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Control Number - 57579

Item Number - 68

Reliability Reporting Storm Report

- **Summary:** Hurricane Nicholas moved through the CNP system late Monday night and early Tuesday morning with powerful gusty winds, heavy rain, and flooding.

- ***For definitions of terms and exclusions see notes at the end of the report.***

- **Storm Period:**
  - Began 09/13/2021 @ 05:15 PM (1 hour before entering trouble level 2)
  - Ended 09/18/2021 @ 07:20 PM (1 hour after returning to trouble level 1)

- **Storm Impact (storm period):**

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	188.74	707.73	0.2667
Forced Interruptions	180.12	705.70	0.2552
Outside Causes	0.01	9.88	0.0006
Scheduled Interruptions	8.61	795.27	0.0108

  - Total non-distinct customers outaged over the period of the storm: 706,429
  - Total customer outage minutes over the period of the storm: 499,963,122
  - Estimated MW Lost: 1905.63
  - Highest Trouble Level (on a scale of 1-8): 8

- **Exclusions (includes forced & outside outages):**
  - Storm exceeded the major event exclusion threshold of 10% of total CNP customers out in a 24-hour period.
    - The 24-hour period used: 09/13/2021 at 16:00 to 09/14/2021 at 15:59.
    - Sustained non-distinct customer outages
      - 24-hour window = 608,561 (23.0%).
      - Had automation not been used in the 24-hour window = 672,391 (25.4%).
  - 09/13, 09/14, 09/15 and 09/16 will be excluded from our Blue Sky SAIDI calculations.

Reliability Reporting Storm Report

- **Pre & Post Storm PUC Goal Update (full day period):**
  - YTD forced SAIDI / CAIDI / SAIFI before the storm (09/12/2021):
    - SAIDI = 105.00 minutes (9.54 minutes over goal)
    - CAIDI = 115.88 minutes (8.61 minutes over goal)
    - SAIFI = 0.9061 interruptions (0.0128 interruptions under goal)
  - YTD forced SAIDI / CAIDI / SAIFI after the storm (09/18/2021):
    - SAIDI = 106.06 minutes (8.62 minutes over goal)
    - CAIDI = 115.65 minutes (8.40 minutes over goal)
    - SAIFI = 0.9171 interruptions (0.0209 interruptions under goal)

- **Impact Breakdown (includes forced interr. & outside causes only):**

Cause	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
Weather	122.89	749.25	0.1640
Vegetation	40.49	678.31	0.0597
Equipment Failure	5.21	515.01	0.0101
Substation	0.01	9.88	0.0006
Transmission	0.00	0.00	0.0000
Unknown	7.11	583.18	0.0122
Other	3.91	646.14	0.0061
Wildlife	0.19	724.27	0.0003
Third Party	0.32	109.80	0.0029

Outage Level	(includes forced, outside & scheduled outages)		
Circuit	125.85	568.15	0.2215
Overhead Fuse	48.69	1488.63	0.0327
URD Fuse	5.83	809.46	0.0072
Transformer	7.64	1653.97	0.0046

Service Area	(includes forced, outside & scheduled outages)		
Baytown	12.32	750.46	0.0164
Brazoria	52.70	1772.07	0.0297
Bellaire	25.57	844.29	0.0303
Cypress	5.42	377.09	0.0144
Ft Bend	5.20	643.45	0.0081
Galveston	18.80	439.12	0.0428
Greenspoint	14.60	501.52	0.0291
Humble	7.85	434.35	0.0181
Katy	1.73	200.99	0.0086
Spring Branch	9.80	653.72	0.0150
South Houston	18.01	673.96	0.0267
Sugarland	16.76	609.32	0.0275

Reliability Reporting Storm Report

- **Distribution Automation Impacts (storm period):**
  - SAIDI Minutes saved due to automation: 13.70
  - Customer Outage Minutes absent use of automation: 536,215,875 (SAIDI - 202.44)
  - Customer Outage Minutes with automation: 499,963,122 (SAIDI - 188.74)
  - Customer Outage Minutes saved due to automation: 36,252,753
  - Customers positively impacted by the operation of automation: 70,142 (9.93% of storm cust out)
  - Number of devices operated remotely by Dispatch:
    - 117 (86% successful)
    - 18 required multiple attempts
    - 16 did not respond to multiple commands
  - Customer Outage Minutes saved due to remote operation of devices by Dispatch: 1,076,803

- **Trouble Events (Forced, Outside, & Scheduled Causes):**
  - Listed are the events coded with the outage type shown. Some events may have multiple outage types, but only the primary outage type is listed below.
  - Circuit Lockouts ---------------------------------- 317 events
  - Partial Circuit Outages ---------------------------- 103 events
  - Overhead Line Fuses Blown --------------------- 1,424 events
  - Transformer Fuses Blown ------------------------ 1,260 events
  - Burned Up Transformers ------------------------ 164 events
  - Spans Primary Down ----------------------------- 410 events
  - Spans Secondary Down --------------------------- 520 events
  - URD Terminal Poles Blown --------------------- 362 events
  - Major Underground Line Fuse ------------------- 14 events
  - Poles Down --- 72 events
  - Drops Down -- 1,026 events
  - Meter Failures -------------------------------------- 88 events

- **Weather Impact:**
  - Lighting strikes = 327
  - Sustained wind speeds = 29 mi/hr
  - Gust wind speeds = 44 mi/hr
  - Total rainfall in service area = 5.47 in

- **Substation Impacts:**
  - 09/13/2021 19:01:00 CB10 tripped at 138 kV WC
  - 09/13/2021 20:53:00 TR3 tripped at 138 kV WR
  - 09/14/2021 04:04:00 TR6 tripped at 138/35 kV THW
  - 09/14/2021 04:07:00 TR6 tripped at 138 kV THW
  - 09/14/2021 05:30:00 M550, M600, M630 tripped at 345 kV JCK
  - 09/14/2021 05:30:00 AT1 tripped at 345/138 kV JCK
  - 09/14/2021 05:30:00 M400, M430, M460 tripped at 138 kV JCK
  - 09/14/2021 05:31:00 M550, M570, M600, M660, M630 tripped at 345 kV JCK
  - 09/14/2021 05:31:00 AT1 tripped at 345/138 kV JCK
  - 09/14/2021 05:44:00 AT1 tripped at 345 kV DOW

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- 09/14/2021 05:47:00 345A Bus tripped at 345 kV DOW
- 09/14/2021 05:49:00 M370 tripped at 138 kV JCK
- 09/14/2021 05:50:00 D090, D040, D070 tripped at 345 kV DOW
- 09/14/2021 06:12:00 AT1 & 345D BUSS tripped at 345/138 kV JCK
- 09/14/2021 06:27:00 D090, D380, D040 tripped at 345 kV DOW
- 09/14/2021 06:27:00 AT1 tripped at 345/138 kV DOW
- 09/14/2021 06:36:00 D090, AT1 tripped at 345 kV DOW
- 09/14/2021 06:37:00 D040, D070 tripped at 345 kV DOW
- 09/14/2021 06:48:00 V620, V620 tripped at 138 kV CTZ
- 09/14/2021 07:49:00 345B tripped at 345 kV DOW
- 09/14/2021 07:57:00 345D Bus tripped at 345 kV JCK
- 09/14/2021 15:35:00 TR4 tripped at 138/35 kV BA
- 09/14/2021 17:32:00 THW-3 tripped at kV THW
- 09/15/2021 04:41:00 AT2 tripped at 345/138 kV JCK
- 09/15/2021 19:37:00 AT2 tripped at 345/138 kV JCK
- 09/15/2021 19:37:00 345B tripped at 345 kV JCK

- **Transmission Impacts:**
  - 09/13/2021 18:28:00 138 kV Line 48 Lockout from STW to WBY
  - 09/13/2021 19:46:00 345 kV Line 39 Lockout from STP to WAP
  - 09/13/2021 20:08:00 138 kV Line 60 Instantaneous Operation from DYN to LC
  - 09/13/2021 20:20:00 138 kV Line 60 Instantaneous Operation from DYN to LC
  - 09/13/2021 21:50:00 138 kV Line 2 Lockout from BKE to WC
  - 09/14/2021 00:52:00 138 kV Line 59 Lockout from STW to WBY
  - 09/14/2021 01:07:00 138 kV Line 36 Instantaneous Operation from JCK to CPR
  - 09/14/2021 02:15:00 69 kV Line 53 Instantaneous Operation from KR to MV
  - 09/14/2021 02:59:00 138 kV Line 2 Instantaneous Operation from TV to WAP
  - 09/14/2021 03:00:00 138 kV Line 2 Lockout from HOC to WAP
  - 09/14/2021 05:32:00 138 kV Line 82 Instantaneous Operation from GLO to OYS
  - 09/14/2021 05:42:00 138 kV Line 82 Instantaneous Operation from GLO to OYS
  - 09/14/2021 05:44:00 138 kV Line 82 Lockout from DOW to VL
  - 09/14/2021 05:48:00 138 kV Line 82 Instantaneous Operation from GLO to OYS
  - 09/14/2021 05:49:00 138 kV Line 59 Lockout from JCK to SRF
  - 09/14/2021 05:55:00 138 kV Line 82 Instantaneous Operation from GLO to OYS
  - 09/14/2021 05:56:00 138 kV Line 82 Instantaneous Operation from GLO to OYS
  - 09/14/2021 06:01:00 138 kV Line 82 Instantaneous Operation from GLO to OYS
  - 09/14/2021 06:02:00 138 kV Line 82 Instantaneous Operation from GLO to OYS
  - 09/14/2021 06:37:00 138 kV Line 48 Instantaneous Operation from CTZ to MRE
  - 09/14/2021 07:20:00 345 kV Line 27 Lockout from DOW to OAS
  - 09/14/2021 07:36:00 138 kV Line 82 Instantaneous Operation from BFP to OYS
  - 09/14/2021 07:44:00 345 kV Line 18 Instantaneous Operation from STP to JCK
  - 09/14/2021 08:34:00 345 kV Line 18 Lockout from STP to JCK
  - 09/14/2021 08:47:00 138 kV Line 48 Instantaneous Operation from CTZ to JCK
  - 09/14/2021 10:14:00 138 kV Line 48 Instantaneous Operation from CTZ to MRE

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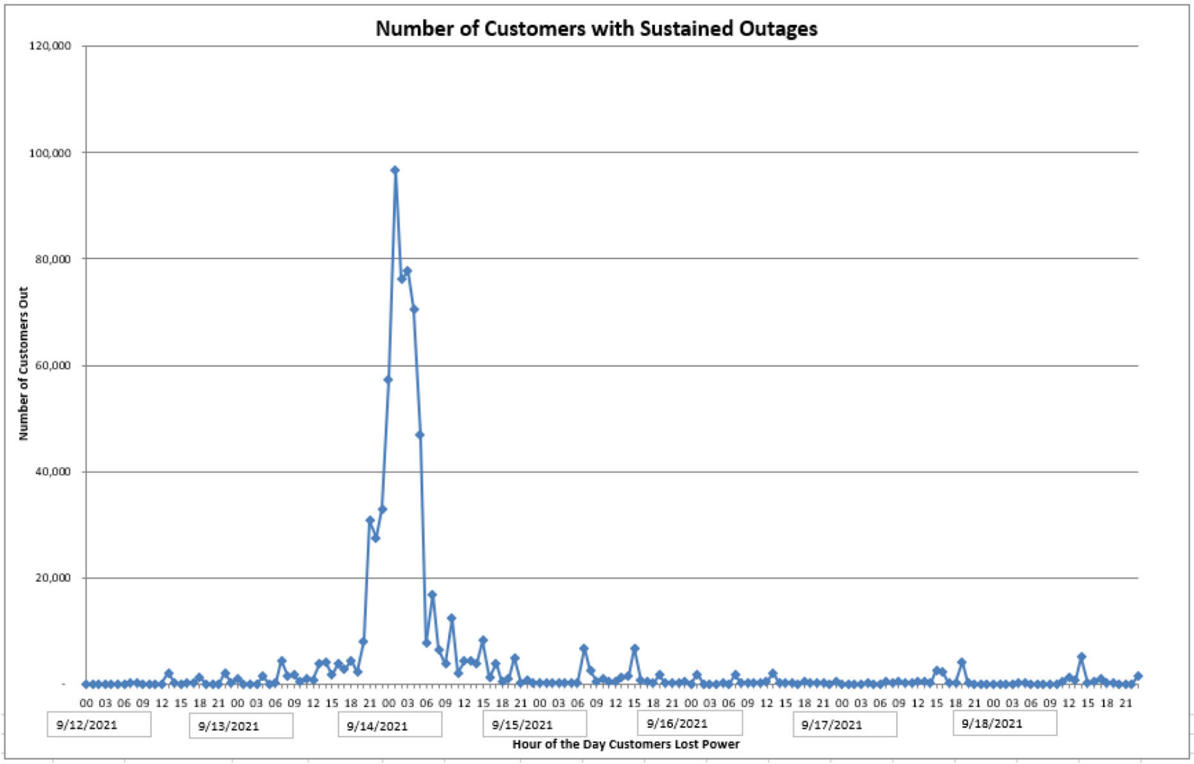
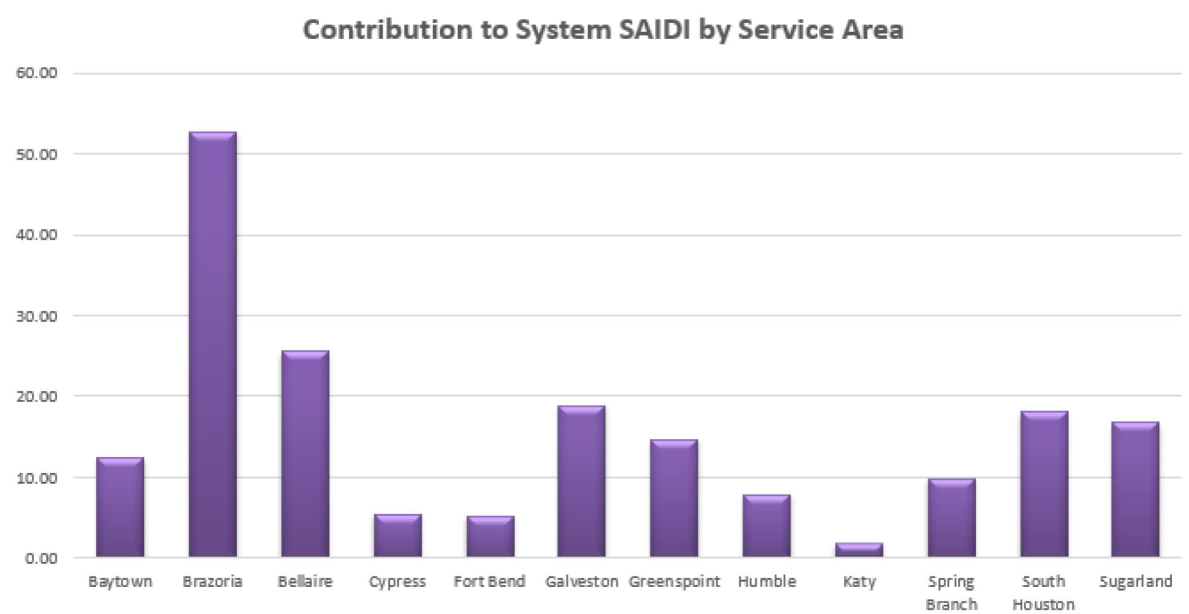
- 09/14/2021 10:18:00 138 kV Line 59 Instantaneous Operation from FP to SRF
- 09/14/2021 22:35:00 138 kV Line 59 Instantaneous Operation from JCK to SRF
- 09/15/2021 00:46:00 138 kV Line 59 Instantaneous Operation from JCK to SRF
- 09/15/2021 01:28:00 138 kV Line 59 Instantaneous Operation from JCK to SRF
- 09/15/2021 04:41:00 345 kV Line 27 Instantaneous Operation from DOW to JCK
- 09/15/2021 04:41:00 345 kV Line 18 Instantaneous Operation from STP to JCK
- 09/15/2021 04:41:00 345 kV Line 27 Instantaneous Operation from JCK to REF
- 09/15/2021 04:41:00 345 kV Line 18 Instantaneous Operation from JCK to DOW
- 09/15/2021 19:37:00 345 kV Line 18 Instantaneous Operation from STP to JCK
- 09/17/2021 05:23:00 345 kV Line 39 Instantaneous Operation from STP to ZAN

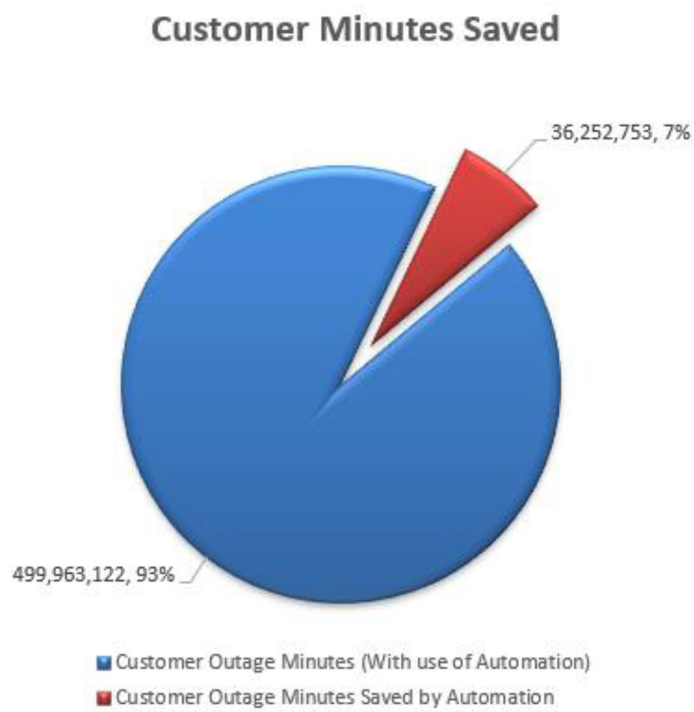
- **Notes / definitions / exclusions**
  - This report is based off the data as of today. The storm impacts are subject to change as data cleanup is completed over the next few weeks.
  - Non-distinct - includes customers with multiple outages and single outages. For example, if a customer has three sustained outages during a storm, it will count as three outages.
  - The PUC-TX has established a metric that applies to SAIDI / SAIFI numbers for 'Forced' (distribution level only) outage minutes / interruptions. An exclusion from the metric for events that exceed 10% of CNP's total customers outaged over a 24-hour period is allowed by the Commission rules.
  - An additional exclusion was created for events that only impacted a specific service area or two. This exclusion is used when the storm customer minutes in a service area are greater than 25% of the preceding rolling 12 months of customer minutes, including all storm days, for that area.
    - This exclusion would also be used if automation minutes saved would have increased the storm customer minutes to above the service area's 25% threshold.
  - Exclusions were created by PUC-TX for natural events that occur that exceed CNP's distribution structural design criteria: tornados, microburst, wind shear, flooding, inability to access area.
  - Major events are reported to the PUC-TX as a separate line item from the overall SAIDI / SAIFI metric. As part of the major event, all outages that occurred during the storm period are included whether they are 'Forced', 'Outside' (Substation / Transmission), or 'Scheduled' outages.

Reliability Reporting Storm Report





Reliability Reporting Storm Report



Reliability Reporting Storm Report

- **Summary:** A warm front pushed across the CNP region bringing strong gusty winds, tornados, lightning, and locally heavy downpours on Saturday & Sunday.

- ***For definitions of terms and exclusions see notes at the end of the report.***

- **Storm Period:**
  - Began 01/08/2022 @ 12:10 PM (1 hour before entering trouble level 2)
  - Ended 01/09/2022 @ 05:30 PM (1 hour after returning to trouble level 1)

- **Storm Impact (storm period):**

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	5.13	173.34	0.0296
Forced Interruptions	4.53	165.95	0.0273
Outside Causes	0.00	0.00	0.0000
Scheduled Interruptions	0.60	261.14	0.0023

  - Total non-distinct customers outaged over the period of the storm: 79,138
  - Total customer outage minutes over the period of the storm: 13,717,407
  - Estimated MW Lost: 87.32
  - Highest Trouble Level (on a scale of 1-8): 4

- **PUC Exclusions (includes forced & outside outages):**
  - Storm did not exceed the major event exclusion threshold of 10% of total CNP customers out in a 24-hour period.
    - The 24-hour period used: 01/08/2022 at 7:00 to 01/09/2022 at 6:59.
    - Sustained non-distinct customer outages
      - 24-hour window = 73,831 (2.8%).
      - Had automation not been used in the 24-hour window = 85,881 (3.2%).
  - Storm did not exceed the major event exclusion threshold of 25% of a service area's 12-month SAIDI.
    - Service Area closest to exclusion: Humble (1.20% exclusion value).
  - Some outage events coded as W5 (Tornado) will be excluded from PUC calculations as per the Tornado evidences found here.

- **BSS Service Areas Exclusions (includes forced outages):**
  - 01/08/2022 System Forced SAIDI for the day was 1.9038 so total system was excluded.
  - 01/09/2022 System Forced SAIDI for the day was 3.2747 so total system was excluded.

Reliability Reporting Storm Report

- **Pre & Post Storm PUC Goal Update (full day period):**
  - YTD forced SAIDI / CAIDI / SAIFI before the storm (01/07/2022):
    - SAIDI = 2.53 minutes (0.51 minutes over goal)
    - CAIDI = 89.74 minutes (12.23 minutes under goal)
    - SAIFI = 0.0282 interruptions (0.0073 interruptions over goal)
  - YTD forced SAIDI / CAIDI / SAIFI after the storm (01/09/2022):
    - SAIDI = 5.17 minutes (2.58 minutes over goal)
    - CAIDI = 112.32 minutes (10.46 minutes over goal)
    - SAIFI = 0.0460 interruptions (0.0191 interruptions over goal)

- **Impact Breakdown (includes forced interr. & outside causes only):**

Cause	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
Weather	3.35	180.42	0.0185
Vegetation	0.22	69.90	0.0031
Equipment Failure	0.21	354.70	0.0006
Substation	0.00	0.00	0.0000
Transmission	0.00	0.00	0.0000
Unknown	0.62	178.29	0.0035
Other	0.10	101.97	0.0009
Wildlife	0.01	179.96	0.0000
Third Party	0.03	59.49	0.0006

Outage Level	(includes forced, outside & scheduled outages)		
Circuit	3.61	139.14	0.0259
Overhead Fuse	0.48	282.99	0.0017
URD Fuse	0.49	379.77	0.0013
Transformer	0.54	910.03	0.0006

Service Area	(includes forced, outside & scheduled outages)		
Baytown	0.12	89.50	0.0013
Brazoria	0.01	141.56	0.0001
Bellaire	1.17	271.82	0.0043
Cypress	0.08	36.72	0.0022
Ft Bend	0.07	159.24	0.0004
Galveston	0.00	100.13	0.0000
Greenspoint	0.39	167.61	0.0023
Humble	2.02	247.67	0.0082
Katy	0.04	205.27	0.0002
Spring Branch	0.90	105.88	0.0085
South Houston	0.19	112.10	0.0017
Sugarland	0.13	429.01	0.0003

Reliability Reporting Storm Report

- **Distribution Automation Impacts (storm period):**
  - SAIDI Minutes saved due to automation: 0.26
  - Customer Outage Minutes absent use of automation: 14,420,353 (SAIDI - 5.40)
  - Customer Outage Minutes with automation: 13,717,407 (SAIDI - 5.13)
  - Customer Outage Minutes saved due to automation: 702,946
  - Customers positively impacted by the operation of automation: 12,357 (15.61% of storm cust out)
  - Number of devices operated remotely by Dispatch:
    - 24 (92% successful)
    - 4 required multiple attempts
    - 2 did not respond to multiple commands
  - Customer Outage Minutes saved due to remote operation of devices by Dispatch: 244,879

- **Trouble Events (Forced, Outside, & Scheduled Causes):**
  - Listed are the events coded with the outage type shown. Some events may have multiple outage types, but only the primary outage type is listed below.
  - Circuit Lockouts ---------------------------------- 30 events
  - Partial Circuit Outages --------------------------- 13 events
  - Overhead Line Fuses Blown --------------------- 100 events
  - Transformer Fuses Blown ----------------------- 118 events
  - Burned Up Transformers ------------------------ 28 events
  - Spans Primary Down ----------------------------- 21 events
  - Spans Secondary Down -------------------------- 20 events
  - URD Terminal Poles Blown --------------------- 57 events
  - Major Underground Line Fuse ------------------ 9 events
  - Poles Down -- 2 events
  - Drops Down -- 36 events
  - Meter Failures ------------------------------------- 5 events

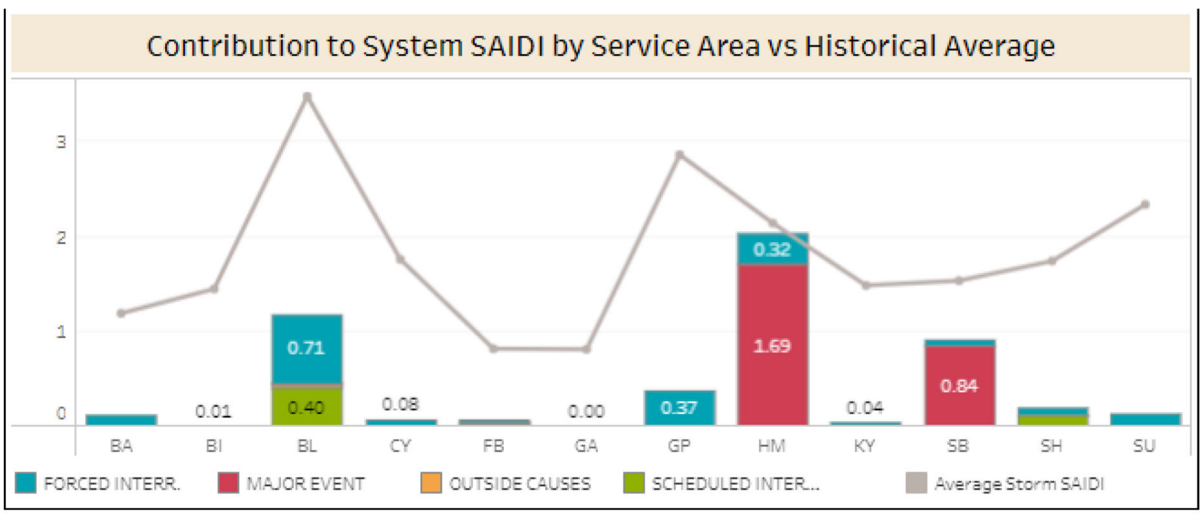
- **Weather Impact:**
  - Lighting strikes = 5,646
  - Sustained wind speeds = 24 mi/hr
  - Gust wind speeds = 30 mi/hr
  - Total rainfall in service area = 0.00 in

- **Substation Impacts:**
  - 01/08/2022 13:11:00 138/12 kV TR1 tripped at HV
  - 01/08/2022 23:42:00 138/12 kV TR2 tripped at CB

- **Transmission Impacts:**
  - 01/08/2022 22:16:00 Line#81 138 kV Instantaneous Operation from KL to WLO
  - 01/08/2022 22:23:00 Line#89 138 kV Instantaneous Operation from FB to WC
  - 01/08/2022 22:50:00 Line#67 138 kV Instantaneous Operation from NB to BA
  - 01/08/2022 22:51:00 Line#81 138 kV Instantaneous Operation from THW to BA

Reliability Reporting Storm Report

- **Notes / definitions / exclusions**
  - This report is based off the data as of today. The storm impacts are subject to change as data cleanup is completed over the next few weeks.
  - Non-distinct - includes customers with multiple outages and single outages. For example, if a customer has three sustained outages during a storm, it will count as three outages.
  - The PUC-TX has established a metric that applies to SAIDI / SAIFI numbers for 'Forced' (distribution level only) outage minutes / interruptions. An exclusion from the metric for events that exceed 10% of CNP's total customers outaged over a 24-hour period is allowed by the Commission rules.
  - An additional exclusion was created for events that only impacted a specific service area or two. This exclusion is used when the storm customer minutes in a service area are greater than 25% of the preceding rolling 12 months of customer minutes, including all storm days, for that area.
    - This exclusion would also be used if automation minutes saved would have increased the storm customer minutes to above the service area's 25% threshold.
  - Exclusions were created by PUC-TX for natural events that occur that exceed CNP's distribution structural design criteria: tornados, microburst, wind shear, flooding, inability to access area.
  - Major events are reported to the PUC-TX as a separate line item from the overall SAIDI / SAIFI metric. As part of the major event, all outages that occurred during the storm period are included whether they are 'Forced', 'Outside' (Substation / Transmission), or 'Scheduled' outages.



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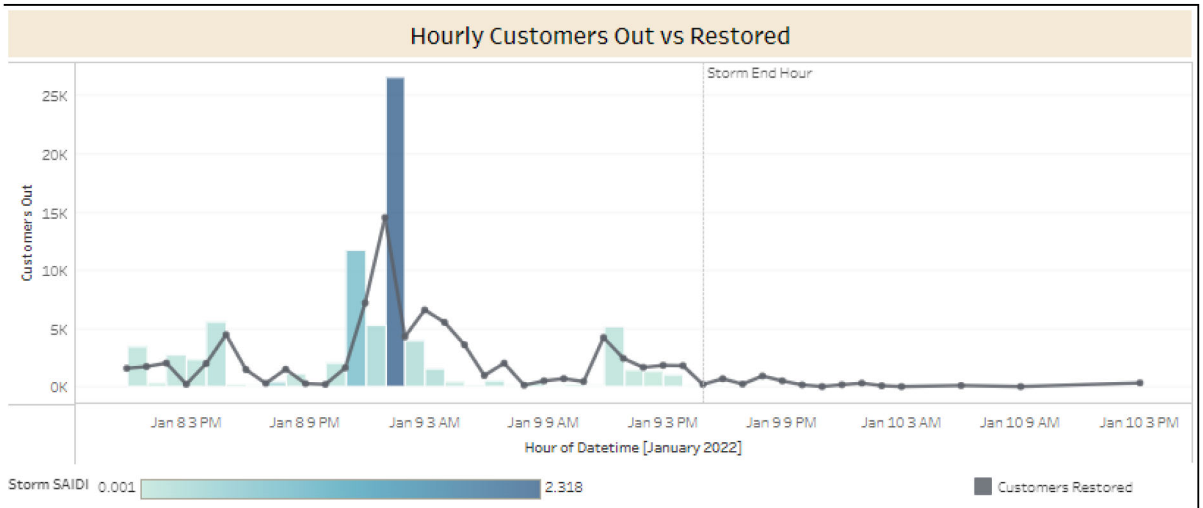
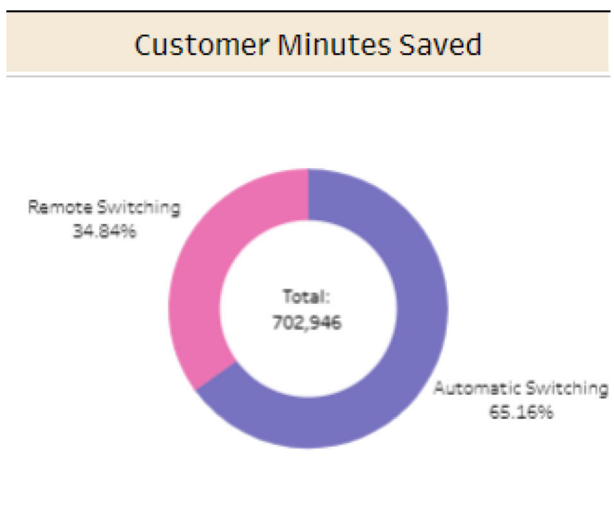




Reliability Reporting Storm Report

- **Summary:** Strong thunderstorms pushed through the CNP service territory on Tuesday morning bringing with them locally heavy rainfall, frequent lightning and wind gusts nearing 40 mph.

- ***For definitions of terms and exclusions see notes at the end of the report.***

- **Storm Period:**
  - Began 03/22/2022 @ 05:30 AM (1 hour before entering trouble level 2)
  - Ended 03/22/2022 @ 01:10 PM (1 hour after returning to trouble level 1)

- **Storm Impact (storm period):**

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	1.46	78.52	0.0185
Forced Interruptions	1.34	80.57	0.0167
Outside Causes	0.05	50.18	0.0010
Scheduled Interruptions	0.06	72.40	0.0009

  - Total non-distinct customers outaged over the period of the storm: 49,743
  - Total customer outage minutes over the period of the storm: 3,905,736
  - Estimated MW Lost: 50.8
  - Highest Trouble Level (on a scale of 1-8): 4

- **PUCT Exclusions (includes forced & outside outages):**
  - Storm did not exceed the major event exclusion threshold of 10% of total CNP customers out in a 24-hour period.
    - The 24-hour period used: 03/21/2022 at 12:00 to 03/22/2022 at 11:59.
    - Sustained non-distinct customer outages
      - 24-hour window = 71,455 (2.7%).
      - Had automation not been used in the 24-hour window = 75,041 (2.8%).
  - Storm did not exceed the major event exclusion threshold of 25% of a service area's 12-month SAIDI.
    - Service Area closest to exclusion: Fort Bend (2.92% exclusion value).
  - There are two outage events (4180658 and 4180645) excluded from PUC calculations due to being directly impacted by the tornado. Documents can be found on the LAN here.

- **BSS Exclusions (includes forced outages):**
  - 03/22/2022 System Forced SAIDI for the day was 1.58 so total system was excluded.

Reliability Reporting Storm Report

- **Pre & Post Storm PUC Goal Update (full day period):**
  - YTD forced SAIDI / CAIDI / SAIFI before the storm (03/21/2022):
    - SAIDI = 20.24 minutes (1.75 minutes over goal)
    - CAIDI = 97.05 minutes (3.40 minutes under goal)
    - SAIFI = 0.2086 interruptions (0.0130 interruptions over goal)
  - YTD forced SAIDI / CAIDI / SAIFI after the storm (03/22/2022):
    - SAIDI = 21.83 minutes (3.13 minutes over goal)
    - CAIDI = 96.09 minutes (4.20 minutes under goal)
    - SAIFI = 0.2271 interruptions (0.0290 interruptions over goal)
- **Impact Breakdown (includes forced interr. & outside causes only):**

Cause	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
Weather	0.74	70.97	0.0104
Vegetation	0.19	68.88	0.0028
Equipment Failure	0.17	110.46	0.0016
Substation	0.05	50.18	0.0010
Transmission	0.00	0.00	0.0000
Unknown	0.17	127.24	0.0013
Other	0.07	119.36	0.0006
Wildlife	0.00	114.03	0.0000
Third Party	0.00	0.00	0.0000
Outage Level	**(includes forced, outside & scheduled outages)**		
Circuit	0.69	48.43	0.0143
Overhead Fuse	0.54	171.73	0.0031
URD Fuse	0.12	166.86	0.0007
Transformer	0.10	260.11	0.0004
Service Area	**(includes forced, outside & scheduled outages)**		
Baytown	0.04	167.83	0.0002
Brazoria	0.01	123.32	0.0001
Bellaire	0.40	155.33	0.0026
Cypress	0.10	84.66	0.0012
Ft Bend	0.31	63.39	0.0049
Galveston	0.01	7.65	0.0010
Greenspoint	0.05	203.53	0.0002
Humble	0.07	51.73	0.0014
Katy	0.01	162.07	0.0001
Spring Branch	0.24	100.11	0.0024
South Houston	0.10	59.52	0.0016
Sugarland	0.11	41.76	0.0027

Reliability Reporting Storm Report

- **Distribution Automation Impacts (storm period):**
  - SAIDI Minutes saved due to automation: 0.01
  - Customer Outage Minutes absent use of automation: 3,935,862 (SAIDI - 1.47)
  - Customer Outage Minutes with automation: 3,905,736 (SAIDI - 1.46)
  - Customer Outage Minutes saved due to automation: 30,126
  - Customers positively impacted by the operation of automation: 1,769 (3.56% of storm cust out)
  - Number of devices operated remotely by Dispatch:
    - 14 (93% successful)
    - 1 required multiple attempts
    - 1 did not respond to multiple commands
  - Customer Outage Minutes saved due to remote operation of devices by Dispatch: 0

- **Trouble Events (Forced, Outside, & Scheduled Causes):**
  - Listed are the events coded with the outage type shown. Some events may have multiple outage types, but only the primary outage type is listed below.
  - Circuit Lockouts ---------------------------------- 19 events
  - Partial Circuit Outages --------------------------- 7 events
  - Overhead Line Fuses Blown -------------------- 145 events
  - Transformer Fuses Blown ----------------------- 88 events
  - Burned Up Transformers ------------------------ 21 events
  - Spans Primary Down ---------------------------- 26 events
  - Spans Secondary Down -------------------------- 24 events
  - URD Terminal Poles Blown -------------------- 38 events
  - Major Underground Line Fuse ------------------- 6 events
  - Poles Down -- 4 events
  - Drops Down --------------------------------------- 29 events
  - Meter Failures ------------------------------------ 6 events

- **Weather Impact:**
  - Lighting strikes = 5,765
  - Sustained wind speeds = 12 mi/hr
  - Gust wind speeds = 38 mi/hr
  - Total rainfall in service area = 1.40 in

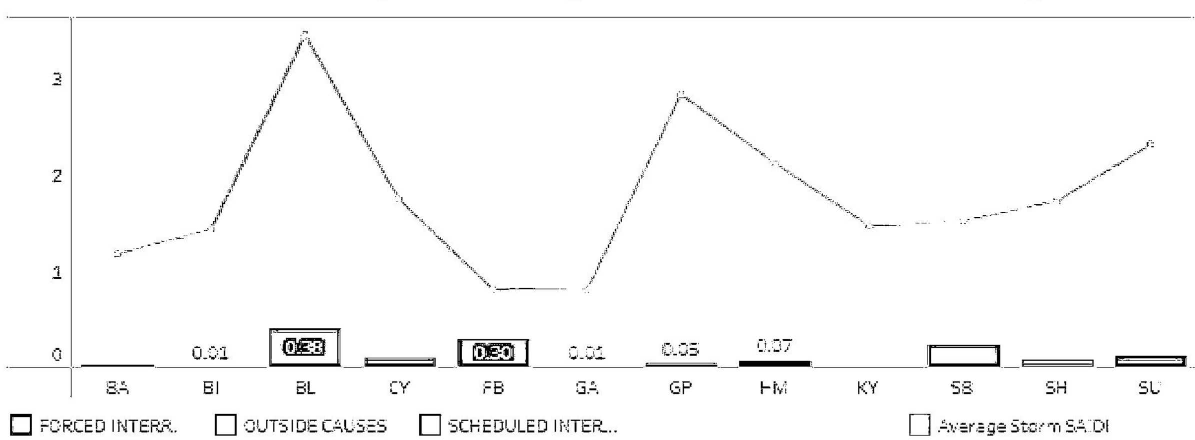
- **Substation Impacts:**
  - 03/22/2022 07:29:00 138kV TR2 tripped at RIC
  - 03/22/2022 07:34:00 138kV TR1 tripped at RIC
  - 03/22/2022 07:49:00 138kV TR4A & TR4B tripped at RUS
  - 03/22/2022 11:01:00 138kV TR2 tripped at TE

- **Transmission Impacts:**
  - 03/22/2022 05:33:00 Line #87 Instantaneous Operation from PT to YBV
  - 03/22/2022 07:14:00 Line #21 Instantaneous Operation from GBY to DAV

Reliability Reporting Storm Report

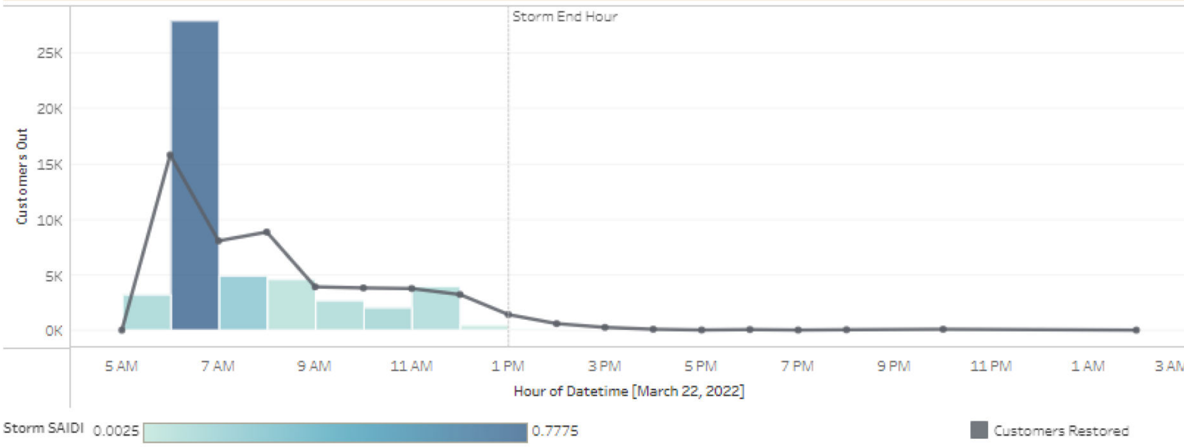
- **Notes / definitions / exclusions**
  - This report is based off the data as of today. The storm impacts are subject to change as data cleanup is completed over the next few weeks.
  - Non-distinct - includes customers with multiple outages and single outages. For example, if a customer has three sustained outages during a storm, it will count as three outages.
  - The PUC-TX has established a metric that applies to SAIDI / SAIFI numbers for 'Forced' (distribution level only) outage minutes / interruptions. An exclusion from the metric for events that exceed 10% of CNP's total customers outaged over a 24-hour period is allowed by the Commission rules.
  - An additional exclusion was created for events that only impacted a specific service area or two. This exclusion is used when the storm customer minutes in a service area are greater than 25% of the preceding rolling 12 months of customer minutes, including all storm days, for that area.
    - This exclusion would also be used if automation minutes saved would have increased the storm customer minutes to above the service area's 25% threshold.
  - Exclusions were created by PUC-TX for natural events that occur that exceed CNP's distribution structural design criteria: tornados, microburst, wind shear, flooding, inability to access area.
  - Major events are reported to the PUC-TX as a separate line item from the overall SAIDI / SAIFI metric. As part of the major event, all outages that occurred during the storm period are included whether they are 'Forced', 'Outside' (Substation / Transmission), or 'Scheduled' outages.

Contribution to System SAIDI by Service Area vs Historical Average



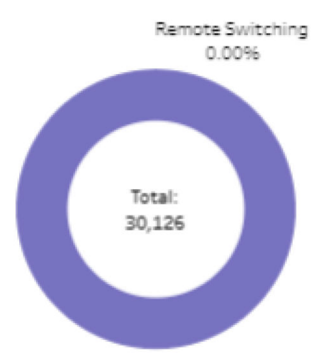
Reliability Reporting Storm Report

Hourly Customers Out vs Restored



SAIDI Min. Saved	Cust. Saved
0.01	1,769

Customer Minutes Saved



Reliability Reporting Storm Report

- **Summary:** A strong disturbance pushed through the region on Tuesday which brought severe thunderstorms with frequent lightning, hail, damaging wind gusts and tornadoes along with locally heavy rain.

- ***For definitions of terms and exclusions see notes at the end of the report.***

- **Storm Period:**
    - Began 01/24/2023 @ 10:10 AM (1 hour before entering trouble level 2)
    - Ended 01/26/2023 @ 09:20 PM (1 hour after returning to trouble level 1)

- **Storm Impact (storm period):**

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	28.49	373.95	0.0762
Forced Interruptions	27.74	397.90	0.0697
Outside Causes	0.21	78.18	0.0027
Scheduled Interruptions	0.53	141.65	0.0037

- Total non-distinct customers outaged over the period of the storm: 207,547
- Total customer outage minutes over the period of the storm: 77,613,139
- Estimated MW Lost: 3789.0
- Highest Trouble Level (on a scale of 1-8): 7

- **Exclusions (includes forced & outside outages):**
    - Storm did not exceed the major event exclusion threshold of 10% of total CNP customers out in a 24-hour period.
        - The 24-hour period used: 01/24/2023 at 9:00 to 01/25/2023 at 8:59.
        - Sustained non-distinct customer outages
            - 24-hour window = 188,732 (6.9%).
            - Had automation not been used in the 24-hour window = 211,770 (7.8%).
    - Storm exceeded the major event exclusion threshold of 25% of a service area's 12-month SAIDI.
        - South Houston (63.76% exclusion value)
        - Baytown (39.94% exclusion value)
    - Storm did have exclusions that exceeded the CNP design criteria.
        - Excluded Distribution SAIDI = 23.44

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
Forced Exclusions	23.44	307.76	0.0369
Outside Exclusions	0	0	0
Scheduled Exclusions	0	0	0

Reliability Reporting Storm Report

- **Storm Impact (After exclusions):**

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	5.35	136.13	0.0393
Forced Interruptions	4.3	131.10	0.0328
Outside Causes	0.21	78.18	0.0027
Scheduled Interruptions	0.53	141.65	0.0037

- **Pre & Post Storm PUC Goal Update (full day period):**
  - YTD forced SAIDI / CAIDI / SAIFI before the storm (01/23/2023):
    - SAIDI = 3.82 minutes (1.68 minutes under goal)
    - CAIDI = 120.28 minutes (22.09 minutes over goal)
    - SAIFI = 0.0317 interruptions (0.0267 interruptions under goal)
  - YTD forced SAIDI / CAIDI / SAIFI after the storm (01/26/2023):
    - SAIDI = 8.25 minutes (2.03 minutes over goal)
    - CAIDI = 125.30 minutes (31.06 minutes over goal)
    - SAIFI = 0.0658 interruptions (0.0002 interruptions under goal)

- **Impact Breakdown (includes forced interr. & outside causes only):**

Cause	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
Weather	24.87	470.31	0.0529
Vegetation	0.90	136.22	0.0066
Equipment Failure	1.28	189.02	0.0068
Substation	0.21	78.18	0.0027
Transmission	0.00	0.00	0.0000
Unknown	0.30	228.03	0.0013
Other	0.19	271.44	0.0007
Wildlife	0.01	220.08	0.0000
Third Party	0.07	281.41	0.0002

Outage Level	(includes forced, outside & scheduled outages)		
Circuit	24.33	379.04	0.0642
Overhead Fuse	3.03	389.16	0.0078
URD Fuse	0.71	230.90	0.0031
Transformer	0.35	379.08	0.0009

Service Area	(includes forced, outside & scheduled outages)		
Baytown	5.95	522.72	0.0114
Brazoria	1.09	135.59	0.0080
Bellaire	1.27	165.81	0.0077
Cypress	0.32	188.12	0.0017
Ft Bend	0.31	139.01	0.0022
Galveston	0.34	159.79	0.0021

Reliability Reporting Storm Report

Greenspoint	0.30	105.68	0.0028
Humble	0.22	75.52	0.0029
Katy	0.43	95.54	0.0045
Spring Branch	0.22	99.27	0.0022
South Houston	17.49	686.90	0.0255
Sugarland	0.55	107.57	0.0051

- **Distribution Automation Impacts (storm period):**
  - SAIDI Minutes saved due to automation: 0.4090
  - Customer Outage Minutes absent use of automation: 78,726,426 (SAIDI – 28.89)
  - Customer Outage Minutes with automation: 77,613,139 (SAIDI - 28.49)
  - Customer Outage Minutes saved due to automation: 1,113,287
  - Customers positively impacted by the operation of automation: 15,198 (7.32% of storm cust out)
  - Number of devices operated remotely by Dispatch:
    - 36 (94% successful)
    - 2 required multiple attempts
    - 2 did not respond to multiple commands
  - Customer Outage Minutes saved due to remote operation of devices by Dispatch: 215,762

- **Trouble Events (Forced, Outside, & Scheduled Causes):**
  - Listed are the events coded with the outage type shown. Some events may have multiple outage types, but only the primary outage type is listed below.
  - Circuit Lockouts ---------------------------------- 118 events
  - Partial Circuit Outages ---------------------------- 30 events
  - Overhead Line Fuses Blown -------------------- 424 events
  - Transformer Fuses Blown ----------------------- 289 events
  - Burned Up Transformers ------------------------ 79 events
  - Spans Primary Down ----------------------------- 98 events
  - Spans Secondary Down -------------------------- 172 events
  - URD Terminal Poles Blown -------------------- 117 events
  - Major Underground Line Fuse ------------------ 9 events
  - Poles Down --- 14 events
  - Drops Down -- 192 events
  - Meter Failures ------------------------------------ 31 events

- **Weather Impact:**
  - Lighting strikes = 13,902
  - Sustained wind speeds = 40 mi/hr
  - Gust wind speeds = 58 mi/hr
  - Total rainfall in service area = 4.05 in

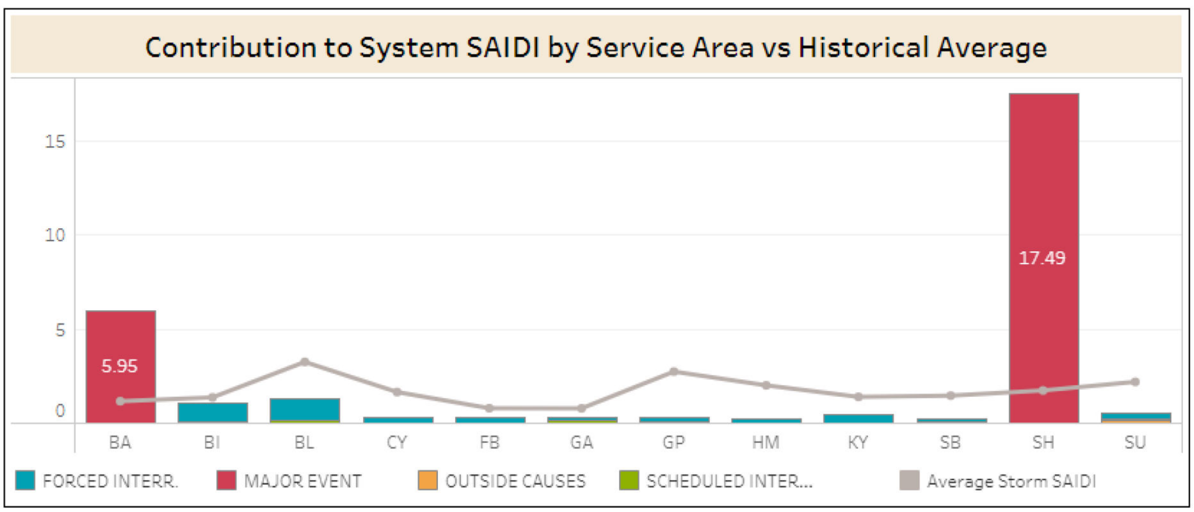
Reliability Reporting Storm Report

- **Substation Impacts:**
  - 01/24/2023 10:32 TR2 WI Sub 138/35 TR2 tripped. WI 44 locked out
  - 01/24/2023 12:31 TR2 PO Sub 138/12 TRIPPED
  - 01/24/2023 14:16 TR2 PE Sub 138/12 Tripped
  - 01/24/2023 14:24 TR2 FT Sub 138/12 Tripped
  - 01/24/2023 14:29 TR3 FT Sub 138/12 Tripped
  - 01/24/2023 14:51 TR4 MB Sub 138/12 TRIPPED. ALL SERVICE ROLLED.

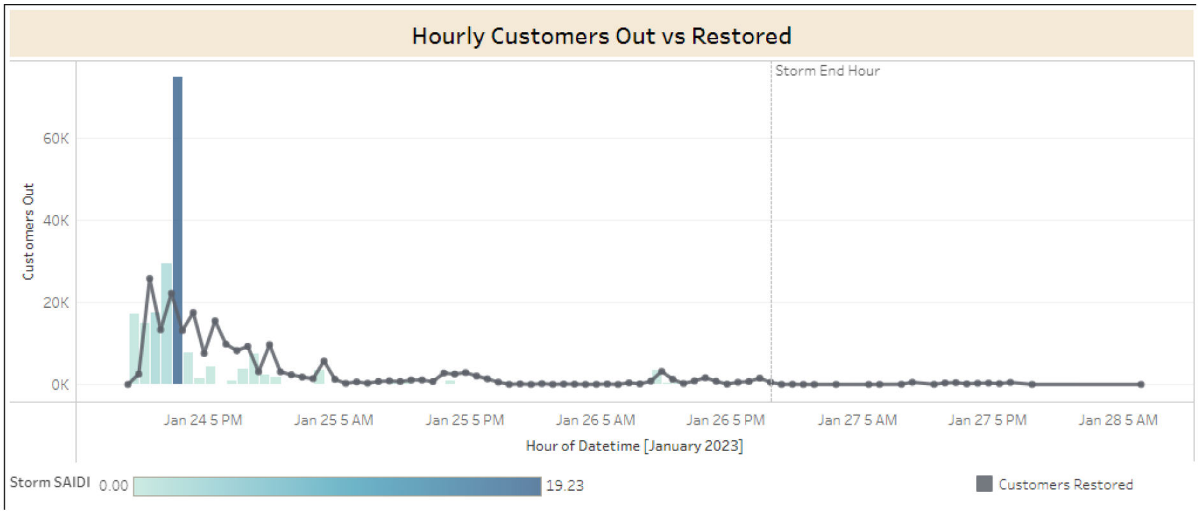
- **Transmission Impacts:**
  - 01/24/2023 12:13 66B TB HK 138 INSTANTANEOUS OPERATION.
  - 01/24/2023 13:43 02B NSH WAP 138 138kV LN02 WAP-NSH LOCKED OUT
  - 01/24/2023 14:19 91A ENC MYK 138 Locked Out
  - 01/24/2023 14:27 21L STA SRB 138 LOCKED OUT
  - 01/24/2023 14:27 97F CTR PHR 345 locked out
  - 01/24/2023 14:31 85B AZ BOG 138 LOCKED OUT
  - 01/24/2023 14:31 88B RH BNS MLR 138 Locked Out
  - 01/24/2023 14:31 06M ROL EAF SRB 138 138kV LN06 SRB-EAF-ROL LOCKED OUT
  - 01/24/2023 14:32 21E SOL MNT 138 LOCKED OUT
  - 01/24/2023 14:32 CS 138 TRIPPED
  - 01/24/2023 14:32 21D SOL SRB 138 LOCKED OUT
  - 01/24/2023 14:45 53B MV WEB 69 Locked out
  - 01/24/2023 21:46 94L FT GV 138 138Kv LN94 FT-WE-CGR-DR-GV SINGLE-ENDED INSTANTANEOUS OPERATION AT GV. Debris was dropped by TOP working on LN97.
  - 01/25/2023 09:43 CE 138 Tripped

Reliability Reporting Storm Report

- **Notes / definitions / exclusions**
  - This report is based off the data as of today. The storm impacts are subject to change as data cleanup is completed over the next few weeks.
  - Non-distinct - includes customers with multiple outages and single outages. For example, if a customer has three sustained outages during a storm, it will count as three outages.
  - The PUC-TX has established a metric that applies to SAIDI / SAIFI numbers for 'Forced' (distribution level only) outage minutes / interruptions. An exclusion from the metric for events that exceed 10% of CNP's total customers outaged over a 24-hour period is allowed by the Commission rules.
  - An additional exclusion was created for events that only impacted a specific service area or two. This exclusion is used when the storm customer minutes in a service area are greater than 25% of the preceding rolling 12 months of customer minutes, including all storm days, for that area.
    - This exclusion would also be used if automation minutes saved would have increased the storm customer minutes to above the service area's 25% threshold.
  - Exclusions were created by PUC-TX for natural events that occur that exceed CNP's distribution structural design criteria: tornados, microburst, wind shear, flooding, inability to access area.
  - Major events are reported to the PUC-TX as a separate line item from the overall SAIDI / SAIFI metric. As part of the major event, all outages that occurred during the storm period are included whether they are 'Forced', 'Outside' (Substation / Transmission), or 'Scheduled' outages.

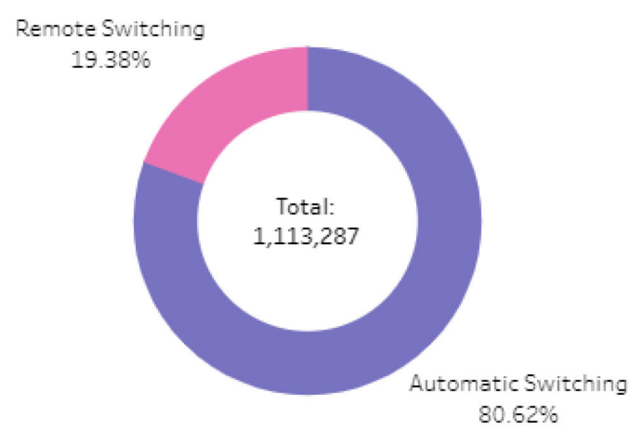


Reliability Reporting Storm Report



SAIDI Min. Saved	Cust. Saved
0.41	11,892

Customer Minutes Saved



Reliability Reporting Storm Report

- **Summary:** Showers and thunderstorms developed north of the CNP area which quickly pushed through and brought frequent lightning, hail and damaging winds.

- ***For definitions of terms and exclusions see notes at the end of the report.***

- **Storm Period:**
  - Began 06/21/2023 @ 07:40 PM (1 hour before entering trouble level 2)
  - Ended 06/25/2023 @ 03:20 AM (1 hour after returning to trouble level 1)

- **Storm Impact (storm period):**

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	116.94	557.87	0.2096
Forced Interruptions	114.92	574.75	0.2000
Outside Causes	0.11	109.39	0.0010
Scheduled Interruptions	1.91	220.67	0.0086

  - Total non-distinct customers outaged over the period of the storm: 574,582
  - Total customer outage minutes over the period of the storm: 320,541,355
  - Estimated MW Lost: 2,126.76
  - Highest Trouble Level (on a scale of 1-8): 8

- **Exclusions (includes forced & outside outages):**
  - Storm exceeded the major event exclusion threshold of 10% of total CNP customers out in a 24-hour period.
    - The 24-hour period used: 06/21/2023 at 19:00 to 06/22/2023 at 18:59.
    - Sustained non-distinct customer outages
      - 24-hour window = 474,709 (17.3%).
      - Had automation not been used in the 24-hour window = 571,728 (20.9%).
  - Storm did have exclusions that exceeded the CNP design criteria.
    - Excluded Distribution SAIDI = 116.94
    - Excluded Transmission SAIDI = 0

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
Forced Exclusions	114.92	574.75	0.2000
Outside Exclusions	0.11	109.39	0.0010
Scheduled Exclusions	1.91	220.67	0.0086

- **Storm Impact (After exclusions):**

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	0	0	0
Forced Interruptions	0	0	0
Outside Causes	0	0	0
Scheduled Interruptions	0	0	0

Reliability Reporting Storm Report

- **Pre & Post Storm PUC Goal Update (full day period):**
  - YTD forced SAIDI / CAIDI / SAIFI before the storm (06/20/2023):
    - SAIDI = 84.60 minutes (26.03 minutes over goal)
    - CAIDI = 119.24 minutes (15.57 minutes over goal)
    - SAIFI = 0.7095 interruptions (0.1472 interruptions over goal)
  - YTD forced SAIDI / CAIDI / SAIFI after the storm (06/25/2023):
    - SAIDI = 85.28 minutes (24.44 minutes over goal)
    - CAIDI = 119.56 minutes (16.17 minutes over goal)
    - SAIFI = 0.7133 interruptions (0.1277 interruptions over goal)

- **Impact Breakdown (includes forced interr. & outside causes only):**

Cause	**SAIDI Minutes**	**CAIDI Minutes**	**SAIFI Interruptions**
Weather	75.93	658.15	0.1154
Vegetation	28.45	465.55	0.0611
Equipment Failure	5.29	338.10	0.0157
Substation	0.11	109.39	0.0010
Transmission	0.00	0.00	0.0000
Unknown	2.03	432.18	0.0047
Other	3.14	1,118.51	0.0028
Wildlife	0.05	468.28	0.0001
Third Party	0.02	103.33	0.0002

Outage Level	**(includes forced, outside & scheduled outages)**		
Circuit	94.26	509.81	0.1849
Overhead Fuse	18.40	1,046.47	0.0176
URD Fuse	2.44	508.39	0.0048
Transformer	1.72	803.38	0.0021

Service Area	**(includes forced, outside & scheduled outages)**		
Baytown	0.47	325.29	0.0014
Brazoria	0.14	343.78	0.0004
Bellaire	3.95	277.27	0.0142
Cypress	20.41	623.31	0.0328
Ft Bend	0.06	333.61	0.0002
Galveston	0.11	118.92	0.0010
Greenspoint	59.58	610.30	0.0976
Humble	29.49	612.45	0.0482
Katy	0.04	55.12	0.0008
Spring Branch	1.18	120.96	0.0097
South Houston	1.03	400.46	0.0026
Sugarland	0.48	613.56	0.0008

Reliability Reporting Storm Report

- **Distribution Automation Impacts (storm period):**
  - SAIDI Minutes saved due to automation: 8.50
  - Customer Outage Minutes absent use of automation: 343,782,439 (SAIDI - 125.44)
  - Customer Outage Minutes with automation: 320,541,355 (SAIDI - 116.94)
  - Customer Outage Minutes saved due to automation: 23,241,084
  - Customers positively impacted by the operation of automation: 109,875 (19.12% of storm cust out)
  - Number of devices operated remotely by Dispatch:
    - 158 (92% successful)
    - 25 required multiple attempts
    - 12 did not respond to multiple commands
  - Customer Outage Minutes saved due to remote operation of devices by Dispatch: 3,864,876

- **Trouble Events (Forced, Outside, & Scheduled Causes):**
  - Listed are the events coded with the outage type shown. Some events may have multiple outage types, but only the primary outage type is listed below.
  - Circuit Lockouts ---------------------------------- 181 events
  - Partial Circuit Outages --------------------------- 86 events
  - Overhead Line Fuses Blown --------------------- 655 events
  - Transformer Fuses Blown ----------------------- 528 events
  - Burned Up Transformers ------------------------ 158 events
  - Spans Primary Down ----------------------------- 267 events
  - Spans Secondary Down -------------------------- 274 events
  - URD Terminal Poles Blown --------------------- 179 events
  - Major Underground Line Fuse ------------------ 8 events
  - Poles Down -- 39 events
  - Drops Down --------------------------------------- 170 events
  - Meter Failures ------------------------------------ 43 events

- **Weather Impact:**
  - Lighting strikes = 19,295
  - Sustained wind speeds = 22 mi/hr
  - Gust wind speeds = 97 mi/hr
  - Total rainfall in service area = 4.04 in

- **Substation Impacts:**
  - 6/21/2023 20:45 AT1-BUS TB 345/138 Instantaneous operation
  - 6/21/2023 21:31 PEARLAND 138KV PE T2HS (TR2) TRIP /Main BRK FAIL ON 05A0.
  - 6/22/2023 23:06 138KV LN21 ADK (Addicks) - CB - TO - WO (White Oak) instantaneous operation. Also 138KV LN76 ADK - TAN - SA - WOR - GE - FRY - ZEN (Zenith) instantaneous operation. ADK 138/35KV TR1 and TR2 tripped ADK-41 ADK-42 ADK-43 & ADK-44 locked out. 138/12KV TR3 at WO low side opened.
  - 6/22/2023 23:06 TR1 ADK 138/35 Tripped
  - 6/22/2023 23:06 138KV LN21 ADK (Addicks) - CB - TO - WO (White Oak) instantaneous operation. Also 138KV LN76 ADK - TAN - SA - WOR - GE - FRY - ZEN (Zenith)

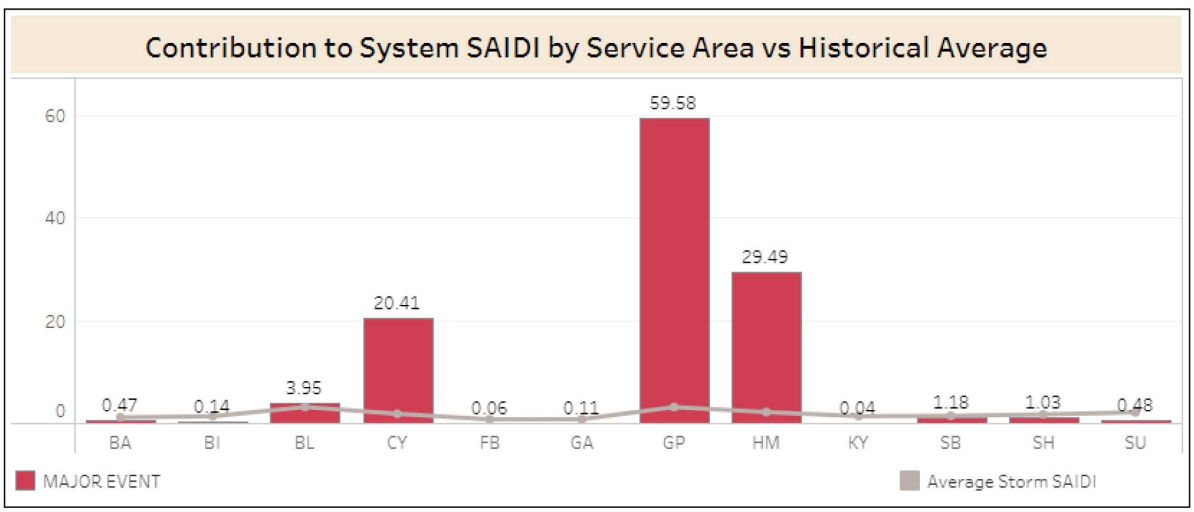
Reliability Reporting Storm Report

instantaneous operation. ADK 138/35KV TR1 and TR2 tripped ADK-41 ADK-42 ADK-43 & ADK-44 locked out. 138/12KV TR3 at WO low side opened.
  - 6/23/2023 19:43 CB20 tripped when 138kV LN91 CR (Crocket) - NS - HR (Hardy) had an instantaneous operation. SSO verified no issues with CB2 and cleared the SCI alarm.
  - 6/25/2023 01:14 CB10 BI 138 Trip voltage imbalance

- **Transmission Impacts:**
  - 6/21/2023 20:28 75B RTW-RNS Locked out
  - 6/21/2023 20:45 74B TB-RTW Locked out
  - 6/21/2023 20:47 22B RTW-RTW Instantaneous operation
  - 6/21/2023 20:47 22B RTW-RTW Locked out
  - 6/21/2023 21:14 17A GBY-GP Instantaneous operation
  - 6/21/2023 21:15 10B GBY-TS Instantaneous operation
  - 6/21/2023 21:53 05B WEB-HOC Instantaneous operation
  - 6/21/2023 22:16 04C DAB-PET Instantaneous operation
  - 6/21/2023 22:23 59A STW-WBY Instantaneous operation
  - 6/22/2023 05:05 26D SN-STR 138KV LN26 SN (Sintek) - STR (Stratt) instantaneous operation. No TWS information for 138KV LN26 SN (Sintek) - STR (Stratt) instantaneous operation at 05:05:57.
  - 6/22/2023 23:06 21H WO-ADK 138KV LN21 ADK (Addicks) - CB - TO - WO (White Oak) instantaneous operation. Also 138KV LN76 ADK - TAN - SA - WOR - GE - FRY - ZEN (Zenith) instantaneous operation. ADK 138/35KV TR1 and TR2 tripped ADK-41 ADK-42 ADK-43 & ADK-44 locked out. 138/12KV TR3 at WO low side opened.
  - 6/22/2023 23:06 76A ADK-ZEN 138KV LN21 ADK (Addicks) - CB - TO - WO (White Oak) instantaneous operation. Also 138KV LN76 ADK - TAN - SA - WOR - GE - FRY - ZEN (Zenith) instantaneous operation. ADK 138/35KV TR1 and TR2 tripped ADK-41 ADK-42 ADK-43 & ADK-44 locked out. 138/12KV TR3 at WO low side opened.
  - 6/23/2023 19:43 21A GBY-GS 138Kv Line 91 CR(Crockett)-NS-HR(Hardy) and 138Kv Line 21 GBY(Greens Bayou)-LB-NS-GS(Gable Street) had instantaneous operations. 138Kv CR CB20 tripped.
  - 6/23/2023 19:43 91F HR-CR Had instantaneous operations. 138Kv CR CB20 tripped with SCI not resetting.

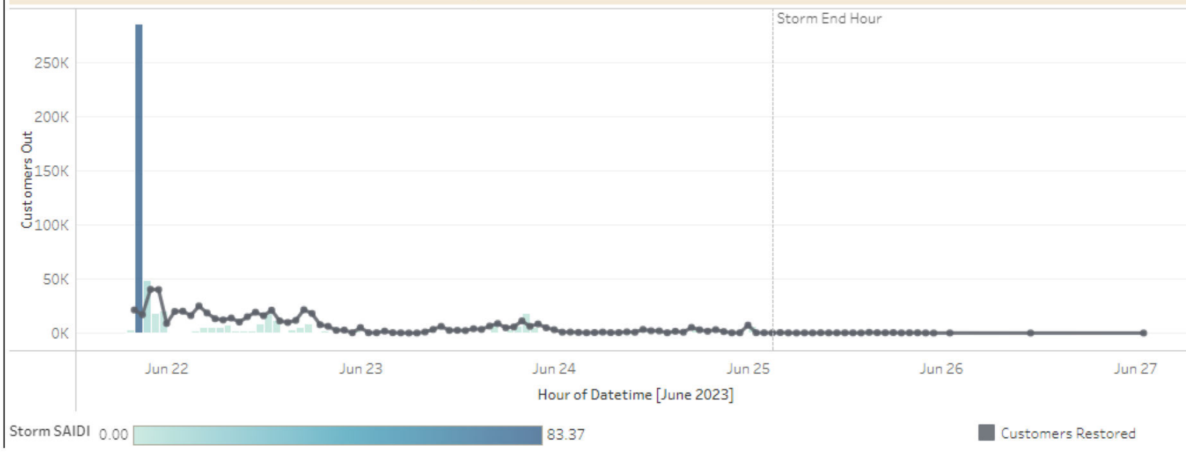
Reliability Reporting Storm Report

- **Notes / definitions / exclusions**
  - This report is based off the data as of today. The storm impacts are subject to change as data cleanup is completed over the next few weeks.
  - Non-distinct - includes customers with multiple outages and single outages. For example, if a customer has three sustained outages during a storm, it will count as three outages.
  - The PUC-TX has established a metric that applies to SAIDI / SAIFI numbers for 'Forced' (distribution level only) outage minutes / interruptions. An exclusion from the metric for events that exceed 10% of CNP's total customers outaged over a 24-hour period is allowed by the Commission rules.
  - An additional exclusion was created for events where 10% of CNP's total customers would have experienced an outage if automation had not been utilized.
  - An additional exclusion was created for events that only impacted a specific service area or two. This exclusion is used when the storm customer minutes in a service area are greater than 25% of the preceding rolling 12 months of customer minutes, including all storm days, for that area.
    - This exclusion would also be used if automation minutes saved would have increased the storm customer minutes to above the service area's 25% threshold.
  - Exclusions were created by PUC-TX for natural events that occur that exceed CNP's distribution structural design criteria: tornados, microburst, wind shear, flooding, inability to access area.
  - Major events are reported to the PUC-TX as a separate line item from the overall SAIDI / SAIFI metric. As part of the major event, all outages that occurred during the storm period are included whether they are 'Forced', 'Outside' (Substation / Transmission), or 'Scheduled' outages.



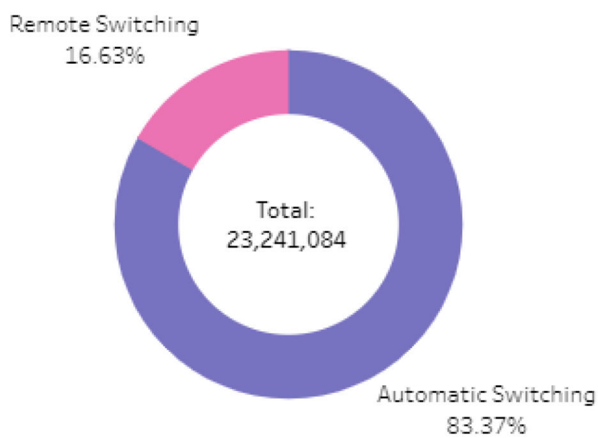
Reliability Reporting Storm Report

Hourly Customers Out vs Restored



SAIDI Min. Saved	Cust. Saved
8.50	81,510

Customer Minutes Saved



Reliability Reporting Storm Report

Content of this report utilizes CEHE PUCT methodology.

- **Summary:** A weather event brought widespread severe weather, derecho storm conditions with windspeeds of up to 100 mph, Category 2 Hurricane-like winds, and two tornadoes into the Houston metro area. A derecho is defined by the National Oceanic and Atmospheric Administration as a line of intense, widespread, long-lived, and fast-moving straight-line windstorms and sometimes thunderstorms that move across a relatively straight swath and is characterized by damaging winds similar to a tornado. Additionally, two EF1 tornados touched down in the Waller and Harris County portions of CNP's service area. These events caused widespread devastation to CNP transmission and distribution system including toppling of transmission towers, falling and broken distribution poles, equipment failures, extensive vegetation and debris damages, and prolonged outages.

- ***For definitions of terms and exclusions see notes at the end of the report.***

- **Storm Period:**
  - Began 05/16/2024 @ 04:57 PM (1 hour before entering trouble level 2)
  - Ended 05/24/2024 @ 03:37 PM (1 hour after returning to trouble level 1)

- **Storm Impact (storm period):**

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	908.95	2,058.31	0.4416
Forced Interruptions	900.19	2,128.82	0.4229
Outside Causes	0.01	5.33	0.0013
Scheduled Interruptions	8.75	502.68	0.0174

  - Total non-distinct customers outage over the period of the storm: 1,227,346
  - Total customer outage minutes over the period of the storm: 2,526,257,811
  - Estimated MW Lost: 4,282.98
  - Highest Trouble Level (on a scale of 1-8): 8

- **Exclusions (includes forced & outside outages):**
  - Storm exceeded the major event exclusion threshold of 10% of total CNP customers out in a 24-hour period.
    - The 24-hour period used: 05/16/2024 at 17:00 to 05/17/2024 at 16:59.
    - Sustained non-distinct customer outages
      - 24-hour window = 957,396 (34.4%).
      - Had automation not been used in the 24-hour window = 1,055,253 (38.0%).
  - Storm exceeded the major event exclusion threshold of 25% of a service area's 12-month SAIDI.
    - Service Area closest to exclusion: Spring Branch (93.55% exclusion value).
  - Storm did have exclusions that exceeded the CNP design criteria.
    - Excluded SAIDI = 908.95

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
Forced Exclusions	900.19	2,128.82	0.4416
Outside Exclusions	0.01	5.33	0.0013
Scheduled Exclusions	8.75	502.68	0.0174

Reliability Reporting Storm Report

- **Storm Impact (After exclusions):**

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	0	0	0
Forced Interruptions	0	0	0
Outside Causes	0	0	0
Scheduled Interruptions	0	0	0

- **Pre & Post Storm PUC Goal Update (full day period):**
  - YTD forced SAIDI / CAIDI / SAIFI before the storm (05/15/2024):
    - SAIDI = 77.53 minutes (38.29 minutes over goal)
    - CAIDI = 108.29 minutes (8.65 minutes over goal)
    - SAIFI = 0.7159 interruptions (0.3270 interruptions over goal)
  - YTD forced SAIDI / CAIDI / SAIFI after the storm (05/24/2024):
    - SAIDI = 84.26 (39.35 minutes over goal)
    - CAIDI = 116.98 (15.50 minutes over goal)
    - SAIFI = 0.7203 (0.2817 interruptions over goal)

- **Impact Breakdown (includes forced interr. & outside causes only):**

Cause	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
Weather	681.33	2,394.90	0.2845
Vegetation	181.44	1,757.07	0.1033
Equipment Failure	28.26	1,279.72	0.0221
Substation	0.01	5.33	0.0013
Transmission	0.00	0.00	0.0000
Unknown	3.76	700.61	0.0054
Other	4.87	1,050.14	0.0046
Wildlife	0.17	90.67	0.0019
Third Party	0.36	318.47	0.0011
Outage Level	**(includes forced, outside & scheduled outages)**		
Circuit	846.97	2,191.33	0.3865
Overhead Fuse	50.95	1,260.99	0.0404
URD Fuse	5.47	810.30	0.0068
Transformer	4.38	882.67	0.0050
Service Area	**(includes forced, outside & scheduled outages)**		
Baytown	76.10	2,077.86	0.0366
Brazoria	0.30	197.48	0.0015
Bellaire	194.09	2,190.08	0.0886
Cypress	167.75	2,157.84	0.0777
Ft Bend	1.14	263.95	0.0043
Galveston	0.28	101.00	0.0027
Greenspoint	176.08	2,050.21	0.0859

Reliability Reporting Storm Report

Humble	47.23	1,631.52	0.0289
Katy	41.32	1,454.56	0.0284
Spring Branch	193.84	2,771.04	0.0700
South Houston	3.82	570.60	0.0067
Sugarland	7.01	687.03	0.0102

- **Distribution Automation Impacts (storm period):**
  - SAIDI Minutes saved due to automation: 58.18
  - Customer Outage Minutes absent use of automation: 2,687,972,540 (SAIDI - 967.13)
  - Customer Outage Minutes with automation: 2,526,257,811 (SAIDI - 908.95)
  - Customer Outage Minutes saved due to automation: 161,714,729
  - Customers positively impacted by the operation of automation: 130,164 (10.61% of storm cust out)
  - Number of devices operated remotely by Dispatch:
    - 226 (96% successful)
    - 21 required multiple attempts
    - 9 did not respond to multiple commands
  - Customer Outage Minutes saved due to remote operation of devices by Dispatch: 14,037,451

- **Trouble Events (Forced, Outside, & Scheduled Causes):**
  - Listed are the events coded with the outage type shown. Some events may have multiple outage types, but only the primary outage type is listed below.
  - Circuit Lockouts ---------------------------------- 533 events
  - Partial Circuit Outages ---------------------------- 183 events
  - Overhead Line Fuses Blown --------------------- 1,486 events
  - Transformer Fuses Blown ------------------------ 1,011 events
  - Burned Up Transformers ------------------------- 263 events
  - Spans Primary Down ------------------------------ 893 events
  - Spans Secondary Down --------------------------- 889 events
  - URD Terminal Poles Blown --------------------- 297 events
  - Major Underground Line Fuse ------------------- 21 events
  - Poles Down --- 134 events
  - Drops Down -- 630 events
  - Meter Failures -------------------------------------- 110 events

- **Weather Impact:**
  - Lightning strikes = 16,982
  - Sustained wind speeds = 11 mi/hr
  - Gust wind speeds = 101 mi/hr
  - Total rainfall in service area = 0.24 in

Reliability Reporting Storm Report

- **Substation Impacts:**
  - Review pending.

- **Transmission Impacts:**
  - Review pending.

- **Notes / definitions / exclusions**
  - This report is based off the data as of today. The storm impacts are subject to change as data cleanup is completed over the next few weeks.
  - Non-distinct - includes customers with multiple outages and single outages. For example, if a customer has three sustained outages during a storm, it will count as three outages.
  - The PUC-TX has established a metric that applies to SAIDI / SAIFI numbers for 'Forced' (distribution level only) outage minutes / interruptions. An exclusion from the metric for events that exceed 10% of CNP's total customers outage over a 24-hour period is allowed by the Commission rules.
  - An additional exclusion was created for events that only impacted a specific service area or two. This exclusion is used when the storm customer minutes in a service area are greater than 25% of the preceding rolling 12 months of customer minutes, including all storm days, for that area.
    - This exclusion would also be used if automation minutes saved would have increased the storm customer minutes to above the service area's 25% threshold.
  - Exclusions were created by PUC-TX for natural events that occur that exceed CNP's distribution structural design criteria: tornados, microburst, wind shear, flooding, inability to access area.
  - Major events are reported to the PUC-TX as a separate line item from the overall SAIDI / SAIFI metric. As part of the major event, all outages that occurred during the storm period are included whether they are 'Forced', 'Outside' (Substation / Transmission), or 'Scheduled' outages.

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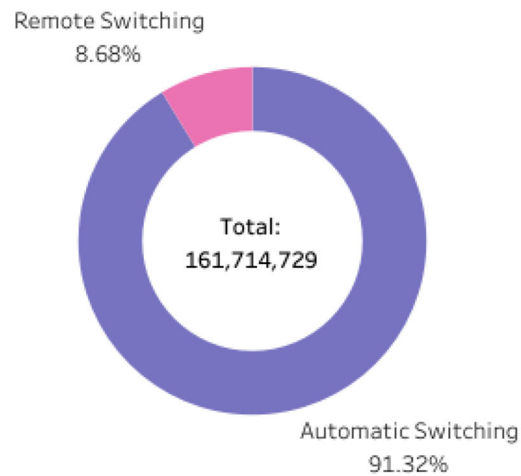
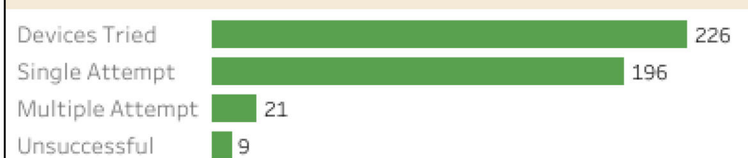
SAIDI Min. Saved	Cust. Saved
58.18	110,478

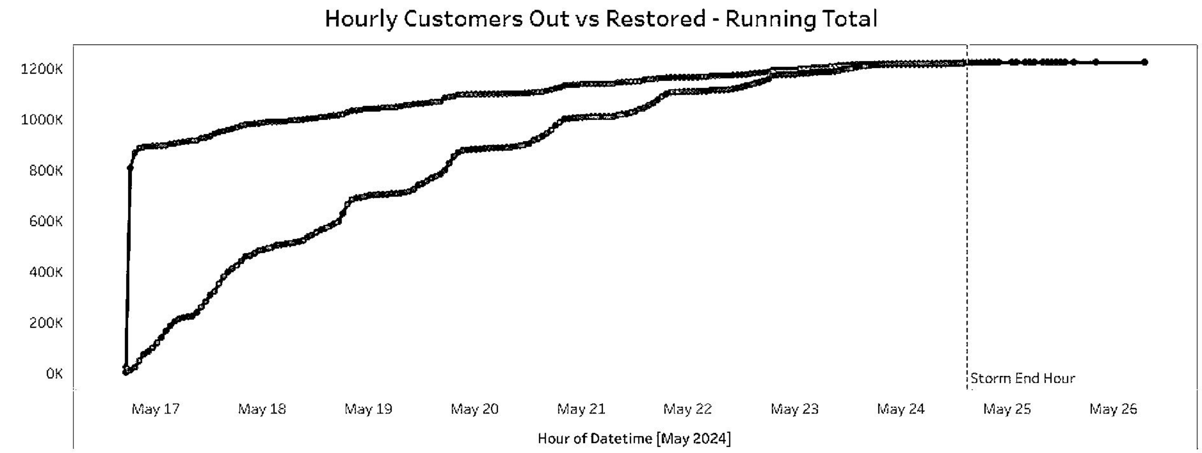
Customer Minutes Saved



Remote Device Operations



Reliability Reporting Storm Report



Reliability Reporting Storm Report

Contents in this report utilize CEHE PUCT methodology.

- **Summary:** Severe storms passed through the CNP footprint which brought strong winds, locally heavy rainfall, and frequent lightning.

- ***For definitions of terms and exclusions see notes at the end of the report.***

- **Storm Period:**
  - Began 05/28/2024 @ 11:52 AM (1 hour before entering trouble level 2)
  - Ended 05/30/2024 @ 06:24 PM (1 hour after returning to trouble level 1)

- **Storm Impact (storm period):**

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	42.42	231.77	0.1830
Forced Interruptions	41.24	232.19	0.1776
Outside Causes	0.03	24.24	0.0014
Scheduled Interruptions	1.14	286.60	0.0040

  - Total non-distinct customers outage over the period of the storm: 508,666
  - Total customer outage minutes over the period of the storm: 117,893,422
  - Estimated MW Lost: 1535.81
  - Highest Trouble Level (on a scale of 1-8): 8

- **Exclusions (includes forced & outside outages):**
  - Storm exceeded the major event exclusion threshold of 10% of total CNP customers out in a 24-hour period.
    - The 24-hour period used: 05/28/2024 at 8:00 to 05/29/2024 at 7:59
    - Sustained non-distinct customer outages:
      - 24-hour window = 462,081 (16.6%)
      - Had automation not been used in the 24-hour window =565,823 (20.4%)
  - Storm did not exceed the major event exclusion threshold of 25% of a service area's 12-month SAIDI.
    - Service Area closest to exclusion: Fort Bend (22.98% exclusion value).
  - Storm did have exclusions that exceeded the CNP design criteria.
    - Excluded SAIDI = 41.27

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
Forced Exclusions	41.24	232.19	0.1830
Outside Exclusions	0.03	24.24	0.0014
Scheduled Exclusions	1.14	286.60	0.0040

- **Storm Impact (After exclusions):**

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	0	0	0
Forced Interruptions	0	0	0
Outside Causes	0	0	0

Reliability Reporting Storm Report

Scheduled Interruptions	0	0	0

- **Pre & Post Storm PUC Goal Update (full day period):**
  - YTD forced SAIDI / CAIDI / SAIFI before the storm (05/27/2024):
    - SAIDI = 84.67 minutes (37.86 minutes over goal)
    - CAIDI = 119.85 minutes (17.76 minutes over goal)
    - SAIFI = 0.7065 interruptions (0.2514 interruptions over goal)
  - YTD forced SAIDI / CAIDI / SAIFI after the storm (05/30/2024):
    - SAIDI = 89.97 (41.27 minutes over goal)
    - CAIDI = 124.23 (21.52 minutes over goal)
    - SAIFI = 0.7242 (0.2525 interruptions over goal)

- **Impact Breakdown (includes forced interr. & outside causes only):**

Cause	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
Weather	25.09	206.70	0.1214
Vegetation	12.46	308.77	0.0404
Equipment Failure	2.67	260.56	0.0103
Substation	0.03	24.24	0.0014
Transmission	0.00	0.00	0.0000
Unknown	0.78	216.19	0.0036
Other	0.21	108.01	0.0020
Wildlife	0.02	484.29	0.0000
Third Party	0.01	867.78	0.0000

Outage Level	**(includes forced, outside & scheduled outages)**		
Circuit	31.27	189.77	0.1648
Overhead Fuse	8.13	619.22	0.0131
URD Fuse	1.79	541.55	0.0033
Transformer	1.15	704.27	0.0016

Service Area	**(includes forced, outside & scheduled outages)**		
Baytown	1.86	213.29	0.0087
Brazoria	0.43	164.81	0.0026
Bellaire	5.75	240.23	0.0240
Cypress	2.44	156.19	0.0156
Ft Bend	2.55	232.75	0.0109
Galveston	0.17	314.73	0.0005
Greenspoint	10.34	201.56	0.0513
Humble	14.37	335.57	0.0428
Katy	1.10	235.95	0.0047
Spring Branch	0.73	201.08	0.0036
South Houston	1.63	234.21	0.0070
Sugarland	1.05	93.06	0.0112

Reliability Reporting Storm Report

- **Distribution Automation Impacts (storm period):**
  - SAIDI Minutes saved due to automation: 9.58
  - Customer Outage Minutes absent use of automation: 144,510,524 (SAIDI - 51.99)
  - Customer Outage Minutes with automation: 117,893,422 (SAIDI - 42.42)
  - Customer Outage Minutes saved due to automation: 26,617,102
  - Customers positively impacted by the operation of automation: 117,280 (23.06% of storm cust out)
  - Number of devices operated remotely by Dispatch:
    - 182 (98% successful)
    - 11 required multiple attempts
    - 3 did not respond to multiple commands
  - Customer Outage Minutes saved due to remote operation of devices by Dispatch: 6,066,285

- **Trouble Events (Forced, Outside, & Scheduled Causes):**
  - Listed are the events coded with the outage type shown. Some events may have multiple outage types, but only the primary outage type is listed below.
  - Circuit Lockouts ---------------------------------- 158 events
  - Partial Circuit Outages --------------------------- 73 events
  - Overhead Line Fuses Blown -------------------- 658 events
  - Transformer Fuses Blown ----------------------- 478 events
  - Burned Up Transformers ------------------------ 92 events
  - Spans Primary Down ----------------------------- 194 events
  - Spans Secondary Down -------------------------- 199 events
  - URD Terminal Poles Blown --------------------- 151 events
  - Major Underground Line Fuse ------------------- 3 events
  - Poles Down -- 21 events
  - Drops Down --------------------------------------- 188 events
  - Meter Failures ------------------------------------ 34 events

- **Weather Impact:**
  - Lightning strikes = 6,722
  - Sustained wind speeds = 12 mi/hr
  - Gust wind speeds = 37 mi/hr
  - Total rainfall in service area = 1.82 in

- **Substation Impacts:**
  - 5/28/2024 13:42 – 138/12kV TR1 at JP (Jacintoport) tripped. JP02 locked out. 12KV 01A0 breaker failure will need to be replaced.
  - 5/28/2024 13:51 – During storms on 5/28/24 TRF-1&2 tripped at Rittenhouse causing the entire sub to go in the dark. SSO found blown arrestors on breaker 9A0 and pitting marks on TRF-2

bus and the TRF-1 crossover bus near the blown arrestor leads whips. The REDE ops messages also show operations on 9A0 immediately bef
- 5/28/2024 15:15 – 69kV A bus at GS (Gable Street) had an instantaneous operation and 69/12kV TR1 TR2 and TR3 at GS tripped. All circuits rolled. ERCOT (Bobby) notified. PAGED -IAW- Per SSO (Solorzano) upon placing a relay back in service a relay point picked up tripping the 69A bus. SOLE 1602 69kV A Bus and 69/12kV T
- 5/29/2024 17:14 – 138/12kV TR4 at GT (Garrott) tripped. GT09 GT10 GT12 and GT13 are locked out. 138/12kV TR4 at GT (Garrott) returned to service.
- 5/30/2024 00:18 – 0018 138/12kV TR1 at VL (Velasco) tripped all circuits rolled. 1524 138/12kV TR1 at VL (Velasco) returned to service. ERCOT (Zach).

- **Transmission Impacts:**
  - None

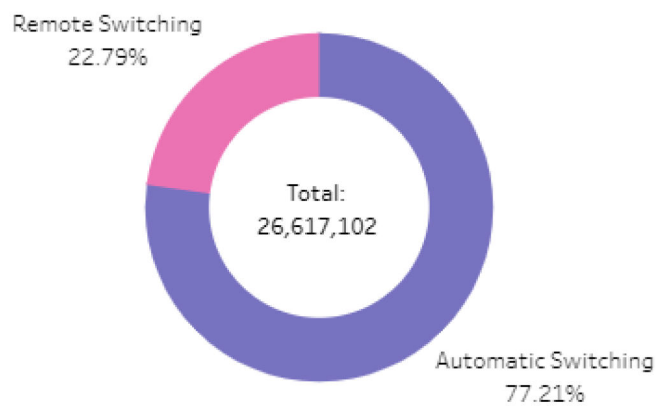
Reliability Reporting Storm Report

- **Notes / definitions / exclusions**
  - This report is based off the data as of today. The storm impacts are subject to change as data cleanup is completed over the next few weeks.
  - Non-distinct - includes customers with multiple outages and single outages. For example, if a customer has three sustained outages during a storm, it will count as three outages.
  - The PUC-TX has established a metric that applies to SAIDI / SAIFI numbers for 'Forced' (distribution level only) outage minutes / interruptions. An exclusion from the metric for events that exceed 10% of CNP's total customers outaged over a 24-hour period is allowed by the Commission rules.
  - An additional exclusion was created for events where 10% of CNP's total customers would have experienced an outage if automation had not been utilized.
  - An additional exclusion was created for events that only impacted a specific service area or two. This exclusion is used when the storm customer minutes in a service area are greater than 25% of the preceding rolling 12 months of customer minutes, including all storm days, for that area.
    - This exclusion would also be used if automation minutes saved would have increased the storm customer minutes to above the service area's 25% threshold.
  - Exclusions were created by PUC-TX for natural events that occur that exceed CNP's distribution structural design criteria: tornados, microburst, wind shear, flooding, inability to access area.
  - Major events are reported to the PUC-TX as a separate line item from the overall SAIDI / SAIFI metric. As part of the major event, all outages that occurred during the storm period are included whether they are 'Forced', 'Outside' (Substation / Transmission), or 'Scheduled' outages.

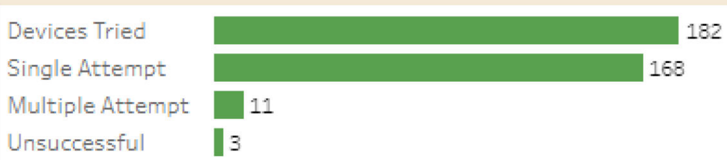
Reliability Reporting Storm Report

SAIDI Min. Saved	Cust. Saved
9.58	85,057

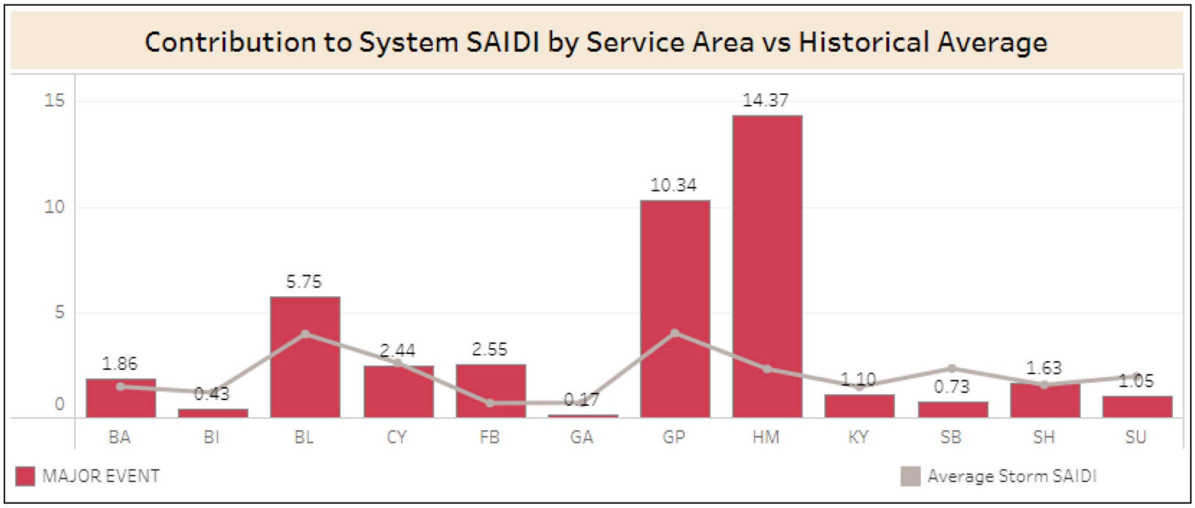
Customer Minutes Saved



Remote Device Operations



Reliability Reporting Storm Report



Subject Matter Expert Report Related to CenterPoint Energy Wood Pole Asset Management

prepared by

Nelson G. Bingel, III
Utility Lines Expert
National Electrical Safety Code (NESC)
Past Chairman – 2023 – 2028
Chairman – 2016 – 2023
Member – Executive Subcommittee
Member – Strength & Loading Subcommittee
Member – Clearances Subcommittee

July 22, 2024

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Appendix A – Nelson G. Bingel III Curriculum Vitae

I. Introduction

My name is Nelson Bingel. I am the founder and principal of Nelson Research, LLC, and have over 36 years of experience in the electric utility industry. I have been retained by CenterPoint Energy (CPE) to assess and evaluate the Wood Pole Asset Management Programs.

II. Qualifications

I briefly summarize my educational and work background, professional associations, and publications below. My complete Curriculum Vitae is attached at Appendix A.

A. Education

I received a Bachelor of Science in Mechanical Engineering (BSME) from Purdue University in 1973.

B. Work History

Osmose®

I was employed for 30 years with Osmose Utilities Services, Inc., the largest services company for the inspection, maintenance, repair, and restoration of electric utility structures in North America.

- Responsibilities focused on finding and developing better ways to inspect, maintain, and repair/restore wood, steel, concrete, and fiberglass utility structures. Included research, full-scale testing, and ongoing development in each area.

- Worked with utility companies nationwide to help optimize their wood pole inspection and maintenance programs. Developed a tool to project the future condition of their entire pole plant depending on the efficacy of different programs.
- Developed *StrengthCalc®*, an electronic inspection tool used to determine the remaining strength of wood poles based on the measurements of damage that was caused by decay, mechanical impact, or insect infestation. This tool is used to inspect millions of wood utility poles each year.
- Developed two versions of a comprehensive pole loading program, *O-Calc®/O-Calc Pro™*, that is used by utility companies and contractors across the United States to evaluate the environmental loading that is applied to in-service poles and to address make ready requirements.

Work History ***(cont'd)***

- I was awarded three U.S. patents for unique designs of steel trusses to restore strength to wood poles weakened by decay near the groundline. I was also awarded two U.S. patents for automated inspection of wood poles to detect decay.

NELSON RESEARCH In 2017 I founded and became principal of Nelson Research, LLC, through which I provide product development and expert witness services in the electric and telecom utility industries.

C. Technical Associations and Leadership Roles

National Electrical Safety Code (NESC)
Premier national safety standard for overhead and underground lines

- Past Chairman, 2023 -2028
- Chairman, 2016 – 2023
- Member, Executive Subcommittee, 2006 – Present
- Member, Main Committee, 2006 – Present
- Chairman, Strength & Loading Subcommittee, 2006 – 2016
- Member, Strength & Loading Subcommittee, 1991 – 2016

Accredited Standards Committee O5 (ASC-O5)
Publishes manufacturing standards for new wood poles and crossarms

- Vice chairman – 2021-Present
- Chairman – 2006 – 2020
- Member, 1989 - Present

Institute of Electrical and Electronics Engineers (IEEE)

- Member, 1989 – Present
- Working Group Coordinating Changes to the NESC
  - Vice-Chairman, 2017 – 2020
  - Chairman, 1992 – 2017

American Society of Civil Engineers (ASCE)

- Member, 1994 – 2021
- Co-authored publications listed below

D. Recent Publications and Presentations

ASCE Manuals

- *Recommended Practice for Design and Use-Wood Pole Structures for Electrical Transmission Lines*, ASCE Manual No. 141 (2019) (Co-Author & Editor)
- *Reliability-Based Design of Utility Pole Structures*, ASCE Manual No. 111 (2006) (Co-Author & Editor)
- *Fiber-Reinforced Polymer Products for Overhead Utility Line Structures*, ASCE Manual No. 104 (2003) (Co-Author & Editor)

Recent Articles

- "Poles Apart: The Surprising Truth About Power Pole Evaluation Methods and Their Results", *T&D World Magazine (2023)*
- "IEEE Hosting National Electrical Safety Code (NESC) Change Proposal Development Workshop," *IEEE Press Release* (2018)
- "Wood Pole Strength & Loading - Key to Resiliency, Require Programs," *Natural Gas & Electricity* (2017)
- "The Pole Express – Road to System Resiliency Varies, but all Benefit from Taking a Closer Look," *Power Grid International* (2017)
- "Guest Editorial | 2017 Revisions and Review Underway to the National Electrical Safety Code (NESC)," *Electric Energy Online* (2016)

Recent Presentations

- 2023 POWERLINE Overhead Lines Conference, October 11, 2023, Overland Park, Kansas, Effectiveness of Traditional Wood Pole Assessment Methods
- 2023 Osmose University – Joint Use, June 20-21, 2023, Peachtree City, GA, Update on the NESC
- 2023 National Electrical Safety Code (NESC) Workshop - 2023 Edition Overview, June 1-2, 2023, San Antonio, TX, Host and Presenter
- 2021 POWERLINE Overhead Lines Conference, August 11, 2021, Memphis, TN, National Wood Pole Standards
- 2019 National Electrical Safety Code (NESC) Change Proposal Comment Period Workshop, October 2-3, 2019, Kansas City, MO, Host and Presenter
- 2018 National Electrical Safety Code (NESC) Change Proposal Development Workshop, April 10-11, 2018, Savannah, GA, Host and Presenter
- 2018 National Association of Regulatory Utility Commissioners (NARUC), Winter Policy Summit, February 11-14, 2018, Washington, D.C., "Utility Distribution Poles and Lines – How Strong is Strong Enough?

III. Materials Reviewed

In formulating my opinions on this matter, I have reviewed the following materials:

- National Electrical Safety Code (NESC) 2017
- CenterPoint 007-231-06 Rev 15 Ground Line Treatment Specification
- CenterPoint Pole Life Extension Summary 2024-04-08
- Direct Testimony of Eugene Shlatz
- CEHE – Tutunjian Direct Testimony FINAL 4.25.24
- D5648 – Application of CEHE for Approval of its Transmission and Distribution Resiliency Plan
- STD-CRI-DIS RES REL Distribution Grid Resiliency & Reliability 08/15/2022
- *T&D World – February 2023 – "Building New Resilience In the Sooner State"*
- *"The Power of Trusses – Post-Storm Research Proves Trusses are a Long-Term Solution"- White Paper Published by Osmose Utilities Service, Inc*

IV. Executive Summary

CenterPoint Energy has had a focused on effective asset management for decades. This was back when RELIABILITY was the primary concern so that computer systems would not crash. The CenterPoint wood pole assessment/inspection, maintenance and restoration programs have been active through that period and to today.

With a series of damaging hurricanes in Florida during the early 2,000's and culminating with Super Storm Sandy, RESILIENCY has become a focus along with SAFETY and RELIABILITY. System resiliency improvement includes many different aspects that play different roles. Although resiliency is a complex multi-faceted issue for utility companies, the definition and measurement of resiliency is simple:

How well does a system resist a major storm to minimize outages
and
How quickly are services restored

Utility companies have become familiar with the term "Structural Resiliency", especially in reference to wood poles. When fewer wood poles break and fail in a storm, less outages is usually a result but more importantly, services can be restored more quickly and at a much lower cost.

The groundline assessment, maintenance, and restoration programs are all about retaining as much of the original structural strength and resiliency as possible, preventing future degradation, and restoring strength to decayed poles. These CenterPoint programs accomplish that to a very good degree. As will be explained, there are only a few tweaks that can improve the effectiveness of those programs.

Resiliency and high winds now bring the need to evaluate the loading side of wood poles. The National Electrical Safety Code (NESC) is a basic safety standard and governs the installation, operation, and maintenance of overhead lines. It includes District Loads that are based on combined ice and wind conditions (expected winter loads) along with Extreme Wind loads (summer storms). However, the NESC does not require poles extending less than 60 feet above groundline to comply with the Extreme Wind Load case.

One result of this exclusion has been that coastal utilities who complied with the NESC District Loads were found to have extensive damage during major storms. Those results are what brought about an emphasis on resiliency.

In addition to effective wood pole assessment, maintenance, and restoration programs, CenterPoint has enacted structure hardening programs and taken many additional steps to improve system resiliency. Firstly, they took the initiative in 2022 to apply the Extreme Wind load case to all poles. Along with that they have conducted pole loading assessments on specific circuits and installed steel upgrade trusses on wood poles along with replacing poles with engineered non-wood poles that have greater strength and structural resiliency.

To date this work has not been extensive but the standards and mechanics are in place to move forward if that is the strategy. Best in class utility companies that have significantly increased structural resiliency tend to operate with a short term plan and a long term plan. The long term plan may take 20 years to execute across an entire system.

The short term plan is to perform loading assessments and upgrade wood poles that don't meet a higher load requirement with the steel truss upgrade. This option is the lowest cost, can be installed quickly, and has shown to resist the hurricanes with almost no failures. The short term plan quickly improves resiliency and can last for decades as any other long term plan is executed.

In this report, the aspects of wood poles are explained in sections V through VII. The CenterPoint asset management and resiliency initiatives are explained in section VIII and IX and compared to Best in Class.

The balance of this section will provide a high level look at each program with comments on comparison with Best in Class.

High Level Overview of Program Evaluations

Wood Pole Procurement	Best in Class; Third party inspection at pole plant
Wood Pole Assessment	Best in Class
External Preservative Past	Best in Class
Internal Void Preservative	Best in Class
Fumigant Preservative	A better more effective and longer lasting fumigant should be adopted to support a 10 year cycle
Steel Truss Restoration	Unnecessary restrictions limit the restoration candidates; not Best in Class
Steel Upgrade Trusses	Unnecessary restrictions limit the upgrade candidates; not Best in Class
Upgrading with Non-wood Engineered Poles	
Concrete	Only targeted for highway crossings; underground preferred; Best in Class
Modular Fiberglass	Not a commonly used upgrade pole; very expensive; only 19,000 installed
Ductile Iron	Targeted for specific applications; only 1,800 installed
Critical Installations on Engineered Poles	Many of these poles are either restored or upgraded with steel trusses at Best in Class utility companies
Large Transformer Banks	Best in Class; Go underground or install ductile iron;
Adopted NESC Extreme Wind Loading	Best in Class
Freeway Crossings	Best in Class; Underground first; Concrete second
Require minimum class 2 wood poles for feeders	Best in Class
Increasing wood pole embedment depth	Best in Class
Apply Pole Toppers and Groundline Preservative to new pole installations	Very Best in Class

Wood Utility Pole Basics

V. Wood Utility Pole Strength and Original Preservative Treatment

The species of the pole involved in this incident was Southern Yellow Pine. Pine poles are a thick sapwood species that readily accepts preservatives deep into the sapwood. (see Figure 1).

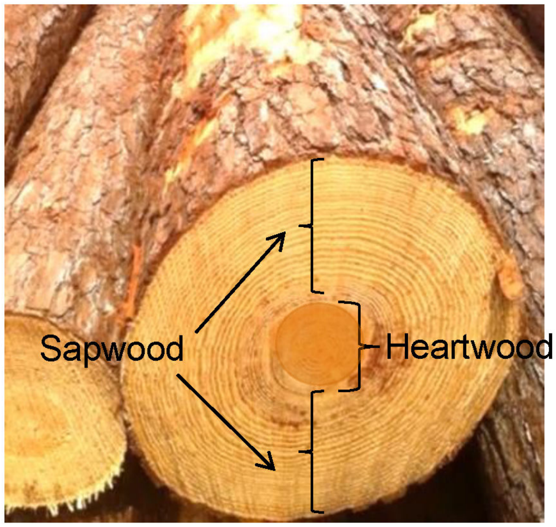


Figure 1. The cross section of a Southern Pine pole

During manufacturing, poles are placed on small rail cars that roll into a pressure vessel that is then filled with preservative, pressurized, and maintained at a specified temperature (see Figure 2). The heartwood of a pole does not accept preservative treatment even when pressurized.

Figure 2. A mini-rail car with treated poles leaving the treatment cylinder.

The poles are full-length treated, but the main concern is to prevent decay from establishing below groundline.

The bending strength of wood poles is identified by their length and class. The groundline circumference determines the class which corresponds with a horizontal load applied 2 ft from the tip. The length of the pole determines the distance from the applied load to the groundline. A general rule of thumb for the setting depths of poles is 10% of the pole length plus 2 ft.

A sample of distribution pole classes and the corresponding average applied horizontal load that the class can support is shown in Figure 3. The applied load is calculated by multiplying the horizontal load (lb) times the distance from the groundline (ft) and is expressed in foot-pounds (ft-lb) because the loading creates a bending or torque load at the groundline.

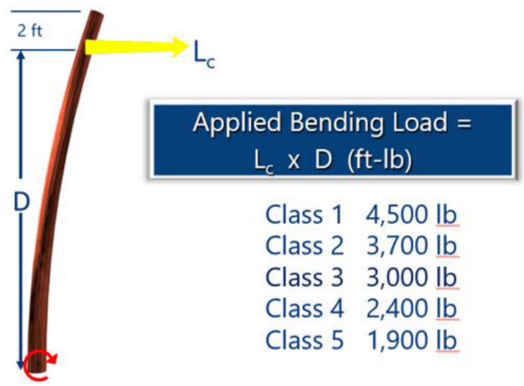


Figure 3. Typical distribution class poles and the tip loads

The bending strength or capacity (as opposed to the applied load) of a pole is determined using the formula below. Directly related to the fiber strength of the wood species multiplied by the cube of the groundline circumference. The fiber strength for southern pine poles is 8,000 psi. Be aware that the fiber strength is a mean value so for a given population of poles, half of the poles have a greater fiber strength and the other half have less strength.

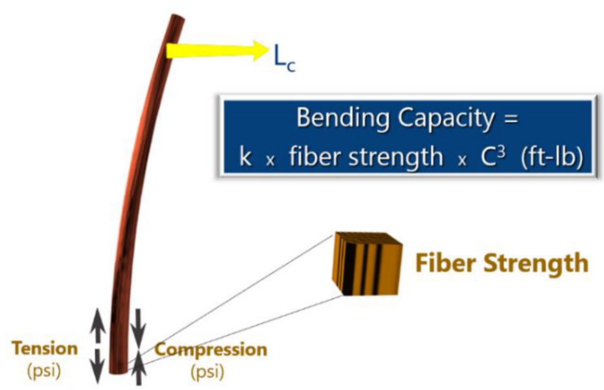
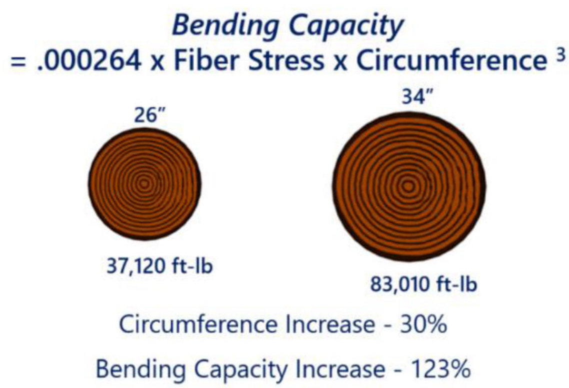


Figure 4. The bending strength of a pole is based on the groundline circumference.

The bending capacity of a specific pole is based on the circumference at the groundline. As the circumference increases in size, the bending capacity increases significantly due to the cube of the circumference factor. These next examples show a 30% increase in circumference results in a 123% increase in bending capacity.



Common industry references for distribution poles are that:

Approx. 50% of bending strength is supported by the outer 1" of shell

Approx. 75% of pole bending strength is supported by the outer 2" of shell

VI. Wood Utility Pole Loading

Wood poles are round, tapered structures that are installed as a cantilever. Loading is applied in many directions. However, the pole design is usually governed by the transverse bending loads applied by wind pressure on the wires (including ice when appropriate), equipment, and the pole surface as illustrated in figure 5.

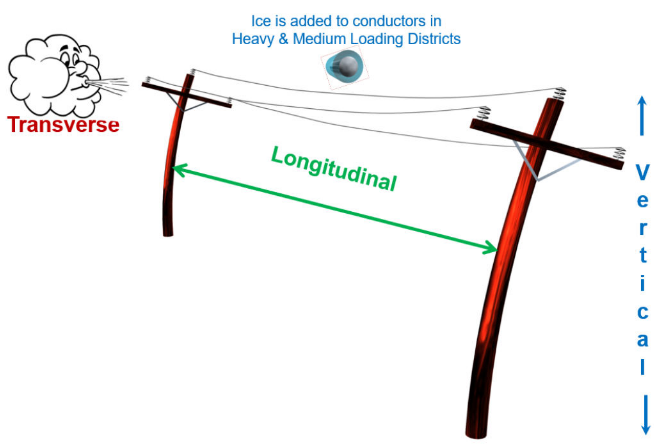


Figure 5. Utility structures most importantly support the transverse ice and wind loading which is perpendicular to the wires.

In this cantilever structural configuration, the maximum stress point along the pole is where the circumference is 1.5 times the circumference of the load point (see Figure 6). The maximum stress point is the theoretical location where a wood pole is expected to break due to maximum bending stress. Wood poles are not a very homogeneous material so defects or variation in pole properties may cause a pole to break a short distance above ground due to bending loads.

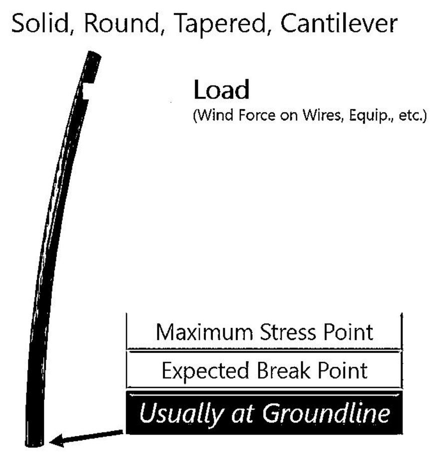


Figure 6. The maximum stress point due to bending loads for poles up to at least 60 feet in length is usually at the groundline.

Not only is the expected break point at groundline, this is where decay is also most likely to occur and weaken the pole (see Figure 9). External decay in the groundline zone causes a significant reduction of the pole's ultimate bending capacity.

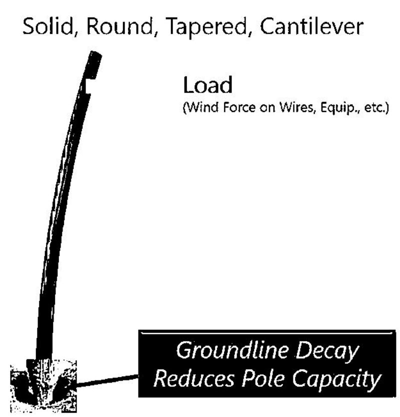


Figure 7. Decay occurs at the expected break point causing a reduction of the bending capacity.

In almost all cases, when a pole line is designed, the bending loads created by the ice and wind are the governing design criteria. That means that if the structures are strong enough for the wind loading, they are more than strong enough for the vertical and longitudinal loading.

VII. Wood Utility Pole Decay and Loss of Strength

The structural integrity of wood may be reduced by decay fungi that feed on wood. This can occur in wood poles after years of service if the original treatment is no longer present at adequate levels to resist decay. However, decay fungi require components for the decay process to occur:

1. Moisture
2. Oxygen
3. Food (untreated wood)
4. Favorable Temperatures

Wood with a moisture content below 20% is usually safe from fungi. Wood cell structure forms tall cylinders and so water wicks up the pole by capillary action from the butt until reaching above groundline. At that point, the moisture dissipates into the air and there is usually not enough moisture in the pole above ground to support the decay process.

The food source for the decay process is wood that no longer has adequate original preservative levels below ground to resist decay. The oxygen level in the soil below 18" usually is not adequate to support decay on the outer shell of the pole below ground.

Due to the moisture limit at groundline and the oxygen limit at 18" below ground, the groundline zone (groundline to 18" below) is the most decay prone section of southern pine poles (see Figure 8). The decay most often initiates on the outer shell below ground which causes a rapid loss of pole bending strength.

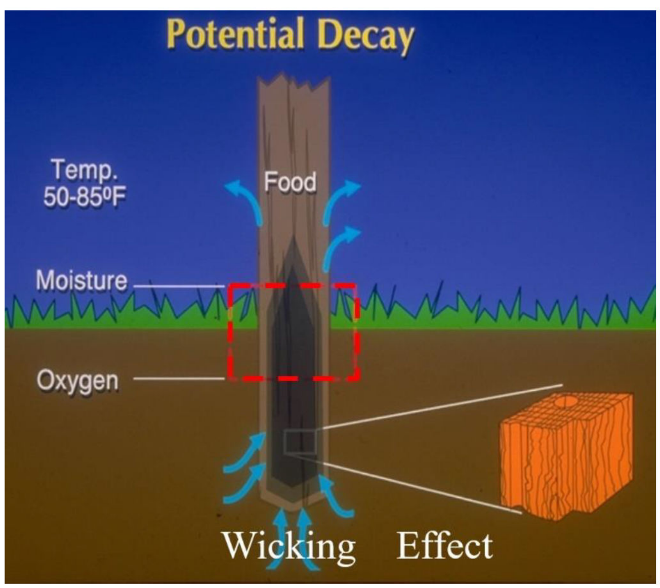


Figure 8. The most decay prone zone of a southern pine pole is limited above ground by lack of moisture and below ground by a lack of oxygen deeper than 18".

Figure 9 shows how abruptly decay in southern pine poles ends at 18 inches below groundline due to a lack of oxygen to support decay.

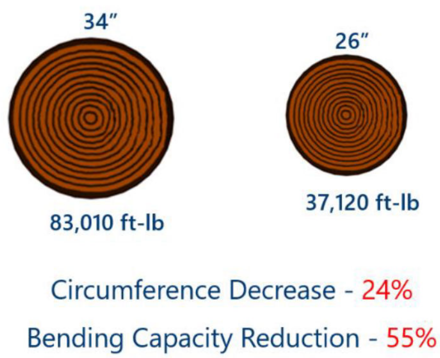
Figure 9. The section of a failed southern pine pole from the groundline and below.

The sooner that shell rot is identified in a pole, the more original bending strength is retained, and the pole can be treated to control future deterioration. The following images show that shell rot identified early can be chipped off the pole and the effective remaining circumference is measured to determine the remaining bending strength.

The next images show an example of more advanced shell rot which had been removed. The remaining sound wood was subsequently treated with preservative paste to prevent future decay. The bending strength was restored with the installation of a steel truss as shown on the right. Pole restoration can be completed much faster and for much less cost than pole replacement.

The decay process was so advanced for this pole that the only option was to replace it.

It was mentioned earlier that the outer 1" of shell supports around 50% of a wood pole's bending strength. In this example, which is drawn to scale, a 24% reduction in circumference due to external decay results in losing 55% of the bending capacity. Controlling shell rot in southern pine poles is critical to retaining the much-needed bending capacity.

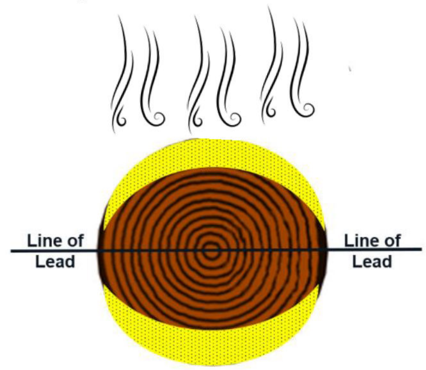


As shown in the examples above, shell rot generally forms rather evenly around the outer shell. Removing the shell rot and measuring the circumference of the remaining sound wood is a good method for determining the remaining bending strength as a percentage of original strength. That pole now has the bending capacity of a sound pole having a circumference equal to the effective circumference.

It has been mentioned that the outer shell of a wood pole provides most of the support for bending loads. However, since bending loads are generally perpendicular to the direction of the wires, the entire circumference does not contribute to the bending support.

For a pole with spans directly opposing each other (span to the east and a span to the west) , the Line of Lead is a line going through the center of a pole in the direction of the overhead wires (see figure below). This line also represents the Center of Gravity for the cross section of the pole, meaning the average location of all the weight or the balance point of the cross section.

With the wind blowing from the north in this figure, only the yellow highlighted outer shell contributes to the pole capacity when bending toward the south. The portion of the pole cross section that is close to the Line of Lead in this image can do little to help support the north/south bending loads.



CenterPoint Wood Pole Asset Management Programs

VIII. CenterPoint Wood Pole Asset Management Programs

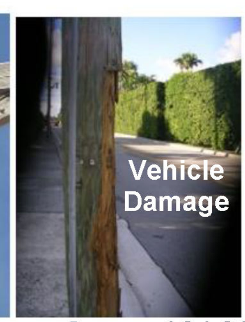
-Retaining and Upgrading Structural Resiliency-

A. Wood Pole Assessment/Inspection – Best in Class

Pole owners are required by national, state, and local codes to inspect utility lines. There are a wide range of methods, tools, and instruments that may be incorporated in a pole owners inspection program. The CPE assessment/inspection program is the best in class as all the following steps are incorporated right up to full excavation.

Visual Assessment

The inspector visually examines the pole from the top down to groundline. Issues to be reported include items such as woodpecker holes, split tops, decayed tops, broken insulators, rotten/broken crossarms, slack/broken guy wires, mechanical or fire damage, and other visible issues. Since most decay conditions occur below ground, this method does little to identify groundline decay.



Sounding Assessment

The inspector sounds the pole with a hammer all around the pole circumference and as high and low as he has access to the pole to locate internal decay. Hammer marks should be visible to indicate where the pole was sounded. A firm, ringing tone suggests sound wood while a hollow or dead sound locates internal decay and the most likely location for boring to assess further.

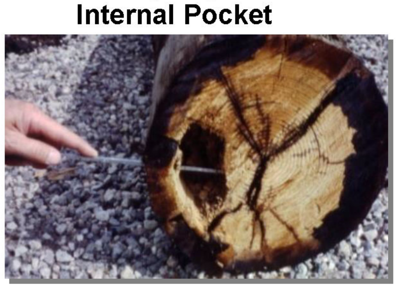
Boring Assessment

Boring can be accomplished before any excavation and is the only option when dealing with poles set in concrete or other obstacles that prohibit digging. It is most effective to bore after excavation, which is described in 7.4, as the most decay prone section of the pole is exposed and boring can start at a deeper location.

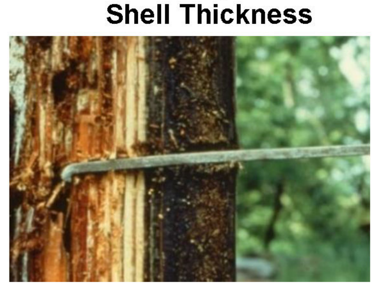
Typically, a 3/8" or ½" bit is used for drilling the pole at a 45° angle to the center of the pole. If there is a suspected internal pocket following sounding, a boring should be started there. Multiple borings should be made to determine the extent of advanced internal decay. Care should be taken to ensure multiple borings are not initiated on the same plane.

A shell thickness indicator should be used to measure the depth of a pocket and the remaining sound shell as shown in these images.

Measuring Depth of an Internal Pocket



Measuring Sound Shell Thickness

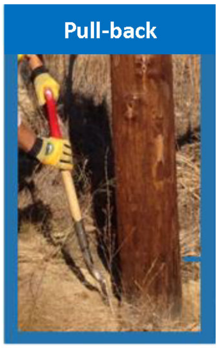


A Variety of Excavation Processes Can be Incorporated

Excavation of wood utility poles takes many forms from a simple pull-back on one side to a full excavation all around the pole to a depth of 18" to 24" depending on local soil conditions and pole species. ***The greater the amount of excavation, the higher the efficacy for accurately finding all decay conditions.***

The range of excavation program types includes the following:

Single and double pull-back



Usually performed with a narrow tool used for chipping and removing shell rot from a pole or with a shovel. The chipper is pushed below ground at the circumference of the pole and then pulled back to expose that portion of the pole below ground. A sharp triangular tool is then used to scrape the pole surface to detect shell rot.

A double pull-back pulls the soil back on opposite sides of the pole to provide greater potential for finding external decay that does not extend around the full circumference.

Single and double partial-excavation

A shovel is used to remove the soil from a shovel width and to a depth of 6"– 8". The surface of the pole is then checked for very early stages of external decay or to measure the depth of more advanced conditions of shell rot.

A double partial-excavate applies the excavation to opposite sides of the pole to provide greater potential for finding external decay that does not extend around the full circumference.

Full excavation

Excavate around the entire circumference of the pole whenever possible to a depth of 18" to 24" depending on local soil conditions and potential for decay. The excavation should extend at least 10" from the pole at the groundline and a minimum of 4" at the bottom to enable proper evaluation of the pole.

Full excavation provides the highest efficacy of finding all decay conditions.

Removal of Decay

Removing decayed wood from the pole will help to control the advance of additional decay and enables measuring the remaining sound wood circumference for estimating the remaining strength of the pole. A trained inspector uses a "chipper" to remove the decay in slices without removing much sound wood. The chipped wood should be removed from the excavation, so it does not spread decay to the remaining sound wood.

Chipping and removing the decayed wood also prepares the pole for application of supplemental preservatives which provides a boost to the original treatment to help prevent future decay deterioration

Remaining Strength and Resulting Pole Classifications

For decades early wood pole inspection incorporated a slide rule or tables that were limited in the ability to account for all the variables that affect wood pole remaining strength. Since the early 2000's, electronic strength calculators have been in use to account for more variables to determine the remaining strength more accurately.

As shown in this photo, measuring the remaining circumference of a pole after removing the shell rot provides a good estimate of the remaining strength. In this case, the remaining strength of a pole with an original circumference of 34" was the equivalent of a 32" circumference pole.

In addition, any internal decay measurements are input to the electronic strength calculator to determine the final remaining strength of the pole.

The National Electrical Safety Code (NESC) specifies the reduced strength at which a pole requires restoration or replacement:

NESC Table 261-1 Footnote 2

"Wood and reinforced concrete structures shall be replaced or rehabilitated when deterioration reduces the structure strength to 2/3 of that required when installed. When new or changed facilities modify loads on existing structures, the required strength shall be based on the revised loadings."

Since wood poles are considered serviceable until the point that the groundline strength is reduced to 2/3 of the required strength, each pole inspected as part of a scheduled inspection program will be classified into one of 4 conditions:

No decay

Decayed but serviceable (DBS)
-remaining strength ***above*** code requirement >67%

Decayed Reject
-remaining strength ***below*** code requirement ≤67%

Decayed Priority Reject
-remaining strength ***below*** pole owner requirement

Wood Pole Assessment/Inspection

IN SUMMARY:
Poles with extremely advanced shell rot decay **(Priority Reject)** are likely easier to detect than poles with very early stages of shell rot **(DBS)**. The ability to accurately identify these conditions depends on how comprehensive the inspection procedure is.

The CenterPoint Energy specification for wood pole assessment calls for all of the steps above to be completed during the assessment. This is **Best in Class**, especially when full excavation is included. There is no instrument or tool that can be added to the assessment process that will improve the efficacy of the assessment.

B. Supplemental Preservative Application – Life Extension

External Preservative Paste Application -Best in Class

Remedial treatments provide a boost to the original treatment of a pole which helps control decay and extend the useful life of a pole. The presence of shell rot indicates the original preservative is no longer at threshold levels that prevent decay. Applying supplemental external preservatives provides a boost to the original treatment and can help prevent decay for the recommended inspection cycle.

If a pole has no sign of shell rot, the outer shell is still treated to help make sure the pole strength is retained and there is no shell rot on the next assessment cycle. If there is shell rot present, it is removed so that the preservative does not soak into the decayed wood and have less opportunity to protect the sound wood.

These photos show the removal of an early stage of shell rot and then the application of a preservative paste to the critical outer shell to control future decay. A plastic backed paper is then wrapped around the pole below groundline to help the preservative migrate into the pole by osmosis.

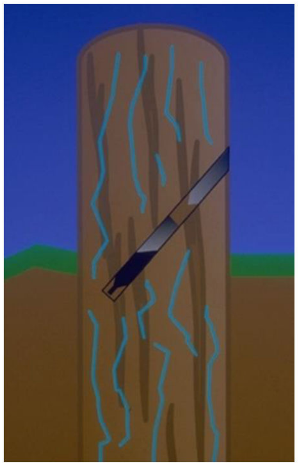
CenterPoint's practice of full excavation whenever possible and applying MP-500 external past is Best in Class.

Internal Void Preservative Treatment – Best in Class

Some of the poles inspected will have existing internal voids. There is a liquid preservative treatment that only requires a splash contact with the surface of the void to help control decay until the next assessment cycle. The product, which is applied under pressure, is called Hollow Heart and included in CenterPoint's specification. Hollow Heart is only intended for use when internal decay has advanced to create a void.

Fumigant Treatments to help Sterilize Sound Wood

A more effective fumigant should be adopted to support a 10 year cycle



A third treatment type is referred to as fumigants. Sound wood is bored into, and the fumigant treatment is applied into the hole and then plugged. The fumigant treatment may be in liquid form, a solid in a tube, or in granular form. Whatever the original form, a chemical reaction occurs to create a gas that migrates both up and down from the point of application. That treatment is a booster to the original treatment in the pole. This sterilized the internal section of the pole to help prevent decay for another inspection cycle.

The older portions of the CenterPoint system have a greater portion of the poles located in backlots that cannot be fully excavated around the pole circumference. CenterPoint is currently using a liquid form of fumigant called WoodFume which was developed more than 50 years ago. In recent years, a new granular fumigant has been developed that is more effective and much longer lasting. That product is called OsmoFume and would be an enhancement to the current program.

C. Wood Pole Restoration–Life Extension – Program can be expanded

When pole assessments determine a remaining strength that is below NESC requirements, those poles either need to be restored with a steel truss or replaced. The steel truss was tested at many utility companies during the 1970's and 1980's, including Houston Lighting and Power shown in the far right image below.





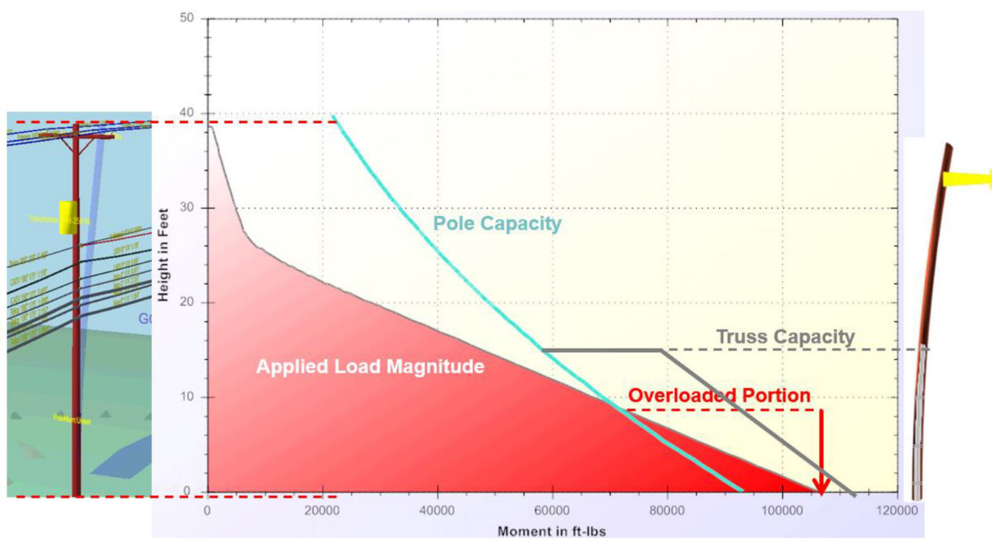
The truss proved to work every time and utility companies switched from thinking of trussing as a temporary fix to a restoration that has shown to last for 30 to 40 years and even more. CenterPoint does restore a percentage of the poles that are below NESC strength requirements.

However, restrictions on restoring certain poles like equipment poles, that were initiated in the 1980's, are still in effect. Many utility companies have shown over decades of implementation that many of CenterPoint's reject poles restricted from restoration can be quickly and efficiently restored to the original level of safety.

D. Steel Upgrade Truss Systems Increase Pole Capacity and Resiliency

CenterPoint has engaged but the rate of implementation should increase

Some in-service poles may be overloaded or may need to be upgraded to support higher wind loading. A pole is not overloaded from top to bottom. As shown below, there is a location between the pole tip and groundline where the applied load becomes greater than the pole capacity.



The upgrade steel truss can increase the bending capacity of wood poles by 1, 2, or 3 classes. This system is a low cost and quick way to make wood poles more resilient.

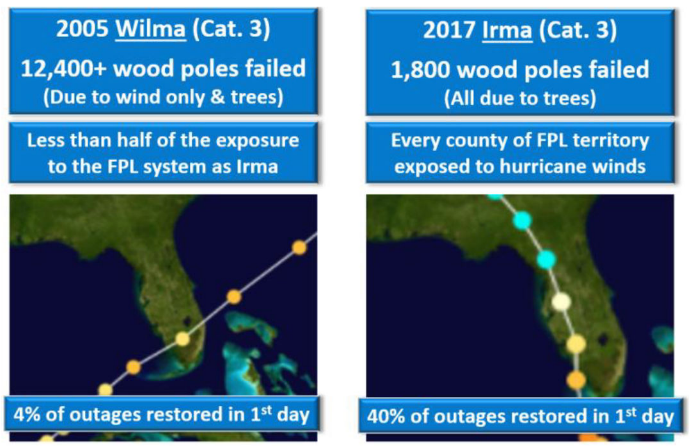
Best in class utility companies like Florida Power & Light and Oklahoma Gas & Electric install upgrade trusses as soon as a pole is found to be overloaded or in need of upgrading to support higher wind speeds. The upgrade is a low cost installation that can be completed quickly. The trusses are considered a long term fix. However, they may also have a 20 year plan for what is thought of as a more permanent fix, but the upgrade trusses provide the same improved resiliency quickly, at a much lower cost with an expected life of 30 years or more.

The following are case studies from these two utilities that have storm proven performance of the steel upgrade trusses.

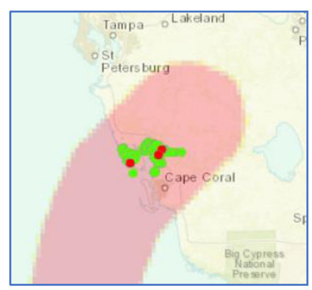
These excerpts and images were taken from the magazine article and white paper listed in the Materials Reviewed section.

Florida Power & Light began an aggressive hardening program in 2006. There are more than 23,000 upgrade trusses installed as shown on this map.

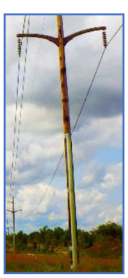
The following images show the comparative performance of the FP&L system resulting from hurricane Wilma in 2005 versus hurricane Irma in 2017. Irma covered more than twice the amount of service territory and only 1,800 poles failed compared to Wilma where 12,400 poles failed. Only 4% of the outages were restored the first day after Wilma whereas 40% of the outages were restored the first day following Irma.



On September 28, 2022, category 4 hurricane Ian made landfall in Florida.



Osmose Utilities Services, Inc. independently researched the actual wind speeds and conducted a field study to determine how the steel upgrade trusses performed. The field study was conducted in or near Port Charlotte where the weather data showed sustained winds of 150 mph. The poles had been upgraded with the steel upgrade truss from 8 to 12 years earlier.

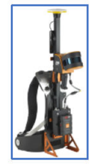


A total of 288 poles with steel upgrade trusses were visited and it was found that 283 (98%) of the poles were resilient and survived Ian with no damage. There were 5 poles that had been replaced so it was not clear how those 5 upgraded poles performed during the storm.

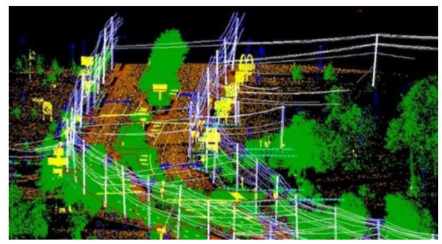
An added benefit of the steel upgrade truss is that it increases the surface area that is bearing on the soil. Poles with the trusses had much less movement at the groundline and did not require straightening.

Oklahoma Gas & Electric experienced a severe ice storm in October 2020 which showed that the structural resiliency of their system needed to be increased. They ended up adopting a four stage process to harden their lines and establishing a system-wide wind speed of 150 mph.

Step 1: Detailed field data collection which consisted of vehicles outfitted with GPS, light detection and ranging (LiDAR), high resolution cameras and a backpack version for walkout data collection. This process collected highly accurate data for modeling circuits.



Step 2: Automated classification of poles, equipment, wires, buildings, etc., using the LiDAR data and imagery from step 1. Technicians measure heights and distances between poles precisely, identifying attachments and creating a georeferenced database for all attached objects. This data is automatically fed into O-Calc Pro pole loading software and a model of each pole is created.



Step 3: O-Calc Pro pole loading software was used to create a complete digital model of OG&E's pole network, including comprehensive structural load analysis. The model enabled prescribing effective solutions for any found conditions throughout the network and offer efficient remediation options.

Step 4: Provide a pole-by-pole recommendation, considering the remaining strength estimation performed during the evaluation and life-extension treatment process as well as the pole load analysis results. The outcomes included:

-Poles that already meet the 150 mph wind loading

-Poles that should be strengthened using steel upgrade trusses

-Poles that required stronger replacement poles

The work is ongoing, but it is estimated that this initial effort will analyze and harden more than 1,200 line-miles encompassing 38 circuits and roughly 49,000 poles. It is projected that over a quarter are projected to require strengthening with the steel upgrade truss to meet the new OG&E wind loading. Cost savings are estimated as up to 65% versus replacing every identified pole. Further, the pole replacement rate required to bring true weather resiliency to OG&E's customers is less than 5% of all poles evaluated.

In a recent high-wind storm event, a circuit that was hardened with the above process had no poles fail. Neighboring circuits experienced multiple pole failures.

CenterPoint has incorporated some Lidar pole loading assessments to identify poles that need to be hardened to meet the NESC extreme wind criteria. Some of the steel upgrade trusses have been installed as well. The results of the last two years are shown here:

2022

The company rebuilt **33** circuits (6 circuits are still outstanding)
About **145** miles of line was completed out of 147 miles
1,855 pole replaced
539 upgrade trusses installed

2023

The company completed **21** circuits for a total of **64** miles of line
1,177 poles replaced
306 upgrade trusses installed
Also reviewed and included poles that passed extreme wind loading adding another **100 miles** of line

These quantities seem to represent a rate that is established for a long term plan. It is likely that an accelerated plan of installing upgrade trusses could possibly upgrade all the main feeders in one and half to two years.

Additional CenterPoint Wood Pole Asset Management Programs

IX. Additional CenterPoint Proactive Resiliency Improvements

CenterPoint Standard, Distribution Grid Resiliency & Reliability, issued in March 2022 and August 2022 includes many additional steps toward improving system resiliency.

The following includes excerpts from the CenterPoint Distribution Grid Resiliency & Reliability Standard.

A. Upgrading with Engineered Poles -The Quantities Seem Low

CenterPoint has approved multiple options for upgrades with non-wood engineered structures.

5.3 Non-Wood Engineered Structures

CenterPoint Energy evaluated alternate materials to provide options as EWL is adopted across the system. Use of non-wood, engineered materials in certain design situations will increase overall system resiliency.

a. Concrete poles

In some cases, concrete poles are a desirable structure but there are limitations which have kept the use of concrete pole limited.

1. Concrete – Allows for higher strengths but has highest weight. Installation requires truck accessibility. In most cases, concrete poles are not field customizable and must be manufactured with known framing hole standard(s) in advance.

b. Fiberglass poles

CenterPoint has worked with a fiberglass pole manufacturer to design and develop high strength fiberglass poles. When it is necessary, the fiberglass poles are designed to have a similar tip deflection as wood poles.

3. Modular Fiberglass – These are modular, light weight, field customizable, and high strength but deflection is higher than other pole materials. Fiberglass pole modules can be carried by hand and allow for installations without a truck. Fiberglass poles are advantageous in difficult to access locations.

The total number of fiberglass poles installed in the CenterPoint territory is **19, 429.**

c. Ductile iron poles

Ductile iron poles offer a stiffness that is helpful in reducing deflection in high wind loading. Like fiberglass poles, ductile iron are installed for specific types of installations that it is well suited for because of its stiffness.

2. Ductile Iron (DI) – Also allows high strengths but weighs like wood poles. DI poles are field drillable and fully coated for corrosion protection. DI poles are preferred material for certain applications due to their ability to field drill for various configurations and the customization they offer. Due to the installation practices and weight, DI poles require less installation time and coordination.

The total number of ductile iron poles installed in CenterPoint territory is: **1,822.**

d. Critical Installations on Engineered Structures

-Steel Truss Upgrading should be considered

4.2.1 Equipment Poles

All major equipment including Intelligent Grid Switching Devices (IGSDs), large three-phase transformer banks (>250kVA), pole top switches, terminal poles, capacitor banks, regulator racks, junction poles, and double stacked circuits will be installed on poles composed of a non-wood, engineered material like fiberglass, ductile iron, and/or concrete.

- Intelligent Grid Switching Devices
- Regulator Racks
- Large Transformer Banks (3-250 kva, 3-333 kva, 3-500 kva banks)
- Double Circuit Poles
- Junction Poles
- Substation Getaways
- Capacitor Banks
- Pole Top Switches
- Three Phase Terminal Poles (Feeder Dips, Substation Terminal Poles)

e. Large Transformer Banks

Large transformer banks have not performed well in extreme storms. Putting those structures underground or on stronger engineered ductile iron structures does improve resiliency.

B. Significantly Increasing Wind and Ice Loading – Best in Class

> **4.1.1 Extreme Wind Loading**
>
> CenterPoint Energy adopted National Electrical Safety Code (NESC) Rule 250C (Extreme Wind) and 250D (Extreme Ice with Concurrent Wind Loading), regardless of pole height. All new distribution structures and replacements will be designed to applicable hurricane level extreme wind speeds; 110-mph (North of US 59 and Hwy 90) and 132-mph (South of US 59 and Hwy 90).

The NESC has a District Loading map which specifies deterministic Combined Ice and Wind loads for all poles. For poles extending more than 60 feet above groundline, the NESC requires an Extreme Wind additional load case to be evaluated. The Extreme Wind maps show higher wind speeds that are based on the probability of occurrence. In many cases, the Extreme Wind conditions create a greater load on poles that extend less than 60 feet above ground, but they are excepted from that rule from that rule based on safety considerations.

By adopting the Extreme Wind conditions for all poles, CenterPoint has gone above and beyond what is required to account for hurricane events. This new requirement will help to improve structural resiliency for years to come.

C. Freeway Crossings -Best in Class

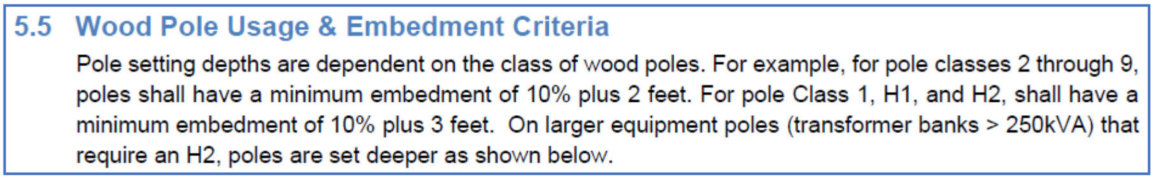
> **4.2.3 Freeway Crossings**
>
> For all freeway crossings underground construction will be the primary design option. If that is not feasible, then overhead construction with concrete pole will be considered.

D. Requiring Class 2 as the minimum wood pole class on feeders -Best in Class

Pole failures on feeders can lead to more widespread outages than laterals. Increasing the minimum wood pole class increases feeder structural resiliency.

E. Increasing Embedment Depth for Heavy Load Class Wood Poles -Best in Class

The industry rule of thumb for embedment depth of wood poles is 10% of length plus 2 feet. As pole class increases, the corresponding percentage of foundation capacity decreases. CenterPoint has increased the setting depth for high class poles as an improved measure to increase foundation capacity and reduce the chance of foundation failure and leaning poles in extreme weather events.

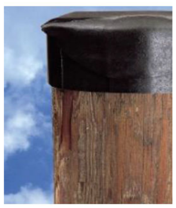


5.5 Wood Pole Usage & Embedment Criteria

Pole setting depths are dependent on the class of wood poles. For example, for pole classes 2 through 9, poles shall have a minimum embedment of 10% plus 2 feet. For pole Class 1, H1, and H2, shall have a minimum embedment of 10% plus 3 feet. On larger equipment poles (transformer banks > 250kVA) that require an H2, poles are set deeper as shown below.

F. Installing pole toppers and groundline preservative wrap on new pole installations – Best in Class

Installing the groundline preservative wrap provides a booster shot to the original preservative treatment right at day one. This is sure to retain adequate levels of preservative for additional years.



Groundline decay has the highest potential for wood pole deterioration. The second highest potential for degradation is the pole top. Over time the top tends to split and in many cases decay originates there. A split or decay can extend down to the connection point for crossarms and other equipment. The pole topper provides long lasting protection against UV and environmental conditions.

X. Opportunities for Improvement

A. Change wood pole fumigant from liquid WoodFume to granular OsmoFume for greater effectiveness and longer lasting. This will support the 10 year inspection cycle.

B. Reduce the limitations for restoring reject poles. Many of the poles not allowed to be restored are in fact restored by utility companies across the nation.

C. Increase pole loading assessments, perhaps on the main feeders, to enable steel truss upgrading and quickly increasing resiliency.

I reserve the right to modify or amend my opinions upon receiving additional or new information.

Respectfully submitted,

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Appendix A

Nelson G. Bingel, III
Curriculum Vitae

Hurricane Beryl After-Action

Final Report

October 25, 2024

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Executive Summary

In July 2024, PA Consulting Group, Inc. (PA) was engaged by CenterPoint Energy, Inc. (CenterPoint, CNP, or the Company) to conduct an independent assessment and prepare an after-action review of the Company's storm preparedness and restoration efforts associated with Hurricane Beryl. This report is intended to provide CenterPoint Energy with recommendations to enhance resiliency and be better prepared for future extreme weather events and other emergencies. In certain areas, it may provide specific context from CenterPoint's response in Hurricane Beryl, but it is not intended to be a comprehensive review of CenterPoint's performance during Hurricane Beryl. The report focuses on areas of improvement since CenterPoint commissioned PA to help it understand areas of improvement, and as such, this report does not conclude that CenterPoint's overall preparation and response was insufficient.

This report focuses on go-forward improvements. Furthermore, we understand that CenterPoint is already underway on many of the recommendations as part of its Greater Houston Resiliency Initiative, and we anticipate that CenterPoint will proceed to consider all of the recommendations with its regulator and other key stakeholders.

Hurricane Beryl made landfall as a Category 1 storm on July 8 at 4:00 AM, sweeping directly through the CenterPoint Energy Houston Electric (CEHE)[1] service territory. As the storm slowly weakened, it caused extensive damage, particularly northeast of the eye (the "dirty side"), severely impacting the Greater Houston area and its dense tree canopy. Although the transmission system was generally not impacted, thousands of trees were uprooted, many of which fell on CenterPoint's overhead electric lines, resulting in widespread damage to the Company's distribution system and those of neighboring electric utilities.

CenterPoint's emergency preparedness and restoration efforts during Hurricane Beryl came under intense scrutiny from customers, local governments, and other public officials. Public frustration in Houston grew quickly due to the lack of a customer outage tracker and the absence of timely Estimated Time of Restoration (ETR) information. This issue will be explored in detail throughout the report. In contrast, CenterPoint demonstrated effective application of lessons learned from past wind events, such as Hurricane Ike in 2008. Notably, its transmission system largely withstood the storm, highlighting the success of CenterPoint's system hardening initiatives.

Aligned with CenterPoint's commitment to building the most resilient coastal grid in the country and enhancing its storm restoration efforts, PA developed this report to assess the utility's storm preparedness and restoration performance. The report offers detailed recommendations to enhance CenterPoint's standard practices, including near-term actions to improve the utility's response to potential storm events in 2024. It also outlines mid-term strategies for action ahead of the 2025 storm season, as part of Phase 2 of the Greater Houston Resiliency Initiative, with additional actions planned for subsequent beyond Phase 2. CenterPoint has implemented, or has already begun planning to implement, a number of the strategies and recommendations contained in this report.

[1] CenterPoint Energy Houston Electric is the electric transmission and distribution subsidiary for the Houston area of CenterPoint Energy, which operates across several states. While CenterPoint Energy as a whole manages a wide range of utility services, including natural gas distribution, CenterPoint Energy Houston Electric specifically handles the delivery of electricity to customers in the Houston area. References to CenterPoint Energy generally relate to CenterPoint as a whole including CEHE, but where the context requires, references to CenterPoint Energy may relate solely to CEHE.

Hurricane Beryl

Hurricane Beryl began as a tropical depression in the Atlantic on June 28, 2024, and rapidly strengthened into a Category 4 hurricane by June 29. On July 1, Beryl made landfall on Carriacou Island in Grenada. Beryl made history as the first Category 4 hurricane ever recorded in the month of June and later escalated to a Category 5.

As Beryl moved through the Caribbean, it weakened, making a second landfall on the Yucatán Peninsula as a Category 2 hurricane on July 5. After reentering the Gulf of Mexico, Beryl regained strength and made its final landfall in the Greater Houston area on July 8 as a Category 1 storm. The hurricane swept across 80% of CEHE's service territory, with its 'dirty side' delivering wind gusts up to 84 mph and sustained winds up to 58 mph. As Beryl moved further inland, it retained its strength, with gusts reaching up to 83 mph and sustained winds peaking at 62 mph. This resulted in extensive damage in the Greater Houston area, particularly to the urban tree canopy and forested areas.

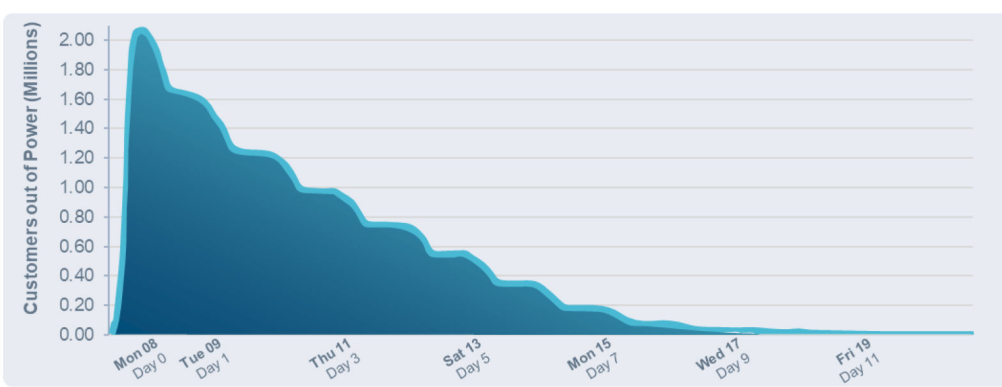
For CenterPoint and the Houston area, the storm's potential severity remained uncertain almost until Beryl made landfall in Texas on July 8. From July 1 to July 4, weather forecasts indicated that the storm would strike Northeast Mexico, suggesting minimal to no impact on Houston. However, on the morning of July 6, the forecast shifted to project Beryl's landfall near Rockport, Texas, with a post-landfall path west of Houston, resulting in moderate impacts expected in Houston. By July 7, the forecast evolved further, placing the Greater Houston area directly in Beryl's path.

CenterPoint's Response to Hurricane Beryl

Hurricane Beryl caused extensive damage to CEHE's electric infrastructure but primarily impacted the distribution system. The impact was intensified as the storm hit the city's most densely populated service area, with a high number of tree falls—many from outside CenterPoint's easements—in part, due to weakened roots and saturated soils from recent heavy rains, making trees more likely to topple. Over 75% of overhead distribution circuits experienced lockouts, leaving more than 2.1 million CenterPoint Energy customers (~75%) without power. The last windstorm of a similar magnitude that CenterPoint experienced was Hurricane Ike in 2008.

While the distribution system was significantly impacted, the transmission system proved resilient. CenterPoint experienced 6 substation outages (2.0%) and 15 customer substation outages (8.0%),[2] all of which were restored to service quickly. Only 31 transmission line segments (8.0%) experienced outages, 16 transmission structures (0.05%) required replacement, and 4 others (0.01%) needed repairs. Figure ES - 1 shows CenterPoint's restoration curve for Hurricane Beryl. The blue line represents the number of customers without power due to Hurricane Beryl on each specific day.

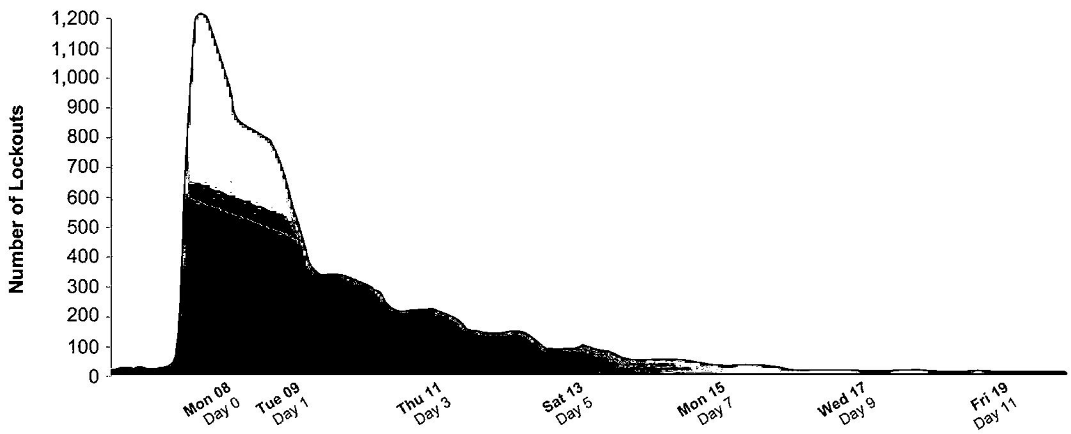
Figure ES - 1: CenterPoint's Restoration Curve for Hurricane Beryl



[2] CenterPoint substations that experienced an outage include Intercontinental, Treaschwig, Kingwood, Pinehurst, and West Bay. In addition, a customer owned substation, Inteq, also experienced an outage.

The extensive number of distribution circuits lockouts was the major technical restoration challenge Beryl presented. CenterPoint's long overhead circuits with few field sectionalizing devices,[3] resulted in distribution circuit breakers protecting large areas of the system. Patrolling for and repairing damage to such large areas contributes to longer restoration times. As shown in Figure ES - 2, distribution circuit breaker lockouts peaked at 1,202, these being almost exclusively from the 1,675 overhead circuits on the CEHE system. Circuit re-energization results from Monday afternoon and Tuesday show significant progress, but also show the magnitude of the challenge, as 316 distribution circuits remained deenergized on Tuesday night, 36 hours after Beryl left CEHE's territory.

Figure ES - 2: Distribution Feeder Lockouts During Hurricane Beryl



Due to the extensive damage caused by Hurricane Beryl, CenterPoint did not identify and issue a global ETR that first day. Daily press releases containing information regarding restoration expectations began on July 10. For example, the July 10 press release indicated that CenterPoint expected to have 400k customers restored by Friday, July 12, and another 300k customer restored by Saturday, July 13. Additionally, CenterPoint provided a map of outages, restoration status, and circuit based ETRs, that was updated at least daily.

This approach falls short of industry-leading practices, as global ETRs help shape customer expectations and inform them of necessary actions, if any. Furthermore, these estimates aid external stakeholders, such as municipalities, water districts, and other agencies, in coordinating their responses. The absence of this information limits customers' ability to plan and manage their activities during outages, heightens uncertainty, and undermines communication between the utility and its customers. CenterPoint's customers quickly voiced their frustration over the lack of restoration information.

CenterPoint's external communications and overall narrative regarding the storm quickly deteriorated due to its inability to provide sufficient outage information to customers. The customer-facing Outage Tracker was unavailable during Hurricane Beryl because of technical issues that had been identified during the May 2024 derecho. While CenterPoint's outage tracking systems typically perform well under normal conditions, it's important to acknowledge that similar challenges have been encountered by other utilities during major storm events, particularly when faced with unprecedented volume and demand. Additionally, CenterPoint's Power Alert Service® (PAS) failed to consistently notify customers that the Company was aware of their outages or to deliver timely updates, primarily due to bandwidth limitations. Furthermore, as only 42% of customers were enrolled in PAS prior to the storm, only that percentage of customers would have received critical information even if the service had been

[3] When originally conceived, CenterPoint's distribution design philosophy was intended to be the most cost-effective solution for rate payers.

functioning properly. It's important to highlight that the legally mandated involvement of Retail Electric Providers (REPs) as intermediaries between the distribution provider and customer creates a communication barrier not typically encountered in the industry. Bridging the gap between CenterPoint and its end users will significantly enhance storm preparedness, response, and the overall customer experience in future storms, and will be discussed in detail in this report.

Beryl's restoration ultimately took 11 days, which was significantly shorter than the 17 days required for the Company to restore power after Hurricane Ike and on par with peers during Hurricane Beryl in spite of the direct storm impact to CenterPoint. However, even after 8 days of efforts, approximately 78,000 customers were still without power, resulting in a prolonged outage that posed significant challenges for many customers in the Greater Houston area.

Overall Conclusions

CenterPoint's preparation and response to Hurricane Beryl were found to be generally consistent with industry standards, and its overall restoration time was comparable to its neighboring utilities. While the report highlights a number of recommendations and areas of improvement, it purposely does not try to describe the many instances where CenterPoint's actions were typical and/or leading practices in the industry. Examples of these include the timely acquisition of roughly 15,000 mutual assistance resources, and the rapid deployment of staging sites and associated logistics.

As detailed in the Customer Experience segment of the 'Findings & Recommendations' section of this report, customer sentiment declined from before the storm to after its impact. This negative feedback primarily arose from the communication challenges CenterPoint encountered throughout the storm. While proactive and frequent communication is crucial during major events, specific key information—particularly the status of customer outages and associated estimated restoration times—is essential to the communication's effectiveness. Additionally, CenterPoint did not provide a global ETR within 48 hours, which is the common industry practice, leaving customers uncertain about when their power would be restored. Ultimately, it was not the communication itself that was the issue, but rather the lack of information provided within those communications.

CenterPoint's Beryl response has highlighted critical areas for improvement in grid preparedness. Notably, the incidence of circuit lockouts during Hurricane Beryl was comparable to those experienced during Hurricane Ike, despite Beryl having wind speeds that were roughly 40% weaker than Ike's in part due to the difference in the storm's respective paths. Sustained winds inland for Beryl were 62 miles per hour and only 56 miles per hour for Ike. It is imperative that CenterPoint address the overall level of power loss, which affected more than 75% of customers during Beryl. Urgent action should significantly improve the resilience of distribution grid infrastructure. The reasons for feeder lockouts are varied, necessitating tailored solutions for each circuit based on specific damage assessments.

PA observed the need for more sectionalization on circuits. The current midstream devices and circuit end ties do not offer adequate sectionalization to prevent lockouts. To bolster the resiliency of the system, PA found that all circuits should be reinforced up to the first protective device located outside of the substation. This protective device should be placed at the first lateral off the backbone circuit. Enhancing circuits may require a combination of strategies, such as targeted vegetation management, the installation of covered conductors or tree wire, and the potential undergrounding of lines. A comprehensive analysis should be performed on a circuit-by-circuit basis, with the ultimate objective of significantly reducing feeder lockouts and improving overall grid stability.

The report recommends that CenterPoint improve its storm response by prioritizing key actions rather than addressing every recommendation in isolation. Users of this report should not take any one recommendation in isolation or out of context. Focusing on a strategic approach to planning and executing these recommendations is more critical than simply implementing as many as possible. By carefully selecting and aligning initiatives with existing programs, CenterPoint can ensure that its efforts are more effective and meaningful. This strategic prioritization allows for a more coherent and impactful response, ultimately leading to the enhancement of the customer experience and grid resilience.

Recommendation Summary

This report provides the findings of our analysis, with each section detailing specific insights relevant to CenterPoint's operations and performance. Accompanying these findings are tailored recommendations to address identified challenges and enhancing overall effectiveness. Below, you will find an index of these recommendations, designed to facilitate easy navigation through the proposed actions that will drive improvements and support CenterPoint's strategic goals. Each recommendation reflects a targeted approach to optimizing processes and bolstering resilience within the organization.

Table ES - 1: Index of Recommendations

Index ID	Recommendation	Timing	Section
CCH-1	Increase Call Center Resource Pool	Short-Term	3.15.2
CCH-2	Analyze Root Cause of IVR Containment Drop	Short-Term	3.15.2
CCH-3	Project Call Center Resource Needs	Mid-Term	3.15.2
CCH-4	Establish a Call Center Storm Response Plan	Mid-Term	3.15.2
COMMS-1	Update the Current Communications Plan	Short-Term	3.7.2
COMMS-2	Revise the Current Communications Strategy	Mid-Term	3.7.2
COMMS-3	Expand Relationships with External Stakeholders and Government Officials	Mid-Term	3.7.2
COMMS-4	Develop a Liaison Protocol	Mid-Term	3.7.2
COMMS-5	Establish Customer Experience Feedback Mechanisms	Mid-Term	3.7.2
CX-1	Implement Real-Time Customer Feedback during Major Events	Short-Term	3.9.2
CX-2	Increase Customer Enrollment and Customer Contact Database	Mid-Term	3.9.2
CX-3	Enhance Customer Communication Channels	Mid-Term	3.9.2
CX-4	Inform Customers of the Potential Need for Electrical Service Work	Short-Term	3.9.2
DER-1	Continue to Catalog DERs and Microgrids in CenterPoint Territory	Short-Term	3.17.2
DER-2	Leverage Capacity Maps	Mid-Term	3.17.2
DER-3	Use DERs during Restoration Efforts	Mid-Term	3.17.2
DM-AS-1	Integrate Damage Assessment and Vegetation Management Crews	Short-Term	3.12.2
DM-AS-2	Pre-Stage Materials/Equipment	Short-Term	3.12.2
DM-AS-3	Streamline Damage Assessment for Work Packages	Short-Term	3.12.2
DM-AS-4	Upgrade Damage Assessment Technology	Mid-Term	3.12.2
DM-AS-5	Revise Resource Utilization	Mid-Term	3.12.2
DM-PR-1	Gather Beryl Damage Data for Model Refinement	Short-Term	3.5.2
DM-PR-2	Refine Restoration Productivity Assumptions	Short-Term	3.5.2
DM-PR-3	Build, Develop, or Acquire more Comprehensive Damage Prediction Models	Mid-Term	3.5.2

Index ID	Recommendation	Timing	Section
EP&R-1	Enact 24-Hour EOC/DOC Operations	Short-Term	3.3.2
EP&R-2	Reevaluate FCC Support	Short-Term	3.3.2
EP&R-3	Focus Planning Section on Strategic Functions	Mid-Term	3.3.2
ETR-1	Calculate and Disseminate Global ETRs	Short-Term	3.6.2
ETR-2	Develop ETR Strategy and Processes	Mid-Term	3.6.2
ETR-3	Integrate ETR Manager Role into IC	Mid-Term	3.6.2
ETR-4	Define and Track ETR Accuracy	Mid-Term	3.6.2
GRID-1	Develop a Program to Segment Less than 500 Customers per Remotely Controllable Circuit	Short-Term	3.18.2
GRID-2	Develop Laterals protection and sectionalizing strategy	Short-Term	3.18.2
GRID-3	Replace Composite Pole and Cross-arms	Mid-Term	3.18.2
GRID-4	Replace Open Wire with Covered Conductors	Mid-Term	3.18.2
IC-1	Streamline EOC Layout	Short-Term	3.2.2
IC-2	Revise IC Roles and Responsibilities	Short-Term	3.2.2
IC-3	Expand IC/EOC Training	Short-Term	3.2.2
IC-4	Continue to Streamline EOC Layout	Mid-Term	3.2.2
IC-5	Establish EOC-Sections Daily Meeting	Mid-Term	3.2.2
IT/OT-1	Factor Storm Volumes into All Systems	Short-Term	3.20.2
IT/OT-2	Ensure Data Quality and Robustness	Short-Term	3.20.2
IT/OT-3	Harden IT/OT	Mid-Term	3.20.2
LOG-1	Use Enhance Operational Efficiency through Alternative Staging Site and Logistics Solutions	Short-Term	3.11.2
LOG-2	Use Select Service Centers for Staging	Short-Term	3.11.2
MA-1	Reevaluate FCC Support	Short-Term	3.10.2
MA-2	Develop Mutual Assistance Tool	Short-Term	3.10.2
MA-3	Reevaluate Storm Rider Policy	Short-Term	3.10.2
MA-4	Supply Mobile Technology to Crews	Mid-Term	3.10.2
MA-5	Create Equipment Equivalents List	Mid-Term	3.10.2
MA-6	Utilize Mutual Assistance Crews in the Same Efficiency as Internal Crews	Mid-Term	3.10.2
OT-1	Replace Outage Tracker	Short-Term	3.8.2
OT-2	Revise Technology Selection and Testing Processes	Short-Term	3.8.2
OT-3	Expand Customer Reporting	Short-Term	3.8.2

Index ID	Recommendation	Timing	Section
OT-4	Use Positive Language in Outage Tracker	Mid-Term	3.8.2
OT-5	Host Software Platforms Reliably	Mid-Term	3.8.2
RM-1	Expedite IAP Completion	Short-Term	3.13.2
RM-2	Evaluate FCC Pool Size	Short-Term	3.13.2
RM-3	Use Substation Restoration Segmentation	Short-Term	3.13.2
RM-4	Test Processes and Technology	Mid-Term	3.13.2
RM-5	Change RTO/DCO Jurisdictional Boundary	Mid-Term	3.13.2
SAF-1	Expand Safety Standdowns	Short-Term	3.4.2
SAF-2	Revise Substation Breaker Reclose Policy	Short-Term	3.4.2
SAF-3	Bolster Safety Leadership Responsibility	Mid-Term	3.4.2
TG-1	Catalog Critical Load Customers	Short-Term	3.16.2
TG-2	Test Existing On-site Generation	Short-Term	3.16.2
TG-3	Establish Deployment Priority List	Short-Term	3.16.2
TG-4	Develop and Promote Interconnection Services for Temporary Generation	Mid-Term	3.16.2
TG-5	Procure Additional Distribution-scale Generation	Mid-Term	3.16.2
UG-1	Identify a Pilot to do Underground Replacement of Existing Overhead Rear Lot Construction	Short-Term	3.19.2
UG-2	Develop Worst Performing Feeder Underground Program	Short-Term	3.19.2
UG-3	Expand UG Priority Circuits	Mid-Term	3.19.2
VM-1	Revise Trimming Cycles	Short-Term	3.14.2
VM-2	Optimize Crew Coordination	Short-Term	3.14.2
VM-3	Enhance Tree Replacement Program	Mid-Term	3.14.2
VM-4	Develop a Digital Intelligence Program to Effectively Perform Condition-Based Trimming	Mid-Term	3.14.2

1. Introduction

01

1.1 Report Purpose & Objectives

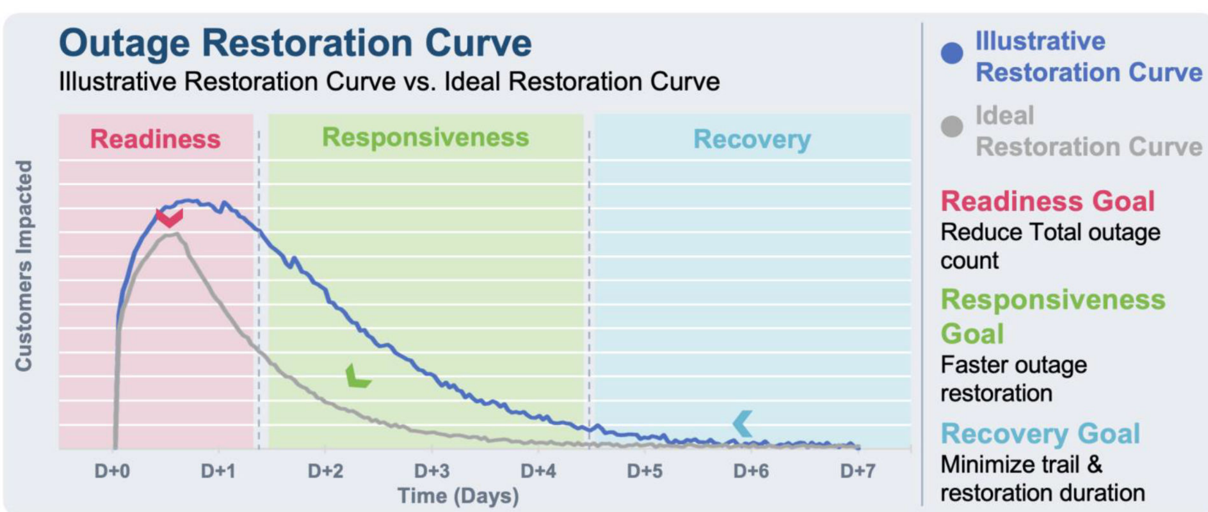
The purpose of this after-action review is to evaluate CenterPoint's preparedness and response efforts during Hurricane Beryl. It provides a detailed overview of the events surrounding the hurricane. Additionally, the report examines how CenterPoint designed and executed its emergency restoration plans across all phases of the restoration curve in response to Beryl. This report evaluated outage data, restoration timelines, communication effectiveness, and crew performance, incorporating insights from both frontline workers and management.

1.1.1 Resiliency

Beryl's storm restoration curve provided valuable context and a foundation for conducting an after-action review of the restoration effort. The storm restoration curve contains valuable customer experience information and demonstrates the resilience of the electric system, offering insights that can be leveraged to identify both process improvements and necessary investments in the system. This curve accurately portrays the overall customer outage experience during the event, distinguishing between those who are restored with minimal effort and those who experience prolonged outages, while also identifying areas that warrant targeted hardening or mitigation projects in the long term.

The restoration curve is divided into three key phases—readiness, responsiveness, and recovery. As illustrated in Figure 1 - 1, each phase begins and ends at distinct points within the overall restoration process, with specific goals and corresponding actions to achieve those goals. The readiness phase focuses on proactive measures, ensuring that systems and personnel are prepared to respond effectively. In the responsiveness phase, utilities optimize crew resources and implement immediate actions to address outages and restore service as quickly as possible. Finally, the recovery phase emphasizes restoring service to all customers (e.g., least accessible, single outages, etc.), completing the restoration effort.

Figure 1 - 1: Illustrative Restoration Curve



PA examined the sequence of events and processes that took place during the three restoration stages to understand how CenterPoint carried out their emergency restoration plans and to determine whether the stated objectives of those plans were sufficient to meet the challenges of a particular major outage event. These phases not only provide a structured approach to emergency restoration but also underscore the importance of strategic actions and planning at each stage. By understanding the unique characteristics and goals of each phase, utilities can optimize their efforts and investments, resulting in more efficient and effective restoration outcomes.

Readiness

For the readiness phase, PA evaluated how CenterPoint prepared through its planning and decision-making for the major event. The timeframe analyzed spanned from the initial identification of Hurricane Beryl up until the commencement of restoration activities, typically marked by the deployment of damage assessment resources. Specifically, PA examined:

- Actions taken within any established operational readiness processes and/or procedures in anticipation of Hurricane Beryl.
- Technology and systems readiness, including whether critical Information Technology/Operational Technology (IT/OT) systems (e.g., Outage Management System (OMS), dispatch software, outage maps) were sufficiently prepared, switched into storm mode, and verified to be operating optimally before Hurricane Beryl, and what, if any, mitigation actions were taken for identified issues or risks.
- Pre-event management of resources (contractor and mutual assistance), logistics, and operational preparedness activities (Incident Command Structure activation, securing resources, pre-staging crews and materials), along with mobilization efforts (e.g., staging site activations, fuel distribution, mutual assistance onboarding, and safety briefings) undertaken.
- Efforts made to understand and address the potential consequences of electric infrastructure and IT/OT system failures, along with associated contingency plan.
- Application of lessons learned from prior events and improvements committed to after previous storms (e.g., Hurricane Ike, May 2024 derecho), and how these lessons were incorporated into the emergency response plan used during Beryl's restoration planning.
- Development and customization of proactive messaging and associated customer communications/ alerts created prior to the storm's arrival, as well as omni-channel information dissemination plans.
- Verification of updates, testing, configuration management, and patch management of mission-critical IT/OT systems completed.
- Coordination made with other local utilities (e.g., water districts), stakeholders (municipalities, first responders), and critical customers (e.g., hospitals, major customers).

Responsiveness

PA focused on CenterPoint's restoration activities, which included the strategies, decisions, and execution of the restoration plans. These efforts commenced with the decision to initiate damage assessments and extended until the majority of affected customers had their power restored. PA's examination included:

The quality of the emergency restoration plan, particularly in relation to:	How the plan was executed during the event, including:
• Restoration strategy and prioritization of jobs/tickets. • Resource management (internal and mutual assistance), including the line crew/vegetation crew mix and required support and logistics resources. • Stakeholder engagement (e.g., general customer base, critical customers, elected	• Allocation of restoration resources across districts, staffing of call centers and liaison organizations. • Integration and utilization of contractor and mutual assistance crews throughout the restoration process. • Accuracy and timeliness of resource dispatch and work management during restoration.

The quality of the emergency restoration plan, particularly in relation to:	How the plan was executed during the event, including:
officials, local and city governments, and key accounts). • Development and dissemination of public-facing messaging. • Customer communications (e.g., messaging, updates, channels), with a specific focus on ETR communications including initial estimates and updates. • Systems/technology utilization, performance, and associated contingencies.	• Information flow between various groups, and how data (e.g., assessed damage, customer counts, outage statistics) was collected and analyzed to inform decision-making. • Effectiveness of communications and coordination with stakeholders. • Timeliness and accuracy of ETR updates (global, regional, local, and ticket/job-based). • The effectiveness of system design, grid automation, and communications technology in supporting restoration operations.

Recovery

Lastly, PA examined how the utility executed the final phase of customer restoration, assessed the effectiveness of its after-action review processes, and explored how lessons learned were identified and integrated into future restoration plans. Specifically, PA analyzed:

How well nested outages were identified and addressed.	The prioritization of the final restoration efforts, the resources held over to complete these tasks, and the handling of emergent outages that were not storm related.	The decisions and execution of demobilization plans for mutual assistance/ contractor crews and internal resources.	Areas where system controls and management excelled, as well as opportunities for improvement.

1.2 After-Action Review Methodology

The after-action review is an independent assessment of CenterPoint's preparedness, response, and recovery efforts during Hurricane Beryl. This evaluation was carried out through multiple rounds of data requests, which thoroughly examined the Company's performance. The review covered customer outage data, logistics, Supervisory Control and Data Acquisition (SCADA) information, asset data, and internal and external communications. To supplement this data, discovery interviews were conducted with key personnel overseeing emergency preparedness and response efforts. PA held over 30 interviews with CenterPoint employees, including all leadership staff within CenterPoint's Incident Command (IC), using a combination of on-site and virtual discussions. By gathering both quantitative data from requests and qualitative data through interviews and primary source documents and analyzing both, the after-action report evaluates all aspects of the utility's response to the hurricane and provides recommendations for improvements to the three stages (readiness, responsiveness, and recovery) to improve performance during the next event.

In this review, PA independently developed the outage restoration curve using a "bottom-up" approach, based on source data provided by CenterPoint. This data covered all grid events in CEHE's territory, along with their associated outages, which were then aggregated to produce a territory-wide outage count throughout the storm. Although PA's calculated outage metrics closely align with CenterPoint's initially reported numbers, discrepancies exist in the maximum number of customers affected and the daily restoration counts. These differences stem from PA utilizing outage data that had undergone post-storm Quality Assurance (QA) at the end of July.

PA noted that CenterPoint's data lacked timestamps, which could result in inconsistencies in measurement timing. Utilities typically need to reconcile their outage data, especially after major events like hurricanes, to ensure accurate record-keeping matches restoration actions in the field. For example, three customers may be connected to a reportedly damaged distribution transformer, resulting in a reported customer impact of 3 but the field crew may have repaired a single service drop and not the transformer, with a real customer impact of 1. This can lead to inaccuracies in the reported extent of the damage and the number of customers and locations affected. In CenterPoint's Request for Information (RFI) responses to the PUCT as well as in its operational compendium related to Beryl, both of which are used as references throughout this report, outage statistics had not yet undergone this QA process. After the QA process was completed, CenterPoint's numbers align with PA's. PA's dataset included precise outage timestamps, allowing for consistent daily reporting. Consequently, when referencing outage metrics and event chronology in this report, PA's calculations are used.

2. Hurricane Beryl

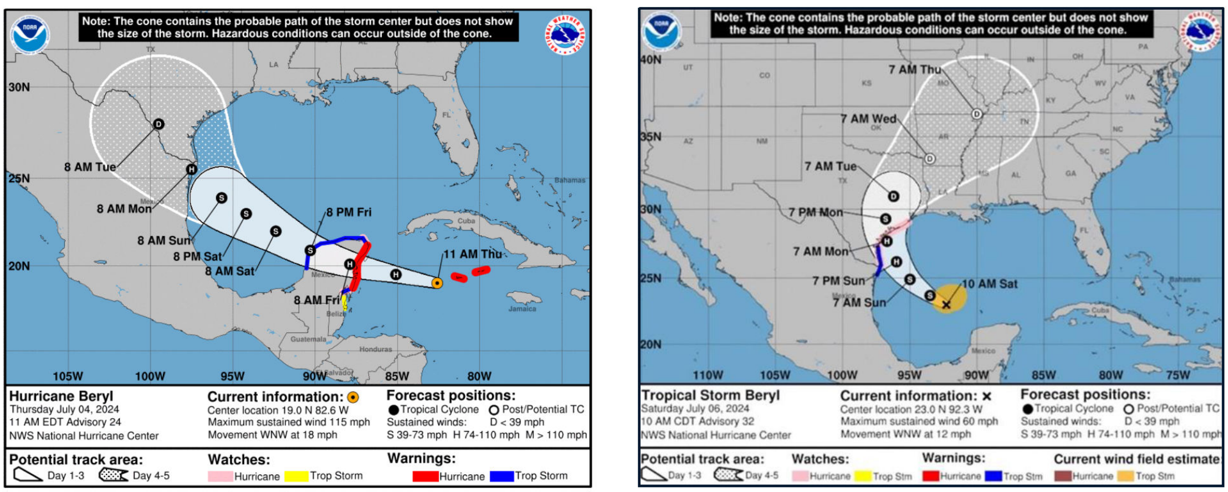
02

2.1 Hurricane Overview

Hurricane Beryl originated as a tropical depression in the Main Development Region of the deep tropical Atlantic on June 28, 2024, with winds of 35 mph. For the next week, the storm traveled across the Gulf of Mexico.[4]

After passing through Carriacou, Beryl continued to strengthen in the Eastern Caribbean Sea, becoming a Category 5 hurricane. Following this peak intensity, the storm began to weaken, passing south of Jamaica as a Category 4 on July 3. It further diminished before making a second landfall on the Yucatán Peninsula as a Category 2 on July 5. As Beryl moved over land, it lost strength but reemerged into the Southwest Gulf of Mexico later that day as a strong tropical storm. Despite its movement, Beryl struggled to regain intensity due to increased wind shear and dry air.[5] On July 6, Beryl's precise landfall location was still uncertain as it moved through the Gulf of Mexico. However, by July 8, the storm regained strength and made landfall in Texas.

Figure 2 - 1: Hurricane Beryl's Projected Track Area as of July 4 and July 6, 2024 (NOAA)



Prior to reaching Texas, Beryl's projected path had several possible trajectories based on various forecast models.[6] These potential paths included (shown in Figure 2 - 1):

- Gulf of Mexico: Initially, as Beryl reentered the Gulf of Mexico after crossing the Yucatán Peninsula, forecasts showed that it could take a more westward or northwestward path. This trajectory included potential landfalls anywhere along the Gulf Coast, from northern Mexico to the central Texas coastline.
- Northern Mexico: One possible path had Beryl moving towards northern Mexico, similar to previous storms that have crossed the Yucatán Peninsula and then curved westward. This would have resulted in a landfall near the Tamaulipas or Veracruz states.

[4] National Oceanic and Atmospheric Administration Climate.gov website. https://www.climate.gov/. Accessed August 2024.
[5] National Oceanic and Atmospheric Administration Climate.gov website. https://www.climate.gov/. Accessed August 2024.
[6] National Oceanic and Atmospheric Administration website. https://www.nhc.noaa.gov/. Accessed August 2024.

- South Texas: Another predicted path had Beryl targeting the southern Texas coast, potentially making landfall between Corpus Christi and Brownsville. This would have steered the storm away from major urban centers like Houston but still affected smaller coastal communities.
- Central Texas Coast: A more central path included potential landfall near Matagorda Bay, which would have put both Corpus Christi and Houston at risk, depending on the storm's trajectory after landfall.
- Eastern Texas and Louisiana: Some models suggested Beryl could curve more northeastward, which would have brought it closer to the Texas-Louisiana border or even into Louisiana, threatening areas like Beaumont, Port Arthur, and Lake Charles.

As the storm progressed, its path became more defined, leading to its eventual landfall and subsequent impact on the Greater Houston area. On July 8, Beryl made landfall as a Category 1 Hurricane. The forecast, as of 3:00AM CT,[7] indicated that the storm would have high impact to Houston with hurricane force winds and rain. The storm made landfall at 4:00AM and the eyewall tracked through Houston throughout the morning until around 2:00PM. The storm weakened slowly after hitting the coast and caused high levels of damage as it moved through Houston. Beryl's eye passed over the west side of the metro area, with the most damaging area of the storm northeast of the eye (or the "dirty-side"), passing directly through Houston as a direct hit.

The combination of high winds, over a foot of rainfall, and surge flooding led to downed trees, poles, and power lines, resulting in more than 2.1 million CEHE customers in the Greater Houston area losing power. Beryl caused significant flash flooding, power outages, and damage to vegetation creating a difficult environment for utility and emergency response crews to operate in. Multiple deaths were reported due to trees falling on homes and heavy rain caused several roadways in the area to become flooded with officials needing to perform almost 50 high water rescues by 3:30PM.[8] Figure 2 - 2 presents a daily breakdown of customer outages, detailing the extent of power loss experienced over the first nine days of the storm restoration period.

Figure 2 - 2: Customer Peak Outages Per Day Post-Beryl

[7] All times listed are Central Time unless otherwise stated.
[8] University of Houston Public Media article. "Beryl blows into Houston: Hurricane makes landfall as category one; three deaths reported." Accessed September 2024.

Following the initial power outage, nearly two hundred thousand customers remained without electricity for over a week as CenterPoint continued its restoration efforts.

Figure 2 - 3: Map of Customer Restoration Dates

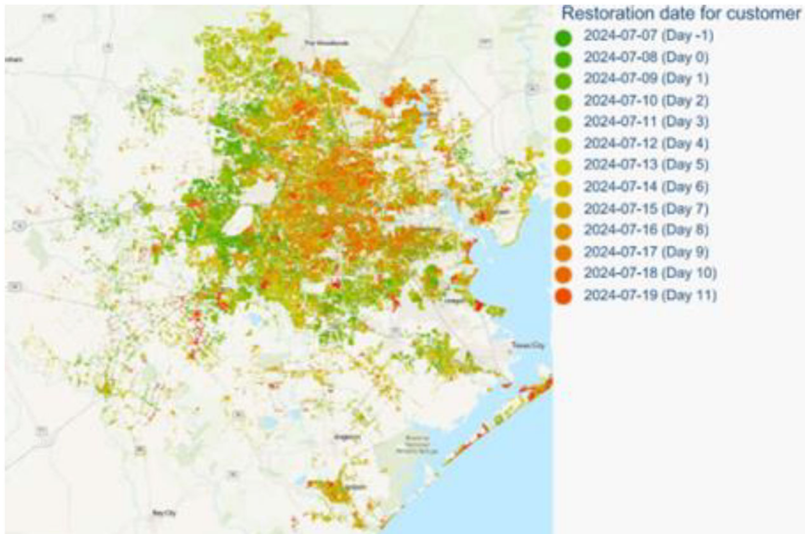


Image provided by CenterPoint Energy.

After the storm passed, government officials and nonprofits began opening cooling centers for the public to seek refuge from the heat, charge electronic devices, and access food and clean water. However, due to power loss some cooling centers were unable to operate.

During the storm, St. Luke's Health-Brazosport Hospital faced power outages and sustained damage, forcing it to rely on its standby generator. As a result, patients had to be transferred to nearby facilities. While most hospitals, including Houston Methodist and Memorial Hermann Health System, remained open, many outpatient facilities and clinics closed. Memorial Hermann's convenient care centers were limited to emergency services only and patients were moved to other hospitals due to the storm's impact.

Federal and state officials responded to the event with Federal Emergency Management Agency (FEMA) providing disaster relief to 67 counties in Texas and disaster declarations were issued in 121 counties. CenterPoint mobilized roughly 15,000 personnel for distribution line repair and vegetation management, deployed across 21 staging sites set up between July 8 and July 12 and in place throughout the duration of storm response. This included over 13,000 mutual assistance resources, 1,217 native contractors, and 583 CenterPoint resources. Over the course of the response the utility replaced over 3,000 downed or damaged poles and almost 2,500 transformers and used over 146,000 feet of wire in its effort to restore power to all affected customers.

On September 12, 2024, the Harris County Institute of Forensic Sciences submitted a request under the Texas Public Information Act to determine the number of deaths related to Hurricane Beryl in Harris County.[9] The response to the request confirmed 22 deaths attributed to the storm. Additionally, neighboring counties—including Fort Bend, Galveston, Montgomery, and Matagorda—reported further fatalities, bringing the overall death toll to 42. Trees falling on homes and people in vehicles also caused at least 3 deaths and flooding causing people to be trapped in cars. Overall, the storm caused between $2.5 and $3.5 billion in property damage to the area with the total approximate economic loss nationwide being between $28 and $32 billion.[10] After passing through Houston, Beryl weakened to a

[9] Harris County Institute of Forensic Sciences Texas Public Information Act Data Request. https://ifs.harriscountytx.gov/. Accessed September 2024.
[10] Axios Houston article. "Hurricane Beryl's estimated damage is in the billions." July 2024.

tropical storm once it was approximately 20 miles northwest from Houston or approximately 80 miles from landfall.[11]

2.2 Summary Event Chronology

The following visual timeline provides a concise summary of CenterPoint's key actions before, during, and after Hurricane Beryl. It highlights CenterPoint's preparedness efforts, response measures, and restoration activities as the storm unfolded, capturing critical decisions and milestones in the storm management process. This overview offers a clear snapshot of CenterPoint's performance and challenges throughout the event, reflecting both the successes and areas where improvements were identified for future response strategies.

Figure 2 - 4: Summary Timeline of CenterPoint Actions throughout Hurricane Beryl

Summary of Events & Response Actions

July 4 - July 6 **Pre-Storm Preparations**	July 7 **Day Before Beryl Landfall**	July 8 **Beryl Hits Houston**	July 9 **First Full Restoration Day**	July 10 - July 16 **Restoration Continues**	July 17 - July 18 **Post-Beryl Thunderstorm**	July 19 **Restoration Complete**
• CNP was actively monitoring Beryl since June 25 • Staging sites were notified for potential activation • Operational, planning, and weather meetings began on July 6 • Internal crew and native contractors were activated to report on July 8 • Initial request for mutual assistance was made • PAS® alert was sent to enrolled customers	• Emergency Level 2 Activation initiated • ICS was physically assembled • CNP contacted SEE and TXMAG to secure more resources • Requested mutual assistance for line skills, vegetation management & damage assessment • 4 staging sites were planned for July 8 mobilization • 4,468 crew resources were activated	• Beryl arrives at 4:00 AM • Emergency Level 1 Activation initiated • Daily leadership briefings began • Requested additional veg. management, mutual assistance • Began damage assessment • 4 staging sites were dispatch ready with 4,938 FTEs on site • Evaluated TEEEF location deployment • Over 339k customers restored by EOD	• Restoration activity continued: damage assessment and cut-and-clear • Established 14 additional staging sites (18 total) • Evaluated TEEEF location deployment • 10,589 crew members were on site (out of the 13,991 activated) • 74% of circuit lockouts cleared and over 1.1 million customers restored by end of day	• Over 1.3 million customers were restored by the evening of July 11 • Crews continued restoration activities (with over 15,000 total resources) • 21 staging sites were operational • 31 generation units were deployed and energized at 28 critical sites • 80% of customers were restored by July 14	• A thunderstorm (with 60+ mph winds) triggered additional outages • Restoration activities continued • Evaluated TEEEF location deployment • One TEEEF unit remained energized • Over 15,000 crew resources were on site	• All hurricane-related outages were restored • All non-union resources were demobilized • All TEEEF units were demobilized • Deactivated EOC • Transitioned out of Emergency Level 1 • Distribution Operations conducted post-storm recovery activities

CenterPoint Outage Tracker and ETRs

Absence of Outage Tracker discussed	• Outage tracker was not available • Global ETR was not provided • EOC and DOC suppressed system-generated ETRs	• July 9: A map of outages, circuit states, and circuit-based ETRs was rendered manually at least daily using an ArcGIS Story Map. A count of current customers impacted and those restored in the preceding 24-hour period was posted on CenterPoint's website. • July 10: Information regarding restoration expectations and high-level updates (such as customer counts) began to be provided on July 10 and continued to be released daily through press updates.

2.3 Hurricane Beryl Comparison

Beryl was one of the three most significant wind events in Houston, alongside Hurricanes Alicia (1983) and Ike (2008). While the 2024 storm wasn't as strong as the previous two, Beryl's direct path through the city accounted for the high level of damage to Houston's infrastructure and vegetation. With

[11] National Weather Service website. "Hurricane Beryl 2024." https://www.weather.gov/lch/2024Beryl. Accessed September 2024.

sustained winds up to 58 mph and gusts up to 84 mph, the storm damaged roughly 50% of Houston's urbanized area tree coverage and about 7.8 million acres of forestland.[12,13]

Table 2 - 1 outlines the characteristics of select storms in Houston where CenterPoint provided response and restoration efforts. Notably, it highlights that the reported wind speeds of Hurricane Beryl were the highest among these comparable storms. Additionally, CenterPoint's response to Hurricane Beryl marked the largest storm response in recent history, mobilizing roughly 15,000 internal and external resources—more than any previous response to comparable storms. Despite these comparisons, Beryl proved particularly devastating for Houston due to a combination of factors that intensified its effects compared to other storms.

Table 2 - 1: Houston Area Storms Comparable to Beryl

Select Houston Area Storms					
Storm Characteristics	Beryl	Derecho	Nicholas	Harvey	Ike
Storm Landfall Date	July 8, 2024	May 16, 2024	Sept 14, 2021	Aug 25, 2017	Sept 12, 2008
Sustained Wind Speed Reported at HOU*	58 mph	43 mph	43 mph	30 mph	75 mph
Peak Gusts Reported at HOU*	84 mph	62 mph	55 mph	40 mph	92 mph
Sustained Wind Speed Reported at IAH**	62 mph	40 mph	33 mph	25 mph	56 mph
Peak Gusts Reported at IAH**	83 mph	62 mph	51 mph	36 mph	82 mph
Weather Event Type	Wind	Wind	Water	Water	Wind
Storm Category at Landfall	1	-	1	4	2
Restoration Duration	11 days	7 days	4 days	10 days	18 days
Resources Mobilized (approx.)	15,000	6,700	5,000	10,000	12,000
Peak Outage Count	2.1M	858,271	502,000	1.27M	2.1M
Deaths in Houston Area	42	8	0	89	112
Houston Area Damage Cost (estimated)	$6.0B	$1.3B	$1.2B	$160.0B	$43.2B

Note: *National Weather Service historical data recorded at William P. Hobby Airport
**National Weather Service historical data recorded at Houston Intercontinental Airport
Source: Publicly available data from the PUCT and confidential CenterPoint Documents.

As the earliest recorded Category 5 storm in the Atlantic, Beryl made landfall in Houston in July, shortly after a severe derecho impacted the city in May. This sequence of events created a particularly challenging period for the region, as it faced the compounded effects of consecutive extreme weather events in a short period of time. The May derecho brought heavy rainfall, leading to significant soil expansion, which, combined with root stress from Winter Storm Uri and a drought in 2022-2023, resulted in an increased tree fall rate. This elevated fall rate adversely affected the distribution infrastructure, with 50% of circuit outages attributed to vegetation damage, particularly in rear lot distribution areas. As a result, Beryl's peak customer outage count exceeded 2.1 million, making it one of the highest in CenterPoint history.

[12] Austin, Texas KXAN Weather News. https://www.kxan.com/weather/2024-tropical-timeline-tracker/. Accessed September 2024.
[13] Texas A&M Forest Service website. https://tfsweb.tamu.edu/content/article.aspx?id=33655. Accessed September 2024.

Hurricanes Beryl and Ike share similarities in terms of damage amounts, the number of customers impacted, and the crew resources required for recovery. However, a notable difference between the two storms is the extent of damage to transmission infrastructure. As shown in Table 2 - 2 almost four times as many transmission structures were replaced in Ike as were in Beryl indicating the benefit of investments made in the transmission system.

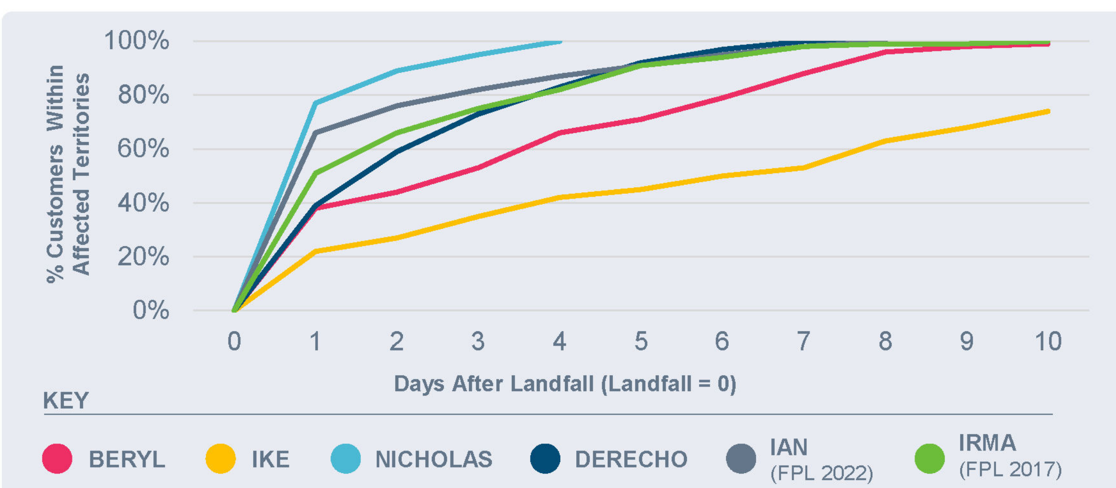
Table 2 - 2: Beryl vs. Ike Damage Summary

Comparable Houston Area Storms		
Impact	Beryl	Ike
Storm Landfall Date	July 8, 2024	Sept 12, 2008
Transmission Line Outages	8% (31/389)	31% (99/320)
Substation Outages	2% (6/313)	18% (49/267)
Customer Sub Outages	8% (15/194)	41% (56/137)
Customers Out at Peak	75.0% (2.1/2.8M)	90.5% (1.9/2.1M)
Transmission Structures Replaced[14]	16 (.06%)	60
Transmission Structures Needing Repair[15]	4 (.01%)	82
% Feeder Circuits Out	75%	88%
Distributions Poles Replaced	3,025	8,500

Source: Publicly available data from the PUCT and confidential CenterPoint Documents.

Despite the vast number of crews deployed, the widespread damage to the distribution infrastructure resulted in a long duration effort. The restoration curve for Beryl was flatter during the earlier days of the response, with a similar shape to Ike's, when compared to other similar storms in Houston. This flat start to the curve indicates a challenge in quickly restoring power to a large portion of affected customers due to the significantly larger quantity of damage locations caused by Beryl and Ike compared to the other storms. As shown in Figure 2 - 5, PA leveraged restoration data from Florida Power & Light (FPL), which is a leader in infrastructure resiliency and hurricane response, for an industry comparison.

Figure 2 - 5: Restoration Curves for Comparable Storms



[14] Historical data on CenterPoint's total transmission structures is not available.
[15] Historical data on CenterPoint's total transmission structures is not available.

2.4 Hurricane Beryl Response Comparison

As Beryl impacted each service territory, the responses from CenterPoint, Texas-New Mexico Power (TNMP), and Entergy Texas, Inc. (ETI or Entergy) were similar in how the utilities tracked the storm, requested mutual aid, deployed crews and resources, communicated with customers, and restored power.

Service Territory Damage

The damage that Beryl caused in each utility territory varied as shown in Table 2 - 3. While all utilities experienced relatively similar levels of distribution pole damage, none reported significant transmission infrastructure failures. TNMP experienced the highest level of distribution pole damage, with approximately 0.5% of their total poles down. Beryl's path directly hit CenterPoint service territory resulting in the larger amount of customer outages experienced compared to the other two utilities.

Table 2 - 3: Key Beryl Restoration Metrics from Peer Utilities

Peer Utilities Performance of Hurricane Beryl			
Utility	CEHE	Entergy	TNMP
Peak Customer Outage Count	**2.1M**	**299,512**	**142,000**
Restoration Duration (days)[16]	**11**	**8**	**9**
Average Restoration Time (hours)	**43**	**72**	**55**
Maximum Outage Length (hours)[17]	**248**	**227**	**242**
% of Affected Customers	**75%**	**45%**	**53%**
Total Distribution Poles Down	**3,025**	**910**	**481**
Non-wood Failures	337	-	-
Wood Failures	2,688	910	481
Total Poles	1,165,862	517,683	103,032
Total Distribution Pole Failure %	**0.26%**	**0.18%**	**0.47%**
Total Transmission Structure Failures	**20**	**6**	**-**
Non-wood Failures	-	-	-
Wood Failures	20	6	-
Total Transmission Structures	25,849	25,087	2,737
Total Transmission Structure Failure %	**0.1%**	**-**	**-**

Source: Publicly available data from the PUCT (RFI Responses) and confidential CenterPoint Documents.

[16] The end date of restoration is considered to be the day that all customers who can safely receive service are restored.

[17] Maximum outage lengths reported may exceed restoration duration due to some customers being unable to receive power after restoration efforts were complete.

Storm Tracking & Preparedness

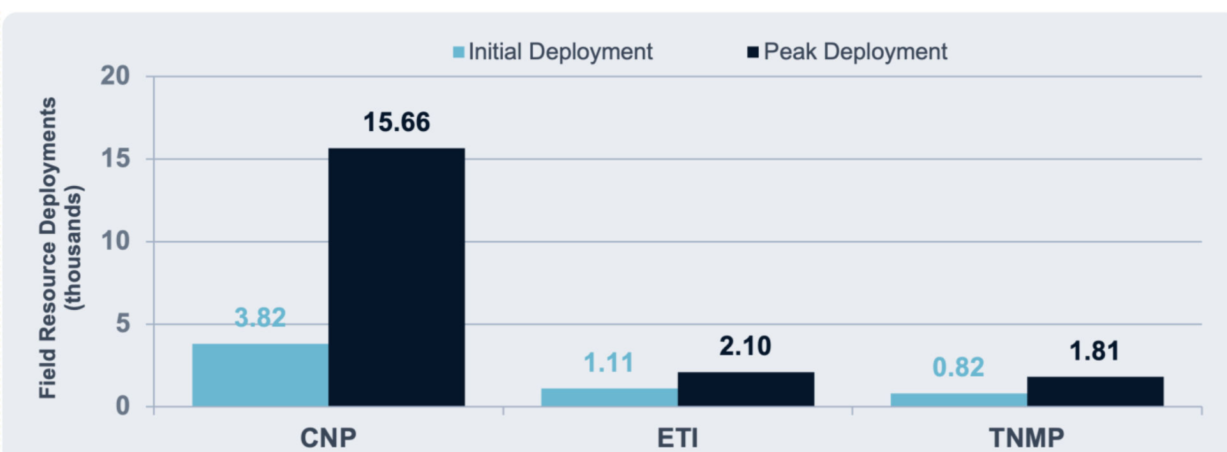
CenterPoint began tracking tropical disturbance 7 (which would become Hurricane Beryl) on June 25. On July 2, CenterPoint received a notification from StormGeo indicating that Hurricane Beryl could possibly make landfall near Houston. StormGeo is a professional meteorologist and weather forecasting vendor that provides daily weather forecasts and 24/7 meteorological support. The same day, CenterPoint initiated storm preparations and began coordinating with a line skills resource aggregator. Similarly, ETI had begun monitoring the disturbance on June 25 and commenced storm preparedness activities subsequent to that date. TNMP's storm monitoring began on June 30, a few days after the neighboring utilities, and initiated storm preparedness on July 6.

A key element in storm preparedness is to ensure all systems are working properly. CenterPoint's Outage Tracker was not available during Hurricane Beryl; however, the Company deployed an alternative Outage Map that provided customers with a map of outages, restoration process, circuit states, and circuit-based ETRs. TNMP reported that their outage tracker was not specifically tested as the tracker's "functionality and performance are continuously monitored as part of normal operations."[18] ETI reported having a dedicated team that regularly tests the functionality and performance of their outage tracker, including planning and storm preparation activities, throughout the year. The utility stated, "monitoring is increased during major storms to quickly detect and address any issues affecting the ability to accurately track outages."[19]

Mutual Assistance Comparison

ETI initiated mutual assistance coordination on July 5, submitting its first request for 640 field restoration resources on July 7. TNMP requested initial resources on July 6 and identified roughly 90 nearby full-time contractors who were prepared to assist in the area. Both utilities leveraged local contractors, and once Beryl made landfall on July 8, each utility requested mutual assistance crews and began deploying resources to respond to the storm. Similar to CenterPoint, neighboring utilities activated their respective incident commands by July 7. Due to the extensive damage brought to CEHE's territory, CenterPoint coordinated and managed a considerably greater number of mutual assistance and field resources compared to neighboring utilities.

Figure 2 - 6: Peer Utility Crew Deployments during Beryl

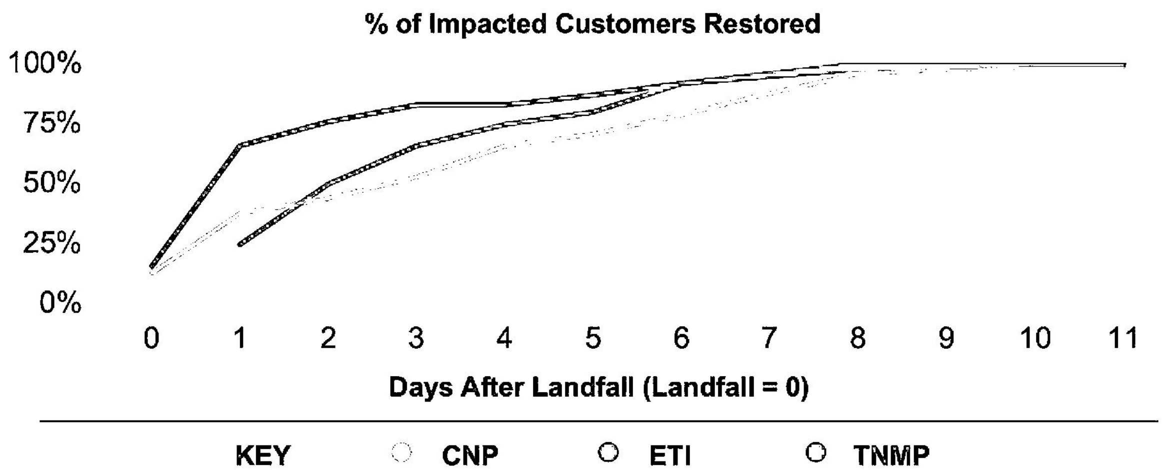


[18] Public Utility Commission of Texas Filing. Texas-New Mexico Power Company's Response to Commission Staff's First Request for Information. PUC Docket No. 56822. Accessed September 2024.
[19] Public Utility Commission of Texas Filing. ETI's Responses to Staff's 1st RFI Questions 1 Through 55. PUC Docket No. 56822. Accessed September 2024.

Outage Restoration

As crews operated in each territory, customer restoration timelines varied across the three utilities, as illustrated in Figure 2 - 7. ETI achieved the fastest restoration timeline, fully restoring service to all customers by July 16, followed by TNMP on July 17 and CenterPoint on July 19. TNMP's restoration curve indicates it experienced the largest initial step of outage restorations, with over 80% of customers restored by July 11, just three days after Beryl made landfall.

Figure 2 - 7: Beryl Restoration Curves of Peer Utilities[20]



[20] ETI did not report the percentage of restoration achieved on the 8th, as crews were engaged in overnight operations, and it appears that damage assessment was not fully completed by the time of their last press release that day.

3. Findings & Recommendations

03

This section presents targeted recommendations designed to address specific challenges that emerged during Hurricane Beryl. PA identified areas of concern and potential improvement, along with strategies to enhance storm response and strengthen CenterPoint's resilience by completing a thorough review of the restoration performance data and preparedness processes. The recommendations in this section are intended to optimize response strategies and enhance CenterPoint's infrastructure, ensuring greater response effectiveness in future storms.

3.1 Resiliency Planning & Portfolio Management

Throughout this report, PA presents a series of tailored actions aimed at enhancing CenterPoint's storm response and driving overall improvement. However, the key to success lies not solely in the specifics of each recommendation but in rationalizing these actions, evaluating their potential impact, and prioritizing them effectively. Once prioritized, the portfolio of actions can be harmonized with existing capital and operations and maintenance (O&M) programs, significantly advancing resilience, and delivering a noticeably improved customer experience. By employing the methodology outlined below, CenterPoint can craft an ideal restoration curve that aligns with the customer experience they aim to deliver. This approach will enable the creation of a portfolio of initiatives, which can be leveraged to develop a comprehensive roadmap for achieving their stated objectives within realistic resource constraints.

01 **Dissect Beryl's Restoration Curve:** Dissect the restoration curve from Beryl, along with similar historical curves (such as Ike), on an order-by-order basis—evaluating factors like damage severity, ease of restoration, and resource deployment. Developing a disaggregated restoration curve with order-by-order granularity will serve as the foundation for further analysis and establish a baseline for forecasting improvements.

02 **Develop the Target Restoration Curve:** Develop a targeted restoration curve that outlines the expected timeline and sequence for restoring services after a major event. The curve considers the specific needs of different customer types and their associated challenges. By aligning restoration efforts with customer expectations and operational capabilities, CenterPoint can enhance their response strategies, improve overall customer satisfaction, and help ensure a more resilient grid.

03 **Conduct an Impact Analysis:** Conduct an impact analysis by evaluating historical storm data alongside forecasts of potential future events to determine the benefit that implementing each initiative would provide to grid infrastructure and the customer experience.

04 **Prioritize Initiatives:** Once the impact is assessed, prioritize initiatives based on their potential benefits, focusing on those that offer the greatest improvement to grid resilience and customer experience. This helps ensure that resources are directed to the most impactful actions, optimizing both short- and long-term outcomes.

05 **Develop Portfolio of Initiatives:** Once the initiatives are prioritized, develop a portfolio to effectively manage all the initiatives slated for implementation. This portfolio should align with strategic objectives while carefully considering capital and O&M cost constraints. By consolidating initiatives into a cohesive framework, CenterPoint can help ensure that resources are allocated efficiently, track progress, and adjust as needed to maximize both financial sustainability and overall success.

3.2 Incident Command

An IC and EOC are vital components for electric utilities during the storm restoration process. The IC should provide a clear, organized framework for managing emergencies, helping to ensure effective coordination among various teams and resources. By establishing defined roles and responsibilities, the IC enhances communication and decision-making, allowing for rapid responses to evolving situations. The EOC serves as the central hub for strategic oversight, where key personnel can monitor the storm's impact, assess damages, and prioritize restoration efforts. Together, these systems facilitate a streamlined response, benefiting the safety of both utility workers and the public while expediting the restoration of power and critical service. Once activated, the IC assumes unified command (top-down control and management) of all personnel, processes, and technologies involved in the restoration process. The primary responsibilities of the IC include:

Establishing restoration strategies (e.g., ticket, circuit, area)	Acquiring and allocating resources on a continual basis	Setting global ETR and transitioning to circuit-based and ticket-based approaches	Monitoring progress and supporting the Department Operations Center and branch directors	Providing updates to the Crisis Management Committee

In short - the "buck stops" at the IC.

3.2.1 Findings

During CenterPoint's Beryl response, the EOC was activated. PA found that the activation of the IC was consistent with industry practices and many of the IC's functions aligned with industry norms and standards. For example, the CMC served as the policy leader and the DOC played a crucial role in requesting and coordinating resources as well as shaping restoration strategies. However, several of the IC's functions including the planning section did not operate consistent with industry norms and standards.

As the storm track shifted between July 5 and July 7, just before impact, the anticipated damage and the demand for restoration crews and resources increased significantly. On Saturday, July 6, the DOC made the decision to mobilize resources in preparation for a Monday morning start to restoration efforts.

Preparedness

CenterPoint's IC was activated according to the processes outlined in its EOP. IC section level chiefs (or their equivalents) monitored the shifting forecasted storm tracks prior to storm impact and acted accordingly. Staffing plans for Monday morning were influenced by union callout rules and a lack of dedicated storm riders. Daily Incident Action Plans (IAPs) were assembled and documented. IAPs are discussed further in 'Restoration Management' section of this report.

Four staging sites were activated on Sunday July 7, and 21 staging sites were activated by end of day Wednesday July 10. Mutual assistance crews were sought out as CenterPoint reached out to Regional Mutual Assistance Groups (RMAGs) to secure additional resources (e.g., line crews and vegetation crews). DOC effectively took the lead in terms of shaping and executing the restoration plan.

PA observed instances where the flow of information and field experiences did not align with established EOP restoration procedures. Evidence indicates that in certain cases restoration crews addressed damage without utilizing insights from the damage assessment teams. Following the pre-established restoration procedures outlined in any utility's emergency plans allows for greater restoration efficiency.

Performance

PA observed that the activation of the IC adhered to the EOP, which complied with the requirements set forth in Texas Admin. Code 25.53. While the EOP met the letter of the requirements, PA observed that in certain instances IC roles and responsibilities lacked clarity, potentially limiting the IC's effectiveness and coordination. For example, within the EOC and DOC, planning and strategic decisions—typically handled by the Planning Section, such as overall restoration strategy, work prioritization, and resource allocation (including crews and temporary generators)—were instead carried out by the Operations Section.

The CMC was activated throughout the event and, as restoration progressed, assumed an increasingly larger role in its management. The IC received strategic direction from the CMC in a host of areas throughout the event including communications, resourcing, and overall approval of restoration plans.

3.2.2 Recommendations

Short-Term Actionable	Mid-Term Actionable
IC-1 **Streamline EOC Layout:** EOC physical layout should be updated to facilitate communications and information flow. Planning, Operations, Crisis Management Committee (CMC), Logistics, and Finance/Administration each should have dedicated work room in adjacent spaces. Provide workspaces for other Incident Command (IC) leader team members as required (Legal, Liaison, Safety, Customer, etc.). Physically align the EOC and the Distribution Operations Section Chief, when the EOC is open for an electric event. Co-locate the EOC and CMC until each entity is fully established and independently operational.	**IC-4** **Continue to Streamline EOC Layout:** Split the District Operations Branch during an EOC electric event to maximize impact of restoration efforts: Distribution Operations Branch Leadership located at the EOC. Region 1 work assignment located at Addicks Operations Center. Region 2 work assignment located at the Energy Control/Data Center (ECDC).
IC-2 **Revise IC Roles and Responsibilities:** All roles and responsibilities within the EOC structure need to be reviewed and updated as appropriate. The actual personnel staffing these positions should be at the executive level and be the most experienced CenterPoint personnel in major storm restoration. IC organization needs to be at least two-deep across IC section chief and higher roles. Use Deputies as a professional growth and development opportunity. **IC-2-a.** Add ETR Manager and team role within the Planning Section. **IC-2-b.** Clarify and document the placement of the IT/OT Manager within the IC. **IC-2-c.** Technology operations should be given more visibility as it can be a significant factor in restoration, particularly when systems fail to function as expected.	**IC-5** **Establish EOC-Sections Daily Meeting:** Establish a new daily meeting cadence for the EOC and Sections (e.g., Planning, Operations, Logistics, and Finance/Administration).