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PROJECT NO. 54584

RELIABILITY STANDARD FOR THE	§	**PUBLIC UTILITY COMMISSION**
	§	
ERCOT MARKET	§	**OF TEXAS**

ELECTRIC RELIABILITY COUNCIL OF TEXAS, INC.'S
RELIABILITY STANDARD TECHNICAL CONFERENCE PRESENTATION

As addressed at the Public Utility Commission of Texas' (Commission) April 11, 2024 Open Meeting, the Commission will host a technical conference on May 2, 2024 after the conclusion of the Open Meeting to receive stakeholder feedback on the Reliability Standard Study and to facilitate next steps in anticipation of the Commission's rulemaking to establish the reliability standard. Electric Reliability Council of Texas, Inc. (ERCOT) personnel will present the attached presentation at the workshop.

Dated: April 30, 2024

Respectfully submitted,

/s/ Matthew Arth

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Reliability Standard Technical Conference

May 2, 2024

Rationale for the Chosen Reliability Standard Framework

Why use multiple probabilistic measures?

- The most common probabilistic reliability measure, Loss of Load Expectation (LOLE), focuses on the average frequency of loss-of-load (LOL) events across all the Monte Carlo simulation outcomes
- LOLE does not address tail risk characteristics—severe LOL events exemplified by large magnitudes, long durations, or both
- While LOLE is useful, additional measures are needed to ensure that the entire reliability risk profile (averages and tail events) is addressed

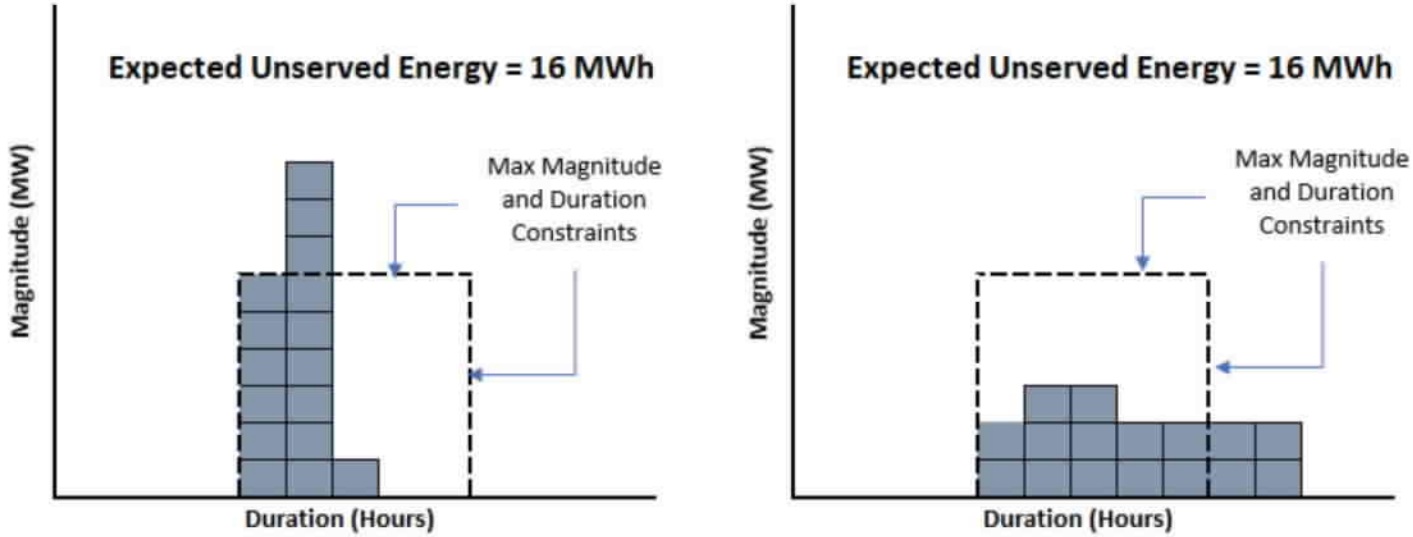
Why include maximum magnitude and maximum duration along with frequency?

- Maximum magnitude addresses a key physical reliability constraint: How many MWs at one time can be effectively managed for rotating load shed purposes?
- Maximum duration addresses a key reliability policy constraint: What is the maximum acceptable length of an outage event for customers?

Rationale for the Chosen Reliability Standard Framework

What about using Expected Unserved Energy as one of the measures?

- EUE is an average measure, like LOLE, and does not distinguish the characteristics of extreme events (magnitude and duration)



- However, EUE is a useful measure for characterizing cost impacts
  - The expected cost of not meeting customer firm load requirements
  - The expected incremental cost of modifying elements of the Reliability Standard

Frequency, Magnitude and Duration Criteria

- **Frequency:**
  - The modeled system in 2026 is expected to yield a LOLE of close to 0.1 loss-of-load events per year (or one day with at least one loss-of-load event every 10 years)
  - This is in line with the industry LOLE standard and is therefore a reasonable benchmark with which to compare alternative values
- **Maximum Magnitude:**
  - Based on TSP information, ERCOT estimates that a load shed amount exceeding 19 GW may not be capable of being fully rotated
- **Maximum Duration:**
  - There are no ERCOT operational considerations that suggest a specific max duration criterion
  - Assuming that all load can be shed on a rotating basis, a 14-hour maximum duration (which is the highest realized amount for the Phase 4 simulations) could be considered acceptable given improved customer lead-time communications since WS Uri

Cost Analysis Approach

- Calculated the system (or societal) average cost, per year, for each resource portfolio; system cost is the sum of three cost components:
  - Market Cost = Load x Market Price
  - Customer Load Shed Damages (Expected Unserved Energy x $25,000/MWh Interim VOLL)
  - Fixed cost of incremental CT additions @ $119,000/MW-year (the interim Cost of New Entry for the simulations)

- Phase 4 results table (next slide) identifies the system costs associated with meeting a range of frequency, maximum magnitude, and duration criteria levels

- Calculated the incremental system cost needed to avoid a MWh of Expected Unserved Energy for each CT addition scenario (Slide 7)

- Evaluated the cost impact of adding sufficient CT capacity to avoid extreme market cost outcomes (Slide 8)

Simulation Results Summary - Phase 4

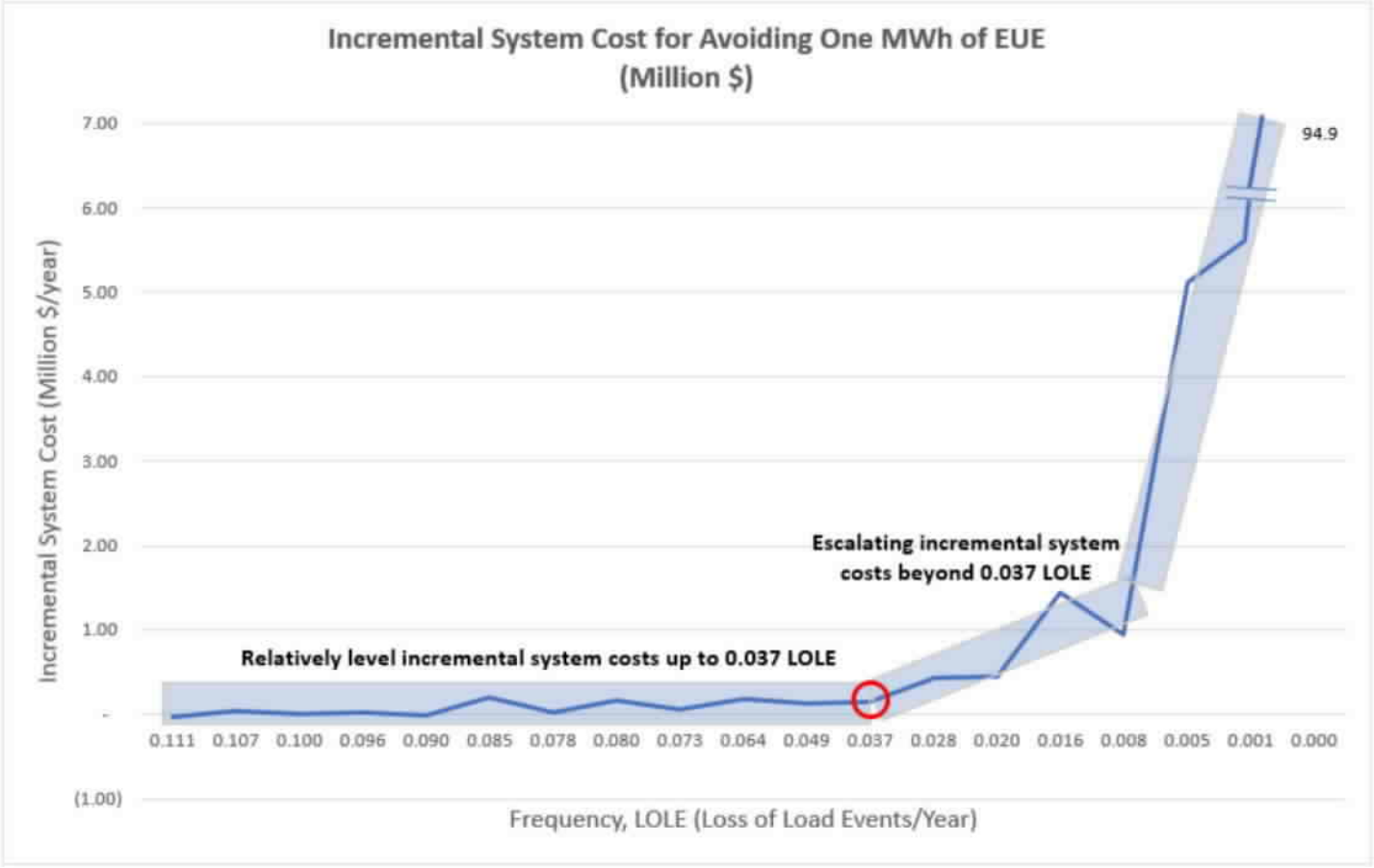
CTs Added	CT Capacity MW (Non-summer Rating)	Frequency (Expected Loss of Load Events/Year, LOLE)	Max Magnitude (MW/hr)	Max Duration (Hrs)	EUE (MWh)	System Cost (Million $/Year)
0	-	0.120	25,652	14	4,213.6	12,264.71
1	371	0.111	22,901	14	3,825.6	12,250.39
2	742	0.107	24,566	14	3,672.8	12,256.09
3	1,113	0.100	22,375	13	3,331.1	12,259.85
4	1,484	0.096	21,669	13	3,075.2	12,264.68
5	1,855	0.090	22,388	13	2,743.9	12,263.77
6	2,226	0.085	22,176	13	2,637.8	12,285.76
7	2,597	0.078	22,013	13	2,418.3	12,290.71
8	2,968	0.080	21,028	14	2,263.2	12,316.17
9	3,339	0.073	21,583	13	2,073.8	12,327.72
12	4,452	0.064	19,771	13	1,744.9	12,387.93
16	5,936	0.049	19,614	13	1,222.9	12,459.16
20	7,420	0.037	18,674	12	731.9	12,535.27
24	8,904	0.028	16,124	11	500.1	12,634.39
28	10,388	0.020	13,418	10	279.2	12,735.21
32	11,872	0.016	12,807	10	188.8	12,865.08
36	13,356	0.008	12,666	9	60.5	12,986.74
40	14,840	0.005	7,903	8	31.1	13,137.44
44	16,324	0.001	5,085	3	3.6	13,293.08
48	17,808	0.000	5,097	3	1.9	13,458.18
52	19,292	0.000	0	0	-	13,628.20
56	20,776	0.000	0	0	-	13,797.07

CT addition scenarios start at the LOLE level (0.12) where no portfolio capacity needs to be removed or added

Key Takeaways:

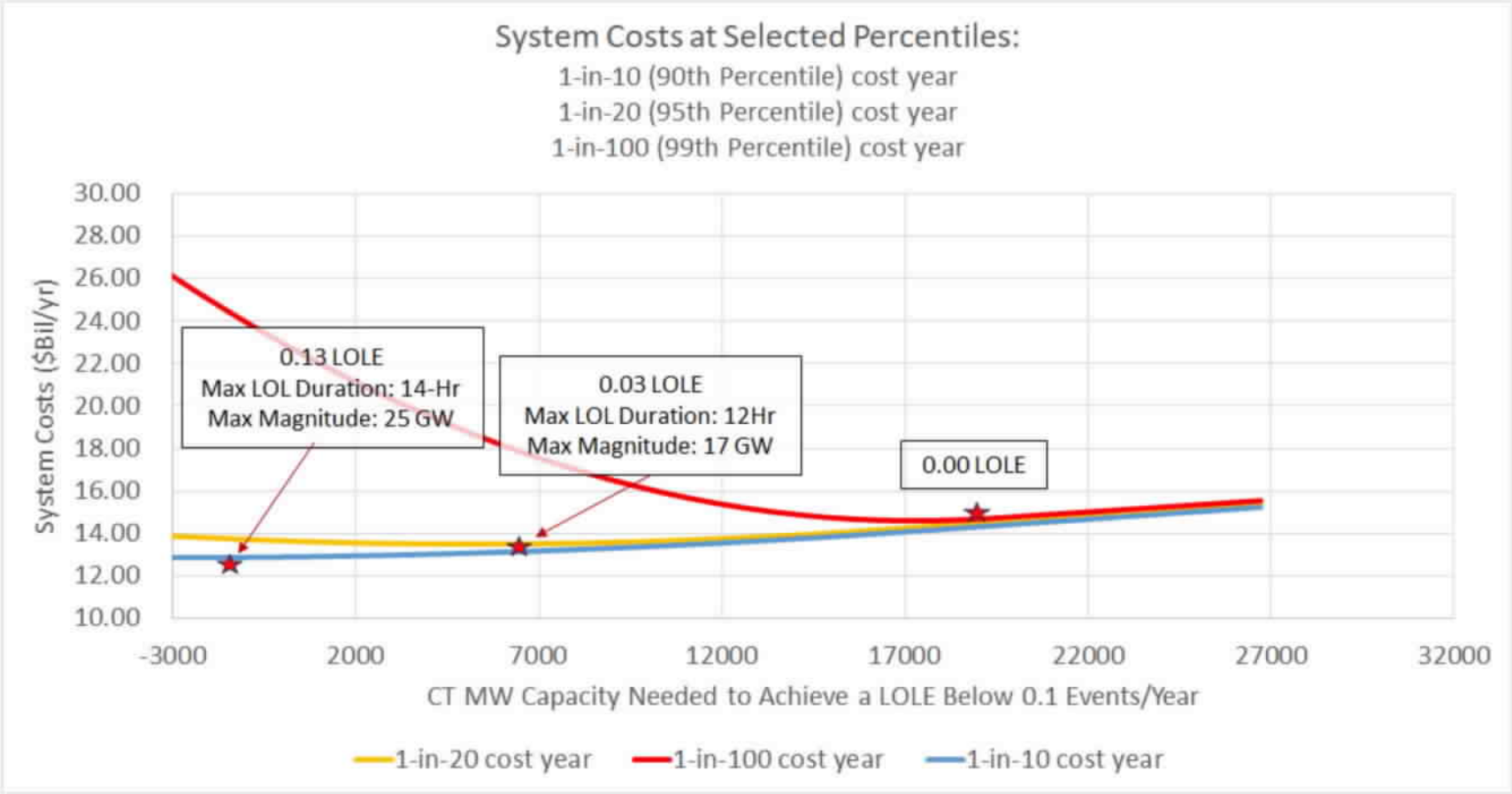
- A 0.1 expected frequency (LOLE) is not sufficient to constrain the max magnitude to 19 GW; a LOLE of ~ 0.04 is needed to do that. The incremental system cost to achieve this increased reliability is between $195 and $271 million per year above the amount that supports a 0.1 LOLE.
- A 0.02 LOLE would be needed to reduce the max duration to 10 hours. This lower frequency increases the annual system cost by $471 million above the amount that supports an approximate 0.1 LOLE.

Incremental System Cost for Avoiding one MWh of Expected Unserved Energy (EUE)



Key Takeaway: Incremental system costs for avoiding a MWh of EUE start escalating as expected loss-of-load frequency (LOLE) goes below ~0.04 events/year.

Comparison of Years with High System Costs



Comparison of High System Cost Years

- Market costs are highly variable from year to year; the SERVM runs reflect average costs across all simulation outcomes
- How much additional CT capacity would be needed to fully hedge against a year with higher-than-average system costs?
- For a "1-in-100" weather year, system costs would be lowest with CT additions sufficient to yield a zero LOLE
  - Requires ~17.1 GW of additional capacity above that needed for a 0.1 LOLE
  - Expected annual cost, in addition to the cost to get to 0.1 LOLE, is $2.03b
- For a 1-in-20 weather year, system costs would be lowest with CT additions sufficient to yield a 0.03 LOLE
  - Requires ~5.2 GW additional capacity above that needed for a 0.1 LOLE
  - Expected annual cost, in addition to the cost to get to 0.1 LOLE, is $618m
- For a 1-in-10 weather year, system costs would be lowest with CT additions sufficient to yield a 0.16 LOLE
  - Expected cost is less than a portfolio designed to achieve 0.1 LOLE ($441m annual savings); however, reliability criteria (max duration and max magnitude) suggested on slide #4 will not be met with this LOLE level

ERCOT Recommendations

Reliability measure criteria

- Maximum magnitude should not exceed 19 GW, frequency should be no more than 1-in-10 years (e.g., 1-in-20 years), and the maximum duration should not exceed 14 hours

- Maximum magnitude is the most binding measure based on the simulations; for example, adopting a 1-in-10-year expected frequency implies a 0.51% exceedance probability for the 19 GW maximum magnitude (or equivalently, a 99.49% chance of not exceeding 19 GW)

FREQUENCY (LOLE)	Exceedance Probability Required for Magnitude 19,000 MW
1 in 8.3	0.70%
1 in 9.0	0.57%
1 in 9.4	0.59%
1 in 10.0	0.51%
1 in 10.4	0.32%
1 in 11.1	0.25%
1 in 11.8	0.15%
1 in 12.4	0.17%
1 in 12.8	0.13%
1 in 13.7	0.08%
1 in 15.7	0.04%
1 in 20.5	0.04%
1 in 27.0	0.00%

ERCOT Recommendations

Sensitivity variables for subsequent Reliability Standard evaluation support

- Weatherization effectiveness: Should be set at 85% or 90% until metrics are available to make more precise effectiveness estimates
- Number of historical weather years for capturing weather risk: Continue using weather years back to 1980 to ensure a robust weather history is accounted for
- Unit retirement assumption: Continue to use 900 MW to account for likely retirements over the next several years
- New capacity assumptions: Continue using combustion turbines; CT capacity can be converted into any other combination of Resource types based on a given resource mix using Effective Load Carrying Capabilities (ELCCs)