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Subject: Engineering/Economic Issues with Entergy's Response to Hurricane Ida

On August 29, 2021 all eight lines supplying electricity to the City of New Orleans were put out of service by Category 4 Hurricane Ida.[1] The utility that serves the area, Entergy, has provided little substantive information about the scale of the disaster, but it appears that damages to the system are extensive and may extend beyond the conductors to the steel towers themselves.[2] If so, repairs may be lengthy.[3]

Hurricane Ida, and its predecessors Laura, Delta, and Zeta, reveal two significant problems for the Gulf states:

1. Legacy equipment is unlikely to stand up to increasingly violent and frequent hurricanes;

2. Existing regulatory practices that overstate the life of transmission and distribution equipment slow the pace of repair and replacement at enormous cost to society.

A preliminary view taken from the transmission database at the U.S. Energy Information Administration and local press sources indicates that the storm had isolated New Orleans from Entergy's grid:

[1] https://www.politico.com/news/2021/08/29/hurricane-ida-new-orleans-louisiana-507121 https://www.nhc.noaa.gov/archive/2021/al09/al092021.discus.015.shtml? https://www.nhc.noaa.gov/aboutsshws.php
[2] https://www.nytimes.com/2021/08/31/business/energy-environment/louisana-power-entergy.html
[3] https://www.facebook.com/DEMCOLouisiana/photos/a.503743826360279/4598910076843613

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By all indications, this has been the worst hurricane in Louisiana's recent memory:

	Poles Damaged	Windspeed at Landfall	Hurricane Category	Real 2021 $
Katrina Rita	28,400	121	3	$ 970,044,301.08
Gustav Ike	19,200	107	2	$ 754,904,985.07
Laura	14,000	150	4	$ 1,498,365,685.00
Zeta	2,000	100	3	$ 168,645,118.00
Delta	181	100	2	$ 186,645,116.00
Isaac	6,200	80	1	$ 327,805,773.67
Ida	30,679	150	4	$ 1,611,729,428.49

The value for Ida is an estimate based on the severity of damage and windspeed at landfall.

According to the Entergy New Orleans FERC Form 1, the original cost, net of depreciation, of transmission and distribution is $19,563,000,000.00. Although a comparison between replacement costs and original cost depreciated is necessarily inexact, this indicates that Ida destroyed something on the order of 8.2% of Entergy New Orleans' transmission and distribution assets.[4]

By comparison, Hurricanes Laura, Delta, and Zeta caused $1,853,655,919.00 in damages – 21.2% of the original cost depreciated value of Entergy Louisiana's transmission and distribution assets.[5]

Entergy indicates that it had considered two options in response to the damage from Ida:

[4] 2020 New Orleans FERC Form 1, page 337.
[5] 2020 Louisiana FERC Form 1 page 206.

1. Islanding portions of the Amite South Load Pocket and serving New Orleans by two local power plants, the New Orleans Power Station (NOPS) and the Waterford 3 Nuclear Power Station.[6]

2. Rebuilding the eight transmission lines into New Orleans.[7]

Considering the scale of other problems facing New Orleans, the fifty-third largest city in the United States, leaving the city without electricity for an extended period might well make it uninhabitable. The area including New Orleans has been islanded before, but for a limited period.[8]

A careful review of Entergy Louisiana and Entergy New Orleans indicates two major problems – one engineering and one economic.

On the engineering front, Entergy has apparently followed the traditional utility approach of leaving equipment in place until it is replaced at the end of its useful life, or it has failed – whichever has taken place first.

Category 4 Hurricanes are defined as:

> "130-156 mph Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months."[9]

Entergy testimony before the Louisiana Public Service Commission in docket U-35991 provides both engineering and economic data that give a good idea of the problems.[10]

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[6] https://www.wwltv.com/article/news/investigations/david-hammer/entergy-new-power-plant-electricity-hospitals/289-97565961-85d6-4079-b07e-2a367e56726e
https://www.wwltv.com/article/news/investigations/david-hammer/entergy-explains-plan-restore-power/289-76c13381-97c8-4a63-98ae-355befbcda9a

[7] https://www.entergynewsroom.com/news/entergy-two-viable-paths-for-first-light-into-greater-new-orleans-area

[8] NERC Reliability Guidelines, September 2018 - https://www.nerc.com/comm/PC_Reliability_Guidelines_DL/Reliability_Guideline_Methods_for_Establishing_IROLs.pdf

[9] NOAA Saffir-Simpson Hurricane Wind Scale - https://www.nhc.noaa.gov/aboutsshws.php

[10] Louisiana PSC Direct Testimonies for *Application for Recovery in Rates of Costs Related to Hurricanes Laura, Delta, Zeta and Winter Storm Uri and for Related Relief*. https://lpscpubvalence.lpsc.louisiana.gov/portal/PSC/DocumentDetails?documentId=156213

As reported in the testimony, older transmission structures in Louisiana were only designed to resist winds of up to 110 miles per hour (MPH):

> "Specifically, the unified Entergy Design Standard requires all transmission lines built or substantially upgraded in the Lake Charles area to be designed for 140 mph sustained wind, which exceeds current NESC requirements. Older transmission lines located in the Lake Charles area that were designed and constructed before the development of the unified Entergy Design Standard arc based on legacy GSU design standards, which I discuss further below."[11]

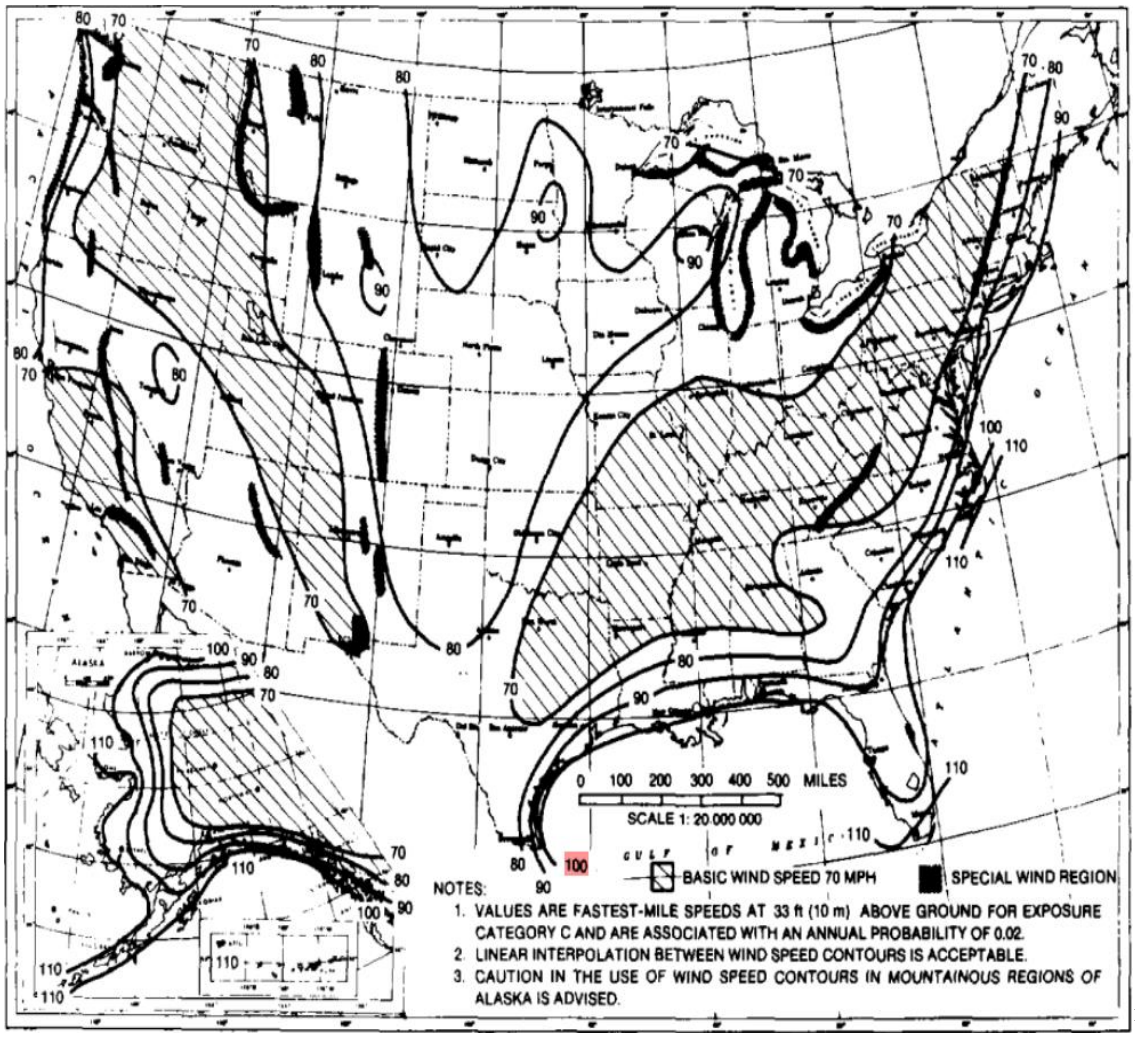
> "On the Company's 230 kV system, the three most heavily damaged lines in the Lake Charles area were built by GSU to withstand 110 mph wind -a standard which, again, met or exceeded NESC requirements at the time of construction. And most of the 138 kV facilities in the Lake Charles area that sustained heavy damage during Hurricane Laura were designed and constructed for 95 mph wind loading. Newer-construction 230 kV and 138 kV lines designed for 140 mph performed quite well, with no 230 kV or 138 kV structures destroyed on facilities designed to the new Entergy standard."[12]

When the legacy equipment was designed and installed more than twenty years ago, the standard reference assumed that the windspeed at landfall for a hurricane would be 110 MPH or less and that the speed would diminish rapidly after landfall.

The basic references used in the industry depend on maps showing the exposure of locations to high winds. Contour lines on these maps indicate areas of similar high wind exposure.

The chart below is from the ASC 74, Guidelines for Electrical Transmission Lines Structural Loading:

[11] *Direct Testimony of Michelle P. Bourg on Behalf of Entergy Louisiana, LLC.* p. 19. April, 2021 - https://lpscpubvalence.lpsc.louisiana.gov/portal/PSC/DocumentDetails?documentId=156213
[12] Ibid, p.19

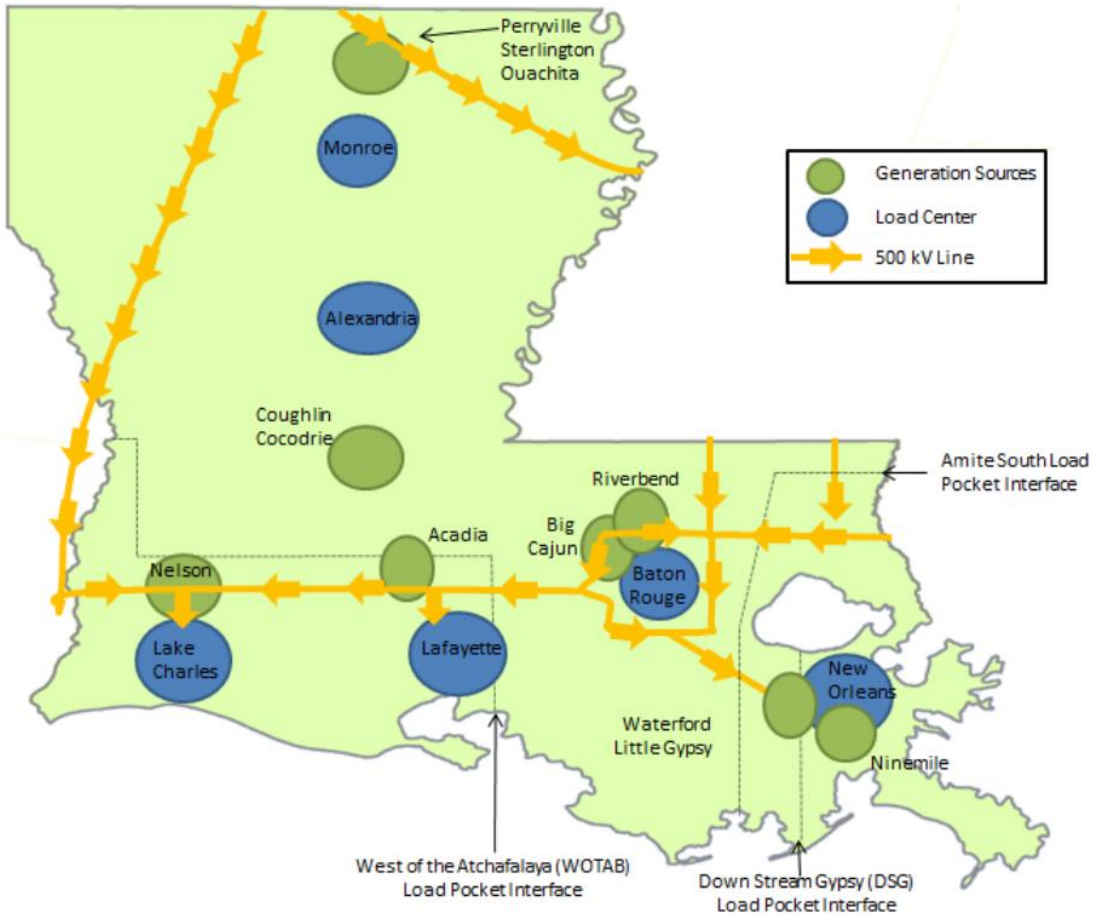


[13]

The highlighted value in the chart is the assumed windspeed for southern Louisiana from this period. As noted in the testimony, equipment built to this standard failed to handle the high windspeeds associated with Category 4 Hurricane Laura.

The next chart is a high-level picture of Entergy Louisiana and Entergy New Orleans:

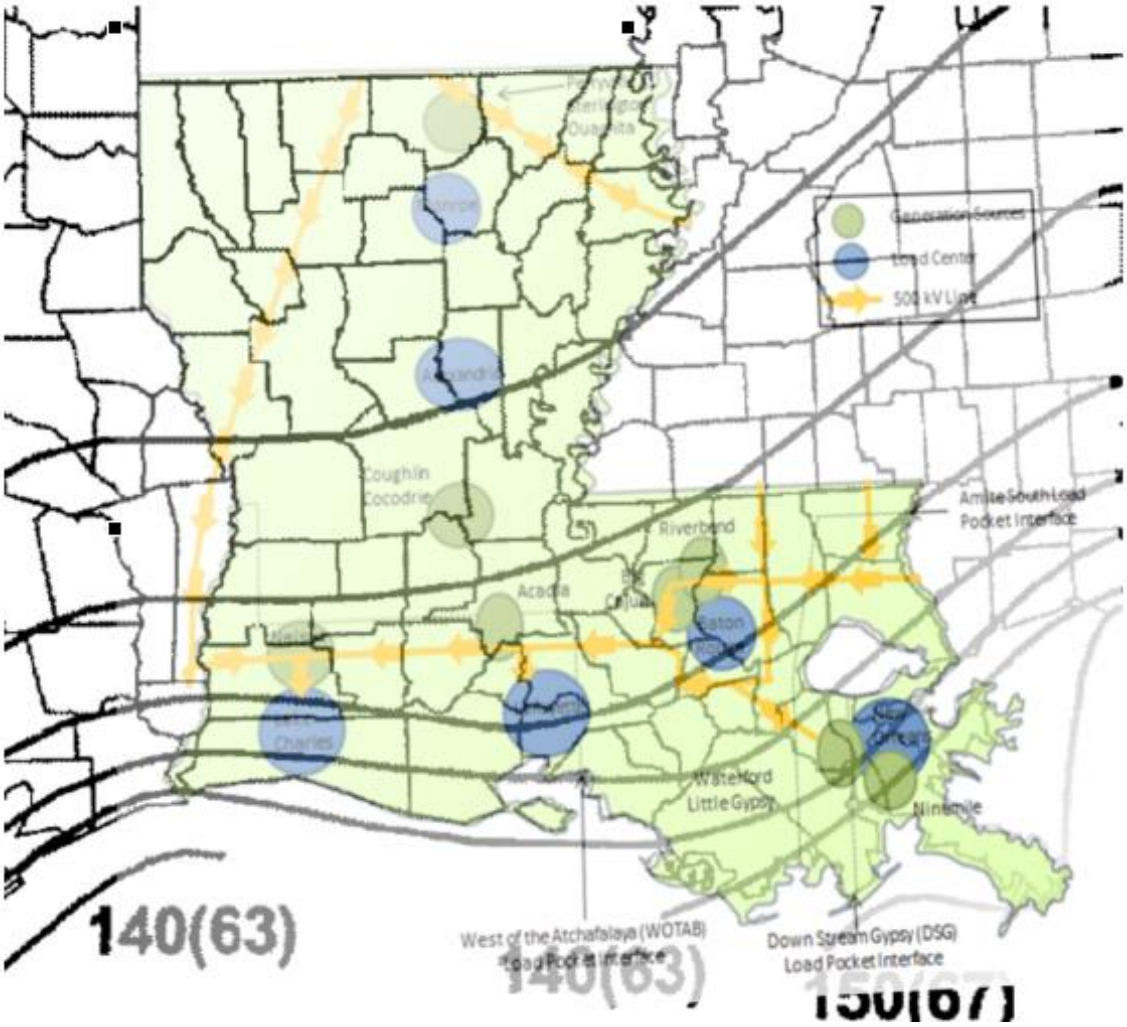
[13] National Electrical Safety Code® Secretariat Institute of Electrical and Electronics Engineers, Inc. Approved 15 March 1996, Institute of Electrical and Electronics Engineers, Inc. Approved 6 June 1996, American National Standards Institute 1997 Edition, page 250c.



Hurricane Laura made landfall at Lake Charles, whereas Hurricane Ida made landfall to the south of New Orleans.

Superimposing the most recent windspeed contours on this system map shows that Hurricanes Laura and Ida exceeded the 140 MPH levels from the 2017 NESC Code. [14]

[14] NESC Code 2017, page 209.



The impact of Hurricane Laura on Lake Charles one year ago provides clear evidence that the assumed lifetime of Entergy's transmission and distribution equipment was overstated.

Utilities schedule replacement of equipment based on standard engineering lifetime estimates. The estimated engineering lifetimes are generally stable, representing the normal wear and tear of equipment observed over many years.

Along the Gulf coast, however, the assumption of thirty year lives for major transmission equipment is no longer applicable, given the high probability that the next Category 4 hurricanes will destroy even more equipment built to the previous engineering standard. – Notably, over the past 12 months, four hurricanes have hit the Gulf coast.

Many utilities wait until older equipment is destroyed rather than preemptively replacing equipment. There are understandable regulatory reasons for doing so: it is easier to recover the cost of storm damage than it is to argue for early retirement of existing assets. Colloquially, it is often better to ask forgiveness than to seek permission, but this does not produce optimal results for either the utility or its customers.

The correct regulatory solution is to break the cycle of seeking after-the-fact regulatory approval for storm damage and to adopt depreciation schedules that reflect a more accurate estimate of the life of transmission and distribution equipment subjected to extreme storm weather. This allows for replacement of equipment before failure, saving tremendous social cost.

Both regulatory approaches require substantial rate increases. However, the after-the-fact approach – retaining equipment built to outdated safety standards until it fails – is far more costly for society as a whole. Hurricane Ida demonstrates once again that the cost of a prolonged outage eventually will dwarf the actual replacement expense of poles and conductors.