Listing of Previous Testimony Filed by Michelle P. Bourg

DATE	TYPE	SUBJECT MATTER	REGULATORY BODY	DOCKET NO.
09/25/2013	Direct	ETI 2013 Rate Case	PUCT	41791
10/18/2016	Direct	ENO GAS AMI	CCNO	UD-16-04
11/22/2016	Direct	ELL GAS AMI	LPSC	U-34320
05/02/2017	Direct	ELL Gas Storm Restoration	LPSC	U-34445
09/15/2017	Rebuttal	ENO Gas Infrastructure Rebuild	CCNO	UD-07-02
09/21/2018	Direct	ENO 2018 Rate Case	CCNO	UD-18-07
03/22/2019	Rebuttal	ENO 2018 Rate Case	CCNO	UD-18-07

Summary of Transmission Storm Costs for Hurricanes Laura, Delta, and Zeta

Description	Laura	Delta	Zeta	Total
Direct				
Contract Work	$ 372,462,742	$ 12,839,974	$ 12,655,481	$ 397,958,197
Employee Expenses	387,368	10,104	8,142	405,614
Labor	2,377,206	579,598	360,101	3,316,905
Materials	50,533,800	1,315,283	1,953,511	53,802,595
Other	32,529,162	1,393,573	1,734,742	35,657,477
ESL Billings	4,094,776	128,434	81,810	4,305,021
Loaned Resources	662,479	26,060	15,026	703,565
Audited Costs through 2/28/2021	$ 463,047,533	$ 16,293,026	$ 16,808,814	$ 496,149,373
Mutual Assistance	$ 23,683,265	$ 458,575	$ -	$ 24,141,840
Adjustments	(11,069)	(14,172)	(464)	(25,705)
Total Costs through 2/28/2021	$ 486,719,729	$ 16,737,429	$ 16,808,349	$ 520,265,508
Estimated Cost to Complete Repair	4,460,000	-	-	4,460,000
Total Gross Cost	$ 491,179,729	$ 16,737,429	$ 16,808,349	$ 524,725,508

Summary of Transmission Storm Costs for Winter Storm Uri

Description		Uri
Direct		
Contract Work	$	1,252,820
Employee Expenses		180
Labor		251,768
Materials		74,172
Other		104,432
ESL Billings		3,299
Loaned Resources		-
Costs Recorded Through 2/28/2021	$	1,686,671
Estimated Cost to Complete Repair	$	1,273,329
Total Gross Cost	$	2,960,000

Funding Project Number	Funding Project Name	Project Driver	Year 2017	2018	2019	Total
F1PPU50942	Lake Charles Trans. Project	Regional Reliability	60,795,679	116,655,669	5,220,460	182,671,807
F1PPU75736	SWLA69IP: Bld Lines&Sub-Ph1	Regional Reliability	278,161	34,238,504	51,578,680	86,095,345
F1PPU75634	Build Terrebnn-BayVista 230kV	Regional Reliability	12,994,445	63,053,451	154,438	76,202,334
F1PPU75803	LETP: Louisiana Economic Trans Plan	Eliminate Congestion	24,448,149	46,630,036	702,464	71,780,649
F1PPU50791	Fancy Point Add 2nd Auto	Regional Reliability			60,685,514	60,685,514
F1PPU75790	Ninemile-Barataria Rebuild	AM Renewal			51,203,969	51,203,969
F1PPU75258	SELA Ph 3 Oakville to Alliance 230k	Regional Reliability		46,232,582	136,174	46,368,756
F1PCUD0279	Transmission Lines Program Blanket	AM Renewal	6,550,673	17,626,793	20,752,951	44,930,416
F1PPUX4862	Robert New 230kV Sub & T-line	Local Reliability - T&D			41,795,113	41,795,113
F1PPU51198	LCPS: Intercon & Bkrs Upg at Nelson	Customer Connect			40,477,713	40,477,713
F1PPU75766	SCPS: Intercon & Brkrs Upg at Gypsy	Customer Connect	17,192,068	17,058,046	(700,871)	33,549,243
F1PPUX4748	Cadeville-Build Sub & Line	Local Reliability - T&D	2,622,395	20,614,686	331,495	23,568,576
F1PCUD0122	Wood Pole Replace/Reinforce Blk	AM Renewal	3,800,584	7,631,992	9,773,847	21,206,423
F1PPU51012	NERC CIP-014: Sub Physical Sec	Security & Other		12,041,004	7,054,323	19,095,326
F1PPU51018	Horseshoe_Bld New 230kV SwSta	Regional Reliability	18,667,643	12,965		18,680,608
F1PPUT0556	T-Substation Failure Blanket	AM Renewal	3,487,537	5,860,594	7,911,595	17,259,726
F1PPU51314	Purchase Perryville Transformers	Security & Other	16,480,843	537,444		17,018,287
F1PPU75602	Ninemile-Harvey2 115 Rebuild	Regional Reliability		15,042,357	372,861	15,415,218
F1PCUD0551	Transmission Line Failure Blk	AM Renewal	3,928,728	5,440,051	4,719,499	14,088,278
F1PPU75587	PtHudson-ZachREA Line Upgrade	Regional Reliability	13,441,286	287,666		13,728,952
F1PPU51091	Solac: Upgrade 2-230/69 kV ATs	Regional Reliability			13,725,034	13,725,034
F1PPU36947	Carlyss-Olin TDI Ln Wood Pole Rplc	AM Renewal			12,741,486	12,741,486
F1PPUT0119	T-Sub Breaker Replacement Blnk	AM Renewal	1,830,245	2,626,559	7,338,730	11,795,534
F1PPUT0117	T-Sub Relay Improvements Blnk	AM Renewal	3,195,613	3,033,738	5,278,044	11,507,395
F1PPIOT071	CIP V6 Transmission	Security & Other		11,174,198	65,699	11,239,897
F1PPU75666	NERC Clearnc Complnce Prgm - Ph2	Security & Other	1,944,852	2,859,331	5,882,612	10,686,795
F1PPUFLSUB	Subs Reliability Failure Blanket	AM Renewal	971,396	891,958	8,232,386	10,095,740
F1PPU75783	Contrbd-Solac 69: Upgrd Ln	Regional Reliability			9,890,385	9,890,385
F1PPU50959	EGL_Axiall:Build New Sub	Customer Connect	9,380,634	246,637	189,846	9,817,117
F1PPU75651	EGL_LCBulk-Chlomal: Rebuild	Regional Reliability	5,079,641	4,561,305	26,665	9,667,611
F1PCUX4500	Schriever Build New 230/13.8kV Subs	Local Reliability - T&D	9,585,350	(5,271)		9,580,079
F1PPUX4839	Beekman 115: New Sub	Local Reliability - T&D			8,197,913	8,197,913
F1PPU75967	Carlyss-Sabine Reliability Improve	AM Renewal			7,746,839	7,746,839
F1PPU75854	Nelson-Lk Charles Blk: Upgrd Ln	Regional Reliability			7,722,195	7,722,195
F1PPU75654	Francis-Maryda 69kv Ln Upg	Regional Reliability	7,534,721	131,942	-	7,666,663
F1PPUX4827	Hodge: Relocate D-sub&lines	Local Reliability - T&D		354,314	7,090,371	7,444,685
F1PPU75856	LCPS: NRIS/Reliability Projects	Customer Connect			7,411,831	7,411,831
F1PPU51251	Praxair: Mt Houmas 230/13kV SS	Customer Connect		7,827,005	(572,799)	7,254,206
F1PP4ELA16	ELA Circuit Replacement Program 16	Security & Other	6,433,066	779,400	-	7,212,466
F1PP4ELA17	ELA Legacy Circuit Replacement 2017	Security & Other	6,361,948	426,114	-	6,788,063
F1PPUX4842	Swisco: Build 138/13.2 kV Sub	Local Reliability - T&D	6,693,412	81,593	(68,222)	6,706,782
F1PPU51034	Carlyss Relay Imprv SPOF	Regional Reliability		4,429,969	2,000,002	6,429,972
F1PPU50891	EGL -WGlen Relaying Imprv SPOF	Regional Reliability			5,991,994	5,991,994
F1PPU75652	EGL_Scott-Carencro 69kV Ln Upg	Regional Reliability	5,721,380	48,514		5,769,894
F1PPUX4845	Solac: Add Xfmr	Local Reliability - T&D			5,547,179	5,547,179
F1PPU75618	Ninemile-Westwego 115 Rebuild	Regional Reliability		5,369,195	27,936	5,397,131
F1PPU75759	Rebld Vienna-TrusselCrsng	Regional Reliability		5,180,377		5,180,377
F1PPU75829	Dunn-Winnsboro: Bld 115kV Ln	Regional Reliability			4,603,857	4,603,857
F1PPU75774	Upgrade Gloria-Flanry 69kV line	Regional Reliability			4,223,958	4,223,958
F1PPU51315	Purchase CLECO Substations	Security & Other	3,790,710	275,528		4,066,238
F1PPU50940	Bayou Verret: Inst Cap Bank	Regional Reliability	3,308,272	(12,878)		3,295,394
F1PP4ELA18	ELA Legacy Circuit Replacement Prog	Security & Other		2,914,298	300,726	3,215,024
F1PPU36963	L208 RACELAND-WF 230SWYD	AM Renewal			2,729,576	2,729,576
F1PPU51036	Tezcuco Relaying Imprv SPOF	Regional Reliability		2,645,215	(3)	2,645,213
F1PPU50894	SPOF ELL -NMP Relaying Imprv	Regional Reliability	383,722		2,206,578	2,590,301
F1PPU51035	Snakefarm Relaying Imprv SPOF	Regional Reliability	671,433	382,924	1,514,217	2,568,574
F1PPU36662	02_07_2017 ELA T-GRID STORM TORNADO	AM Renewal	2,308,850	12,493		2,321,343
F1PPU51059	Install Cap bank: Norco sub	Regional Reliability	1,750,707	465,383		2,216,090
F1PPUX4937	Monsanto: Add XFMR Luling Sub	Customer Connect		4,622,143	(2,429,520)	2,192,623
F1PPU51031	Little Gyp Relaying Imprv SPOF	Regional Reliability	199,289	1,877,612		2,076,901
F1PPUX4844	Lowe Grout Rd: Build New Sub	Local Reliability - T&D			2,065,731	2,065,731
F1PPU75884	HWY 90 Bridge L13/L14 Pole Relocati	Regional Reliability			1,926,052	1,926,052
F1PPU51166	Geismar Area (Ellem): Bld 138 kV SS	Regional Reliability			1,832,823	1,832,823
F1PPU75964	Comite Diversion- Relocate Strs	Regional Reliability			1,750,555	1,750,555
F1PPU51033	Nelson 500kV Relaying Imprv SPOF	Regional Reliability		1,653,165	2,309	1,655,473
F1PPU36503	INF16: Columbia Tap-Standard:R.Strx	AM Renewal	1,562,432	16,211		1,578,643
F1PP4ELA19	ELL Legacy Circuit Replacement 2019	Security & Other			1,562,341	1,562,341
F1PPU36433	WP16: Moss Bluff-Chalkley:Rplc Strx	AM Renewal	1,367,554	(17,137)		1,350,417
F1PPUT0554	T-Substation Program Blanket	AM Renewal	51,063	187,186	1,044,716	1,282,965
F1PPU75566	Cameron LNG Interconnection	Customer Connect		1,270,455	5,210	1,275,665
F1PPUT0115	T-Sub Transformer Life Extension	AM Renewal		58,553	1,188,867	1,247,420
F1PPU51254	Golden Meadow- Rpl Failed Cap Bank	Local Reliability - T&D		1,257,905	(15,976)	1,241,929
F1PPU36663	03302017 ELA T-GRID STORM	AM Renewal	1,101,056	(48)		1,101,009
F1PPU36820	WP17: Crown2-Port Hudson: WPole Rep	AM Renewal	1,093,568	6,975		1,100,543
F1PPU36850	WP17: Napolnvle-Racelnd WPoleRplcm	AM Renewal		1,093,281		1,093,281
F1PPU51143	Willow Glen Delist: Road/Sub Mods	AM Renewal	331,360	722,677	-	1,054,038
F1PPU75286	Willow Glen-Conway New 230kV Line	Regional Reliability	1,030,804	12,102		1,042,906
F1PPU51077	Champange Instl 69kV,14.4mVAR CapBa	Regional Reliability		1,023,903		1,023,903

			Year			
Funding Project Number	**Funding Project Name**	**Project Driver**	**2017**	**2018**	**2019**	**Total**
F1PPU51115	Repapco Sta equ upgrade	Regional Reliability		1,020,479		1,020,479
F1PPU36784	T-GRID STORM DAMAGE HURR HARVEY	AM Renewal	867,462	100,992	-	968,454
F1PPU36787	ELA Subs Flood Mitigation project	AM Renewal	881,110	81,460		962,570
F1PPU36582	WP17:L254, Lake Charles Bulk-Bayou	AM Renewal	942,707	(2,810)		939,898
F1PPU36732	WP17: Gibson-Humph WPole Replcmt	AM Renewal	794,580	128,351	(5,088)	917,843
F1PPUT0139	T-Sub Instru Transf Repl Blnk	AM Renewal	79,217	276	808,952	888,445
F1PPU51142	Coly 230kV:Install breaker	Regional Reliability		837,434	35,745	873,179
F1PPU51113	Nesser 69kV CapBank installation	Regional Reliability	867,381			867,381
F1PPU51120	Underrated Brkrs Project Ph2	Regional Reliability	798,017	60,758		858,776
F1PPVP0093	Union Post Acquisition Projects	Security & Other		415,344	381,552	796,895
F1PPIOF076	CIP-003-7	Security & Other			764,182	764,182
F1PPU51032	Hooker: Relaying Imprv SPOF	Regional Reliability	962,292	(199,398)		762,893
F1PPUX4905	3Ellender: Inst Xfmr	Local Reliability - T&D		692,108	63,579	755,687
F1PPU36751	FAIL16:Behrman-PtNickl Termnl Pole	AM Renewal	747,239	(93)		747,146
F1PPUT0116	T-Sub RTU Replacement Blnk	AM Renewal	43,547	-	686,615	730,162
F1PPU36788	NMile Swyrd: Add Battery House	AM Renewal	663,341	63,616		726,957
F1PPU75882	Kirk-New Iberia L-511-Instl GOAB	Customer Connect	661,262	12,303	25,878	699,443
F1PPU36583	ELA AUGUST 2016 STORM FLOODING	AM Renewal	106,961	585,729	-	692,689
F1PPU51164	Snkfrm 230kV: Instl 2nd AT	Regional Reliability			684,730	684,730
F1PPU36727	Pecue:Add 230Bkrs, Relays& CntrlH	Regional Reliability	660,895	17,707		678,602
F1PCUD0556	D-Substation Equipment Failures Blk	Local Reliability - T&D	394,475	557,747	(283,607)	668,615
F1PPU36340	Tilnes Warehouse Bosco Sub	AM Renewal	642,170			642,170
F1PPU51140	Tiger 230kV:Install breaker	Regional Reliability		446,890	151,796	598,686
F1PPU51131	ELL:Purch spare 138x115 AXFMR	AM Renewal	590,200			590,200
F1PPU51333	Devil Swamp-Replace Bkr 20210	AM Renewal			584,803	584,803
F1PPU51141	Harelson 230kV:Install breaker	Regional Reliability		565,821		565,821
F1PPU75881	Lawtag-Lake Arthr L-39- Instl GOAB	Customer Connect	251,954	310,497		562,451
F1PPU36796	9MILE: Replace S2012 OCB	AM Renewal	547,693	11,524		559,217
F1PPUX4899	Plaquemine: Inst 3rd Xfmr	Regional Reliability		571,033	(30,471)	540,562
F1PPU36729	05/03/2017 ELA T-GRID STORM	AM Renewal	536,531			536,531
F1PPU51169	Meaux: Inst 138kV Bus Tie Bkr	Regional Reliability		427,432	106,379	533,811
F1PPU51038	Waterford Relaying Imprv SPOF	Regional Reliability	511,554	278		511,832
F1PPU36781	LGypsy T1 trans life extension	AM Renewal	496,122	-		496,122
F1PPUX4966	DHL Graphic Pkg-Russel Sage	Customer Connect		435,417	31,319	466,736
F1PPU36798	9mile: Replace S2018 OCB	AM Renewal		461,792	(3,334)	458,458
F1PP4GSL15	EGSI Circuit Replacement Program 15	Security & Other	432,424	11,279		443,703
F1PCUD0550	Transmission Mandated Blanket	Local Reliability - T&D	37,957	302,037	101,374	441,368
F1PPU36933	ELL 07/10/2019 T-LINE GRID STORM	AM Renewal			430,659	430,659
F1PPU36833	INF17: Nelson-Richard	AM Renewal	425,819	(6,895)	-	418,924
F1PPU36797	9Mile: Replace S2015 OCB	AM Renewal	396,080	12,219		408,298
F1PPU36813	Jaguar L750 Replace Panels	AM Renewal	402,972	2,599		405,571
F1PPU36812	Ninemile: Rplc Luling Line Pnl	AM Renewal	300,801	-	102,259	403,060
F1PPU36861	04062018T-LINE STORM	AM Renewal		398,409		398,409
F1PPU36851	3-29-2018_ELA T-GRID STORM	AM Renewal		386,189	185	386,374
F1PPU36762	Coly L712/747 Rplc Pri&BU Panels	AM Renewal	385,064	-		385,064
F1PPUD0136	T&D AM System Programs-Blanket	AM Renewal		28,712	355,034	383,746
F1PPUX4872	ELAC_WR Grace: Mimosa: Add 2 Xfmrs	Customer Connect			382,354	382,354
F1PPU36925	06/24/2019 ELL T-LINE GRID STORM	AM Renewal			372,339	372,339
F1PPU36891	T-LINE STORM 04/13/2019	AM Renewal			365,734	365,734
F1PPU36868	Port Hudson: Rplc brk 14645	AM Renewal		351,251	-	351,251
F1PPU36748	INF17:L130.3, McCall-Plaquemine	AM Renewal	338,734	8,449	-	347,183
F1PPU36878	Barataria: Replace GCB S9179	AM Renewal		338,486	-	338,486
F1PPU36626	RedGum: Install Vanquish Fence	Local Reliability - T&D	334,434			334,434
F1PPU36802	9mile: RPLC 230kV N.Bus Diff Pnl	AM Renewal			332,308	332,308
F1PPU36872	Cosmar replace Bus tie 14685	AM Renewal	218,793	112,227		331,020
F1PPU36929	NERC19: Crown 2-Starhill Tap Struc	AM Renewal			324,712	324,712
F1PPU51050	NERC-PRC-002:Inst DDR&DFR-ESI	Security & Other			322,580	322,580
F1PPU36743	Scott 138KV L232 relay line Pnl	AM Renewal	322,083			322,083
F1PPU36785	Luling: Replace OCB S8788	AM Renewal	312,843	7,834	989	321,666
F1PPU36837	Jennings Rplc L204 relay panel	AM Renewal	247,320	73,961		321,281
F1PPU51206	Webre GIS Bushings	AM Renewal	316,645			316,645
F1PPU36915	06202019 ELL T-LINE STORM GRID	AM Renewal			315,824	315,824
F1PPU36834	Red Gum: Rplc R3462 & Switches	AM Renewal	282,399	16,217	15,542	314,158
F1PPU36852	Lutcher-RPLC 115kv Bkr S0993	AM Renewal	199,365	109,743		309,109
F1PPU36761	LA Station: Rplc L-364 relay panel	AM Renewal	297,310			297,310
F1PPIOT066	OT Transmission Server Refresh	Security & Other			291,974	291,974
F1PPU50809	Kirk: Bld NewSub&138-69kV_Auto	Regional Reliability	286,987	(499)		286,488
F1PPU36714	04 30 2017 ELA T-GRID STORM	AM Renewal	285,700			285,700
F1PPU36772	Fancy Point 230kV Brkr Rplcmnt	AM Renewal	276,226			276,226
F1PPU36747	INF17:L232, Judice-Scott	AM Renewal	271,605	(421)		271,184
F1PPU36830	Gonzales: Replace Brkr 14770	AM Renewal	260,799	3		260,803
F1PPU36831	Coly: Replace L750 Pri & Bu Pnl	AM Renewal	259,562	424		259,985
F1PPU36789	Gretna: Replace S7587 OCB	AM Renewal	259,954			259,954
F1PPU36763	PtHudsnL712/747 Rplc Pri&BU Pnl	AM Renewal	256,400	-		256,400
F1PPU51037	UnionCarb Relaying Imprv SPOF	Regional Reliability	255,952	-		255,952
F1PPU36873	Plantation: Repl S Natchez Panel	AM Renewal	198,122	56,768		254,890
F1PPU36746	INF17:L249, Maurice-Scott	AM Renewal	255,498	(806)		254,692
F1PPU36847	Coteau: Rplc T Bonne Line Panel	AM Renewal	252,168	(495)		251,673

Funding Project Number	Funding Project Name	Project Driver	Year 2017	2018	2019	Total
F1PPU51029	BaxWilson Relaying Imprv SPOF	Regional Reliability	248,595			248,595
F1PPU36752	WP17: Zoar-Port Hudson WoodPole Rpl	AM Renewal	244,152	1,164		245,316
F1PPU36855	Richard 138KV L650 relay pnl	AM Renewal	207,998	35,900		243,899
F1PPU36572	INF16:L114,Amite-Bogal	AM Renewal	254,680	(10,832)		243,848
F1PPU36836	Sterl 115: Repl Crossett Line Pnl	AM Renewal	234,137	4,266		238,404
F1PPU36928	NERC19:Crown Z-Horseshoe Struc Rpl	AM Renewal			234,709	234,709
F1PPU36803	9mile: RPLC 230kV S.Bus Diff Pnl	AM Renewal		233,792		233,792
F1PPU36930	ELL 06272019 T-LINE GRID STORM	AM Renewal			216,286	216,286
F1PPU50792	Willow Glen Replace Autoxfmr	Regional Reliability	207,174			207,174
F1PPU36862	ELA T-GRID STORM 04/14/2018	AM Renewal		203,238	(2,180)	201,058
F1PPU51110	Couch: New Control House	Regional Reliability	200,244			200,244
F1PPU36819	INF17: Blount-Port Hudson	AM Renewal	192,691	(2,718)		189,973
F1PPU36755	10222017 ELA T-GRID STORM	AM Renewal	180,346	9,522	0	189,867
F1PPU36832	03112018_ELA T-GRID STORM	AM Renewal		187,677		187,677
F1PPUX4840	Alaska Substation: Add Xfmr	Local Reliability - T&D		447,639	(270,933)	176,706
F1PPU36760	Scenic L764 Rplc relay panel	AM Renewal	174,324	-		174,324
F1PPU36816	ELA T-GRID STORM 01/16/2018	AM Renewal		171,365	(1)	171,363
F1PPM42147	MAIN TRNSFMER MTX-XM2 OIL PUMP REPL	AM Renewal	165,522			165,522
F1PPM42196	MAIN XFORMER MTX-XM1 OIL PUMP REPL	AM Renewal			162,882	162,882
F1PPU36927	NERC18: Gardere-WGlen Pole Rplc	AM Renewal		148,582	12,188	160,769
F1PPVLM051	UP4 - Replace GSU Surge Arrestors	AM Renewal		159,265		159,265
F1PPU51298	Camellia Fiber Project	Customer Connect		121,009	30,374	151,382
F1PPVLM059	UP3 Replace/Upgrade GSU Surge Arr	AM Renewal		151,346		151,346
F1PPU75788	INF15: Waggaman-Luling:Repl Strux	AM Renewal	146,096	-		146,096
F1PPU36932	ELL 07/07/2019 T-LINE GRID STORM	AM Renewal	-		145,931	145,931
F1PPUM2008	FP for Minor Adds with Closed FP	Security & Other		10,334	129,981	140,315
F1PPUT0111	T-Sub Insulator Replacement	AM Renewal	117,862	11,636	8,857	138,356
F1PPU51165	Port Hudsn: Upgrd T6 Bay	Regional Reliability	137,774	(4,296)		133,478
F1PPU36518	WP16: L647 Richard-Scott rpl ro	AM Renewal	122,440			122,440
F1PPVLY353	LG3 Main Transformer High Side Bush	AM Renewal	118,737			118,737
F1PPU36703	FAIL16: L126.2 Pardis-Raclnd	AM Renewal	116,124			116,124
F1PPU36912	05/08/2019 ELL T-GRID STORM	AM Renewal			112,722	112,722
F1PP4ELI15	ELI Circuit Replacement Program 15	Security & Other	104,140		-	104,140
F1PPUX4760	EGL Casino: Add XFMR	Local Reliability - T&D	102,628			102,628
F1PPU36585	01/02/2017 ELA T-GRID STORM	AM Renewal	100,428			100,428
F1PPU51119	BASF at Belle Helene Sub	Regional Reliability	92,106			92,106
F1PPU36906	ELL T-LINE STORM 04/25/2019	AM Renewal			90,053	90,053
F1PPUT0577	T-Line/Sub Tools & Equip Blanket	AM Renewal		88,130		88,130
F1PCUD0554	D-Sub Substation Programs Blanket	Local Reliability - T&D	80,710			80,710
F1PPUX4917	ELAS_Fourchon/Leeville DSTATCOM	Security & Other		502,694	(424,924)	77,769
F1PPU36883	11_01_2018 MINOR T-LINE STORM GRID	AM Renewal		74,075	2,367	76,441
F1PPUT0113	T-Sub Arrester Replacement Blnk	AM Renewal	10,199	41,017	22,890	74,107
F1PPU50954	EGL_Vincent: 61MVAR_Cap	Regional Reliability	69,500	1,822		71,322
F1PPU36730	06_21_17 ELA T-GRID STORM TS Cindy	AM Renewal	59,777	3,181		62,958
F1PPVGM833	NL6 - Dynamic Rating Bushing & Gas	Security & Other		60,891		60,891
F1PPU36865	T-LINE STORM 08/21/2018	AM Renewal		58,825	1,361	60,185
F1PPU36712	04/02/2017 ELA T GRID STORM	AM Renewal	60,033			60,033
F1PPU36661	01/21/17 to 1/24/17 ELA T-GRID STO	AM Renewal	60,307	(2,710)		57,597
F1PPU36336	Alliance-Barataria Foundations	AM Renewal	53,474			53,474
F1PPU36775	FAIL15:GlobalSpooling-Choupique	AM Renewal	52,059			52,059
F1PPU50887	EGL Underrated Breakers	Regional Reliability	38,927			38,927
F1PPU36805	STORM: 101119 T-GRID STORM DAMAGE	AM Renewal			38,080	38,080
F1PPU51159	Wtrfrd-Rclnd: Upgrd Line Bay	Regional Reliability			36,648	36,648
F1PCUD0123	Shield Wire Replacement Blanket	AM Renewal	35,107		-	35,107
F1PPU36890	12/27/2018 TGrid LA STORM	AM Renewal			32,629	32,629
F1PPU36864	T-LINE STORM 06/30/2018	AM Renewal		32,475	(24)	32,451
F1PPU75792	Carlisle-Port Nickel Split	AM Renewal	29,898	(2,224)		27,674
F1PPU36860	4-3-18 STORM DAMAGE	AM Renewal		25,157	(65)	25,092
F1PPUX4706	Carencro Upgrade T1 & T2	Local Reliability - T&D	24,948			24,948
F1PPUX4874	Sacksonia-Interconnct Denbury Delhi	Customer Connect	23,521			23,521
F1PPU36426	MAN16: PrtofLkChrls:Reloc Tline Str	Local Reliability - T&D	22,298			22,298
F1PPU36314	INF15: MossBluff-Chalkley Xarm Remo	AM Renewal	21,377	-		21,377
F1PPU36296	ELA_02-23-2016 Storm Damages	AM Renewal	19,747			19,747
F1PPU36645	INF16:Srpta-Haynsvl Rplc Struc	AM Renewal		19,441		19,441
F1PPU50795	Colonial Sprg 138kV : Cap Bank	Regional Reliability	18,303			18,303
F1PPU36598	WP16:Paradis-Raceland STR Rplc	AM Renewal	18,291	-		18,291
F1PPU36550	INF16: L296, Hollywd-Orange;Repl	AM Renewal	15,788			15,788
F1PPU50888	ELL Underrated Breakers	Regional Reliability	15,733			15,733
F1PPU51160	SCPS: ERIS-Snkfrm-Labrr Bay Bus Upg	Regional Reliability	16,979	(1,516)		15,463
F1PPU51171	Moril: Upgrd AT CTs	Regional Reliability	14,426	-		14,426
F1PPU36266	INF15: L147 Oak Grove-Chickasaw	AM Renewal		14,019	-	14,019
F1PPU36578	11282016 ELA T-GRID STORM	AM Renewal	12,487			12,487
F1PPUD0129	Skylining/Hazard Tree Blanket	Local Reliability - T&D	11,166			11,166
F1PPU75683	Intracoastal:Add 69kV Line & Auto	Customer Connect	10,655			10,655
F1PPU36304	WP15: EGSL_Champagne-E.Opelousas Co	AM Renewal	9,953	-		9,953
F1PPU36432	Carlisle-Prt Nckl Shieldwire	AM Renewal	9,387	-		9,387
F1PPUIS094	IC Waterloo 230kV Breaker Addition	AM Renewal	7,913			7,913
F1PPU36647	INF16:Paradis-Lulng rplc Xarm&ins	AM Renewal		5,673		5,673

			Year			
Funding Project Number	Funding Project Name	Project Driver	2017	2018	2019	Total
F1PPU36649	WP16:Maurc-Scot pole replacemt	AM Renewal	881	4,371		5,252
F1PPU36650	FAIL16:Grnwd-Terrbn Struc replc	AM Renewal		5,142		5,142
F1PCUD0204	T Equipment Testing Blanket	Security & Other		4,799		4,799
F1PPU36434	WP16: L233 NCrowley-Scott:Rplc Str	AM Renewal	4,746			4,746
F1PPU36552	INF16:L225,Cece-Moril Str Rplc	AM Renewal	-	4,555		4,555
F1PPU75700	EGSL_L390 Willow Glen-Geismar	AM Renewal			4,255	4,255
F1PPU36415	FAIL15: HarveyTap-9mile:Rmv Tower	AM Renewal		3,530		3,530
F1PPIOT055	CIP V5 Substations - EGSL	Security & Other	3,311			3,311
F1PPUDT116	RTU Replacements Blanket	AM Renewal	2,890			2,890
F1PPU51047	Gosport-L673 TP: Upg Sta Equ	Regional Reliability	2,780			2,780
F1PPU36631	Esso Sub Replace brkr 21560	AM Renewal	2,704			2,704
F1PPU36576	ELA T-GRID STORM 07/22/16_07/30/16	AM Renewal	3,196	611	(1,167)	2,639
F1PPU36651	FAIL16:Pardis-Racland rplc Struc	AM Renewal		2,513		2,513
F1PPU36646	INF16:Lamy-Selman, Str replace	AM Renewal		2,336		2,336
F1PPU75796	WP15: Cytec-Ninemile_Repl Strux	AM Renewal		2,323		2,323
F1PPU36648	INF16:Lkhart-JonsCrk rplc Xarms&ins	AM Renewal		2,174		2,174
F1PPU36642	Alfol L-253 relay panel replacement	AM Renewal	1,601			1,601
F1PPU36299	03172016 ELA T-Grid Storm	AM Renewal	1,532			1,532
F1PPUX4983	Goudchaux- Gen Intercon to D-Sub	Customer Connect			1,510	1,510
F1PPU75793	INF15: Bayou Ramos-Gibson:Repl Strx	AM Renewal			1,267	1,267
F1PPVP0095	Union Acquisition	Security & Other	1,162			1,162
F1PPU36281	Coly 500kV GIS	Local Reliability - T&D	1,097			1,097
F1PPU75721	EGSL_ Nelson-Richard 500kVline	AM Renewal	1,070			1,070
F1PPU36297	03092016 ELA T-Grid Storm	AM Renewal	847			847
F1PPU36574	07142016 ELA T-GRID STORM	AM Renewal			693	693
F1PPU75948	Relocate Poles LN 206 Choupique-Int	Customer Connect			610	610
F1PPU36643	LC Bulk L-254 rplc relay panel	AM Renewal	545			545
F1PPUX4817	Mosaic - GI Upgrades	Customer Connect	504			504
F1PPU51130	AEP Layfield Sub:Upgrd Relayng	Customer Connect	496			496
F1PPU36603	Pt Nickel:Add 115kV Bkr S2648	AM Renewal	399			399
F1PPU75794	INF15: Greenwd-Terrebne:Repl Strux	AM Renewal		383	-	383
F1PPU36526	03312016 ELA T-GRID STORM	AM Renewal	365			365
F1PPU75942	Lotte-LACC Structure Relocation	Security & Other		506	(241)	265
F1PPU36532	INF16: Behrman-Port Nickel Replac	AM Renewal		561	(341)	221
F1PCUD0117	D-Sub Relay Improvements Blanket	Local Reliability - T&D	113			113
F1PPIOT052	SCADANet Hardware Refresh	Security & Other	(361)	437		76
F1PPUX4837	Graphic Packaging-Frostcraft	Customer Connect	(237)	237		0
F1PPU36536	05192016 ELA T-GRID STORM	AM Renewal	772	229	(1,513)	(512)
F1PPU75775	INF15: Chalkley-Solac_Repl Xarm	AM Renewal		(693)	-	(693)
F1PPU36413	INF16: L206 Ashlnd-Houma:Rplc Insul	AM Renewal		(2,098)		(2,098)
F1PPU36422	INF16: L698 Jennings-LC Bulk	AM Renewal	(2,944)			(2,944)
F1PPU75723	INF15 L.Charles Bulk-Colon Welsh	AM Renewal		(4,218)	-	(4,218)
F1PPUDR554	IC - Substation Programs Blanket	AM Renewal	-	(5,076)		(5,076)
F1PPU75767	INF15: Repl Strux/Xarm_Carter-Elton	AM Renewal		(5,301)	-	(5,301)
F1PPU51065	BECI: Cut-In Spanish Trail POD	Customer Connect	(5,880)			(5,880)
F1PPU51137	SHELLCHEM SUB DEMOLITION	Regional Reliability	(6,447)			(6,447)
F1PPU51322	Criterion Catalysts-Connect New Sub	Regional Reliability			(7,325)	(7,325)
F1PPU36263	WP15: Bloomfield-E.Opelousas:R.STR	AM Renewal		(7,903)		(7,903)
F1PPU50970	Tezcuco Sub Add Bays 5 and 6	Customer Connect	(9,037)			(9,037)
F1PPU36372	INF16: Carlyss-Choupique:Repl Strx	AM Renewal	(14,892)	-		(14,892)
F1PPU36666	Winnfield Sub: Rplc OCB R9293	AM Renewal	(16,019)			(16,019)
F1PPU36373	INF16: Carlyss-Intercoastal:R.Strx	AM Renewal	(6,554)	(11,313)		(17,867)
F1PPIOT056	CIP V5 Substations - ELL	Security & Other	(18,618)			(18,618)
F1PPU36599	INF16:Grnwd-TerbonXarm&Ins Rplc	AM Renewal	(16,952)		(1,781)	(18,733)
F1PPU36530	INF16: L183.5_Cnvnt-Rmvil Rpl Insit	AM Renewal	(26,188)	(1,392)	-	(27,580)
F1PPU36531	INF16: L183.6_Rmville-Witn Repl Ins	AM Renewal	(33,146)	(585)	-	(33,730)
F1PPU36556	INF16:L146.1,Bogal-Barker Crnr	AM Renewal	(23,828)	(10,520)		(34,348)
F1PPU36475	INF16: Chavin-Valentine: Repl Insul	AM Renewal	(59,052)	4,739		(54,314)
F1PPUIS084	IC Kentwood:Add 115kV Breaker Incr	Regional Reliability	(80,198)			(80,198)
F1PPU36468	INF16: Peters Road-Estelle:Rplc Arm	AM Renewal	(119,322)			(119,322)
F1PPU36264	MAN15: L281 Five Points-Texas Erath	Local Reliability - T&D	(153,125)	-		(153,125)
F1PPU75791	Carlisle-Port Nickel Repair	AM Renewal	208,756	(525,540)		(316,785)
F1PPU75445	Oakridge to Dunn Bld new 115kV Line	Regional Reliability	(424,944)			(424,944)
F1PPU36342	STM15:Lil Gypsy-Pontchar Repl STRs	AM Renewal	(496,000)			(496,000)
TOTAL			292,805,185	491,523,686	449,441,065	1,233,769,936

Site Number	Damage Severity	Facility	Voltage (kV)	Latitude	Longitude	Facility Type	LN#/STR#	ABOVE GROUND HEIGHT (ft.)	AVERAGE HEIGHT FOR LINE SECTION (ft.)
1	High	Hollywood-Orange 138kV	138	30.172587	-93.530961	Line	296/619	70	57
		Orange-Mossville 138kV	138			Line	295/341	74	57
2	High	Jennings-LC Bulk 138kV	138	30.26082	-92.888697	Line	298/256	52	57
		Henning-LC Bulk 138kV	138			Line	28/256	52	57
3	High	Chalkley Bulk-Solac 230kV	230	30.154866	-93.115616	Line	608/80	72	68
4	High	Mud Lake-Sabine 230kV	230	30.060702	-93.576428	Line	428/123	129	129
5	High	Nelson-Rhodes 500kV	500	30.281824	-93.414359	Line	850/41	127	133
6	High	Arizona-Citgo 138kV	138	30.183524	-93.329182	Line	665/36	70	70
		Butadiene-Carlyss 69kV	69			Line	290/49	70	57
7	High	Nelson-Rhodes 500kV	500	30.28189	-93.36087	Line	850/24	141	128
		Nelson-Carlyss 230kV Line (Underbuild)	230			Line	652/24	89	76
8	Low	Orange-Mossville 138kV	138	30.23561	-93.31411	Line	295/467	52	57
9	Low	Hollywood-Orange 138kV Line	138	30.20959	-93.40316	Line	296/546	54	53
10	Low	Chalkley Bulk-Solac 230kV	230	30.154202	-93.170391	Line	608/109	60	65
11	Low	Carlyss-Mud Lake 230kV	230	30.151176	-93.447335	Line	441/49	73	73
12	Low	Nelson-Richard 500kV	500	30.40201	-92.99037	Line	620/141	121	125
13	Low	Nelson-Richard 500kV	500	30.33043	-93.14361	Line	620/83	116	119
		Gillis-Chalkley Bulk 230kV	230			Line	680/90	60	60
14	Moderate	Mud Lake-Sabine 230kV	230	30.099039	-93.496612	Line	428/82	68	73
15	Moderate	Hartburg-Rhodes 500kV	500	30.28169	-93.52323	Line	520/75	132	135
16	High	Reigel 69kV Substation	69	30.17586	-93.20531	Area Near Station	613/96	68	
17	High	Greinwich 69kV Substation	69	30.19858	-93.17769	Area Near Station	272/108	58	
18	High	Ellender 69kV Substation	69	30.062809	-93.348228	Area Near Station	206/230	65	
19	Low	Choupique 69kV Substation	69	30.16033	-93.37566	Area Near Station	206/89	58	
20	Low	Lake Arthur 69kV Substation	69	30.079686	-92.674722	Area Near Station	39/221	56	
21	Low	Lawtag 69kV Substation	69	30.232269	-92.724053	Area Near Station	14/447	63	
22	Low	Swisco 138kV Substation	138	30.211097	-93.338655	Area Near Station	229/92	67	
23	Low	Graywood 230kV Substation	230	30.11085	-93.281783	Area Near Station	609/57	100	
24	Moderate	Ann Street 69kV Substaiton	69	30.231819	-93.218478	Area Near Station	283/159	60	
25	Moderate	Lake Charles Bulk 138_69kV Substation	138	30.26016	-93.12147	Area Near Station	28/130	55	
		Lake Charles Bulk 138_69kV Substation	69			Area Near Station	299/40	70	
26	Low	Rhodes-Patton 500kV	500	30.28019	-93.43635	Line	634/8	132	

QUANTA TECHNOLOGY

REPORT

Assessment of Lake Charles Transmission System Performance during Hurricane Laura

PREPARED FOR

Entergy Louisiana, LLC

DATE

April 30, 2021

(Version 1.0)

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QUANTA TECHNOLOGY

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VERSION HISTORY:

Version	Date	Description
1.0	4/30/2021	Final Report

EXECUTIVE SUMMARY

As part of its ongoing effort to maintain and improve its transmission system, Entergy Louisiana, LLC (ELL), asked Quanta Technology to perform an independent study to evaluate the performance of the transmission system in the Lake Charles area during Hurricane Laura. Quanta Technology partnered with Quanta Utility Engineering Services (QUES)—a sister Quanta Services, Inc., company—to conduct this assessment. These Quanta Services companies (hereinafter "Quanta") performed the following activities as a part of this assessment:

- Reviewed ELL's legacy Gulf States Utilities (GSU) and current Entergy design standards for conformance to the National Electric Safety Code (NESC) structural requirements
- Reviewed ELL's maintenance, inspection, and vegetation management programs relative to standard industry practices
- Reviewed ELL's Utility Incident Response Plan
- Visited damaged structures in the field
- Performed an analysis of the wind pressures that Hurricane Laura exerted on the structures

The review of ELL's design standards in Section 3.2 confirmed that the standards met or exceeded the structural requirements of the NESC at the time they were issued. Given that the design standards have changed over time and that the use of average wind speeds has been replaced with the use of wind gusts, all wind analysis was performed using wind pressure.

Typical structure configurations were identified for each voltage class that was impacted by Hurricane Laura in the Lake Charles area, which included 69 kV, 138 kV, 230 kV, and 500 kV. These typical structure configurations were used to determine span lengths and the effective height of conductors and ground wires for use in the wind pressure analysis performed in Section 5.1.2.

The review of ELL's maintenance, inspection, and vegetation management programs in Sections 3.3 and 3.4 established that those programs are consistent with industry practices for maintaining transmission systems.

In Section 4, the wind speeds and path of Hurricane Laura are described, including the measured wind speeds of 133 mph at a height of 10 m at the National Weather Service (NWS) weather station in Lake Charles prior to the weather station being destroyed. This section also describes the damage to ELL's transmission system, as well as damage sustained by other similar facilities in the area such as the NWS radar tower and the transmission tower at the KPLC broadcast station.

The wind pressure analysis in Section 5.1.2 is divided into two parts: 1) an analysis of the impact of the winds on typical structures and 2) a line-specific analysis using estimated wind gusts at each line location. Both analyses employ a conservative approach using the following assumptions:

- The loading calculated only accounts for the force of the wind and does not account for any debris or objects that might be present in the wind.

- The loading calculated does not account for additional pressure caused by adjacent structures on the line that failed or by other structures that have failed and fallen into the line.
- The loading calculated does not account for the loss of strength of the soil due to saturation.
- The analysis accounts for the strength of the structure at the time of installation and does not account for any degradation of the structure over time.
- The structures included in this analysis were built to the legacy GSU standards. These standards evolved over time to meet and/or exceed the prevailing NESC loading standard. All structures included in the analysis were assumed to be designed and constructed to the most conservative mechanical failure load of 31 pounds per square foot (psf) defined under the post-1977 legacy GSU standard unless otherwise noted.

Figure E-1 below shows the wind pressure analysis for a typical 69-kV structure.

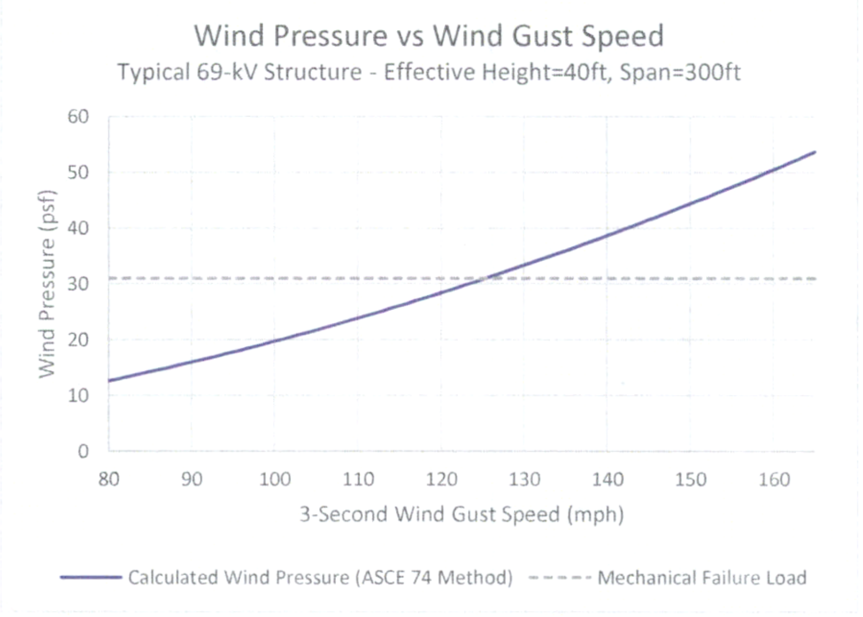

Figure E-1. Wind Pressure Analysis for a typical 69-kV Structure

This analysis was performed for each voltage class that had structure failures: 69 kV, 138 kV, 230 kV, and 500 kV. The results of the analysis are summarized in Table E-1 below.

Table E-1. Threshold Wind Gust Speeds to exceed Mechanical Failure Load

Design Standard	Voltage Class	Material/Type	Threshold Wind Gust Speed for Mechanical Failure according to ASCE MOP 74-20 (mph)
GSU	69 kV	Wood Pole	126
GSU	138 kV	Wood H Frame	127
GSU	230 kV	Wood H Frame	127
GSU	500 kV	Steel Lattice Towers	127

The line-specific analysis was performed using estimated 3-second wind gust speeds at the average height of each structure in the line. The results of this analysis can be found in Table E-2 below. Please note that ELL identified that the Jennings-LC Bulk and Henning-LC Bulk 138-kV lines were built prior to the NESC 1977 Edition and had a mechanical failure load of 22.5 psf. The entry for "Nelson-Rhodes 500kV" (7a) and "Nelson-Carlyss 230kV Line (Underbuild)" (7b) represent structures with both lines attached. For these structures, the wind pressure calculated for the 500-kV line is included in the table. Figure E-2 shows a plot of these results relative to mechanical failure load.

Table E-2. Transmission Line Section Wind Pressure Analysis

Site Number	Line Section	10-Meter Wind Est. (mph)	Avg Height for Line Section (ft)	10-Meter 3-Second Gusts (mph)	Calculated Wind Pressure (psf)	Mechanical Failure Load (psf)
1a	Hollywood-Orange 138kV	108	57	140	39.5	31.0
1b	Orange-Mossville 138kV	108	57	140	39.5	31.0
2a	Jennings-LC Bulk 138kV	81	57	105	22.2	22.5
2b	Henning-LC Bulk 138kV	81	57	105	22.2	22.5
3	Chalkley Bulk-Solac 230kV	100	68	130	35.3	31.0
4	Mud Lake-Sabine 230kV	107	129	139	47.3	31.0
5	Nelson-Rhodes 500kV	105	133	137	42.8	31.0
6a	Arizona-Citgo 138kV	105	70	137	39.2	31.0
6b	Butadiene-Carlyss 69kV	105	57	137	40.1	31.0
7a	Nelson-Rhodes 500kV	104	128	135	41.6	31.0
7b	Nelson-Carlyss 230kV (Underbuild)	104	76	135	39.3	31.0

Site Number	Line Section	10-Meter Wind Est. (mph)	Avg Height for Line Section (ft)	10-Meter 3-Second Gusts (mph)	Calculated Wind Pressure (psf)	Mechanical Failure Load (psf)
8	Orange-Mossville 138kV	104	57	135	36.6	31.0
9	Hollywood-Orange 138kV	107	53	139	38.1	31.0
10	Chalkley Bulk-Solac 230kV	102	65	133	36.4	31.0
11	Carlyss-Mud Lake 230kV	109	73	142	42.7	31.0
12	Nelson-Richard 500 kV	88	125	114	29.6	31.0
13a	Nelson-Richard 500 kV	98	119	127	36.3	31.0
13b	Gills-Chalkley Bulk 230kV	98	60	127	32.9	31.0
14	Mud Lake-Sabine 230kV	113	73	147	45.9	31.0
15	Hartburg-Rhodes 500kV	105	135	137	43.0	31.0

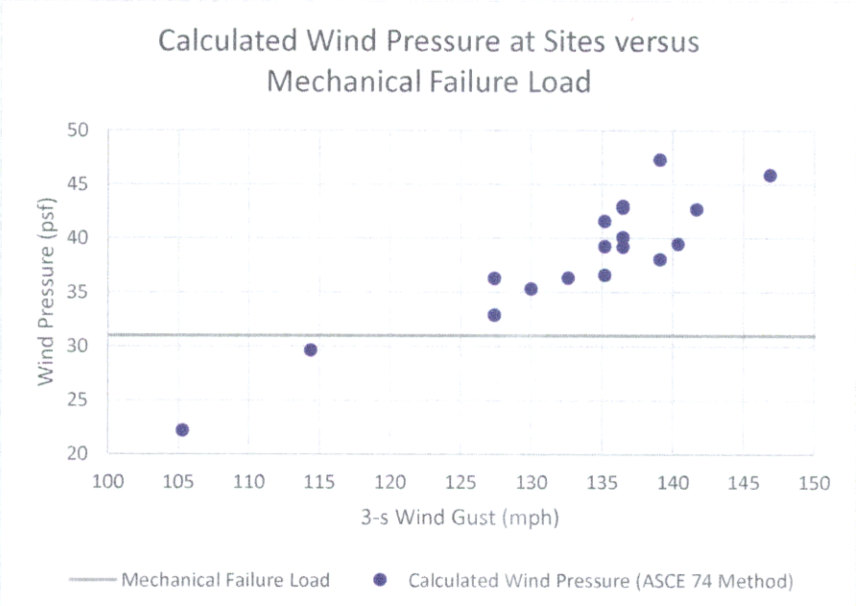

Figure E-2. Line Section Wind Pressures

The analysis of wind pressures concludes that Hurricane Laura exerted wind pressures that exceeded the mechanical failure load of most of the line sections. The line sections that did not experience wind pressures above the mechanical failure load still experienced loads that were within 5% of the mechanical failure load. The analysis does not take into account the presence of debris or other objects that were present in the wind, the additional load of other, neighboring failed structures, the impact of soil saturation, nor the additional load on the structures that could be present from distribution underbuild and/or third-party attachments that could have been added to the structures after initial construction.

Quanta concludes that Entergy's standards and programs were not contributing causes to the failures that occurred during the storm and that the wind pressure and other impacts of Hurricane Laura alone were sufficient causes of failure.

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1 INTRODUCTION

Entergy Louisiana, LLC (ELL), requested Quanta Technology, as an independent third party, to conduct this assessment of the transmission system in the Lake Charles area during Hurricane Laura. The transmission system experienced unprecedented wind pressure as a result of the storm, and this assessment evaluates the impact that this wind pressure had on structure failures in the Lake Charles area.

This report documents the approach used to assess the performance of the transmission structures in the Lake Charles area and the conclusions drawn from the assessment. Quanta Technology partnered with its Quanta Services, Inc., sister company Quanta Utility Engineering Services (QUES) to conduct this assessment (hereinafter "Quanta").

1.1 Project Description

The scope of this project includes a review of ELL's design standards for transmission structures including legacy Gulf States Utilities (GSU) standards, maintenance and inspection programs, and storm readiness. The review of the design standards is to ensure that the standards meet or exceed the requirements of the National Electric Safety Code (NESC) at the time of implementation. The review of the maintenance and inspection programs is meant to identify if ELL's programs are reasonable and aligned to industry norms, and if they are contributors to the structure failures associated with Hurricane Laura. Lastly, the review of ELL's storm readiness approach identifies if ELL was prepared to mitigate the impact of the storm.

This project concludes with an analysis of the wind pressures exerted on the structures in the Lake Charles area relative to the design and mechanical failure loads of the structures. This report does not include a root cause evaluation of each structure failure.

2 PROJECT APPROACH AND METHODOLOGY

Quanta's approach to this project was to assess the performance of the transmission system in the Lake Charles area during Hurricane Laura. The field data were analyzed along with the company's weather analysis reports, storm reports, and various records.

The field activity also included visual assessments of the damaged line infrastructure and other non-ELL infrastructure in the Lake Charles area.

Table 2-1. outlines the methodology Quanta used in the assessment, and the details are described in the subsections that follow. The findings from the assessment of ELL's transmission infrastructure and records are presented in this report.

Table 2-1. Project Approach and Methodology

Task #	Task Name	Task Description
2.1	Review of records and field visit	Reviewed and analyzed existing line inspections, maintenance records, storm performance, and other pertinent data provided by ELL. Inspected the damaged lines in the Lake Charles area to provide additional data not available in the records.
2.2	Readiness assessment	Quanta reviewed ELL's preparations for Hurricane Laura
2.3	Workshops	Interview key ELL personnel
2.4	Performance assessment	Reviewed and analyzed existing records, reports, and data collected during the field assessment and identified performance gaps
2.5	Reporting	Prepared a detailed report on how the transmission system performed.

The scope of this assessment included the review and evaluation of the performance of ELL's transmission system for the Lake Charles area during Hurricane Laura. This assessment reviewed the following:

- Existing design, maintenance, and performance records for ELL's damaged electric transmission lines and associated line components to determine pre-hurricane condition
- Hurricane Laura weather analysis report
- ELL's Hurricane Laura storm response report
- Impact of Hurricane Laura (i.e. wind speed, precipitation, etc.)
- Other damaged facilities in the area

2.1 Data Gathering and Review

Initially, QUES participated in the joint field investigation with ELL representatives, captured several images of the damage, and provided a preliminary field report.

Following the field investigation, Quanta conducted a review of all relevant documented policies, standards, and records including a physical review of the damaged transmission lines in the Lake Charles area. This task provided a baseline understanding against which performance in the recent event can be measured. Additionally, Quanta reviewed storm outage data, weather data, and other records and reports from the event to develop an understanding of the condition of the transmission infrastructure prior to Hurricane Laura.

2.2 Preparedness of Existing Infrastructure

Quanta reviewed ELL's preparations for Hurricane Laura relative to the transmission system serving the Lake Charles area. Items covered by this task included:

- Tree-trimming and vegetation management
- Inspection program for transmission infrastructure
- Transmission asset management plans
- Maintenance and replacement programs of transmission infrastructure
- Standards and construction practices
- Emergency preparedness planning

2.3 Workshops

We interviewed key ELL engineering and operating personnel whose responsibilities cover the management of the transmission system in the Lake Charles area. The workshops were framed for discussion with personnel identified to gain insight into the condition, performance, and impacts of the transmission infrastructure. The workshops were handled through virtual meetings.

2.4 Transmission Infrastructure Performance Assessment

Quanta evaluated the data and information gathered from Tasks 2.1, 2.2, and 2.3 to identify performance gaps and for comparison to industry best practices.

2.5 Reporting

This task included the review and documentation of all findings from the assessment and resulted in this report.

3 TRANSMISSION SYSTEM

Entergy's Transmission Organization consists of the employees that plan, operate, and maintain Entergy's transmission system. The Entergy transmission system is composed of the transmission systems of Entergy's Operating Companies:

- Entergy Arkansas, LLC
- Entergy Louisiana, LLC
- Entergy Mississippi, LLC
- Entergy New Orleans, LLC
- Entergy Texas, Inc.

The Entergy transmission system is comprised of approximately 16,100 circuit miles of transmission lines operated at 69 kV to 500 kV and approximately 1,600 substations. The transmission system spans portions of Arkansas, Louisiana, Mississippi, Missouri, and Texas and covers 114,000 square miles. This system is regulated by the Federal Energy Regulatory Commission (FERC) and retail regulators, including the Arkansas Public Service Commission, the Louisiana Public Service Commission, the Mississippi Public Service Commission, the City Council for the City of New Orleans, and the Public Utility Commission of Texas.

3.1 Entergy Louisiana Transmission System

The ELL transmission system comprises approximately one third of the overall Entergy system by line mileage (see Table 3-1. below).

Table 3-1. ELL Transmission Circuit Mileage by Voltage

Voltage	Circuit Miles	Number of Lines
500 kV	615	25
345 kV	16	2
230 kV	1424	210
138 kV	681	90
115 kV	1700	130
69 kV	895	123
Total	**5331**	**580**

ELL also operates 517 substations that serve 9,761 MW of peak load. See Figure 3-1 below for a breakdown of ELL's customers.

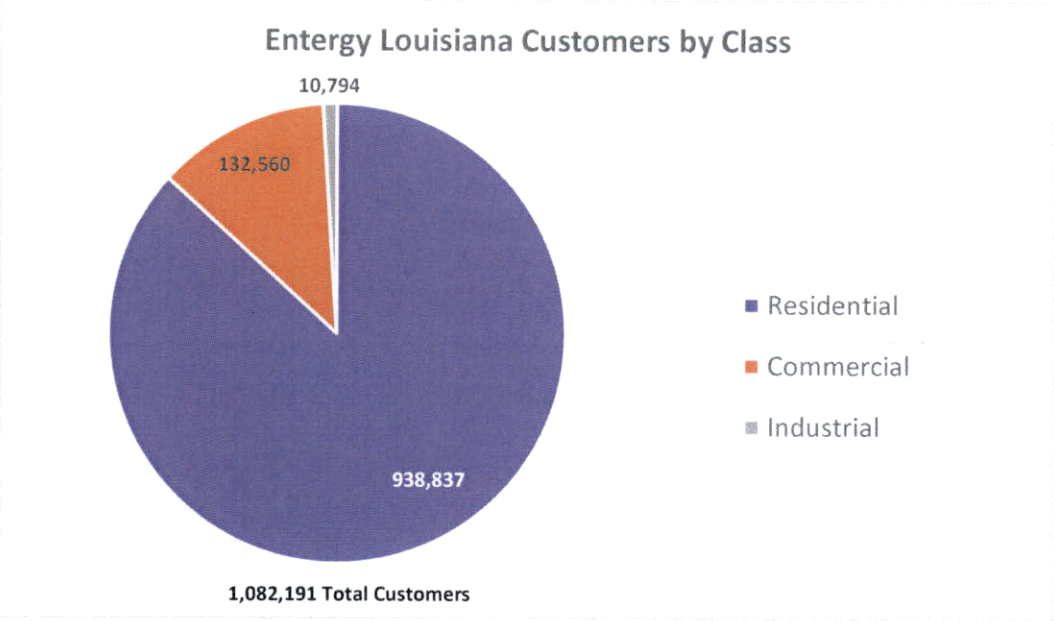

Figure 3-1. ELL Customers by Class

3.1.1 Lake Charles Area

Lake Charles is located on a level plain about 30 miles inland from the Gulf of Mexico at an elevation of 4 m above sea level. The Lake Charles area is part of Calcasieu Parish in Louisiana. Table 3-2. shows the number of lines and total circuit mileage in Southwest Louisiana which includes the Lake Charles area. Figure 3-2 shows the transmission system in the Lake Charles area.

Table 3-2. Southwest Lousiana Transmission Circuit Mileage by Voltage

Voltage	Circuit Miles	Number of Lines
500 kV	146	6
230 kV	198	27
138 kV	538	64
69 kV	598	66
TOTAL	**1480**	**163**

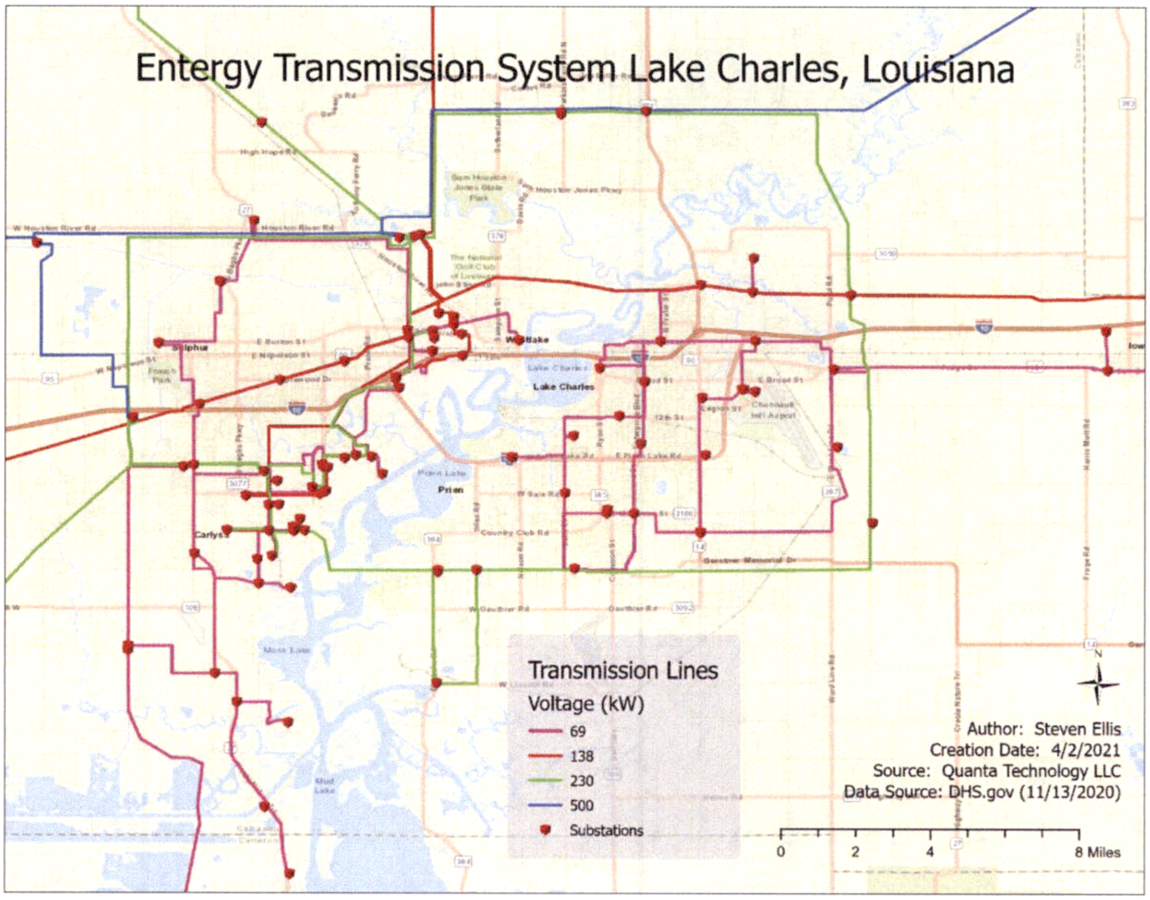

Figure 3-2. Area Map Showing the Entergy Transmission System in the Lake Charles Area

3.2 Design Standards

The transmission system in the Lake Charles area was designed under two different sets of design standards. Older structures were designed to the GSU standards, which have been grandfathered into ELL's system. More recent construction utilizes the Entergy Design Standards, which apply to all of Entergy's operating companies. These two sets of standards were developed under different versions of the NESC, and, therefore, structures built under each set of standards were designed to withstand different wind speeds and durations.

For the purpose of this assessment, all analysis is performed using wind pressure values, which provides a direct comparison across each standard. This assessment is focused solely on the structural elements of the standards and does not concern itself with the electrical aspects.

3.2.1 National Electric Safety Code

In 1915, the Department of Commerce issued a Circular of the Bureau of Standards (No. 54) regarding a "Proposed National Electric Safety Code." This document listed safety requirements for the installation and operation of electric systems. By the 3rd Edition of the NESC, published as Bureau of Standards Handbook No. 3 in 1920, the text and application of the requirements were well defined. The NESC continued to be issued as National Bureau of Standards Handbooks until the late 1960s. In the 1970s, the Institute of Electrical and Electronics Engineers (IEEE) took over publishing the NESC every 5 years.

The design loading requirements have evolved over the last 100 years based on the performance of transmission systems during extreme climatic events. For establishing the design loading requirements, the contiguous U.S. states have been divided into three zones as shown in Figure 3-3 below.

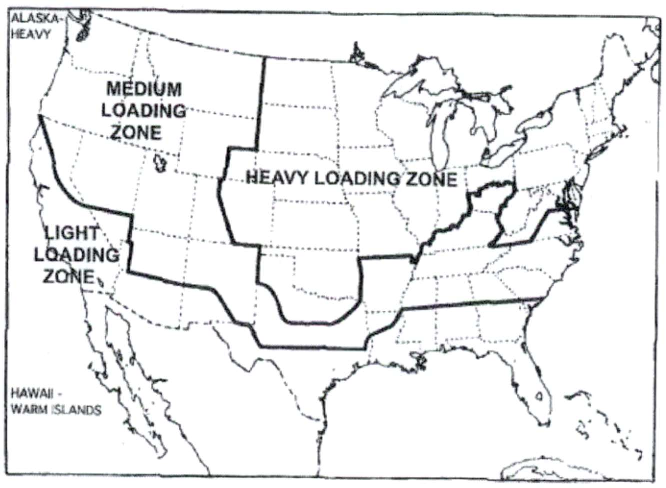

Figure 3-3. NESC Loading Zones

These loadings were established in the 1940s and remain unchanged even in the 2017 edition. Louisiana is in the light loading zone, which correlates to a design wind load of 9 pounds per square foot (psf). With an overload factor of 2.5, the actual wind load applied on the wires and structures is 9 x 2.5 = 22.5 psf. The equivalent wind speed (sustained wind) is 95 mph. This is the wind speed adopted for most of the transmission lines in GSU's Legacy system.

In the early 1970s, transmission systems were experiencing significant failures due to high wind conditions. The NESC 1977 edition addressed this issue by introducing a high wind loading map, in addition to the standard NESC loading criteria. The high wind loading map (see Figure 3-4) includes wind pressure contours. The wind pressure contour near the Lake Charles area is 21 psf. However, the NESC light loading zone requirement of 22.5 psf would be used since it is the greater of the two values.

Figure 3-4. 1977 NESC High Wing Loading Map

The NESC started incorporating extreme wind, extreme ice, and extreme ice and wind loading requirements in the 2002 edition as the need for considering these loads in transmission lines became apparent. These loading data/maps were developed for standards issued by the American Society of Civil Engineers (ASCE) in their own loading standards and guides. ASCE developed a Transmission Structures loading guide, ASCE 74, exclusively for line design, and, even though it is only a guide, it has been widely used and adopted as an unofficial standard. As these ASCE standards and guides use wind gust data for maximum wind speeds, the NESC has followed suit and also uses the gust data for maximum wind speeds in their documents. This is a revision to their earlier practice of using sustained wind speeds in their standards issued prior to 2000.

The extreme wind map from the 2017 NESC, the most recent edition of NESC, is shown in Figure 3-5.

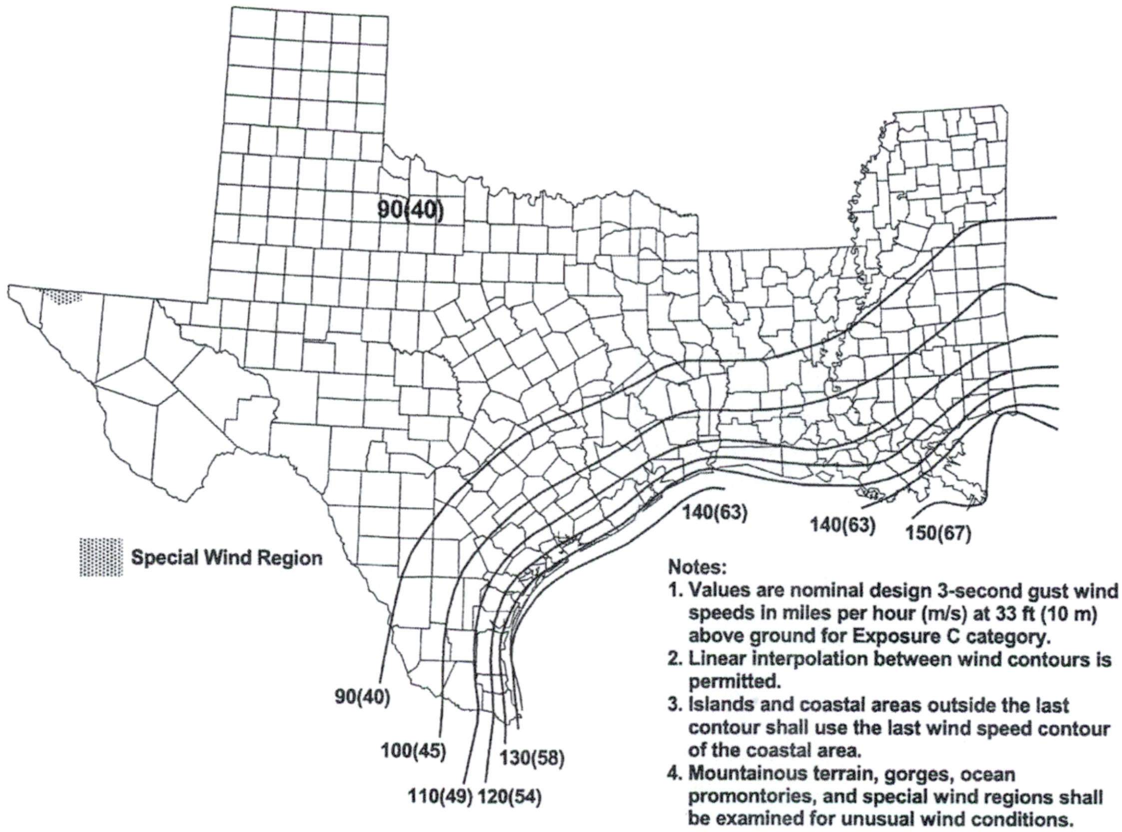

Figure 3-5. Extreme Wind Map for Western Gulf of Mexico Hurricane Coastline [ASCE 74 Figure 250-2(c)][1]

3.2.2 Evaluation Methodology for Design Standards

The performance evaluation of ELL's transmission system after Hurricane Laura in August 2020 requires establishing the maximum loading the transmission lines were subjected to and the withstand capabilities of the transmission structures and their accessories. The collection of weather data during the hurricane and conversion of that data into equivalent physical loads on the systems involves converting high-speed winds lasting a few seconds into a force of a certain magnitude that the wires and support structures were subjected to.

The traditional design method used until early 2000 involves taking the average value of wind speed over a period of 10 minutes or 1 hour. This wind speed value (in miles per hour) is converted into wind pressure. The modern practice of measuring high-speed wind gusts (also in miles per hour) results in different values

[1] Figure 250-2(c) reprinted with permission from ASCE, 1801 Alexander Bell Dr., Reston, VA 20191 from ASCE 74-10, Guidelines for Electrical Transmission Line Structural Loading. Copyright © 2010.

than the 10-minute average. Figure 3-6 below illustrates the difference between wind gusts and average wind speeds.

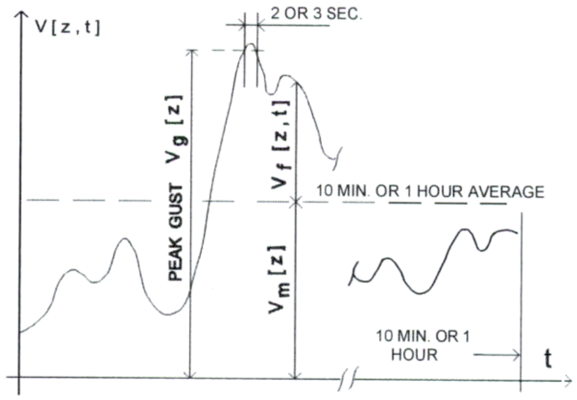

Figure 3-6. Wind Speed: Peak Gust and 10-Minute Average

These different approaches, which use the same units, can lead to confusion and misinterpretation of the wind data unless the data are specified as wind gust or average wind speed. To eliminate this confusion and to use a common approach for measuring the effects of wind, this report uses wind pressure (in psf) as the basis for discussion and evaluation. When evaluating the loading on the transmission system, only wind pressure values will be used. If reference is made to wind speed, it will always be qualified as wind gust or average wind speed.

3.2.3 Legacy Gulf States Utilities Design Standards

The legacy GSU design standards for transmission structures were all developed to meet and/or exceed the NESC guidelines in affect at the time of the design. Before 1977, all GSU transmission facilities were designed and constructed to withstand a minimum of 95-mph sustained winds. This sustained wind load corresponds to a wind pressure of 22.5 psf. Note that prior to 1977, the NESC loading standard did not have an extreme wind loading rule for utilities to apply to their design basis. In 1977, GSU incorporated the new NESC extreme wind loading map into the design basis for new transmission lines, and at this time, GSU modified its design basis for the construction of new transmission facilities capable of operating above 100 kV in extreme southwest Louisiana to 110 mph which corresponds to a wind pressure of 31 psf. According to ELL, the 500-kV East-West tie line in southwest Louisiana was designed and constructed in the late 1960s and early 1970s to withstand 110 mph sustained winds. This standard remained in place until the creation of the Unified Entergy Standard in 1997.

For purposes of analysis, typical structures were identified for each voltage class. The structure configuration used was selected based on the structure failure data. Figure 3-7 through Figure 3-10 show the structure configurations selected for each voltage class.

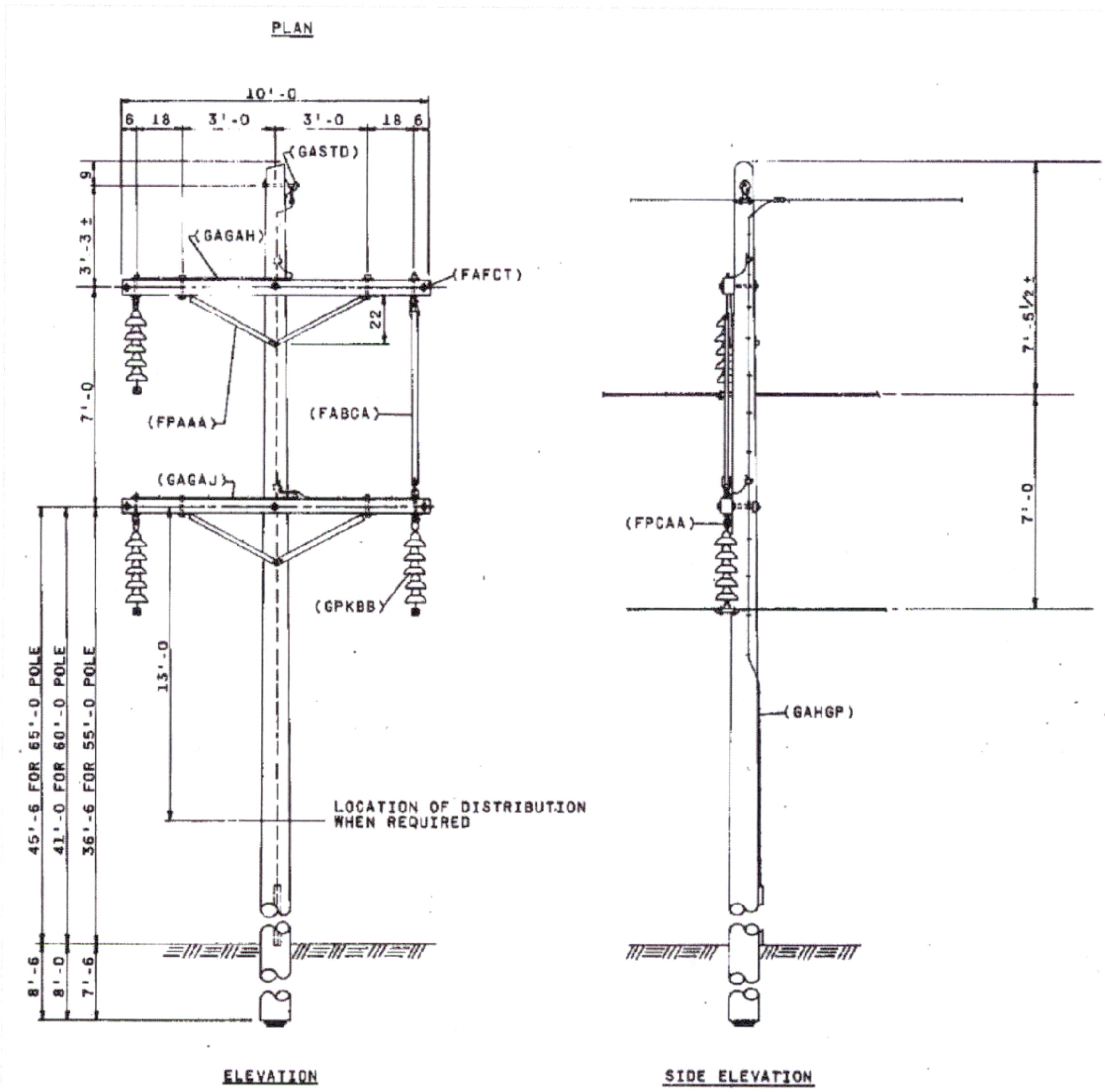

Figure 3-7. Typical 69-kV Structure Used for Analysis

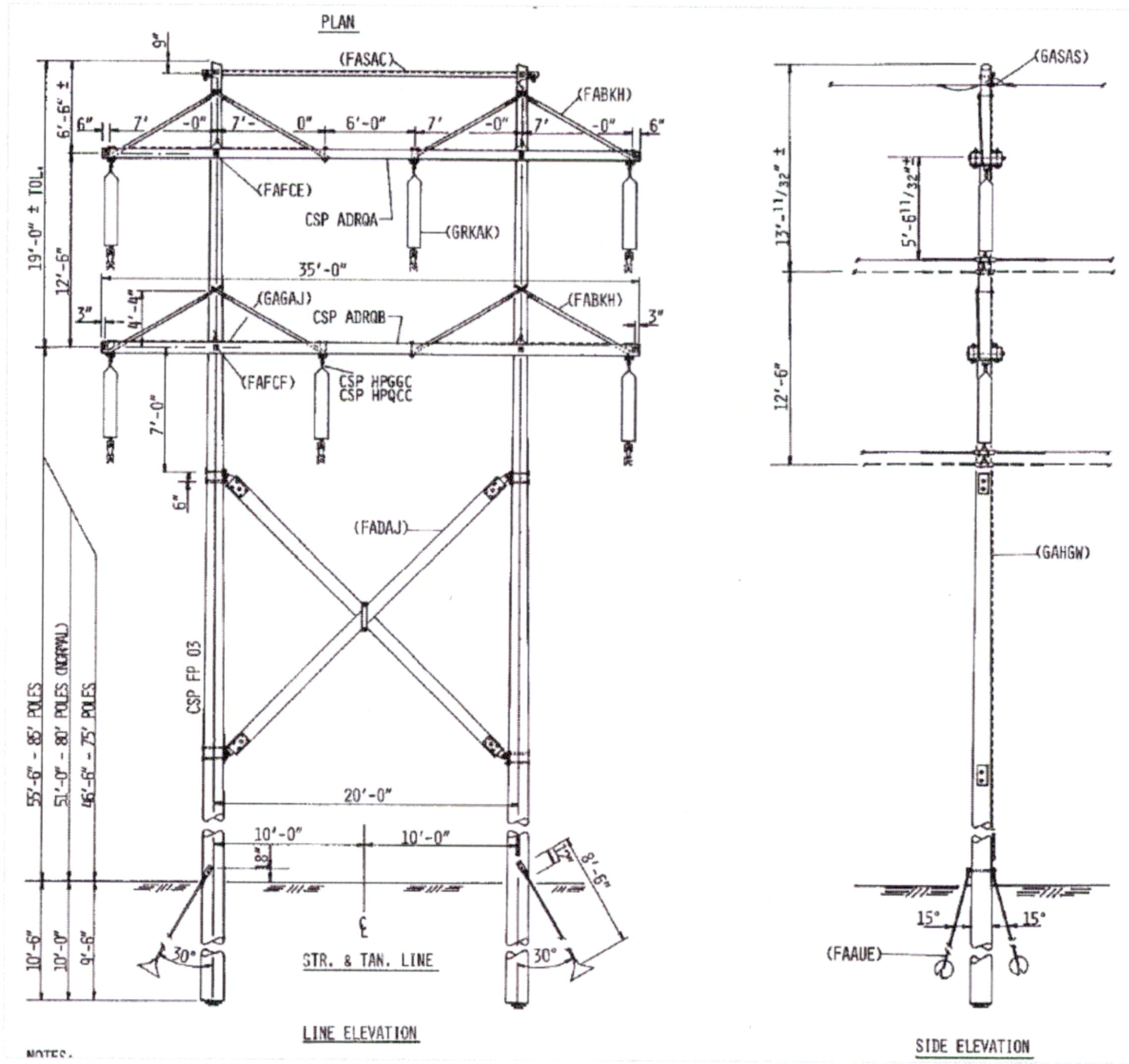

Figure 3-8. Typical 138-kV Structure Used for Analysis

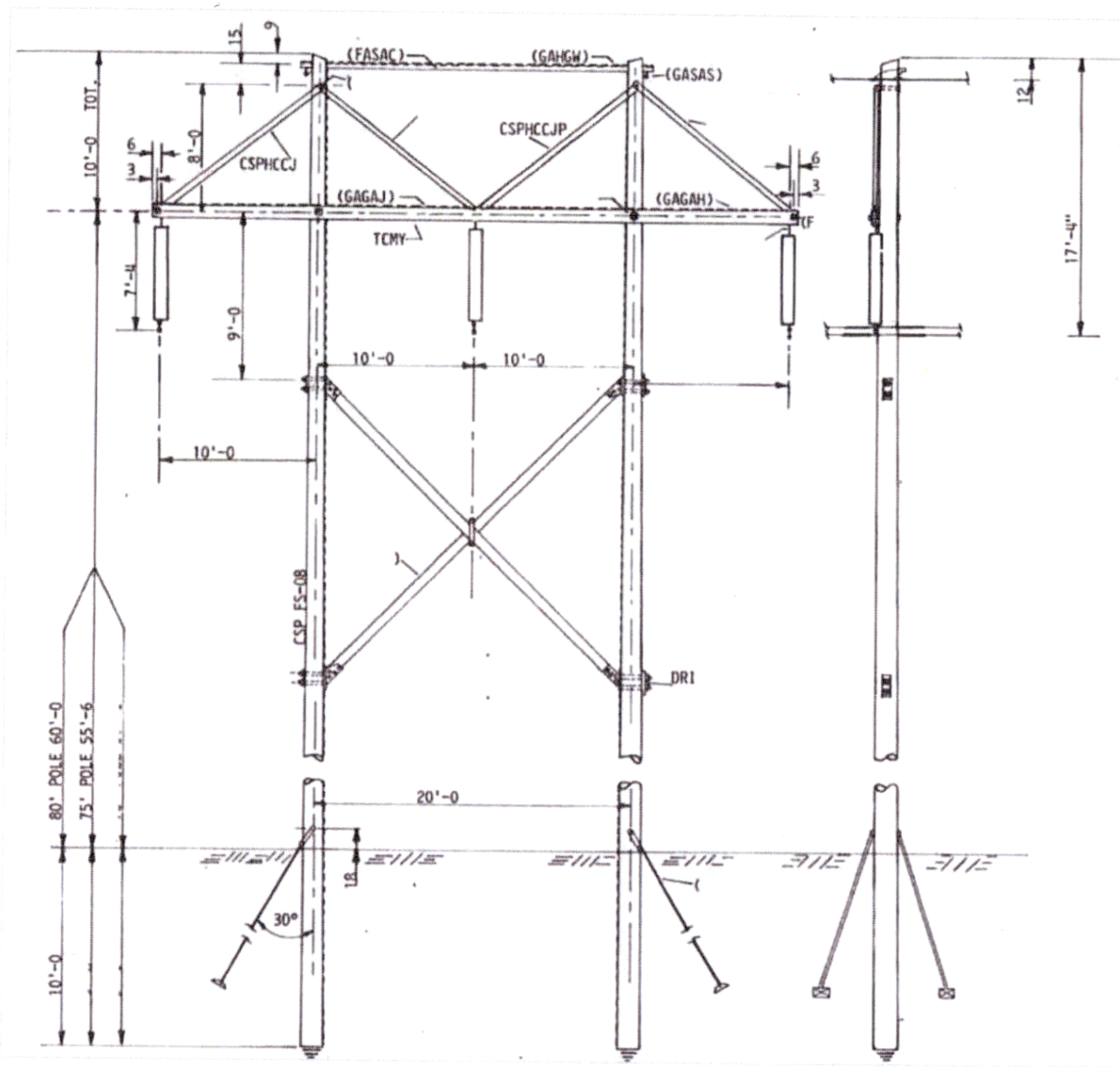

Figure 3-9. Typical 230-kV Structure Used for Analysis

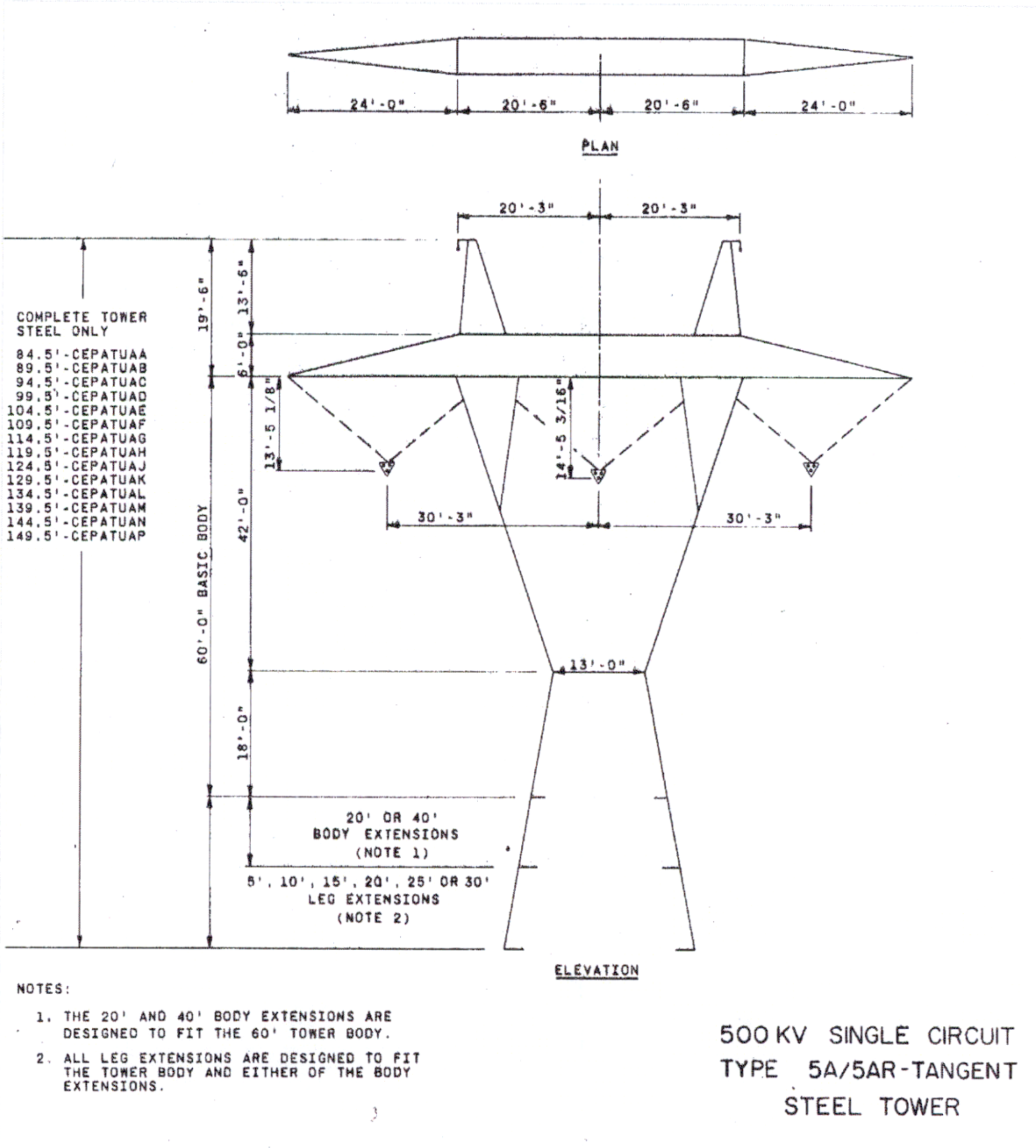

Figure 3-10. Typical 500-kV Structure Used for Analysis

3.2.4 Entergy Design Standards

The analysis performed by Quanta Technology was focused on the structures that were built to the legacy GSU standards and not the structures that were built to Entergy's current standard (also referred to as the Unified Entergy Design Standard), a review of the standards was performed to ensure that they meet or exceed current NESC requirements. In the Transmission Line Design Criteria document, Entergy states that all structures be designed to withstand a load of 140 mph sustained wind, which exceeds the current NESC requirements (see Figure 3-5 above).

3.2.5 Conclusion

The legacy GSU standards and current Entergy standards meet or exceed the NESC requirements at the time of development.

3.3 Maintenance and Inspection Programs

Transmission line maintenance is critical for maintaining reliability, increasing transmission capacity, extending the useful life of lines and structures, preventing failures, and ensuring public and personnel safety. Maintenance programs are typically driven by the following types of inspections:

- Aerial patrols (routine, comprehensive/detailed, and emergency)
- Ground patrols (walking and/or driving)
- Detailed inspections (climbing and/or aerial device)
- Intrusive inspections (wood pole and sub-grade corrosion)
- Specialized inspections (infrared, corona, and corrosion detection)

Routine ground and aerial patrols are the most common and are typically managed as an inspection program by a utility's Transmission Lines Maintenance organization. Detailed inspections, intrusive inspections, and specialized inspections are typically performed on an as-needed basis due to an event or routine inspection finding.

Routine ground-level inspections are typically carried out by reliability inspectors, operations, and/or vegetation management personnel that are trained by the maintenance organization to effectively identify maintenance items. These inspections are performed on an annual or multi-year cycle. During these inspections, the inspectors drive or walk down the lines stopping at each structure and performing a visual inspection of items that are documented on an inspection checklist; they then prioritize the findings for repair, if needed. Utilities have various systems to perform this work, some more automated than others.

Aerial patrols are typically performed by teams of highly qualified inspectors that can execute the task effectively and efficiently. Inspectors use a helicopter to fly down the lines taking pictures of the lines, structures, and components. Aerial patrols are an efficient and cost-effective way of collecting data over a large geographical area in a relatively short timeframe. Unmanned aerial vehicle (UAV)-based patrol inspections are another type of aerial inspection, but it has not been fully developed and implemented for transmission line inspection. However, efforts are underway in many areas to increase their use. IEEE released Std 2821™-2020 as a guide for this type of inspection.

Intrusive and specialized inspections are tests performed at specific locations that can identify decay in wood poles, rust levels on steel structures, and measure defects on different types of hardware. These types of inspections can yield data to estimate the remaining life of a structure, identify candidates for remedial treatments, and identify higher priority maintenance items. Other specialized inspections consist of infrared studies to determine hot spots, corona detection using specialized cameras, and corrosion detection using x-ray and other technologies.

3.3.1 Entergy's Maintenance and Inspection Programs

Entergy guide TO0404 "Transmission Line Maintenance Interval Guide" specifies the types of inspections performed for transmission line structures:

- Routine Aerial Patrol
- Wood Pole Groundline Treatment and Inspection
- Climbing Inspection (wood construction)
- Comprehensive Aerial Inspection (concrete and steel construction)

Climbing and comprehensive aerial inspections are triggered by the performance of the lines and through conditions found during routine aerial patrols, outage patrols, and groundline inspections.

3.3.2 Work Management

Corrective maintenance (CM) items that are identified through Entergy's inspection programs are prioritized for remediation according to Procedure AM-PC-AD-001 "The Work Management Process for Transmission Lines and Substations." This procedure covers the six elements of the Work Management Process:

1. Work identification
2. Prioritization
3. Planning and scheduling
4. Workload management
5. Work execution
6. Measures (trending data for improvement of the Work Management Process)

Work in the transmission system is categorized into the following four types of activities:

- P1, P2, and P3 (High, Medium, and Low) Corrective Maintenance (CM)
- P1, P2, and P3 (High, Medium, and Low) Capital Blanket Work
- Construction Activities
- Inspection Maintenance

Entergy's CM prioritization levels and remediation timeframes are presented in Table 3-3.

Table 3-3. Entergy CM Priorities and Remediation Timeframes

Priority	Remediation Timeframe
Priority 1 (P1)	CM emergency work to begin within 0–24 hours from the time work is identified.
Priority 2 (P2)	CM urgent work to begin in 14 days from the time work is identified.
Priority 3 (P3) High	CM work identified to be planned, scheduled, and work to begin within 90 days from the time work is identified.
Priority 3 (P3) Medium	CM work identified to be planned, scheduled, and work to begin in the next calendar year.
Priority 3 (P3) Low	CM work identified to be planned, scheduled, and bundled with other work.

Additional maintenance procedures revised as part of this evaluation included the following:

- TB0102 "Conductor and Shield Wire Maintenance"
- AM-PD-TO04-001 "Walking/Climbing Inspection"
- AM-PD-TO03-001 "Wood Pole Inspection and Treatment"
- AM-PD-AD-005 "Line Work Management Systems for Transmission Lines"

3.3.3 Conclusion

The types of inspections performed by Entergy are aligned with the industry. Inspection cycles vary across utilities based on many factors including weather characteristics of the region, local environmental factors, past performance, and design characteristics of the system. There is not a set frequency within the industry, but Entergy's inspection intervals are found to be generally in line with industry practices.

Entergy has procedures and guidelines to assign priorities to maintenance items identified during inspections and proper mechanisms to ensure that CM items are addressed per the Entergy priority guidelines and funding availability. Based on this evaluation, Entergy's maintenance practices were not a contributing factor to the structure failures that occurred during Hurricane Laura.

3.4 Vegetation Management

Entergy manages vegetation on and along transmission rights-of-way (ROWs) (floor and side) with the use of approved work techniques to promote long-term electric reliability. The process is accomplished through a combination of chemical, manual, and mechanical integrated vegetation management (IVM) techniques, and the entire process is performed in a safe and efficient manner.

All vegetation to be controlled during maintenance (both floor and side) is cut back to the original ROW edges to provide the maximum clearances from the transmission conductors.

3.4.1 Entergy's Vegetation Management Standard

Entergy's vegetation standard is condition-based for both side trimming and off-ROW risk tree activities, meaning that vegetation personnel monitor the condition of the lines annually through a combination of aerial and/or ground patrols and assign work based on the conditions observed. Work projects are planned based on the condition and proximity of the vegetation to the transmission line, and scheduling of work may range from an entire line down to a specific span or tree along that line based on conditions observed. Vegetation is maintained in a manner that keeps it clear from growing into the transmission lines and causing associated electrical interruptions based on proximity. This approach focuses on the tree-to-wire clearance, not on removing all vegetation that can fall into the transmission lines.

Entergy does not operate on an established, recurrent cycle for side trimming or risk tree activities. Off-ROW risk trees are targeted when they are observed to have a visual weakness that may increase their likelihood of failure (dead, dying, diseased, leaning, etc.). Floor maintenance is performed on a 2- to 4-year recurrent cycle and is completed as part of a low-volume backpack herbicide program that targets only non-compatible woody vegetation species growing within the ROW. Entergy is in compliance with these requirements.

3.4.2 Entergy's Vegetation Management Procedure

Entergy's vegetation management procedure is as follows:

- Floor maintenance is performed on a 2- to 4-year recurrent cycle and is completed as part of a low-volume backpack herbicide program that targets only non-compatible woody vegetation species growing within the ROW. The cycle covers a cross-section of all voltage lines each year.
- Control of vines growing on structures is achieved at the same time as ROW application and includes treatments between cycles if necessary.
- All undesirable woody vegetation within the ROW floor, regardless of size, is treated to satisfactorily control that vegetation.
- All trees and/or brush 12 feet tall or taller are cut, and the remaining stumps are treated with the proper herbicide for future control.
- Side trimming and risk tree work are performed using a condition-based approach and are scheduled based on direct inspection observations from both aerial and ground methods.
- Work is scheduled and completed based on priorities assigned to maintain vegetation at appropriate distances from transmission facilities.
- Qualified personnel inspect the system multiple times annually, inspect work performed to ensure appropriate quality, and schedule work accordingly to prevent vegetation-related reliability issues.

3.4.3 Assessment

Due to Hurricane Laura, trees from outside of the ROW failed due to storm force and fell onto transmission facilities. Based on ELL's assessment, soil saturation was much less of a factor than wind force in terms of vegetation failures. It can be assumed that soil saturation may have contributed to some individual tree failures, but that cannot be said for sure. However, the primary cause for widespread tree failure was structural damage and failure due to wind load. The structural failure ranged from individual limb failure to whole tree failure.

ELL tracks trees that were damaged during storms and addresses those trees as they are identified. ELL's crews continue to remain aware of their surroundings due to tree damage and latent weaknesses that exist caused by the storm force, which results in a continued safety and reliability risk. Much of the area impacted by Hurricane Laura has a high tree density coupled with very large trees that are capable of failure, causing impact to the transmission facilities at any point in time. Increased tree failure due to storm-initiated weakness or damage is expected to increase (or continue) in these areas for the next 3 to 5 years as tree damage is sometimes slow to present and is frequently not visibly evident until the point of failure.

3.4.4 Conclusion

Based on the data provided, Entergy's vegetation management and maintenance procedures are current and aligned with industry standards.

4 HURRICANE LAURA

4.1 Hurricane Laura's History and Track

The Hurricane Laura update provided by NASA on August 28, 2020, clearly describes how Laura originated and went through different phases before strengthening to become a Category 4 Hurricane [16]. As the article describes, on August 19, 2020, Hurricane Laura began as a Tropical Depression (TD) in the central tropical Atlantic even though it originated from an easterly wave. As the next couple of days went by, the Tropical Depression (TD) was held in check and was poorly organized despite passing over warm water. However, as it neared Leeward Isles, it reached minimum tropical storm intensity and was named Laura.

Laura then passed through the Leeward Islands as a weak tropical storm. As it approached Puerto Rico on August 22nd and remained there on the 23rd, Laura was still unorganized but gained a little strength and intensified slightly. On the morning of the 24th, Laura re-emerged over open waters south of Cuba. As Laura neared and crossed western Cuba, it showed signs of becoming better organized, though it remained at tropical storm intensity.

Continuing what the article states, when Laura emerged out into the southeast Gulf of Mexico, it did so over deep, warm water in a humid, relatively low wind-shear environment—the perfect conditions for intensification. Strong convection fired up near Laura's core, lowering the central pressure. By August 25th, 7:15 a.m. CDT, Laura was a Category 1 hurricane. Now well organized and in ideal conditions for strengthening, Laura was primed for further, rapid intensification.

Over the next 36 hours, as Laura gradually turned northward around the western edge of a high-pressure ridge across Florida and headed for the northern Gulf Coast, it underwent a rapid deepening cycle. Reports from NHC showed that maximum sustained winds increased from 75 to 150 mph over this period, taking Laura from Category 1 to a Category 4 hurricane.

By this time, Laura was very near to the coast of western Louisiana where it then made landfall near Cameron, Louisiana, at 1:00 a.m. CDT at the same 150-mph intensity. A wind gust to 133 mph was reported at the Lake Charles Regional Airport. It is estimated that Laura maintained hurricane intensity for the next 10 hours as it moved northward into northern Louisiana.

4.2 Weather Analysis

The National Weather Service highlights information regarding the wind speeds and the timing of those recorded in parts of Louisiana and the Lake Charles area [4]. According to the data, on August 25th, Hurricane Laura intensified from a Category 1 to a Category 4 storm, reaching a peak intensity of 150 mph. The following sequence of events outlines the storm's intensification:

- August 25, 10 AM CDT: became a Category 1 hurricane upon entering the Gulf of Mexico
- August 26, 1 AM CDT: explosively intensified reaching Category 2

- August 26, 7 AM CDT: reached Category 3.
- August 26, 1 PM CDT: reached Category 4

On August 27th, around 1 AM CDT, Laura made landfall at Cameron, Louisiana, with sustained winds of 150 mph. It slowly weakened after landfall. As it passed through Cameron, Calcasieu, and southern Beauregard Parishes, it maintained major hurricane status and weakened to Category 2 as daybreak approached.

There was widespread damage to infrastructure, buildings, trees, road signs, transmission and distribution lines, major stores, etc. There was major-to-catastrophic damage across Cameron and Calcasieu Parishes, with considerable damage across Beauregard and Vernon Parishes where the core of the hurricane passed.

According to the National Oceanic and Atmospheric Administration (NOAA) [4], "the National Weather Service in Lake Charles, Louisiana, recorded a station record highest peak wind gust of 116 knots (133 mph) at 1:42 AM CDT before the ASOS (Automated Surface Observing System) wind equipment failed." The final radar image recorded at Lake Charles, Louisiana, is shown in Figure 4-1.

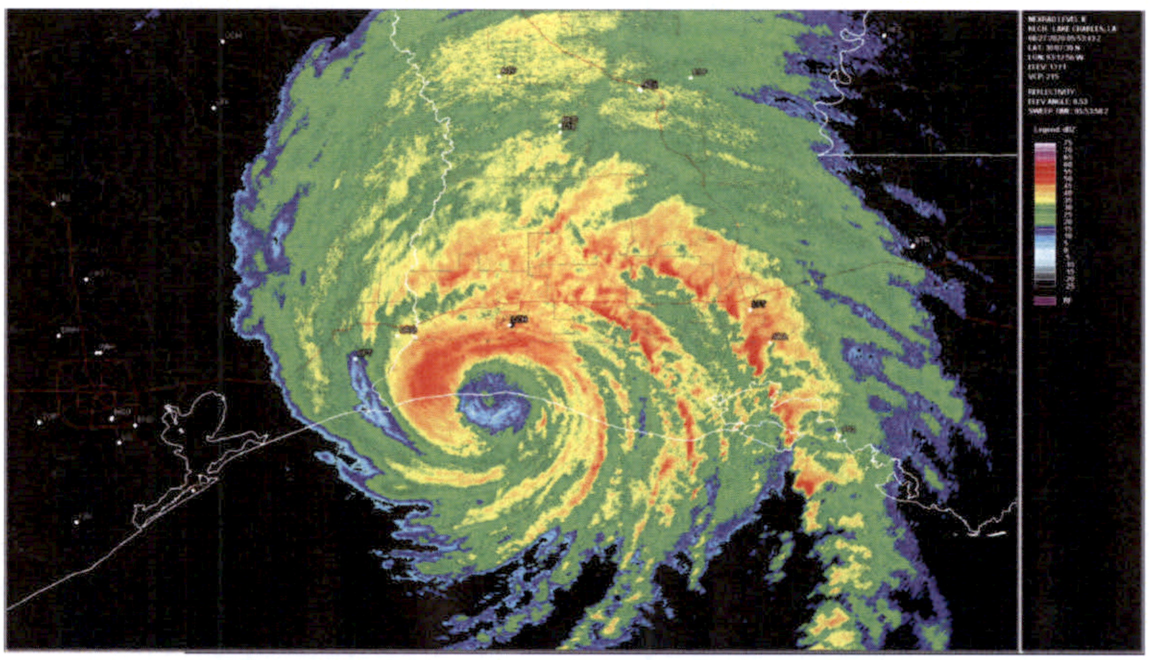

Figure 4-1. Final Radar Image Taken at Lake Charles, LA, WSR-88D Aug 27 at 12:53 AM CDT

According to the Weather Channel [5], the radar that failed in Lake Charles sits atop a 20-meter tower. It is very likely the wind speeds were higher at the radome, which is built to withstand Category 4 winds of 140 mph.

In the northern hemisphere hurricane winds travel in a counterclockwise rotation around the eye of the storm. Hurricane Laura traveled on a northwardly path as it went through Louisiana. Lake Charles was on the east side of the storm. Because of the northwardly path, locations on the east side of the storm received the highest winds. On the east side of the storm, where Lake Charles was located, the counterclockwise wind speed and the forward, northern velocity of the storm were additive resulting in extremely high wind speeds.

The transmission system near the Lake Charles area, just 20 miles east of Hurricane Laura's eye, was heavily impacted. It should be noted that hurricane-force winds extend outward up to 45 miles from the center, large enough to cover the entire Lake Charles area.

4.3 Damaged Infrastructure

4.3.1 ELL's Infrastructure

Hurricane Laura caused catastrophic damage to the ELL system across Louisiana and, specifically, in southwest Louisiana. The eyewall, which brings the most damaging winds and intense rainfall, passed directly over Lake Charles causing widespread damage to that area.

Nine transmission lines interconnect the Lake Charles area to the rest of the electric transmission grid, with seven owned by Entergy and two co-owned by Entergy. All nine transmission tie lines into the Lake Charles area experienced significant-to-catastrophic damage, with nearly 350 transmission structures impacted on these nine transmission lines alone. Transmission facilities in Cameron and Calcasieu Parishes sustained the most damage as a result of Hurricane Laura, with 30% and 23% of existing structures impacted, respectively.

4.3.1.1 Types of Damage Witnessed

The following images show examples of the different types of damage to ELL's infrastructure that was witnessed. Figure 4-2 shows a steel lattice tower that failed at the groundline. The steel exhibited superficial rust but was in good shape overall. Figure 4-3 shows a detail of bent stub angles at the foundation of the structure. Steel structures also failed above the groundline, which is indicative of wind-caused damage. Figure 4-4 shows a steel pole that bent above the groundline, and Figure 4-5 shows a steel pole bent right at the groundline. Figure 4-6 shows a steel lattice structure that bent in half at the waist, and Figure 4-7 shows a steel lattice structure that was damaged at the top of the structure.

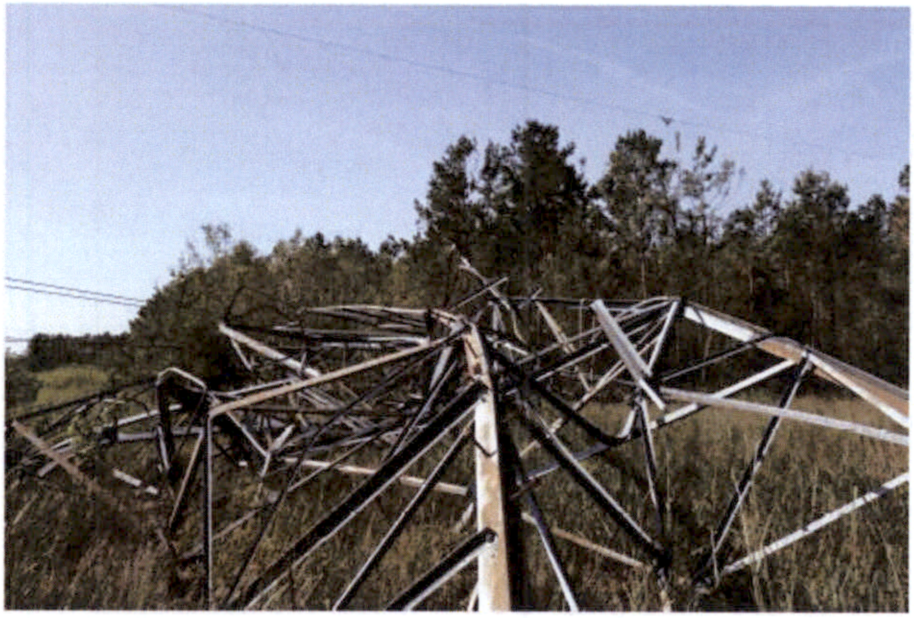

Figure 4-2. Failed Tower Remnants

Figure 4-3. Close-up of Stub Angles Bent Over at Foundation on Structures

Figure 4-4. Steel Structure Failed above the Groundline

Figure 4-5. Steel Pole Bent at the Groundline

Figure 4-6. Steel Structure Failed at the Waist

Figure 4-7. Steel Structure Damaged at the Top of the Structure

Figure 4-8 shows several wood poles that broke well above the groundline. This type of damage is typical of wind-caused failures.

Figure 4-8. Wood Poles Destroyed above the Groundline

Figure 4-9 and Figure 4-10 show a wood pole leaning due to soil displacement.

Figure 4-9. Wood Pole Leaning Due to Soil Displacement

Figure 4-10. Displaced Soil at Base of Pole

The winds caused extensive damage, destroying trees near the transmission structures. Vegetation from well outside of the transmission ROWs was blown into lines. Figure 4-11 shows trees that were knocked over by the wind in the vicinity of the transmission lines near Lake Street in Lake Charles.

Figure 4-11. Trees Damaged near Transmission Line

The wind also blew transmission structures into other facilities. Figure 4-12 shows a pole that was blown into the Conoco-Olin TDI plant.