC | CPSES_UNIT1 | De-Rate | 1/6/14 6:04 | 464 | Failed equipment |
| CITY OF AUSTIN DBA AUSTIN ENERGY | SANDHSYD_SH3 | Trip | 1/6/14 6:06 | 48 | Failed equipment |
| PETRA NOVA POWER 1 LLC | Petra Nova PNP_GT2 | Failed to Start | 1/6/14 6:09 | 88 | Failed equipment |
| NRG TEXAS POWER LLC | THW_THW_55GT | Failed to Start | 1/6/14 6:20 | 57 | Failed equipment |
| NRG TEXAS POWER LLC | THW_THWGT53 | Failed to Start | 1/6/14 6:20 | 57 | Failed equipment |
| LUMINANT GENERATION COMPANY LLC | GRSES_UNIT2 | De-Rate | 1/6/14 6:21 | 50 | Failed equipment |
| LUMINANT GENERATION COMPANY LLC | MLSES_UNIT2 | De-Rate | 1/6/14 6:29 | 170 | Emissions |
| TENASKA GATEWAY PARTNERS LTD | TGCCS_CC1 (CT1) | Trip | 1/6/14 6:38 | 162 | Frozen instrumentation |
| TENASKA GATEWAY PARTNERS LTD | TGCCS_CC1 (CT2) | Trip | 1/6/14 6:38 | 179 | Frozen instrumentation |
| TENASKA GATEWAY PARTNERS LTD | TGCCS_CC1 (CT3) | Trip | 1/6/14 6:38 | 178 | Frozen instrumentation |
| TENASKA GATEWAY PARTNERS LTD | TGCCS_CC1 (UNIT4) | Trip | 1/6/14 6:38 | 389 | Frozen instrumentation |
| CALPINE CORP | FREC_CC1 (GT2) | Trip | 1/6/14 6:47 | 160 | Other |
| CALPINE CORP | FREC_CC1 (ST3) | De-Rate | 1/6/14 6:47 | 75 | Other |
| CITY OF AUSTIN DBA AUSTIN ENERGY | DP_G1 | De-Rate | 1/6/14 6:50 | 165 | Failed equipment |
| BARNEY M DAVIS UNIT 1 | B_DAVIS_B_DAVIG1 | Trip | 1/6/14 7:00 | 335 | Other |
| OAK GROVE MANAGEMENT COMPANY LLC | OGSES_UNIT2 | De-Rate | 1/6/14 7:23 | 65 | Failed equipment |

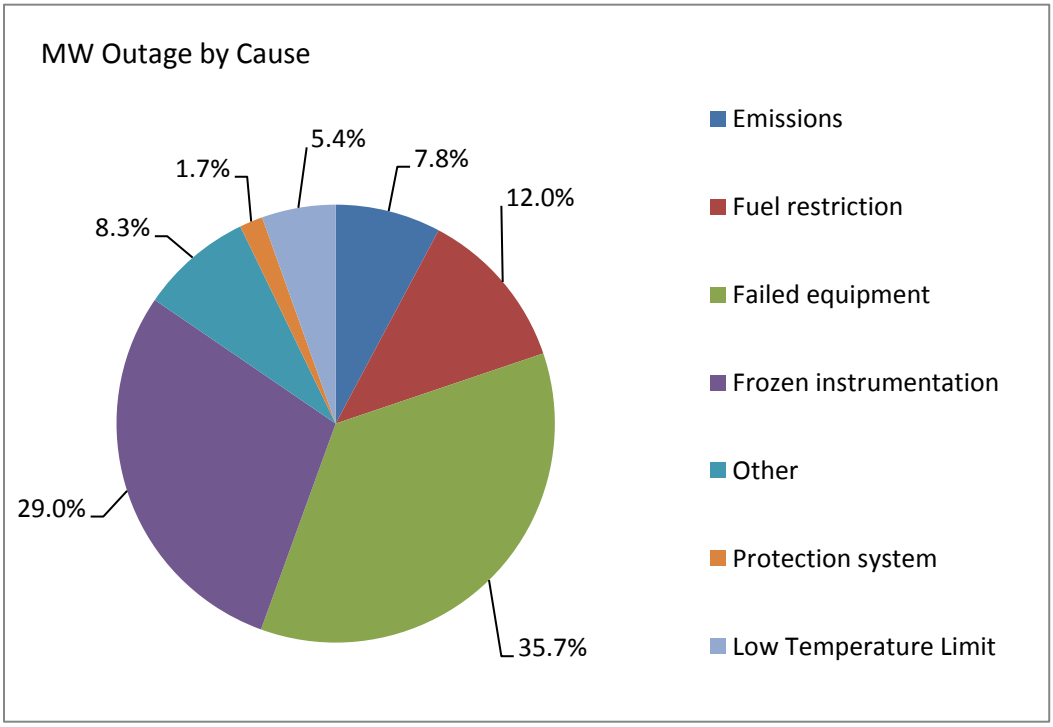
| RESOURCE ENTITY NAME | Unit Name | Type | Trip Time | Lost MWs | Cause Category |
|---|---|---|---|---|---|
| CALPINE CORP | Bosque Sw 5 | De-Rate | 1/6/14 7:24 | 26 | Emissions |
| NRG TEXAS POWER LLC | Greens Bayou GBY_G5 | De-Rate | 1/6/14 7:29 | 41 | Failed equipment |
| BARNEY M DAVIS LP | B_DAVIS_CC1 (G4) | Trip | 1/6/14 7:34 | 165 | Other |
| CCI SIGNAL HILL LLC | WF_COGEN_Unit 1 | Trip | 1/6/14 7:51 | 20 | Failed equipment |
| LAREDO WLE LP (LAREDO ENERGY CENTER) | LAREDO_G4 | Trip | 1/6/14 7:57 | 99 | Other |
| LAMAR POWER PARTNERS LLC | LPCCS_CC1 (CT11) | Trip | 1/6/14 7:59 | 177 | Emissions |
| LUMINANT GENERATION COMPANY LLC | MLSES_UNIT2 | De-Rate | 1/6/14 8:05 | 50 | Emissions |
| LOWER COLORADO RIVER AUTHORITY<br>SANDY CREEK ENERGY ASSOCIATES LP TWO<br>BRAZOS SANDY CREEK ELECTRIC COOPERATIVE INC SANDY CREEK ENERGY ASSOCIATES LP | SCES_UNIT1 | Trip | 1/6/14 8:10 | 970 | Frozen instrumentation |
| NRG TEXAS POWER LLC | THW_THWGT53 | Trip | 1/6/14 8:22 | 57 | Failed equipment |
| SID RICHARDSON CARBON LTD | CARBN_BSP_1 | Trip | 1/6/14 8:24 | 17 | Frozen instrumentation |
| NRG TEXAS POWER LLC | Cedar Bayou (CBY_G1) | De-Rate | 1/6/14 8:27 | 160 | Failed equipment |
| EXTEX-LAPORTE LP | AZ_AZ_G4 | Trip | 1/6/14 8:43 | 45 | Failed equipment |
| CALPINE CORP | CAL_CC1 (GT1) | Trip | 1/6/14 8:50 | 134 | Protection system |
| CALPINE CORP | CAL_CC1 (ST1) | Trip | 1/6/14 8:50 | 56 | Protection system |
| FPL ENERGY PECOS WIND I AND II LP | WOODWARD | De-Rate | 1/6/14 8:53 | 20.5 | Low Temperature Limit |

| RESOURCE ENTITY NAME | Unit Name | Type | Trip Time | Lost MWs | Cause Category |
|---|---|---|---|---|---|
| POST WIND FARM LP | RD_CANYON | De-Rate | 1/6/14 9:29 | 6 | Low Temperature Limit |
| GEUS | STEAM_ENGINE_3 | Trip | 1/6/14 9:29 | 8 | Failed equipment |
| CAPRICORN RIDGE WIND LLC | CAPRIDG_CR2 | De-Rate | 1/6/14 9:58 | 13.8 | Low Temperature Limit |
| CAPRICORN RIDGE WIND LLC | CAPRIDG_CR3 | De-Rate | 1/6/14 10:04 | 25.5 | Low Temperature Limit |
| LUMINANT GENERATION COMPANY LLC | MNSES_UNIT3 | De-Rate | 1/6/14 10:06 | 95 | Emissions |
| LUMINANT GENERATION COMPANY LLC | SCSES_UNIT2 | De-Rate | 1/6/14 10:54 | 252 | Failed equipment |
| BRYAN TEXAS UTILITIES | Dansby G1 | De-Rate | 1/6/14 11:20 | 50 | Failed equipment |
| FPL ENERGY HORSE HOLLOW WIND LLC | HORSE_HOLLOW_4 | De-Rate | 1/6/14 11:41 | 16.1 | Low Temperature Limit |
| WISE COUNTY POWER COMPANY LLC | WCPP_CC1 (CT1 ) | Trip | 1/6/14 11:53 | 240 | Frozen instrumentation |
| WISE COUNTY POWER COMPANY LLC | WCPP_CC1 (ST1) | Trip | 1/6/14 11:53 | 270 | Frozen instrumentation |
| BLUE SUMMIT WIND LLC | BLUE_SUMMIT | De-Rate | 1/6/14 12:16 | 11.2 | Low Temperature Limit |
| FPL ENERGY HORSE HOLLOW WIND LLC | HORSE_HOLLOW_2 | De-Rate | 1/6/14 14:29 | 18.4 | Low Temperature Limit |

# Electric Reliability Council of Texas




MW Outage by Cause
5.4%
7.8%
1.7%
12.0%
8.3%
29.0%
35.7%
Emissions
Fuel restriction
Failed equipment
Frozen instrumentation
Other
Protection system
Low Temperature Limit