PROJECT NO. 42302

REVIEW OF THE RELIABILITY	**$**	**PUBLIC UTILITY COMMISSION**
STANDARD IN THE ERCOT REGION	**$**	**OF TEXAS**
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The Public Utility Commission has an important decision to make concerning the continued use of LOLE versus adopting a new LOLH or EUE standard for determining an adequate reserve margin for ERCOT. My purpose here is to clarify the meanings of the LOLE, LOLH, and EUE figures ERCOT has provided in their latest study posted under Project 42302. I have included at the end of these comments an important NERC paper defining the LOLE: http://www.nerc.com/docs/pc/ivgtf/ieee-capacity-value-task-force-confidential%20(2).pdf which I refer to in my comments on the ERCOT study versus what is stated in the NERC paper.

First, let's define the LOLE, the loss of load expectation, which has been stated as one day in ten years. This does not mean 24 hours of load are not served in a period of ten years. It does not mean 2.4 hours of unserved load (i.e. the LOLH and EUE) in one study year. LOLH is the number of hours load is not served in a year. EUE is the amount of unserved energy in a year. So what does LOLE mean and how does it relate to LOLH and EUE?

LOLE is the sum of the daily loss of load probability (LOLP) for a year. Every hour has an LOLP and we will use the hour with the maximum value. With enough solar power the maximum LOLP may not be the peak load hour, but some point during the day before sunrise or after sunset. Since the max LOLP is determined each day, there is no need to worry about how multiple events during the same day might connect together. This doesn't affect the LOLE.

Does the LOLE tell us how long the outages are? The answer is no. LOLE provides no information on the frequency and duration of outages. The small LOLH values in reliability studies are deceptive since the EUE and even the LOLH values represent much larger unserved energies and loss of load hours during brief periods of stressed years spaced many years apart.

The IEEE paper posted on the NERC website referenced above says that the LOLE use of 1 day in 10 years should be interpreted as "at some time during 1 day in 10 years ". The paper goes on to state in the next sentence: "Therefore, a 1 day in 10 years LOLE target will be more reliable and is distinct from 24 hours in a 10 years target." 2.4 hours has no special meaning.

To calculate the annual LOLE, simply sum up the daily LOLP's. If every day had a loss of load, the annual LOLE would be 365 d/y. LOLE=0.1 d/y has been used for over 50 years consistently. The only reason it's called 1 day in 10 years is to get rid of the decimal point. It has nothing to do with 10 years. So, the real value of LOLE is best thought of as 0.1 d/y for a study year. Intuitively, what does LOLE=0.1 mean? What is the risk for loss of load?

There is a close relationship between the LOLE and the likelihood of loss of load during a year. An LOLE of 0.1 means there is about a 10% chance of having a loss of load some time during a year. The exact percentage is closer to 9.5%. Think of the 10% chance like you would a 10% chance of rain the next day, as in a weather report. The table below are numbers from the ERCOT study with an additional column on the right showing the annual risk for loss of load.

ERCOT study table ES-1 is presented below with a risk column addition to show relative risks.

Reserve Margin	Reliability Measure	Estimated LOLE	Annual Load Loss Risk
7.5%	LOLH=15 hrs	LOLE=4.7 d/y	99.5%
8.14%	LOLH=12 hrs	LOLE=3.5 d/y	98%
9.97%	LOLH=6 hrs	LOLE=1.8 d/y	85%
10.2%	EUE=.002%	LOLE=1.75 d/y	84%
10.96%	LOLH=4 hrs	LOLE=1.25 d/y	72%
11.50%	EUE=.001%	LOLE=1 d/y	64%
12.00%	LOLH=2.4 hrs	LOLE=.8 d/y	56%
16.75%	LOLE=.1 d/y	LOLE=.1 d/y	9.5%

The LOLE points are taken from Figure ES-2 as estimates on the graph as presented. The annual loss of load risk assumes the loss of load is spread evenly over 20 days. An LOLE=0.1 has an annual loss of load risk or ALLR of 1 – (1 - .1/20)^20 = .0954 = about 9.5% chance there is a loss of load during the year.

In the above table the 12% reserve margin case is close to a 50% chance of loss of load in a year. Expect the lower reserve margins to create loss of load events more frequently. Is this greater risk really worth saving a few dollars? Note this is not an operating reserve. This is a planning reserve. Operating reserves are a totally different type of analysis.

There is one last point for discussion. ERCOT shows in this study that an LOLE = 0.1 needs a reserve margin of 17%. What has happened is that the capacity value of wind has been increased recently necessitating a need to increase the reserve margin since the wind in the reliability study did not provide the capacity that ERCOT expects in the reserve margin calculation. The reliability study is attempting to correct the errors made in the wind capacity studies. The wind capacity calculations were not performed using the preferred method as outlined in the paper given on the following 7 pages. My opinion is that a 15% reserve margin would have been observed to produce an LOLE=0.1 if the wind capacity credit had been done in accordance with the IEEE/NERC paper.

Sincerely,

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