The Reliability Triad's Second Leg: Operational Reliability, The Texas Market Based Approach

COMMISSIONER KENNETH W. ANDERSON, JR.
PUBLIC UTILITY COMMISSION OF TEXAS

PRESENTATION FOR PUBLIC UTILITY LAW CONFERENCE
AUGUST 8, 2014

The Reliability Triad
(And Its Relationship To Resource Adequacy)

- The reliability of an electrical grid is the combination of installed generating capacity, generation operational reliability and the adequacy of the transmission and distribution system. These three elements make up the reliability triad. Even though it is the leg of the triad that causes the most customer interruptions, transmission and distribution adequacy is not the subject of today's discussion. The focus of today's talk will be on generation operational reliability. While much discussion has been had over the last several years at the PUCT, among ERCOT stakeholders and in the press around generating capacity, relatively less attention has been paid to generation operational reliability.

The Reliability Triad
(And Its Relationship To Resource Adequacy)

- Installed Generating Capacity
  - Is there enough generating capacity, after adjustment for reasonably expected planned and forced outages, to deal with forecasted variable load, as influenced by weather or other factors?
- Generator Operational Reliability
  - Are the generating assets operated and maintained so that units are available when scheduled or needed.
- Overall resource adequacy is the combination of installed generating capacity and generation operational reliability. Put simply, if your total generating capacity is 180% of your current load (an 80% reserve margin), yet only 50% of your capacity is able to run and make electricity, your resource adequacy is only 90% and load curtailment occurs.

Generator Operational Reliability

- The importance of operational reliability was summarized in 1891 at the 14th National Electric Light Association (NELA) convention by T. Carpenter Smith, "The question whether your light will be reliable or not has a great deal more to do with the way in which it is run than the system used, and I think that is a point which is not nearly enough considered." — 14th NELA Convention transcripts at 208, Montreal Sept 7 – 10, 1891.

- Operational reliability is related to the forced outage rate. If the forced outage rate is 2%, then operational reliability is 98%.
  - "A more rigid preventive maintenance program lowered the forced outage rate from the national average of 2% to 1%." Leonard Arnoff and John Chambers, *Operations Research Determination of Generation Reserves*, AIEE Transactions, Vol. 76 Part III, June 1957 at 323. (Thus improving operational reliability to 99%.)
  - The ERCOT annual forced outage rate for 2013 was 6.8%.*

  - *Samuel Newell, Kathleen Spees, et al., The Brattle Group, *Estimating the Economically Optimal Reserve Margin in ERCOT*, at 10, January 31, 2014.

Generator Operational Reliability
The Controlling Law

- Operational reliability is affected by law and the resulting market structure.
- PURA § 39.001(a) and (d) dictate how this reliability should be achieved.
  - PURA § 39.001(a) states that "electric services and their prices should be determined by customer choices and the normal forces of competition."
  - PURA § 39.001(d) requires that the PUC "shall authorize or order competitive rather than regulatory methods to achieve the goals of [PURA Chapter 39] to the greatest extent feasible and shall adopt rules and issue orders that are both practical and limited so as to impose the least impact on competition."

Generator Operational Reliability
The Controlling Law

- *PURA § 39.151(d) provides:* The commission shall adopt and enforce rules relating to the reliability of the regional electrical network and accounting for the production and delivery of electricity among generators and all other market participants, or may delegate to an independent organization responsibilities for establishing or enforcing such rules.

- *PURA § 35.004(e) directs:* That the "commission shall ensure that ancillary services necessary to facilitate the transmission of electric energy are available at reasonable prices with terms and conditions that are not unreasonably preferential, prejudicial, discriminatory, predatory or anticompetitive."

Generator Operational Reliability
The Controlling Law

- *PURA § 39.154(a)* Beginning on the date of introduction of customer choice, a power generation company may not own and control more than 20 percent of the installed generation capacity located in, or capable of delivering electricity to, a power region.

- An unintended beneficial consequence of the limit on capacity ownership (the purpose of which was to prevent market power abuse), is that it helps protect generator operational system wide reliability. For example: Suppose a generator who owns or controls 50% of the market only can provide 80% operational reliability during a cold weather event (a 20% forced outage rate). Even if the remaining 50% of system resources performed with no forced outages, the best resulting operational reliability the remaining resources could provide would be 90%. This single generator would require the system to provide an 11% reserve capacity to avoid load curtailments. And this doesn't account for planned outages. Limiting a generation entity to 20% reduces the poor performing owner's affect on the system wide forced outage rate.

The Market Structure Determines Generator Operational Reliability

- In ERCOT, operational reliability is achieved largely through our competitive market. The energy-only market is designed to produce scarcity pricing which in turn incents operational reliability.

- Two recent actions by the commission greatly improve operational reliability by improving proper scarcity pricing:
  - The increase of the system wide offer cap (SWOC). First to $4,500, championed by Chairman Nelson. Then in October 2012, the PUCT voted to increase the SWOC incrementally to $9,000/MWh effective June 1, 2015. Currently the SWOC is $7,000/MWh.
  - The PUCT's adoption of an operating reserve demand curve (ORDC) that calculates a value of operating reserves and adds that amount to the real time energy price and also allows total prices to reach $9,000/MWh.

- The SWOC and ORDC provide both a carrot and a stick approach to improve generators' operational reliability.
  - The carrot: If prices rise to $9,000/MWh and a generator is able to run, then that generator will be handsomely rewarded.
  - The stick: If prices rise to $9,000/MWh and that generator is not able run, or trips offline, that generator either will miss the opportunity to make up to $9,000/MWh or, will have to cover the amount of previously sold energy at up to $9,000/MWh, depending upon whether the generator had a previous obligation to produce energy at that particular hour.

Operational Reliability: A Few Historical ERCOT Facts

Operational Reliability Failure of February 2011

- During the cold weather event of February 2, 2011 (the likes of which had not been experienced since 1989), load curtailment occurred at 05:43 at a system demand of approximately 53,500 MW. The then SWOC was $3,000/MWh.* At the worst point of this event, ERCOT experienced a 21.3% forced outage rate, or an operational reliability of only 78.7%. Even though the ERCOT actual *summer peak* load installed capacity reserve margin was over 16%, poor operational reliability required involuntary load curtailment.
  - ERCOT projected peak load would have reached 59,000 MW.**
  - That day's committed generation capacity was 64,500 MW producing a projected operating generator capacity of 109.3%.
  - Even though ERCOT had ample installed real time generating capacity, because operational reliability was poor, the resulting resource adequacy was only (109.3% x 78.7%) = 86%.
  - The result was 4,000 MW of involuntary load curtailment.

- *But it had been $3,000/MWh for only 1 day, the increase occurred on February 1, 2011. Before that it had been $2,250/MWh.
- ** Potomac Economics, Independent Market Monitor, ERCOT 2011 State of Market Report, at 17.

Operational Reliability: A Few Historical Facts

- <u>Operational Reliability Failure of February 2011 (cont'd)</u>

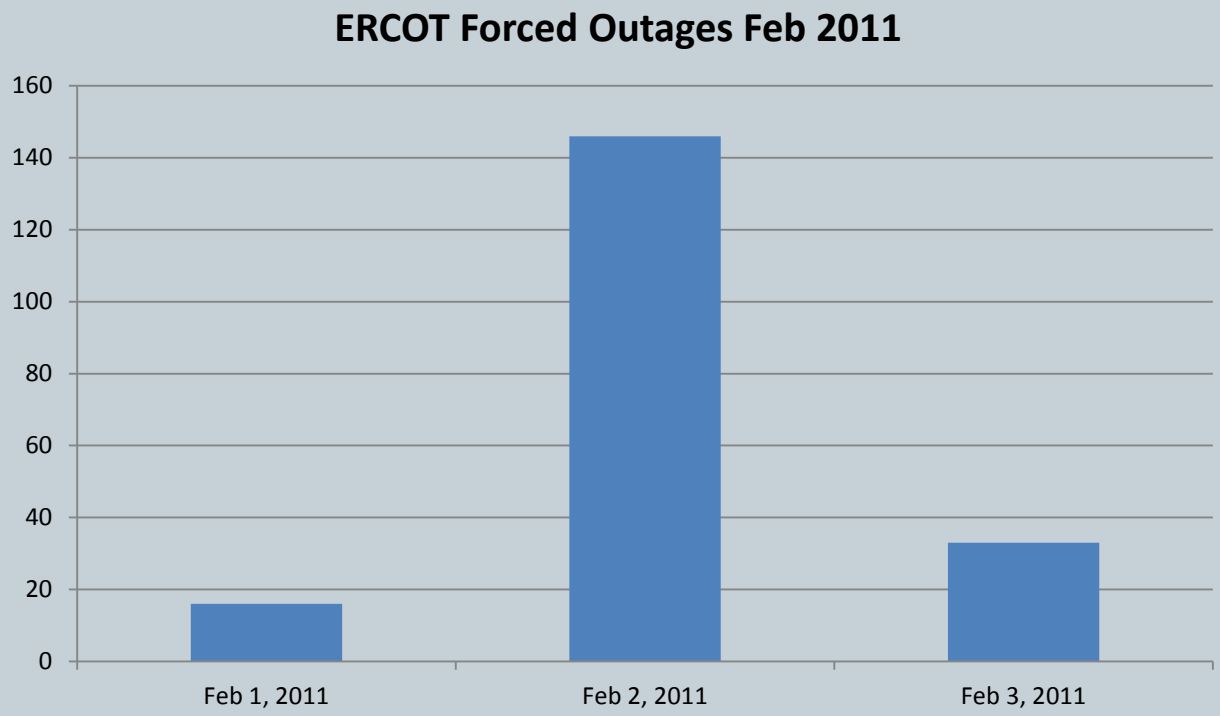
- On February 2, there were 146 generator forced outages requiring a load curtailment of 4,000 MW.

- The previous day, February 1, there had been only 16 forced outages.

- On February 3, there were 33 generator forced outages, no load curtailment, and the system exited the Energy Emergency Alert (EEA) stage in the morning while setting an all-time high peak winter load. Over the course of one day, market forces helped reduce the forced outage rate by 78%. There were no load curtailments and the peak load was a new winter record at 57,300 MW.

- These numbers demonstrate how important operational reliability is to ERCOT system resource adequacy and how ERCOT's scarcity priced based market incents real time operational reliability.

Operational Reliability: A Few Historical Facts



This shows the dramatic deterioration and improvement in operational reliability in just one day. The lack of preparedness manifested itself in poor operational performance on February 2, 2011.

Operational Reliability: A Few Historical Facts

- <u>Operational Reliability Performance of January 6 and 7, 2014</u>

- During January 6, 2014 there were 36 generator forced outages totaling 9,355 MW together with 25 de-ratings of 75 MW or more which totaled 4,837 MW.

- EEA levels 1 and 2 were declared on the morning of January 6. Emergency Responsive Service (ERS) and Load Response (LRS) were both deployed by ERCOT, but no involuntary load curtailment was necessary.

- 1,530 MW (16.4%) of the forced outages and 2,262 MW (46.8%) of deratings were from one generating company. Combined, one generating company caused 26.7% of the de-ratings and forced outages.

- Despite the poor operational reliability demonstrated by this particular company, ERCOT's overall generation portfolio performance improved dramatically from February 2011.

Operational Reliability: A Few Historical Facts

- On January 6, at EEA 2 with approximately 2,000 MW of LRS and ERS deployed, ERCOT set a January hourly peak load record at 55,487 MW.
- The next day, without having to declare an EEA, a new January load record of 57,277 MW was set and came within a few megawatts of tying the record of February 3, 2011.
- Like February 2011, operational reliability improved dramatically in just one day.
- January 6, 2014 operational reliability bottomed out at 85.5%, a significant improvement over February 2011's 78.7%.

Why Did Operational Reliability Improve Day Over Day and Year Over Year From 2011 To 2014?

- Improvement in day over day operational reliability was strongly incented by *scarcity pricing* and improvement in year over year operational reliability was strongly incented by *improved* scarcity pricing.

- In 2011, the SWOC was $3,000/MWh (the price went into effect on February 1).
- In 2014, the SWOC was $5,000/MWh.
- The SWOC is now $7,000/MWh with the ORDC allowing scarcity prices to reach $9,000/MWh. Allowing scarcity prices to reach these levels strongly encourages operational reliability from generator owners.
- THIS IS A MARKET BASED APPROACH TO OPERATIONAL RELIABILITY.

Lessons Learned From February 2011 and January 2014

- Operational reliability is much more important than installed generating capacity in keeping the lights on. As evidenced by 2011 and 2014, operational reliability can deteriorate or improve dramatically overnight. A market based approach providing proper scarcity pricing will incent generators to provide *consistent* operational reliability.

- The increase in the SWOC and implementation of the ORDC and the resulting proper scarcity pricing is critical to ensuring operational reliability.

- For example, in PJM "The winter issue… Incentives are clearly not adequate, a 40% outage rate is unacceptable, incentives need to look like an all energy market." Joseph Bowring, Market Monitor for PJM market during UBS conference call, May 28, 2014 describing the polar vortex event of January 2014 and the outage rate suffered by the PJM market.

Summary

- A reliable grid requires the Reliability Triad, which consists of three elements:
  - Installed Generating Capacity.
  - Generator Operational Reliability.
  - Transmission and Distribution Reliability.
- Resource adequacy is the combination of installed generating capacity and operational reliability.

Summary

- PURA establishes the basis for the market framework that provides generator operational reliability and thus resource adequacy.
- PURA § 39 and legislative intent requires the PUCT to provide a reliable grid through a competitive market construct.
- The resulting energy only market construct of ERCOT, buttressed with the incremental increase in the SWOC (developing proper scarcity pricing) and the ORDC (properly valuing generating reserves and contributing to scarcity pricing), provides an effective carrot and stick approach to encourage operational reliability and necessarily, resource adequacy.
- The improvement in operational reliability from the events of February 2011 to January 2014 is largely attributable to better scarcity pricing.

Summary

- Allowing true scarcity pricing improves operational reliability. Economic forces incent the owners of generating resources to operate reliably and minimizes the need for regulatory intervention.

Contact Information

Kenneth W. Anderson, Jr.

512-936-7005

kenneth.anderson@puc.texas.gov