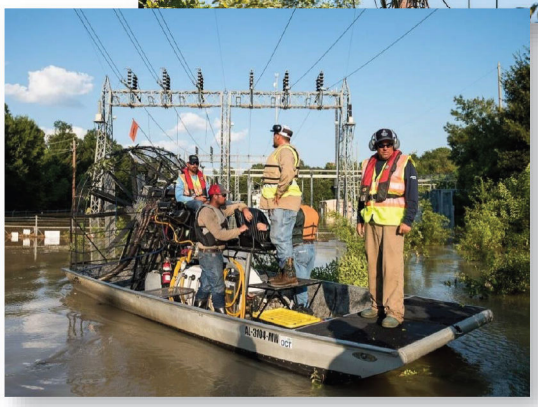
Harvey by the Numbers

Electric Operations Response

CenterPoint Energy

- More than **1.27** million total restorations
- More than **1,200** safety orientations and **120** crew safety observations
- **36** air boats, **15** drones and **15** amphibious vehicles used



Harvey by the Numbers

Gas Operations Response

CenterPoint Energy

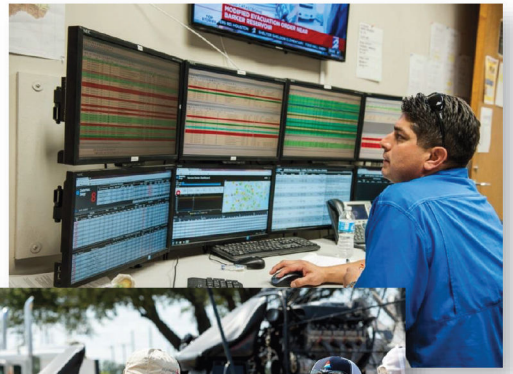
- Responded to **8,246** gas emergency orders
- **130,016** gas meters assessed for damage
- Approximately **53,000** gas meters submerged under water that required remediation
- Approximately **460** crossings inspected of which **7** required remediation

Harvey by the Numbers

Gas Operations Response

CenterPoint Energy

- More than **1,050** EOP responders
- Mutual assistance resources from **4** states
  - Approximately **60** internal and contractor crews traveled to Sinton/Victoria area (Day 1)
  - Approximately **80** internal crews from Arkansas, Oklahoma and North Texas traveled to Houston (Day 5)
  - Approximately **15** internal crews from Louisiana and adjacent Texas offices (Lufkin and Huntsville) traveled to Beaumont (Day 6)
- **21,168** meals served
- CNP coordinated with city of Beaumont to address breach in **18-inch** gas pipeline under the Neches River
  - A remote methane leak detector (RMLD) mounted on a drone to check methane levels in Neches River
  - Divers, air boats, drones and high-profile vehicles used during response



Harvey by the Numbers

Gas Operations Response

CenterPoint Energy

- Inspected **863** stations
  - **83** submerged due to flood waters of which **75** required remediation
    - Relief valves, debris removal, fencing
- Advanced Leak Survey Technology
  - Surveyed **554** miles in South Texas within five days (wind impacted areas)
- Reviewed **83** photos for safety compliance before posting publicly

Customer Service Response:
Lessons from Hurricanes Ike, Sandy and our utility peers

CenterPoint Energy

- Our communication strategy and tactics were grounded in a combination of best practices and hard-earned lessons
- Hurricanes Sandy and Mathew, along with Chartwell research, showed the value of
  - Contextualizing the emergency visually and engaging customers through videos, photos, and graphics in a story-telling approach
  - Giving customers the most reliable, granular information possible in the channel of their choice
  - Responding to customer issues in a timely, personal, empathetic way

Customer Communications Approach

CenterPoint Energy

Give customers timely, relevant, and valuable information

Show the challenge of flood conditions and restoration efforts

Empower customers and employees to educate and advocate for the brand

Customer Communications Strategies

CenterPoint Energy

1. Neighborhood Communications Strategy
   - Our customer communications were grounded in strong, media relations and mass media tactics. They established the base from which other communications were built
   - It was the ability to deliver more targeted, local and relevant information that was the key to our communications success
2. Power Alert Service (PAS) & Email
   - PAS provides enrolled customers free outage restoration updates via email, phone or text. During normal operations, these messages deliver personalized information. Also designed to support “blast” communications when needed
   - Direct email also played critical role in communicating directly to customers: **5.75 million** targeted, rich-text emails were sent in English and Spanish
3. Employee Ambassadors
   - A group of 674 employees volunteered to repost important information to their social networks if needed. This group was activated for the first time during Harvey with tremendous results

Harvey by the Numbers

Customer Service Response

CenterPoint Energy

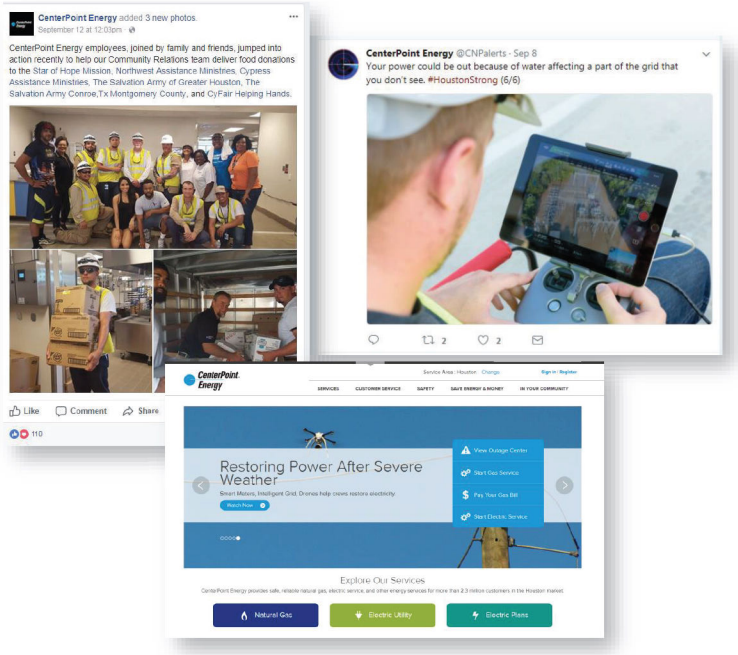
- **485,455** calls to the call center
- **147,612** were answered by agents with IVR handling the remainder
- **352,629** outage notifications delivered through PAS service
- **22,257** new PAS enrollments

Harvey by the Numbers

Customer Service Response

CenterPoint Energy

- **160** Facebook posts that reached **1,095,314** people
- **566** tweets that reached **2,531,685** people
- **630,206** visits to CenterPointEnergy.com
- At the height of the storm, web traffic was more than **600%** higher than average
- Translated more than **50** communications into Spanish



Overall Results: Great impact for CenterPoint Energy's reputation

CenterPoint Energy

In post-event survey:

89% held a positive opinion of CNP

82% say we have hard-working, caring employees

97% of Spanish speakers held a positive view of the company

86% felt we were ready for the storm

79% said we provided useful information vs. only **4%** who said communications were poor

59% of opinions improved as a result of our Hurricane Harvey response

Overall Results: Great Impact on Call Center Operations

CenterPoint Energy

- Proactive messaging & deflection from social care contributed to low call wait times & customer satisfaction
  - Social care transitioned in 2017 to contact center
  - Team handled record number 8,000+ interactions for 3,355 customers
- Of customers with a reason to call, 49% did **not** call
  - PAS assured them we knew of their outage, they self-served online, or heeded our message to call for emergencies only
  - Response time for those who did call was *only* ***104 seconds***
  - 84% of those served by phone or social media reported a positive opinion of the company.
  - Of customers served on Facebook or Twitter, 54% did not call

Harvey by the Numbers

Community Giving and Employee Support

CenterPoint Energy

- **$1.25 million** donated to Harvey recovery and relief efforts
- More than **$125,000** donated to CNP Employees 1st Fund; company matching contributions up to **$200,000**
- Contributed **$50,000** to city of Beaumont for special assistance
- **301** calls to the EOP Employee Assistance hotline

employees 1st

United Way

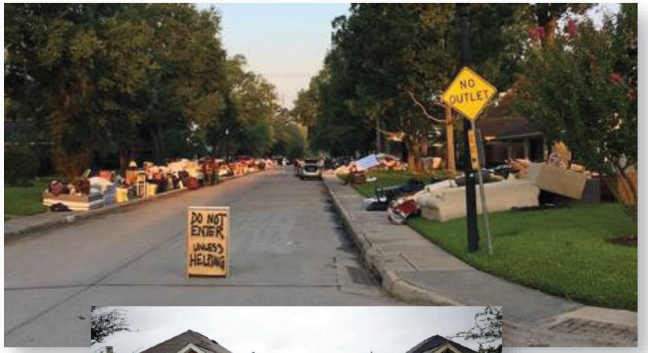
American Red Cross

Harvey by the Numbers

Community Giving and Employee Support

CenterPoint Energy

- **340** employees impacted with home or vehicle damage
- **34** responses from employees offering shelter to another employee
- **68** responses to CNP rideshare program
- **46** children cared for in EOP daycare at CNP Tower



Customer Communications

CenterPoint Energy

- Redouble training with service center representatives who gather local data
- Optimize information-sharing among operations, crew spokespersons, communications, and customer service
  - Situational awareness dashboard integrating outage and response data with key messages and communication
  - Evaluate mobile applications to push key messages to employees that can be shared and tracked on social media
- Enhance targeted communications capability
  - Work with Nextdoor.com to authorize emergency push communications
  - Expand contacts with homeowners associations and neighborhood entities
  - Increase customer enrollment in SMS/email/phone Power Alert Service

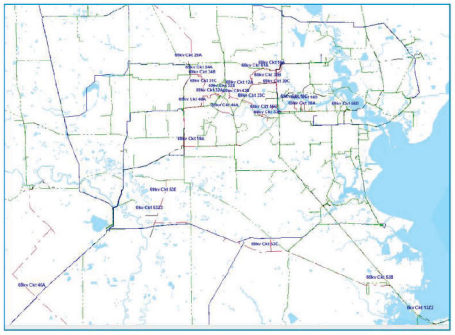
Transmission Hardening

CenterPoint Energy

69 kV Transformers	2017
Auto	19
Power	56

69 kV Circuit Miles	2016	2017
OH	343	295
UG	1.94	1.94
Ckt Count	35	34

69 kV Load in MW	2016	2017
Distr. Load	696.79	775.24
Ind. Cust. Load	132.56	119.22



- Strategic replacement of all wooden H-frame structures with steel or concrete in conjunction with system upgrades
- Replaced damaged structures crossing major waterways
- Defined 69kV to 138kV conversion strategy to replace aging facilities
- Anti-cascading designs for transmission lines
- Anti-galloping device installations based on icing conditions
- Establish underground transmission strategy

Substation Hardening

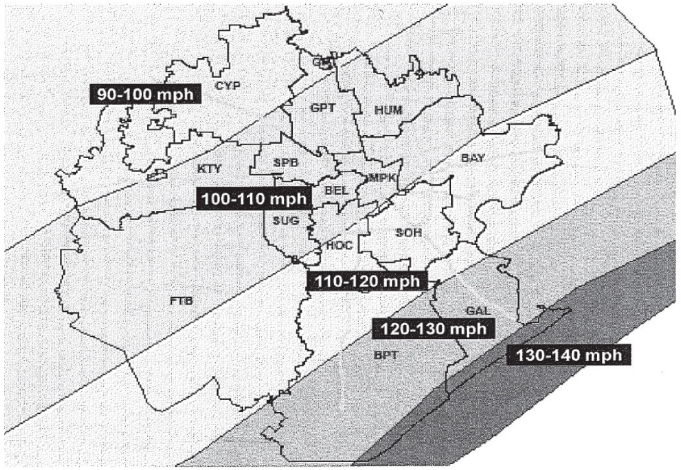
CenterPoint Energy

- Raising elevations of substation equipment and installation of flood walls
- Enhanced mobile substation and relay control capabilities
- Review spare transformer strategy
- Upgrade security at NERC 345kV and mission critical substations – install Videofied, upgrade to IP, upgrade security fencing
- Online monitoring pilot for autotransformers
- Longer range planning for substation sites

Distribution Hardening

CenterPoint Energy

- Evaluating construction standards based on NESC extreme wind loading
- Increased size of poles in key locations and reduced span lengths
- Increased pole setting depth
- Increased pace of IGSD installations
- Implementing ROAMES technology pilot
- Revised VM contractor utilization and increased use of analytics for prioritization
- Augmented distribution inspection programs – poles, guy wires, distribution equipment



CenterPoint Energy service area vs. NESC Extreme Wind Loading Map

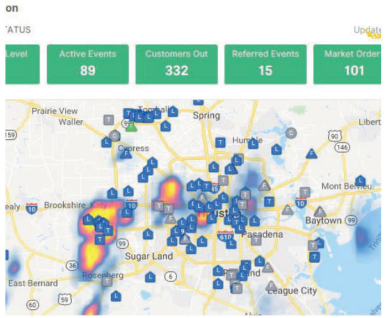
Major Underground Hardening

- Enhancing resiliency strategies for dedicated major underground areas (i.e., Texas Medical Center)
  - Reviewing additional substation sites – possible GIS
  - New TMC 500 ft flood plain elevation requirement established after Tropical Storm Allison.
  - Elevated ancillary service switchrooms to avoid circuit level events
- Revised standard service criteria for commercial services - reduces number of large overhead transformer banks
- Implemented MUG transformer inspection program

Redundancy, Digital, and Analytics

CenterPoint Energy

- Redundancy of control center operations at AOC
- Real time operational situational awareness
- Integration of data from grid sensors and smart meters for better outage location
- Programmatic replacement of cell relay infrastructure



One year after Harvey: Enhanced Operational Capabilities

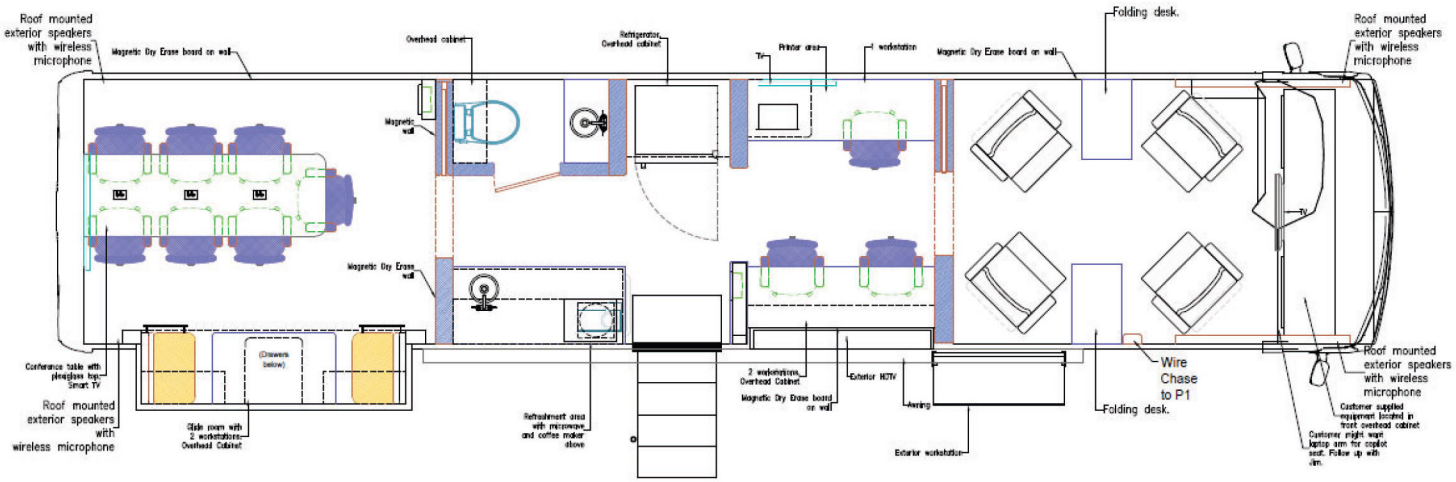
CenterPoint Energy

Purchase of FORTS to use as mobile command centers utilize during emergency events

One year after Harvey: Enhanced Operational Capabilities

CenterPoint Energy

Interior floorplan view of mobile command centers



Post-Harvey Industry Collaboration

CenterPoint Energy

- Close collaboration with Public Utility Commission for after action reviews
  - Facilitate expediting utility connections to FEMA temporary housing
  - Improve mobile substation inventories and deployment process
  - Enable consistent outage reporting among utilities
  - Removal of destroyed structures from lists of active utility accounts
  - Enhance in-state mutual assistance programs and equipment sharing
  - Promote cost effective hardening and raising of infrastructure in areas where flooding occurred
  - Review market processes around move-ins/move-outs/switches
  - Working with the Governor's office prior to a storm to address rule and statute suspension process
- Coordinate with other industry groups in lessons learned activities (Edison Electric Institute, Southeastern Electrical Exchange, Association of Edison Illuminating Companies, Texas Mutual Assistance Group, etc.)

CenterPoint Energy

The Aftermath of Hurricane Harvey
Lessons Learned by CenterPoint Energy

Presented by
Michael J. Pakeltis, P.E.
Director, Transmission Operations
CenterPoint Energy Houston Electric, LLC

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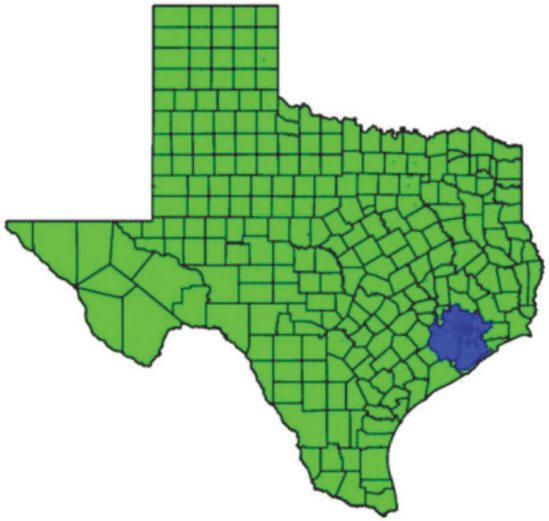

- 5,000 square mile Service Territory…ERCOT
- 345kV, 138kV, & 69kV Transmission
- 35kV and 12kV Distribution
- Houston Area Considerations
  - Very low elevation susceptible to flooding
  - High coastal wind exposure
  - High lightning prone area

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2017 Hurricane Harvey Event

https://abcnews.go.com/US/hurricane-harvey-makes-landfall-texas-category-storm/story?id=49412285

Substation Flood Resiliency

- In 2008, Hurricane Ike's storm surge severely damaged multiple coastal substations.
  - Revised coastal substation designs to account for CAT5 storm surge.
  - Retrofitted more substations with flood walls
- In 2017, Hurricane Harvey's flooding required several substations to be taken out of service, and several more were inaccessible due to high water.
  - Temporary "breaker bypass switching" of substations was implemented
  - Retrofitted more inland substations to account for the 500-year flood plain
  - Expanded Mobile Substation Fleet
    - Dual voltage plug and play designs with interchangeable trailers
    - Fast set-up

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Mobile Substation Deployment

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Substation Flood Resiliency

- Our current practice is to build new or upgrade facilities to a minimum of 1.5' above the worst expected flood conditions considering the following:
  - Historically experienced flood conditions
  - 100-year & 500-year Flood Plain Maps (FEMA, County, City, etc.)
  - Category 5 Storm Surge Maps (NOAA)
  - Flood and storm surge studies

7

Coastal Substation Design

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Substation Flood Wall

9

Elevated Equipment

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Transmission Line Flood Resiliency

- In 2017, Hurricane Harvey's flooding destroyed several transmission line river crossings with floating debris and rapid currents in the floodways that undermined the lattice tower foundations.
- Our current practice is to replace any compromised lattice towers located within river floodways with steel monopoles.
  - Lattice towers collect floating debris, creating additional forces on the tower legs.
  - Loss of one tower leg from the impact of floating debris compromises the entire structure.
  - Tower foundations are designed for each individual leg load and are less massive than a monopole foundation.
  - Steel monopoles do not tend to collect floating debris.
  - Monopole foundations carry the full load of the structure and are much more resilient to impacts from floating debris.
  - Where possible, new structures are located outside the limits of river floodways.

138kV River Crossing Rebuild

12

138kV & 345kV River Crossing Rebuild

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Other Resiliency Improvements

- Substation Physical Security
  - Anti-Cut, Anti-Climb Substation Security Fencing
  - Anti-Ram Fencing and Barriers
  - Ballistic Barriers and Ballistically Hardened Transformers
  - Intrusion Detection Systems
  - Gun Fire Detection Systems
- Substation Equipment Spares
  - Transformers and Breakers
  - Mobile Transformers
  - Mobile Substation Control Cubicles
- Substation Design Standards
  - National Electric Safety Code (NESC 2017) C2 Extreme Wind Loading requirements.
  - IEEE Standard 988-1996 Direct Lightning Stroke Shielding
  - IEEE Standard 979-1994 Fire Protection
  - Spacing between control cubicles & large transformers,
  - Spacing between large transformers, and
  - Firewall design and usage

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Other Resiliency Improvements

- Transmission Design Standards
  - National Electric Safety Code (NESC 2017) C2 Extreme Wind Loading requirements.
  - Anti-cascade structure designs
  - Coastal contamination insulator designs
  - Anti-galloping designs
- Storm Hardening
  - Upgrade older lines to latest NESC design conditions
  - Anti-galloping retrofits
- Fleet Mobility
  - High water vehicles
  - Specialty boats & barges

Contact Information

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Acknowledgement:
This presentation is a compilation of lessons learned from my colleagues at CenterPoint Energy during our response to major flooding from Hurricane Harvey and other past events. My sincere gratitude for their gracious contributions.

Grid Performance Storm Report

- **Summary:** Hurricane Harvey initially impacted the CNP system with outer bands of wind and rain and then moved into the CNP area for an extended period of torrential rains causing record setting flooding, tornadoes, and strong gusty winds.

- **Outage Period:**
  - Began 08/25/2017 @ 01:25 PM (1 hour before leaving trouble level 1)
  - Ended 09/06/2017 @ 11:59 PM (ended on the deactivation of EOP)

- **PUC-TX SAIDI / SAIFI Major Event Exclusion:**
  - 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.
  - 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.
  - This storm exceeded the major event exclusion threshold of 244,864 customers out of a total of 2,448,644 customers on the CNP system.
    - The 24-hour period used was from 08/25/17 at 23:00 to 08/26/17 at 22:59.
    - Sustained non-distinct (includes customers with multiple outages) customer outages in the 24-hour window = 258,617 (10.6%).
  - Sustained non-distinct customer outages had automation not been used in the 24-hour window = 280,856 (11.5%)
  - Forced exclusions:
    - SAIDI = 247.50 minutes SAIFI = 0.3835 interruptions
    - YTD SAIDI / SAIFI before the storm (8/24/17):
      - SAIDI = 78.79 minutes (5.86 minutes over goal)
      - SAIFI = 0.7897 interruptions (0.0664 interruptions under goal)
    - YTD SAIDI / SAIFI after the storm (9/6/17):
      - SAIDI = 79.03 minutes (0.85 minutes over goal)
      - SAIFI = 0.7914 interruptions (0.1227 interruptions under goal)
  - Outside exclusions:
    - SAIDI = 0.39 minutes SAIFI = 0.0117 interruptions
    - There were substations that were taken off-line due to the storm, but much of that load was field switched to neighboring substations or coded as scheduled outages.
  - Scheduled exclusions:
    - SAIDI = 62.90 minutes SAIFI = 0.0463 interruptions
    - Many outages were coded as scheduled due to direction from legal authority or threat of imminent flooding.

- **System Impact:**
  - Total non-distinct customers outaged over the period of the storm: 1,081,288
  - Total customer outage minutes over the period of the storm: 761,018,554
  - MW Lost -746.97.
  - Highest Trouble Level - 8 (on a scale of 1-8).

Grid Performance Storm Report

	SAIDI	SAIFI
Causes (includes forced, outside, & scheduled outages):		
Weather	158.05 minutes	0.1856 interruptions
Vegetation	26.49 minutes	0.0783 interruptions
Equipment failure	12.83 minutes	0.0366 interruptions
Substation	0.39 minutes	0.0117 interruptions
Transmission	0.00 minutes	0.0000 interruptions
Scheduled	62.90 minutes	0.0463 interruptions
Unknown	39.95 minutes	0.0633 interruptions
Other	9.80 minutes	0.0165 interruptions
Wildlife	0.07 minutes	0.0004 interruptions
Third Party Causes	0.30 minutes	0.0028 interruptions
Outage levels (includes forced, outside, & scheduled outages):		
Circuit	162.27 minutes	0.3610 interruptions
Overhead fuses	65.88 minutes	0.0406 interruptions
URD fuses	67.54 minutes	0.0300 interruptions
Transformers	12.96 minutes	0.0079 interruptions
Service Area (includes forced, outside, & scheduled outages):		
Baytown	7.15 minutes	0.0134 interruptions
Bellaire	44.32 minutes	0.0390 interruptions
Cypress	15.14 minutes	0.0286 interruptions
Ft Bend	10.19 minutes	0.0334 interruptions
Galveston	11.83 minutes	0.0248 interruptions
Greenspoint	32.04 minutes	0.0564 interruptions
HO Clarke	15.04 minutes	0.0352 interruptions
Humble	64.66 minutes	0.0844 interruptions
Katy	8.75 minutes	0.0257 interruptions
Spring Branch	49.26 minutes	0.0300 interruptions
South Houston	21.19 minutes	0.0303 interruptions
Sugarland	31.21 minutes	0.0405 interruptions

- **Distribution Automation Impacts:**
  - SAIDI Minutes absent use of automation: 327.01
  - SAIDI Minutes with automation: 310.79
  - SAIDI Minutes saved due to automation: 16.22
  - Customer Outage Minutes absent use of automation: 800,735,719
  - Customer Outage Minutes with automation: 761,018,554
  - Customer Outage Minutes saved due to automation: 39,717,165
  - Customers positively impacted by the operation of automation: 187,156 (7.6%)
  - Number of devices operated remotely by Dispatch:
    - 237 (46 required multiple attempts)
    - 24 did not respond to multiple commands
  - Customer Outage Minutes saved due to remote operation of devices by Dispatch: 15,010,165

Grid Performance Storm Report

- **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 ---------- 408 events
  - Partial Circuit Outages ---------- 210 events
  - Overhead Line Fuses Blown ---------- 1,578 events
  - Transformer Fuses Blown ---------- 1,813 events
  - Burned Up Transformers ---------- 483 events
  - Spans Primary Down ---------- 585 events
  - Spans Secondary Down ---------- 803 events
  - URD Terminal Poles Blown ---------- 1,171 events
  - Major Underground Line Fuse -------- ---------- 20 events
  - Poles Down ---------- --------- 95 events
  - Drops Down ---------- 1,253 events
  - Meter Failures ---------- ---------- 416 events

- **CNP system lighting strikes:**
  - 42,674

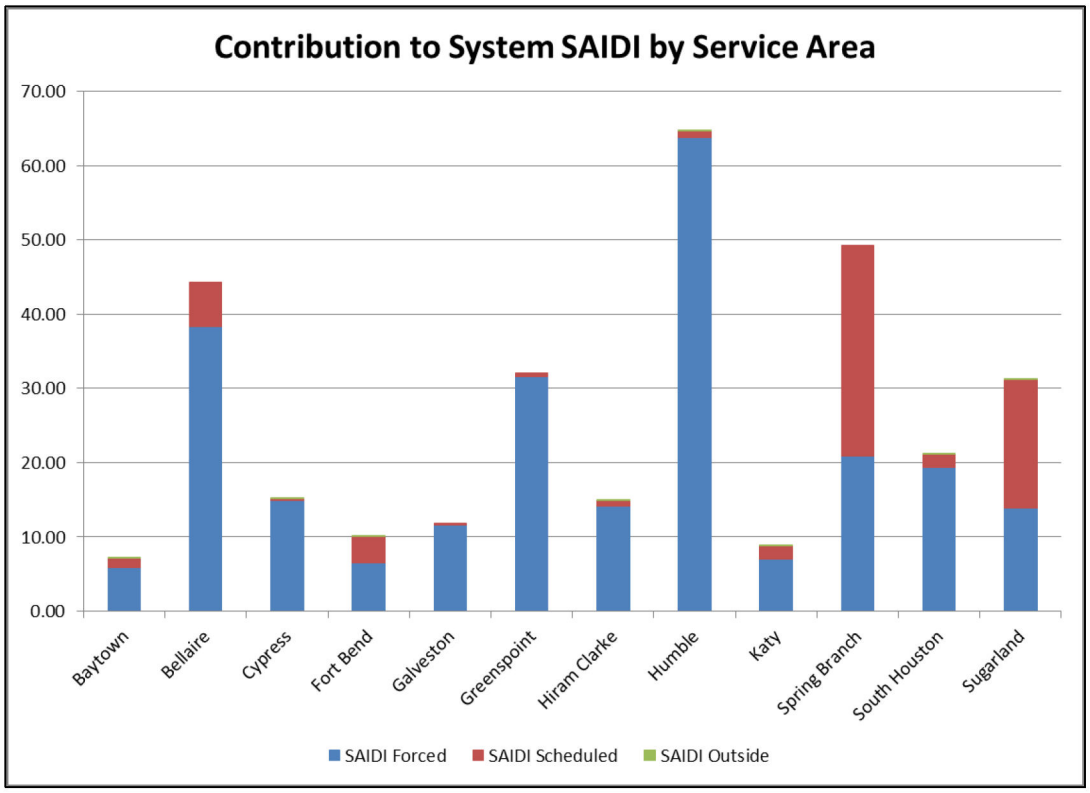
- **CNP system wind speeds:**
  - Sustained: 28
  - Gusts: 40

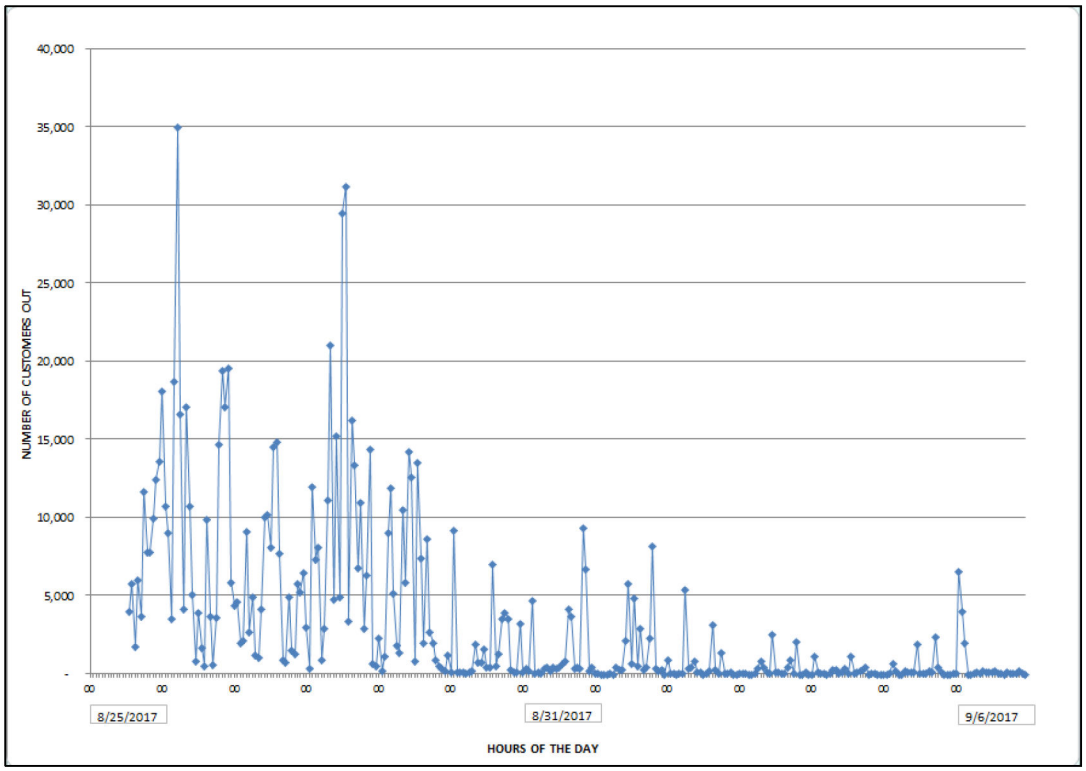
- **Substation Issues:** During Hurricane Harvey, 17 substations were impacted by high water and subsequently 8 were taken out of service or reconfigured. In addition, 18 substation power transformers had unscheduled outages due to relay operations or proactive maintenance and two autotransformers had unscheduled outages. Autotransformer AT3 @ THW caught on fire and as a result, the ECDC utilized backup generators to maintain service until feeders THW-31 and THW-33 could be restored. Due to flooding, Memorial substation was removed from service proactively. A mobile substation was installed to maintain service for most customers in the area.

- **Transmission Issues:** During Hurricane Harvey, seven transmission lines locked out due to weather. Instantaneous operations occurred on other lines as well. Six customer substations requested to be de-energized due to high water.

- **Major Underground Issues:** During Hurricane Harvey, no major issues were reported in the Medical Center or Airports. John Sealy Hospital lost service but was restored when the water receded. When Buffalo Bayou overflowed the banks at the peak of flooding, the downtown area had 83 buildings with no or partial service. MUG worked with the City of Houston to restore service to City Hall, City Hall Annex, Police Communication Bldg, & Municipal Courts. Additional outlying areas are being restored when the customer is prepared to take service.

Grid Performance Storm Report





Storm Report

- **Period:** 05/23/2017 @ 6:50 p.m. through 05/24/2017 @ 1:35 p.m.
- **Remarks:** Strong heating in the afternoon caused increased instability which combined with favorable winds that formed strong thunderstorms in the southeast portion of the CNP area and developed strong wind gusts, frequent lightning and heavy rainfall.
- **System Impact:**
  - Non-distinct customer interruptions during storm (forced & outside) – 62,317
  - Non-distinct customer interruptions max in 24 hour window (PUC exclusion) – 63,045 (2.6%)
  - Sustained customer outages had automation not been used – 11,706
  - Sustained customer minutes had automation not been used – 2,389,136
  - Non-distinct customer interruptions and customer outages had automation not been used – 74,751 (3.1%)
  - MW Lost - 117
  - Highest Trouble Level - 5
- **Excluded events:**

	SAIDI	SAIFI
Exceeded 10% of CNP's total customers out so that all of the outages from the storm can be excluded from PUC reports	None	None
Exceeded 10% of CNP's total customers out, including sustained customer outages had automation not been used, so that all of the outages from the storm can be excluded from PUC reports	None	None
Exceeded 25% of Service Area's rolling 12 month customer minutes so that the outages can be excluded for that area	None	None
Exceeded 25% of Service Area's rolling 12 month customer minutes, including sustained customer outages had automation not been used, so that the outages can be excluded for that area	2.42	0.0028
Outages excluded due to documented tornados, wind shear, and flooding	0.03	0.0018
Outages reduced due to crew inability to access area due to flooding.	None	None

- **Service Areas impacted heaviest:** Katy (32.4% exclusion value), Fort Bend (12.7% exclusion value), Hiram Clarke (6.4% exclusion value).
- **System Impacts:** **SAIDI** **SAIFI**
  - **Overall System:**
    - Storm Period Addition -- 4.98 minutes 0.0256 interruptions
    - Through 05/22 Status ---- 7.26 mins. behind target 0.0241 ints. behind target
    - Through 05/24 Status ---- 8.92 mins. behind target 0.0369 ints. behind target
  - **Causes:**
    - Weather ---------- 3.11 minutes 0.0159 interruptions
    - Vegetation ---------- 1.04 minutes 0.0063 interruptions
    - Equipment failure ------- 0.19 minutes 0.0020 interruptions
    - Substation ---------- 0.00 minutes 0.0000 interruptions
    - Transmission ---------- 0.58 minutes 0.0010 interruptions
    - Unknown ---------- 0.03 minutes 0.0001 interruptions

Storm Report

- Other ---------- 0.03 minutes 0.0002 interruptions
- Wildlife ---------- 0.00 minutes 0.0000 interruptions
- Third Party Causes ----- 0.00 minutes 0.0000 interruptions

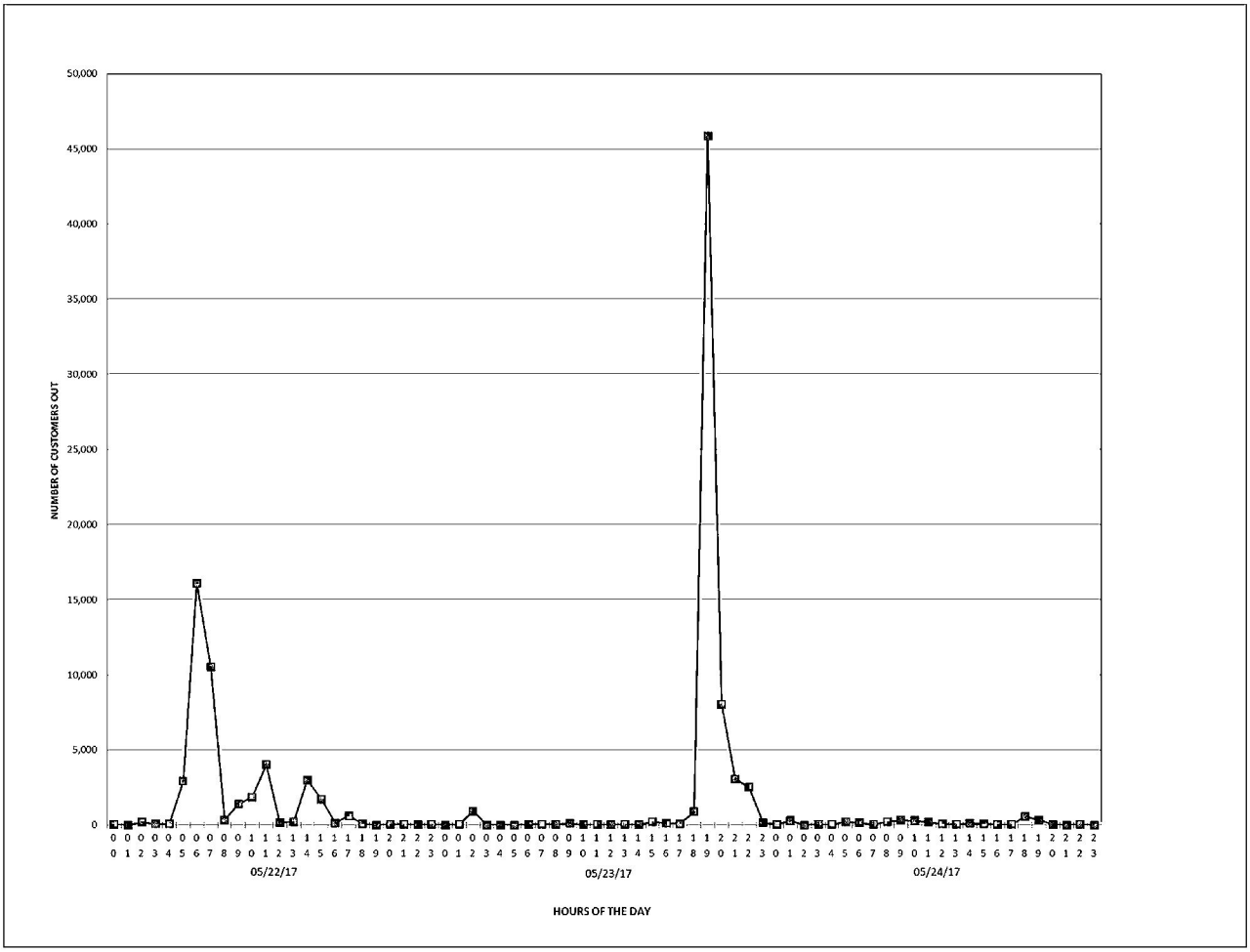
- **Outage levels:**
  - Circuit ---------- 4.33 minutes 0.0236 interruptions
  - Overhead fuses ---------- 0.50 minutes 0.0014 interruptions
  - URD fuses ---------- 0.07 minutes 0.0004 interruptions
  - Transformers ---------- 0.06 minutes 0.0002 interruptions
- **Service Area:**
  - Baytown ---------- 0.04 minutes 0.0003 interruptions
  - Bellaire ---------- 0.04 minutes 0.0003 interruptions
  - Cypress---------- 0.00 minutes 0.0001 interruptions
  - Ft Bend ---------- 1.08 minutes 0.0124 interruptions
  - Galveston ---------- 0.04 minutes 0.0004 interruptions
  - Greenspoint ---------- 0.02 minutes 0.0001 interruptions
  - HO Clarke ---------- 0.77 minutes 0.0049 interruptions
  - Humble ---------- 0.00 minutes 0.0000 interruptions
  - Katy ---------- 2.47 minutes 0.0029 interruptions
  - Spring Branch ---------- 0.06 minutes 0.0004 interruptions
  - South Houston ---------- 0.06 minutes 0.0005 interruptions
  - Sugarland ---------- 0.38 minutes 0.0032 interruptions

- **Automation Update:** Attempted to operate 16 devices with 14 operating successfully (88%). 2 devices required multiple attempts to operate successfully.
- **Trouble Cases (Forced &Outside Causes)**
  - Circuit Lockouts ---------- 23
  - Partial Circuit Outages ---------- 5
  - Overhead Line Fuses Blown ---------- 77
  - Transformer Fuses Blown ---------- 86
  - Burned Up Transformers ---------- 23
  - Spans Primary Down ---------- 18
  - Spans Secondary Down ---------- 22
  - URD Terminal Poles Blown ---------- 17
  - Major Underground Line Fuse -------- ---------- 2
  - Poles Down ---------- --------- 10
  - Drops Down ---------- 46
  - Meter Burned Up ---------- 6
  - Total Non-distinct Customer Interruptions---- 62,317
- **CNP system lightning strikes:**
  - 3,818
- **CNP system wind speeds:**
  - Sustained: 16 mph
  - Gusts: 30 mph
- **Substation Outages:**

Storm Report

- None.

- **Transmission Outages:**
  - 05/23/2017 19:02 138kV line 65 Peters – Sealy – Wallis – East Bernard Operated instantaneously, sectionalized at Sealy and Wallis. Single-end lockout from East Bernard – Wallis. Line damaged between Sealy and Wallis and section is still outage. East Bernard - Wallis restored at 05:54 on 05/24/2017.
  - 05/23/2017 19:36 138kV line 02 W.A. Parish – Nash – West Columbia locked out. Restored at 02:21 on 05/24/2017
  - 05/23/2017 19:36 Instantaneous operation on 138kV line 05 W.A. Parish – H.O. Clarke
  - 05/23/2017 19:36 Instantaneous Operation on 138kV line 09 W.A. Parish – Stafford – Alief – Hayes – Britmoore. Both section switches at Alief opened causing line to sectionalize at Alief deenergizing 138/12kV Transformer #3 at Alief. Section at Alief returned to normal at 00:43 on 05/24/2017.



Reliability Reporting Storm Report

- **Summary:** A strong arctic cold front pushed across the CNP region Tuesday morning bringing severe cold temperatures, freezing rain, sleet, and snow in the morning and afternoon hours. Many roads iced over and did not thaw until midday Wednesday which hindered restoration efforts.

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

- **Outage Period:**
  - Began 01/16/2018 @ 07:30 AM (1 hour before entering trouble level 2)
  - Ended 01/16/2018 @ 11:25 PM (1 hour after returning to trouble level 1)

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

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	3.79	82.40	0.0460
Forced Interruptions	1.89	105.07	0.0180
Outside Causes	1.65	62.74	0.0263
Scheduled Interruptions	0.25	146.61	0.0017

  - Total non-distinct customers outaged over the period of the storm: 113,419
  - Total customer outage minutes over the period of the storm: 9,346,105
  - MW Lost: 217.67
  - Highest Trouble Level (on a scale of 1-8): 7

- **Exclusion:**
  - 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: 01/16/2018 at 6:00 to 01/17/2018 at 5:59.
    - Sustained non-distinct customer outages:
      - 24-hour window = 123,930 (5.0%).
      - Had automation not been used in the 24-hour window = 132,542 (5.4%).
  - Storm did not exceed the major event exclusion threshold of 25% of a service area's 12 month SAIDI.
    - Service Area impacted heaviest: Greenspoint (1.53% exclusion value).
  - Storm did have exclusions that exceeded the CNP design criteria. (Galloping conductor, ice)
    - Excluded Distribution SAIDI = 0.19
    - Excluded Transmission SAIDI = 0.82

- **Pre & Post Storm Information**
  - YTD forced SAIDI / SAIFI before the storm (01/15/2018):
    - SAIDI = 4.42 minutes (1.74 minutes over goal)
    - SAIFI = 0.0478 interruptions (0.0132 interruptions over goal)

  - YTD forced SAIDI / SAIFI after the storm (01/16/2018):
    - SAIDI = 6.58 minutes (3.72 minutes over goal)
    - SAIFI = 0.0685 interruptions (0.0316 interruptions over goal)

Reliability Reporting Storm Report

- **Impact Breakdown (includes forced, outside, & scheduled outages):**

Cause	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
Weather	0.95	92.99	0.0102
Vegetation	0.11	74.66	0.0014
Equipment Failure	0.55	152.48	0.0036
Substation	0.23	86.24	0.0027
Transmission	1.17	67.66	0.0173
Unknown	0.08	70.68	0.0012
Other	0.14	148.40	0.0010
Wildlife	0.00	123.15	0.0000
Third Party	0.06	92.41	0.0006
Outage Level			
Circuit	3.02	71.50	0.0422
Overhead Fuse	0.49	197.88	0.0025
URD Fuse	0.21	211.77	0.0010
Transformer	0.07	239.02	0.0003
Service Area			
Baytown	0.15	145.29	0.0010
Bellaire	0.36	266.39	0.0014
Cypress	0.16	85.57	0.0019
Ft Bend	0.55	118.06	0.0046
Galveston	0.17	55.12	0.0031
Greenspoint	0.76	65.94	0.0116
HO Clarke	0.74	73.77	0.0100
Humble	0.04	25.80	0.0016
Katy	0.41	83.78	0.0049
Spring Branch	0.33	95.59	0.0034
South Houston	0.06	41.67	0.0015
Sugarland	0.05	92.10	0.0006

- **Distribution Automation Impacts:**
  - SAIDI Minutes saved due to automation: 0.14
  - Customer Outage Minutes absent use of automation: 9,691,143 (SAIDI - 3.93)
  - Customer Outage Minutes with automation: 9,346,105 (SAIDI - 3.79)
  - Customer Outage Minutes saved due to automation: 345,038
  - Customers positively impacted by the operation of automation: 8,612 (7.59% of storm cust out)
  - Number of devices operated remotely by Dispatch:
    - 28 (93% successful)
    - 7 required multiple attempts
    - 2 did not respond to multiple commands
  - Customer Outage Minutes saved due to remote operation of devices by Dispatch: 0
    - No minutes saved was reported if crew was on site as they could have operated the device locally.

Reliability Reporting Storm Report

- No minutes saved was reported if switching operation did not bring any service back on i.e. opened a closed device, tried a breaker but it did not hold.

- **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 ---------- 66 events
  - Partial Circuit Outages ---------- 23 events
  - Overhead Line Fuses Blown ---------- 54 events
  - Transformer Fuses Blown ---------- 42 events
  - Burned Up Transformers ---------- 39 events
  - Spans Primary Down ---------- 28 events
  - Spans Secondary Down ---------- 24 events
  - URD Terminal Poles Blown ---------- 28 events
  - Major Underground Line Fuse -------- ---------- 1 events
  - Poles Down ---------- --------- 2 events
  - Drops Down ---------- 36 events
  - Meter Failures ---------- ---------- 6 events

- **Weather Impact:**
  - Lighting strikes = None
  - Sustained wind speeds = 20 mi/hr
  - Gust wind speeds = 31 mi/hr
  - Total rainfall in service area = 0.35 in

- **Substation Impacts:**
  - 1/16/2018 13:00 Instantaneous operation on a bus at Crosby Substation.

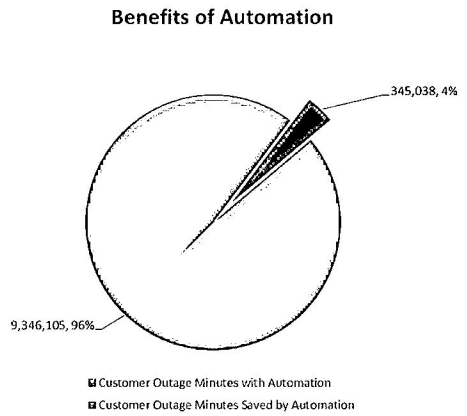
- **Transmission Impacts:**
  - 6 instantaneous operations on 5 different transmission lines.
    - 1/16/2018 07:33 Instantaneous Operation on 138kV Line 60 FB – FL
    - 1/16/2018 08:52 Instantaneous Operation on 138kV Line 09 KT – FL
    - 1/16/2018 10:32 Instantaneous Operation on 138kV Line 60 TGF – LC
    - 1/16/2018 10:52 Instantaneous Operation on 138kV Line 80 WAP – IM
    - 1/16/2018 12:24 Instantaneous Operation on 138kV Line 04 AK – WEB
    - 1/16/2018 13:25 Instantaneous Operation on 138kV Line 67 DQ – NB

  - 18 lockouts on 15 different transmission lines.
    - 1/16/2018 07:40 Lock Out on 138kV Line 60 EB – DYN
    - 1/16/2018 08:09 Lock Out on 138kV Line 25 OB – FL
    - 1/16/2018 08:25 Lock Out on 345kV Line 44 HLJ – XHM
    - 1/16/2018 08:52 Lock Out on 138kV Line 76 ADK – ZEN
    - 1/16/2018 09:12 Lock Out on 138kV Line 73 CE – BM
    - 1/16/2018 09:52 Lock Out on 345kV Line 18 YEC – STP

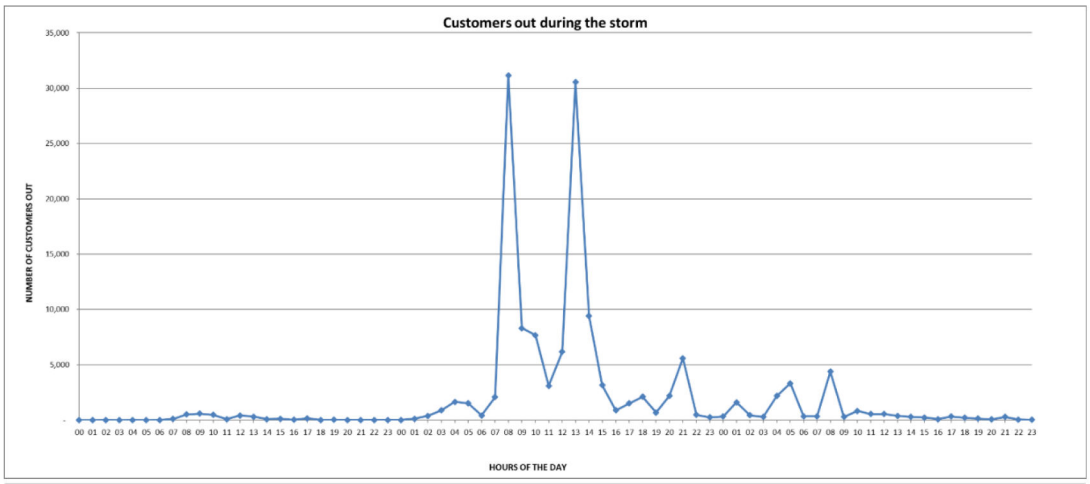
Reliability Reporting Storm Report

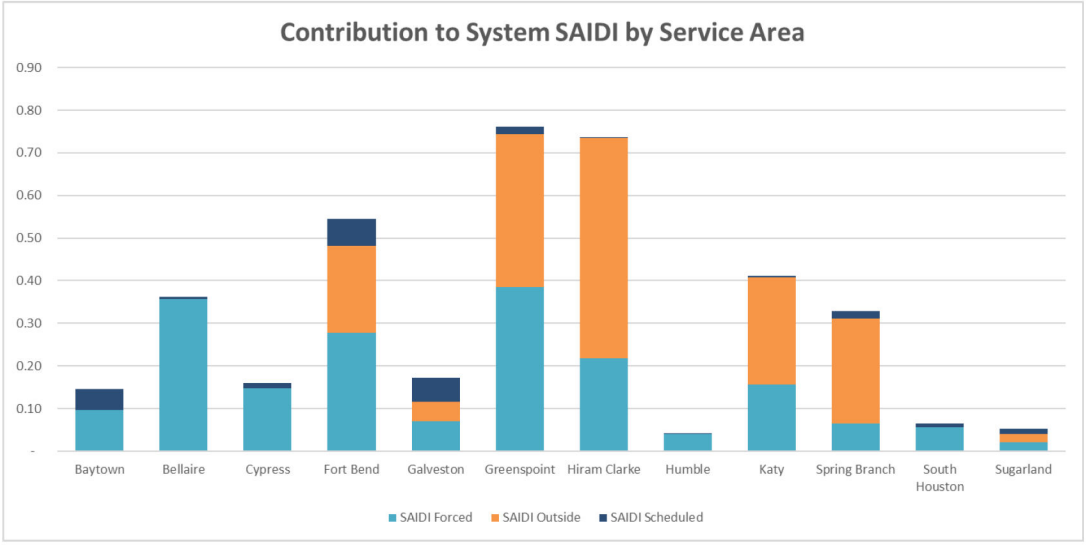
- 1/16/2018 09:55 Lock Out on 345kV Line 27 YEC – STP
- 1/16/2018 10:12 Lock Out on 138kV Line 65 HK – PT
- 1/16/2018 10:32 Lock Out on 138kV Line 04 WC – TGF
- 1/16/2018 12:31 Lock Out on 138kV Line 93 LM – GA
- 1/16/2018 12:46 Lock Out on 138kV Line 63 STW – GA
- 1/16/2018 13:25 Lock Out on 138kV Line 67 NB – BA
- 1/16/2018 13:25 Lock Out on 345kV Line 95 THW – NB
- 1/16/2018 13:49 Lock Out on 138kV Line 02 WC – HN
- 1/16/2018 13:55 Lock Out on 138kV Line 02 WC – LJ
- 1/16/2018 13:57 Lock Out on 138kV Line 02 CPR – VL
- 1/16/2018 14:12 Lock Out on 138kV Line 86 CNR – CS
- 1/16/2018 14:32 Lock Out on 138kV Line 02 JCK – XFK

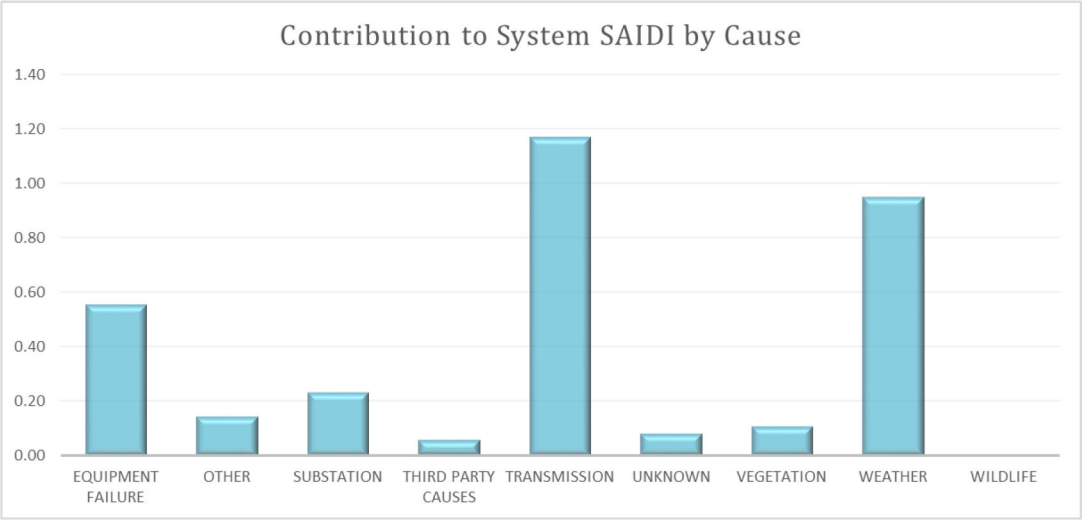
- **Notes / definitions / exclusions**
  - Non-distinct - includes customers with multiple outages and single outages
  - The PUC-TX has established a metric that applies to SAIDI / SAIFI numbers for 'Forced' (distribution level only) outage minutes / interruptions. An exclusion from the metric for events 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 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 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.
  - MW lost is estimated by multiplying the percentage of peak customers out during the storm with the integrated load (total transmission load) before the storm started.



Reliability Reporting Storm Report







Reliability Reporting Storm Report

- **Summary:** A strong, fast-moving disturbance pushed across the CNP area from the southwest producing dangerous thunderstorms with tornados, strong damaging winds, lightning, and heavy rain.

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

- **Storm Period:**
  - Began 04/07/2019 @ 11:30 AM (1 hour before entering trouble level 2)
  - Ended 04/08/2019 @ 05:50 PM (1 hour after returning to trouble level 1)

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

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	19.66	212.82	0.0924
Forced Interruptions	19.28	218.41	0.0883
Outside Causes	0.00	6.72	0.0004
Scheduled Interruptions	0.38	102.49	0.0038

  - Total non-distinct customers outage over the period of the storm: 233,687
  - Total customer outage minutes over the period of the storm: 49,733,193
  - Estimated MW Lost: 536.98
  - Highest Trouble Level (on a scale of 1-8): 8

- **Exclusions:**
  - 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: 04/07/2019 at 11:00 to 04/08/2019 at 10:59.
    - Sustained non-distinct customer outages
      - 24-hour window = 228,400 (9.0%).
      - Had automation not been used in the 24-hour window = 251,118 (9.9%).
  - 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 (22.80% exclusion value).
  - Storm did have exclusions that exceeded the CNP design criteria.
    - Excluded Distribution SAIDI = 1.19

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
Forced Exclusions	1.19	12.93	0.0040
Outside Exclusions	0	0	0
Scheduled Exclusions	0	0	0

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

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	18.47	199.89	0.0885
Forced Interruptions	18.09	205.48	0.0843
Outside Causes	0.00	6.72	0.0004
Scheduled Interruptions	0.38	102.49	0.0038

Reliability Reporting Storm Report

- **Pre & Post Storm Information (full day period):**
  - YTD forced SAIDI / CAIDI / SAIFI before the storm (04/06/2019):
    - SAIDI = 19.63 minutes (3.12 minutes under goal)
    - CAIDI = 99.76 minutes (6.06 minutes over goal)
    - SAIFI = 0.1968 interruptions (0.0491 interruptions under goal)

  - YTD forced SAIDI / CAIDI / SAIFI after the storm (04/08/2019):
    - SAIDI = 38.57 minutes (15.11 minutes over goal)
    - CAIDI = 135.73 minutes (42.08 minutes over goal)
    - SAIFI = 0.2842 interruptions (0.0312 interruptions over goal)

- **Impact Breakdown (includes forced, outside, & scheduled outages):**

Cause	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
Weather	10.89	209.21	0.0520
Vegetation	5.56	210.52	0.0264
Equipment Failure	2.05	292.32	0.0070
Substation	0.00	6.72	0.0004
Transmission	0.00	0.00	0.0000
Unknown	0.17	408.05	0.0004
Other	0.60	255.06	0.0024
Wildlife	0.01	304.25	0.0000
Third Party	0.00	148.04	0.0000
Outage Level			
Circuit	14.33	176.26	0.0813
Overhead Fuse	3.91	505.21	0.0077
URD Fuse	0.59	272.98	0.0021
Transformer	0.80	721.26	0.0011
Service Area			
Baytown	1.97	306.44	0.0064
Brazoria	0.37	174.93	0.0021
Bellaire	3.16	279.98	0.0113
Cypress	2.34	225.66	0.0104
Ft Bend	0.26	57.70	0.0045
Galveston	0.26	321.69	0.0008
Greenspoint	2.26	232.85	0.0097
Humble	4.37	183.91	0.0238
Katy	0.16	97.98	0.0016
Spring Branch	0.35	213.19	0.0016
South Houston	2.25	294.80	0.0076
Sugarland	1.92	153.44	0.0125

Reliability Reporting Storm Report

- **Distribution Automation Impacts (storm period):**
  - SAIDI Minutes saved due to automation: 1.43
  - Customer Outage Minutes absent use of automation: 53,344,817 (SAIDI - 21.09)
  - Customer Outage Minutes with automation: 49,733,193 (SAIDI - 19.66)
  - Customer Outage Minutes saved due to automation: 3,611,624
  - Customers positively impacted by the operation of automation: 24,138 (10.33% of storm cust out)
  - Number of devices operated remotely by Dispatch:
    - 38 (84% successful)
    - 7 required multiple attempts
    - 6 did not respond to multiple commands
  - Customer Outage Minutes saved due to remote operation of devices by Dispatch: 613,704

- **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 ---------- 88 events
  - Partial Circuit Outages ---------- 19 events
  - Overhead Line Fuses Blown ---------- 380 events
  - Transformer Fuses Blown ---------- 350 events
  - Burned Up Transformers ---------- 35 events
  - Spans Primary Down ---------- 102 events
  - Spans Secondary Down ---------- 80 events
  - URD Terminal Poles Blown ---------- 91 events
  - Major Underground Line Fuse -------- ---------- 4 events
  - Poles Down ---------- --------- 17 events
  - Drops Down ---------- 166 events
  - Meter Failures ---------- ---------- 10 events

- **Weather Impact:**
  - Lighting strikes = 9,343
  - Sustained wind speeds = 30 mi/hr
  - Gust wind speeds = 42 mi/hr
  - Total rainfall in service area = 0.97 in

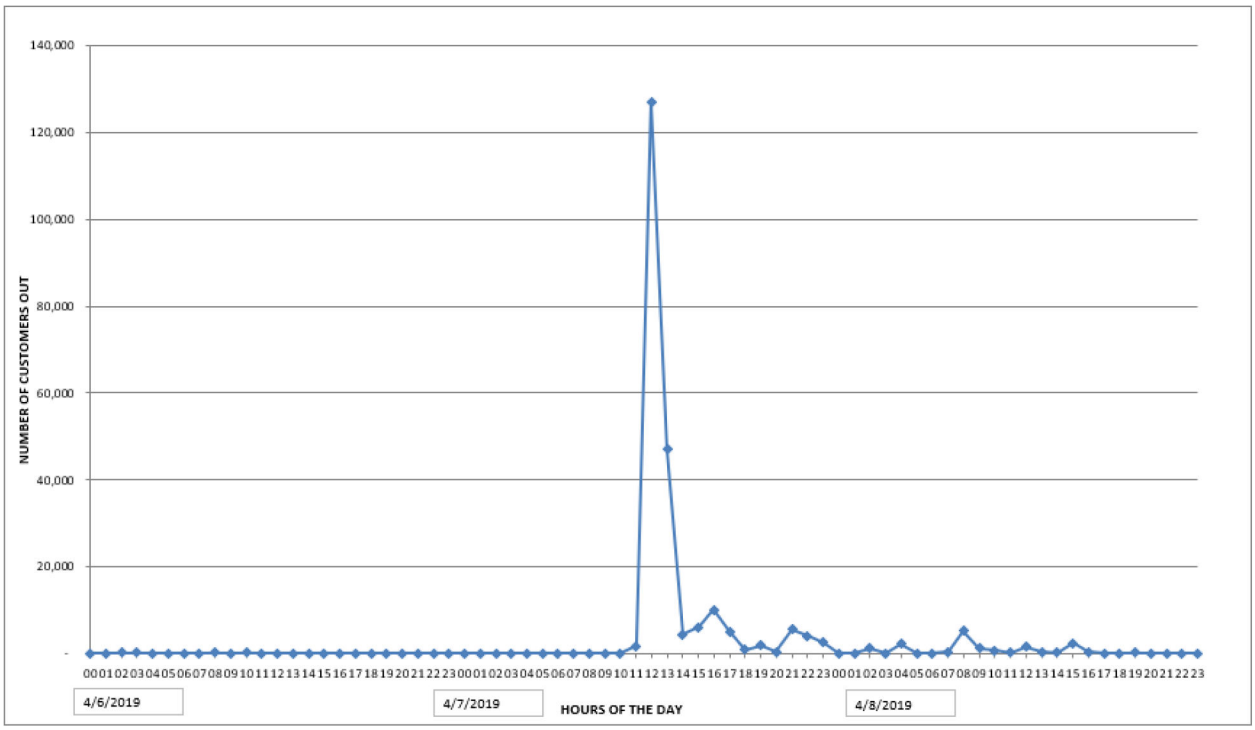
Reliability Reporting Storm Report

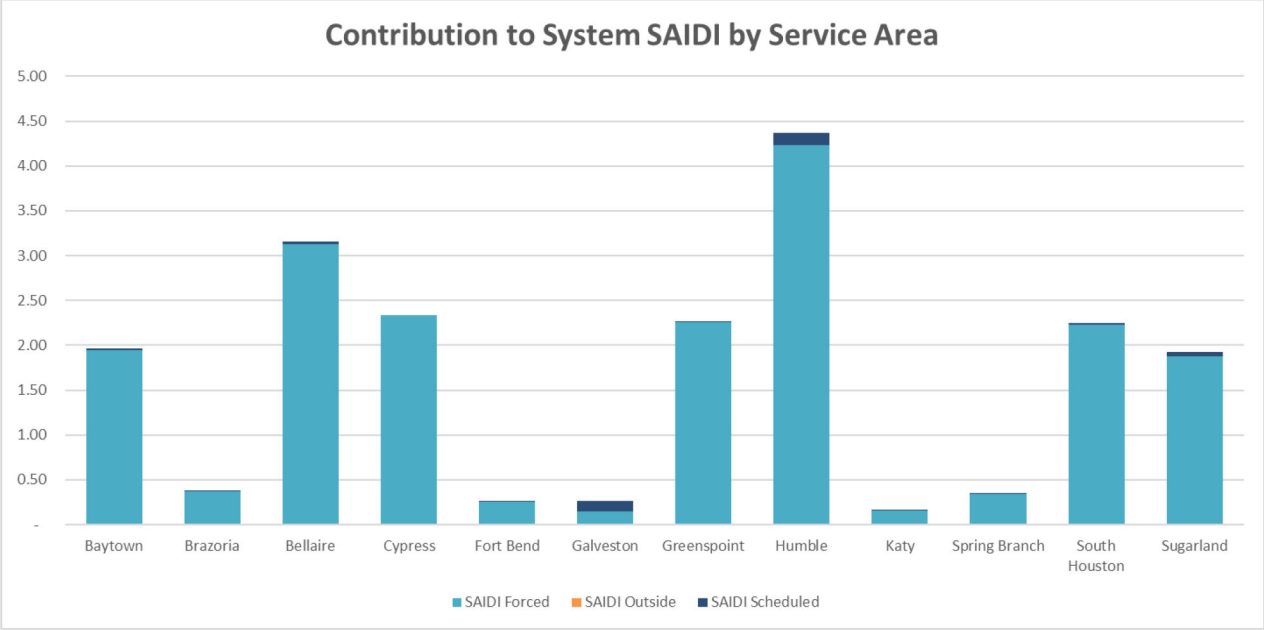
- **Substation Impacts:**
  - 12:35 138/12kV TR.1 at Sauer tripped
  - 12:39 345/138kV Auto #2 at Tomball tripped.
  - 15:24 345B and 138A Bus tripped. High and low side bus for AT2. Tripped after restoration of buses. AT2 was already out, see 12:39.

- **Transmission Impacts:**
  - 12:18 Instantaneous operation on 138kV line 02 W.A. Parrish – Sienna – Quail Valley – Telview – Dewalt – Mula – Blue Ridge – H. O. Clarke. Line sectionalized at Dewalt denergizinfg TR.2 at Dewalt.
  - 12:07 Instantaneous operation on 138kV line 02 W.A. Parrish – Sienna – Quail Valley – Telview – Dewalt – Mula – Blue Ridge – H. O. Clarke

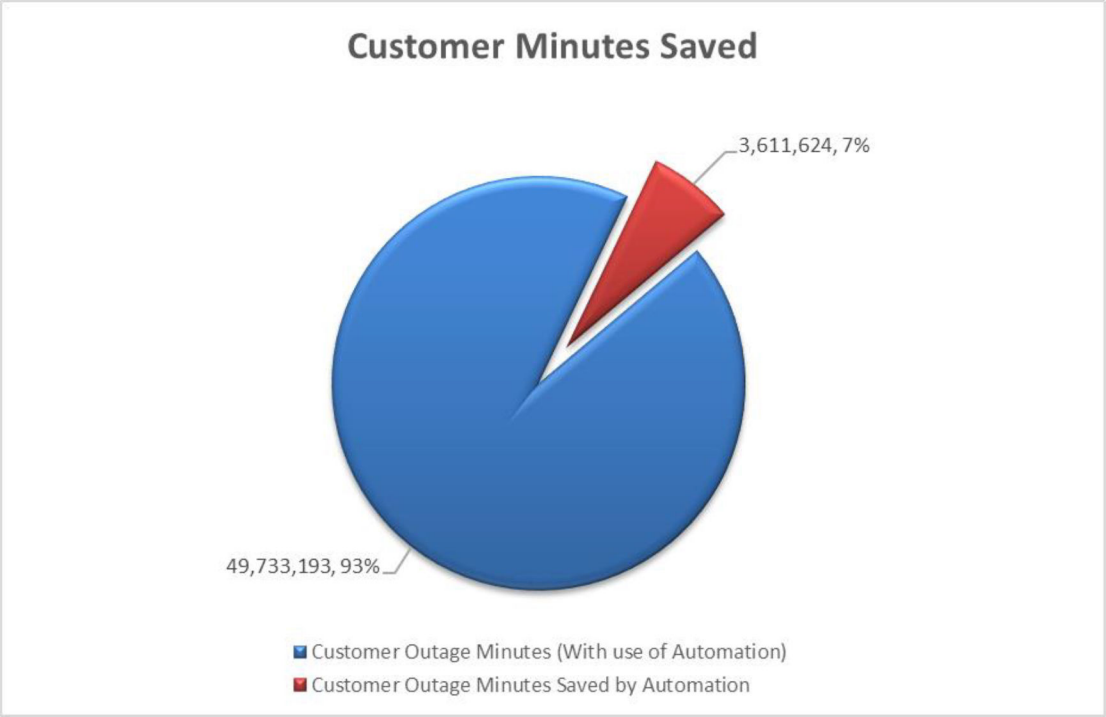
- **Notes / definitions / exclusions**
  - This report is based off the data as of today. The storm impacts are subject to change as data cleanup is completed over the next few weeks.
  - Non-distinct - includes customers with multiple outages and single outages
  - The PUC-TX has established a metric 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 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.

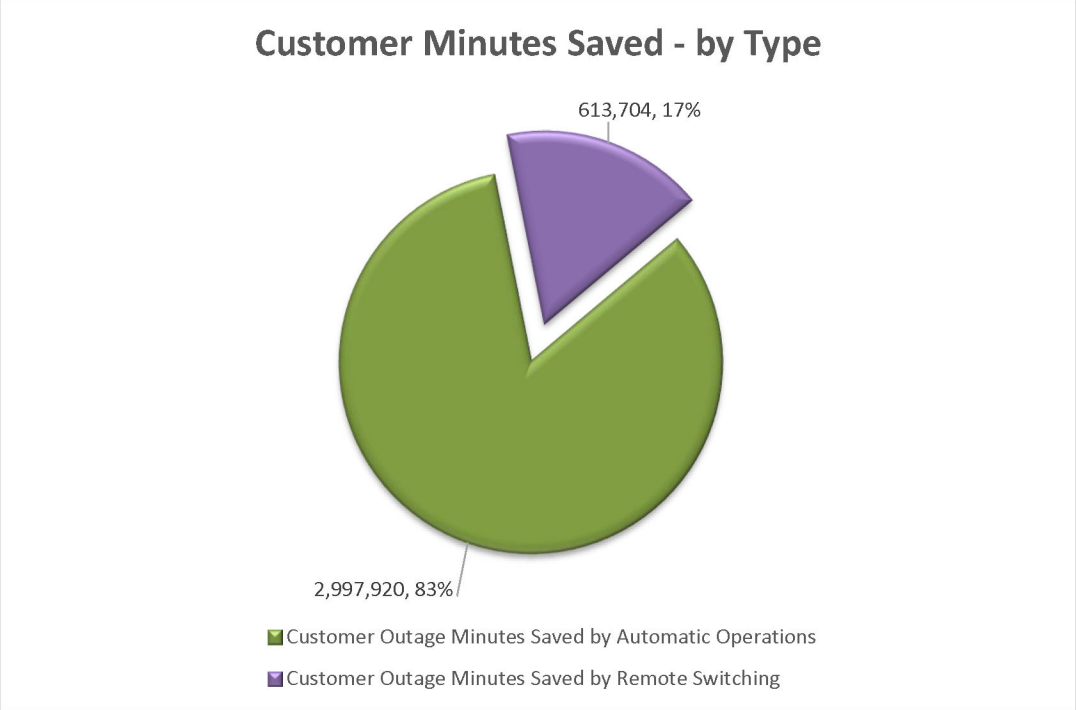
Reliability Reporting Storm Report





Reliability Reporting Storm Report





Reliability Reporting Storm Report

- **Summary:** Tropical Storm Imelda formed quickly off the upper Texas coast on Tuesday, and moved slowly northward over the CNP area with torrential rain, flooding, strong winds, and lightning. An outer band of severe rain developed on Thursday with additional torrential rain, severe flooding, strong winds and intense cloud-to-ground lightning.

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

- **Storm Period:**
  - Began 09/17/2019 @ 04:10 PM (1 hour before entering trouble level 2)
  - Ended 09/20/2019 @ 07:15 PM (1 hour after returning to trouble level 1)

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

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	13.27	187.44	0.0708
Forced Interruptions	11.78	196.87	0.0590
Outside Causes	0.38	56.28	0.0067
Scheduled Interruptions	1.10	230.21	0.0048

  - Total non-distinct customers outaged over the period of the storm: 180,431
  - Total customer outage minutes over the period of the storm: 33,820,816
  - Estimated MW Lost: 247.96
  - Highest Trouble Level (on a scale of 1-8): 8

- **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: 09/18/2019 at 15:00 to 09/19/2019 at 14:59.
    - Sustained non-distinct customer outages
      - 24-hour window = 96,271 (3.8%).
      - Had automation not been used in the 24-hour window = 110,102 (4.3%).
  - 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 (14.55% exclusion value).
  - Storm did have exclusions that exceeded the CNP design criteria.
    - Allowed by CNP's exclusion for a 'Named Storm' (Imelda) impacting 10% of the customers in a service area in a 24-hour period, and for flooding delays / rising water.
      - Humble (13%) and Spring Branch (13%) met the named storm criteria.
    - Excluded SAIDI = 0.98 (Flooding delays, Rising Water)
    - Excluded SAIDI = 4.20 (Named Storm)
    - Total Excluded SAIDI = 5.18 (forced, outside, scheduled)

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

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	8.09	160.59	0.0504
Forced Interruptions	6.97	157.72	0.0442
Outside Causes	0.11	58.93	0.0019
Scheduled Interruptions	1.01	236.44	0.0043

Reliability Reporting Storm Report

- **Pre & Post Storm Goal Update (full day period):**
  - YTD forced before the storm (09/16/2019):
    - SAIDI = 123.43 minutes (28.72 minutes over goal)
    - CAIDI = 122.87 minutes (23.84 minutes over goal)
    - SAIFI = 1.0046 interruptions (0.0854 interruptions over goal)
  - YTD forced after the storm – exclusions removed from numbers (09/20/2019):
    - SAIDI = 131.31 minutes (35.50 minutes over goal)
    - CAIDI = 124.34 minutes (25.27 minutes over goal)
    - SAIFI = 1.0561 interruptions (0.1259 interruptions over goal)

- **Impact Breakdown (includes forced, outside, & scheduled outages):**

Cause	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
Weather	6.14	204.83	0.0300
Vegetation	2.92	185.13	0.0158
Equipment Failure	1.41	193.86	0.0073
Substation	0.04	33.13	0.0011
Transmission	0.34	60.89	0.0056
Unknown	0.60	216.06	0.0028
Other	0.46	276.81	0.0017
Wildlife	0.01	141.18	0.0001
Third Party	0.23	140.97	0.0017
Outage Level			
Circuit	5.42	103.96	0.0521
Overhead Fuse	5.06	429.65	0.0118
URD Fuse	1.46	316.15	0.0046
Transformer	1.27	603.42	0.0021
Service Area			
Baytown	0.60	152.68	0.0039
Brazoria	0.30	183.51	0.0016
Bellaire	2.50	167.71	0.0149
Cypress	0.29	183.08	0.0016
Ft Bend	0.38	154.71	0.0025
Galveston	0.07	59.07	0.0012
Greenspoint	3.21	252.28	0.0127
Humble	3.46	268.67	0.0129
Katy	0.39	97.63	0.0040
Spring Branch	0.74	101.67	0.0073
South Houston	0.45	106.20	0.0042
Sugarland	0.86	224.21	0.0039

Reliability Reporting Storm Report

- **Distribution Automation Impacts (storm period):**
  - SAIDI Minutes saved due to automation: 0.88
  - Customer Outage Minutes absent use of automation: 36,061,203 (SAIDI - 14.14)
  - Customer Outage Minutes with automation: 33,820,816 (SAIDI - 13.27)
  - Customer Outage Minutes saved due to automation: 2,240,387
  - Customers positively impacted by the operation of automation: 22,361 (12.39% of storm cust out)
  - Number of devices operated remotely by Dispatch:
    - 34 (88% successful)
    - 9 required multiple attempts
    - 4 did not respond to multiple commands
  - Customer Outage Minutes saved due to remote operation of devices by Dispatch: 655,810

- **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 ---------- 65 events
  - Partial Circuit Outages ---------- 36 events
  - Overhead Line Fuses Blown ---------- 621 events
  - Transformer Fuses Blown ---------- 625 events
  - Burned Up Transformers ---------- 204 events
  - Spans Primary Down ---------- 104 events
  - Spans Secondary Down ---------- 91 events
  - URD Terminal Poles Blown ---------- 201 events
  - Major Underground Line Fuse -------- ---------- 10 events
  - Poles Down ---------- --------- 14 events
  - Drops Down ---------- 206 events
  - Meter Failures ---------- ---------- 60 events

- **Weather Impact:**
  - Lighting strikes = 52,241
  - Sustained wind speeds = 36 mi/hr
  - Gust wind speeds = 42 mi/hr
  - Total rainfall in service area = 12.68 in

- **Substation Impacts:**
  - 09/17/2019: No Events
  - 09/18/2019: No Events
  - 09/19/2019:
    - 10:24 138/12kV TR.1 at SAUER tripped
    - 11:41 345/138kV AUTO 3 at WHITE OAK tripped
  - 09/20/2019: No Events

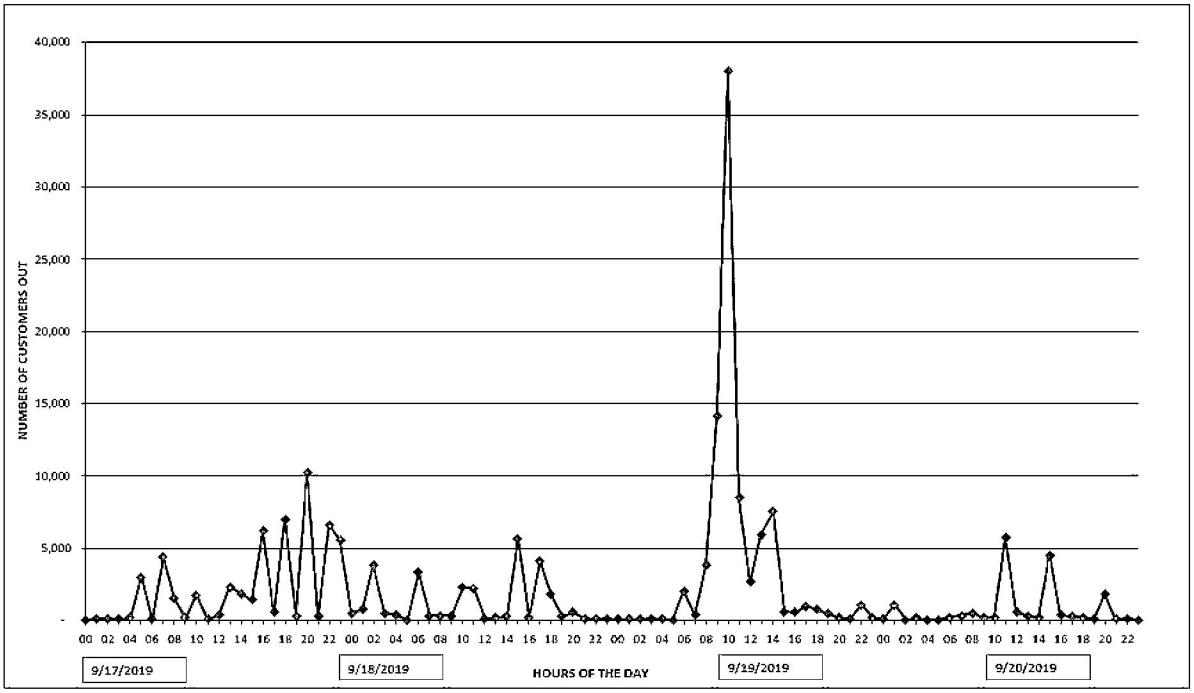
Reliability Reporting Storm Report

- **Transmission Impacts:**
  - 09/17/2019: No Events
  - 09/18/2019:
    - 07:37 Instantaneous operation on 345kV line 27 STP-DOW
    - 16:57 Instantaneous operation on 69kV line 28 ETHYL- SOUTH CHANNEL
    - 17:10 Instantaneous operation on 138kN line 03 CHANNELVIEW –LYNCH
  - 09/19/2019:
    - 10:00 Instantaneous operation on 138kV line 87 CEDAR BAYOU – TEXAS
    - 10:35 138kV line 73 WHITE OAK- WIRT-ECHO locked out (73 SAUER-ECHO out due to faulted cable)
    - 10:35 138kV line 81 WHITE OAK –WIRT locked out
    - 11:21 Instantaneous operation on 138kV line 87 PETERS-BELVILLE SOUTH (LCRA)
    - 14:51 Instantaneous operation on 69kV line 45 WEST COLUMBIA – NASH- DAMON – NEEDVILLE – BIG CREEK (Jumpers open between BIG CREEK and FORT BEND)
    - 16:31 Instantaneous operation on 138kV line 80 W.A.PARRISH – CRAB RIVER-IMPERIAL
    - 19:19 Instantaneous operation on 138kV line 86 HARDY – RITTENHOUSE – ALDINE – GREENS ROAD – LOCKWOOD – SCENIC WOODS – NEWPORT – CROSBY
    - 19:19 Instantaneous single end operation at EXXON on 138kV line 66 EXXON-BAYTOWN
  - 09/20/2019: No Events

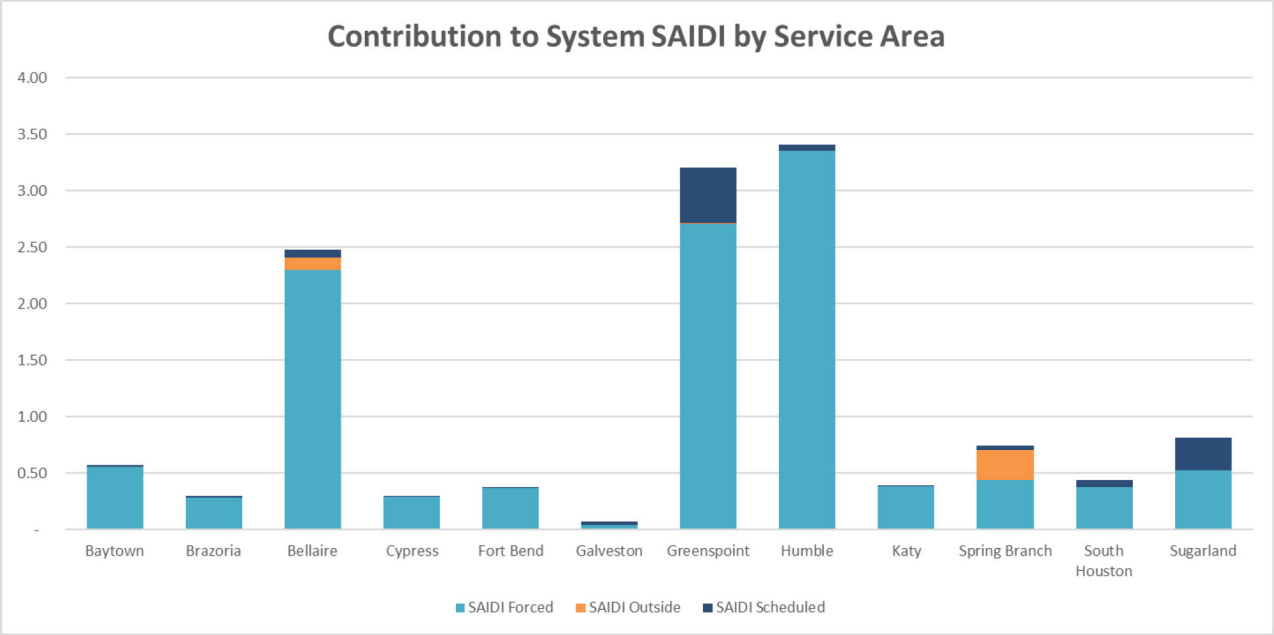
- **Notes / definitions / exclusions**

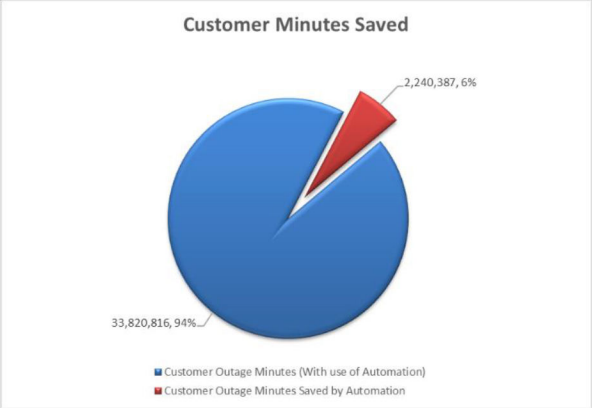
Reliability Reporting Storm Report

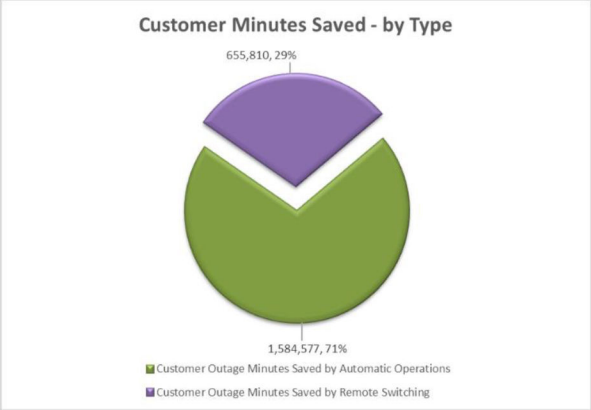
- This report is based off the data as of today. The storm impacts are subject to change as data cleanup is completed over the next few weeks.
- Non-distinct - includes customers with multiple outages and single outages
- The PUC-TX has established a metric that applies to SAIDI / SAIFI numbers for 'Forced' (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 didn't automatically operate. These are cases where service was not interrupted, but would have been if automation was not utilized
- An additional exclusion was created for events that only impacted a 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, named storm.
- 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

- **Summary:** Several powerful polar vortex cold fronts brought extreme record-breaking winter weather Sunday evening through Friday afternoon with strong winds, snow, ice, and bitterly cold temperatures. The severe winter weather forced many Texas power plants offline while load was increasing to record levels, which resulted in an ERCOT system generation shortfall. So, very early Monday morning, ERCOT started requests for CNP to manually shed very significant amounts of load for about 3 days.

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

- **Storm Period:**
  - Began 02/14/2021 @ 05:15 PM (1 hour before entering trouble level 2)
  - Ended 02/19/2021 @ 03:55 PM (1 hour after returning to trouble level 1)

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

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
All	2017.79	650.42	3.1023
Forced Interruptions	58.45	543.71	0.1075
Outside Causes	1941.84	654.21	2.9682
Scheduled Interruptions	17.50	658.81	0.0266

  - Total non-distinct customers outage over the period of the storm: 8,127,986
  - Total customer outage minutes over the period of the storm: 5,286,599,764
  - Estimated MW Lost: 4924.41
  - 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: 02/16/2021 at 20:00 to 02/17/2021 at 19:59.
    - Sustained non-distinct customer outages
      - 24-hour window = 3,379,182 (129.0%).
      - Had automation not been used in the 24-hour window = 3,384,472 (129.2%).
  - The storm dates 2/14/2021 through 2/18/2021 will be excluded from the Blue Sky SAIDI values.

Category	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
Forced Exclusions	58.45	543.71	0.1075
Outside Exclusions	1941.84	654.21	2.9682
Scheduled Exclusions	17.50	658.81	0.0266

- **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 (02/13/2021):
    - SAIDI = 8.44 minutes (2.82 minutes under goal)
    - CAIDI = 100.24 minutes (0.39 minutes over goal)
    - SAIFI = 0.0843 interruptions (0.0336 interruptions under goal)

  - YTD forced SAIDI / CAIDI / SAIFI after the storm (02/19/2021):
    - SAIDI = 11.68 minutes (0.65 minutes under goal)
    - CAIDI = 129.06 minutes (29.55 minutes over goal)
    - SAIFI = 0.0905 interruptions (0.0391 interruptions under goal)

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

Cause	SAIDI Minutes	CAIDI Minutes	SAIFI Interruptions
Weather	24.60	497.27	0.0495
Vegetation	0.92	839.65	0.0011
Equipment Failure	13.93	622.19	0.0224
Substation	14.71	1262.68	0.0116
Transmission	4.48	363.24	0.0123
Unknown	4.70	588.01	0.0080
Other	14.27	539.57	0.0264
Wildlife	0.02	279.24	0.0001
Third Party	0.00	40.52	0.0000

Outage Level	(includes forced, outside & scheduled outages)		
Circuit	1994.27	654.39	3.0475
Overhead Fuse	9.53	423.49	0.0225
URD Fuse	9.15	393.37	0.0233
Transformer	4.48	563.15	0.0080

Service Area	(includes forced, outside & scheduled outages)		
Baytown	107.07	699.32	0.1531
Brazoria	118.70	791.99	0.1499
Bellaire	353.34	800.64	0.4413
Cypress	182.64	559.66	0.3263
Ft Bend	77.49	1028.40	0.0753
Galveston	73.32	802.95	0.0913
Greenspoint	256.36	690.92	0.3710
Humble	144.95	583.46	0.2484
Katy	170.37	621.42	0.2742
Spring Branch	122.22	699.73	0.1747
South Houston	168.47	736.29	0.2288
Sugarland	239.82	823.98	0.2910

Reliability Reporting Storm Report

- **Distribution Automation Impacts (storm period):**
  - SAIDI Minutes saved due to automation: 1.78
  - Customer Outage Minutes absent use of automation: 5,291,269,171 (SAIDI - 2019.57)
  - Customer Outage Minutes with automation: 5,286,599,764 (SAIDI - 2017.79)
  - Customer Outage Minutes saved due to automation: 4,669,407
  - Customers positively impacted by the operation of automation: 18,234 (0.22% of storm cust out)
  - Number of devices operated remotely by Dispatch:
    - 106 (91% successful)
    - 18 required multiple attempts
    - 10 did not respond to multiple commands
  - Customer Outage Minutes saved due to remote operation of devices by Dispatch: 47,331

- **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 ---------- 4,498 events
  - Partial Circuit Outages ---------- 84 events
  - Overhead Line Fuses Blown ---------- 374 events
  - Transformer Fuses Blown ---------- 468 events
  - Burned Up Transformers ---------- 455 events
  - Spans Primary Down ---------- 130 events
  - Spans Secondary Down ---------- 154 events
  - URD Terminal Poles Blown ---------- 405 events
  - Major Underground Line Fuse ---------- 7 events
  - Poles Down ---------- 4 events
  - Drops Down ---------- 207 events
  - Meter Failures ---------- 31 events

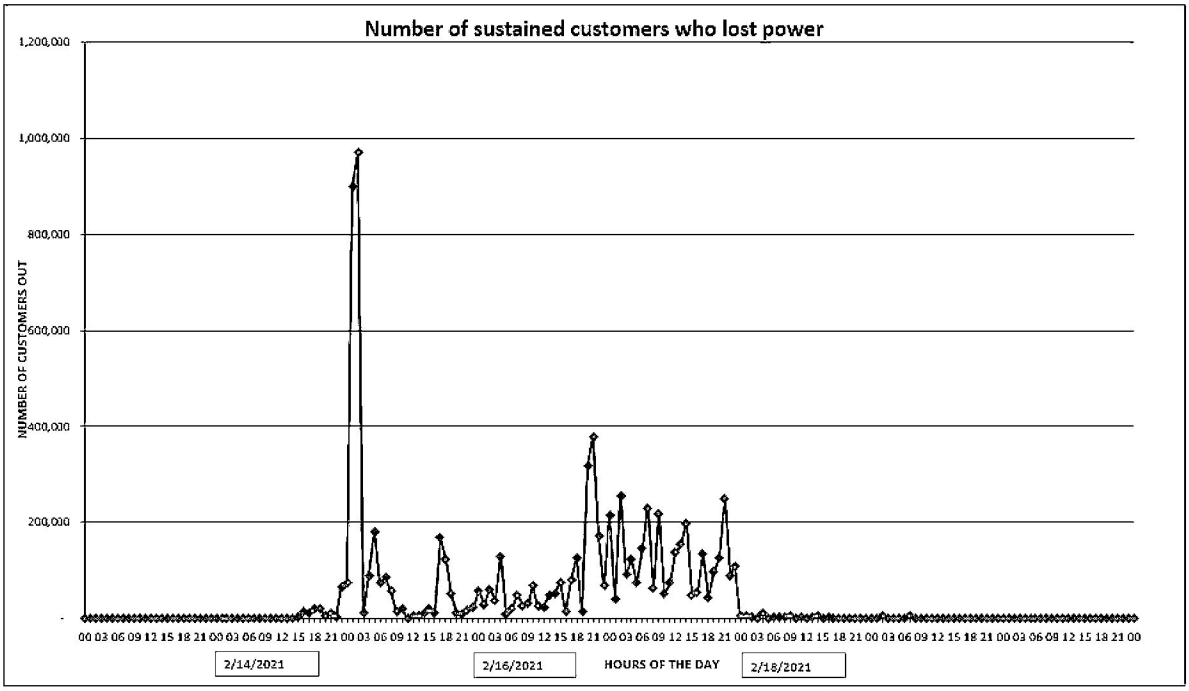
- **Weather Impact:**
  - Lighting strikes = 12
  - Sustained wind speeds = 26 mi/hr
  - Gust wind speeds = 36 mi/hr
  - Total rainfall in service area = 1.77 in

- **Substation Impacts:**
  - 3 substation transformers tripped

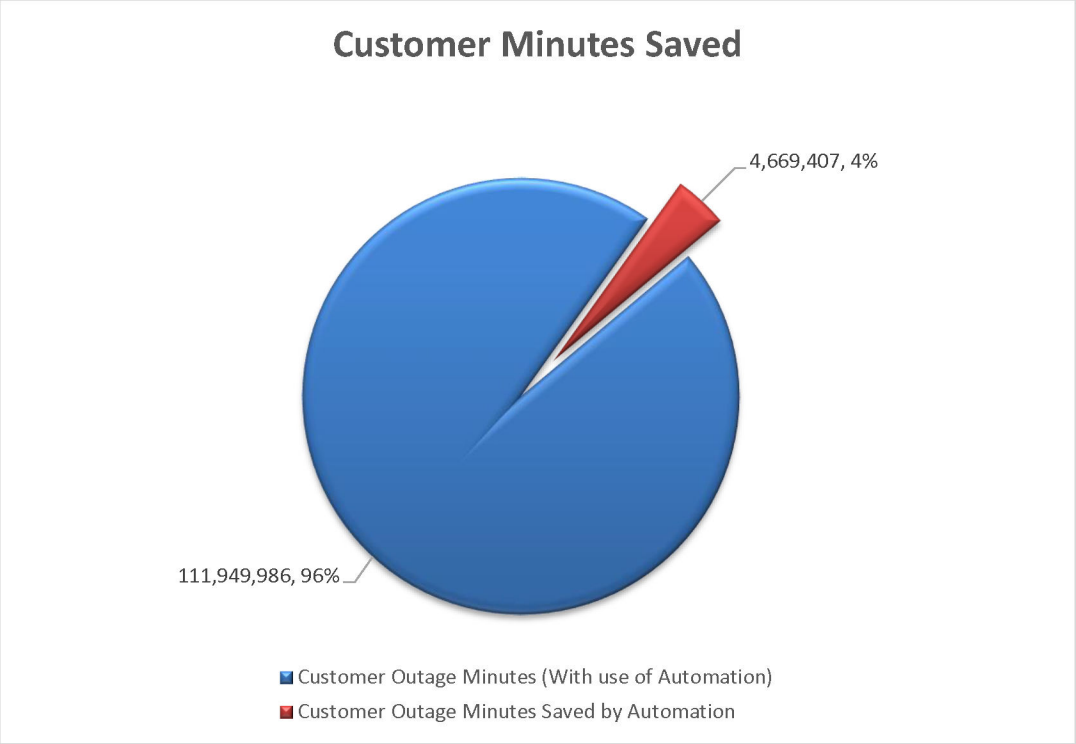
- **Transmission Impacts:**
  - 22 instantaneous operations
  - 25 line lockouts

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 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.



Reliability Reporting Storm Report

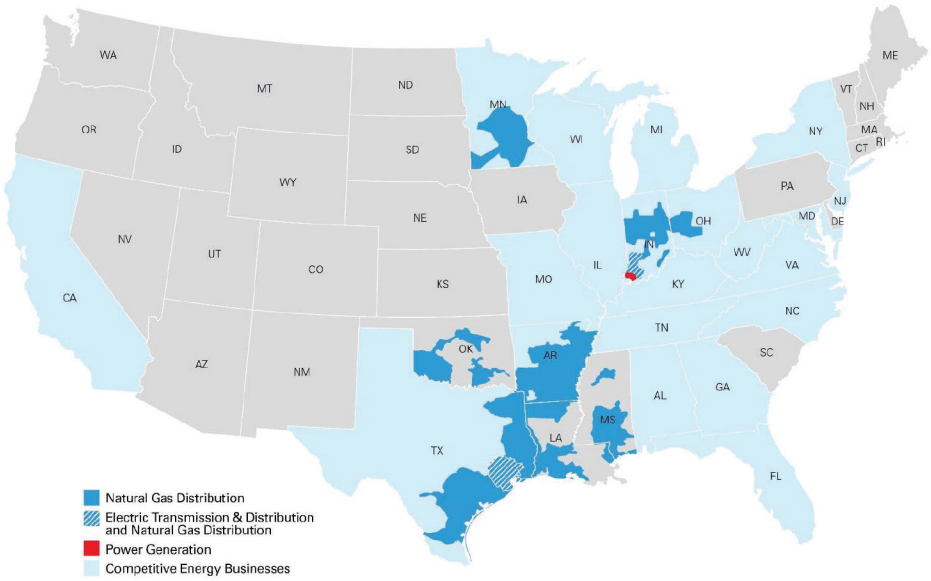


CenterPoint Energy

CenterPoint Energy's Hurricane Nicholas Response and Restoration

About CenterPoint Energy

An Electric and Natural Gas Utility



Electric Transmission & Distribution and Power Generation

more than **2.7 million** METERED CUSTOMERS

2 states

Natural Gas Distribution

more than **4.6 million** METERED CUSTOMERS

8 states

Competitive Energy Businesses

Project activity in more than **20** states

As of Dec. 31, 2020
On April 29, 2021, CenterPoint Energy announced the sale of its Arkansas and Oklahoma natural gas LDC assets to Summit Utilities

Advance Preparations
Emergency Operations Plans

- Our Electric and Natural Gas businesses each has an Emergency Operations Plan (EOP)
- Annual drill to test our emergency response
- Coordinate our EOP with state and local officials
- Work with a mutual assistance network that allows us to provide/receive assistance to/from other utilities across the country following natural disasters
  - On average, CenterPoint Energy sends linemen 4-6 times per year to help other utilities restore power
- Contracts for fuel, lodging and materials are executed in advance so we're ready if a storm strikes

Timeline

CenterPoint Energy

Preparations	Outreach	EOP	Nicholas Makes Landfall	Resources	Operations	Employee Assistance	Status
Sept. 12, 2021 Electric and Gas Operations, logistics, fleet, service centers and facilities make preparations Issue news release on safety tips Begin posting storm readiness tips and safety information on social media	**Sept. 13, 2021** Regulatory and Government Relations work with officials Issue news release on hurricane preparedness Email to employees on preparedness	**Sept. 13, 2021** Electric and Gas Operations activate EOP Activate Incident Command Center Publish social media messages on preparedness and safety Increase in employee messages on preparedness and EOP assignments	**Sept. 14, 2021** Nicholas makes landfall as a Category 1 hurricane on the eastern part of Matagorda Peninsula in Texas Over the next days, Hurricane Nicholas throttled the Texas coast with damaging winds, then soaked the northern Gulf Coast with flooding rain and storm surge	**Sept. 14, 2021** Issue news release on damage assessment and restoration update	**Sept. 14-19, 2021** Electric Operations restores 70% of impacted customers by the end of Day 1; more than 95% by the end of Day 3 (a total of 705,415 customers in five days) Gas Operations system functioning well Mutual assistance crews for Electric Operations arrive	**Sept. 14, 2021** CNP opens the HR Hotline and Employee Storm Assistance	**Sept. 18, 2021** Electric & Gas Operations resume normal operations for most employees on Sept. 18 CNP Foundation makes a food donation to the Salvation Army on Sept. 20

Hurricane Nicholas

CenterPoint Energy

- Hurricane Nicholas made landfall on the eastern part of the Matagorda Peninsula, about 10 miles west-southwest of Sargent Beach, Texas
- Maximum sustained winds were **75 mph** with gusts of more than **90 mph** at landfall
- Storm surge of 3 to 6 feet above normal tide levels was observed on the upper Texas coast, with the highest surge around Galveston Bay
- **4 to 10** inches of rain fell near the middle and upper Texas coast, **5 to 9** inches in southern Louisiana, **4 to 8** inches in southern Mississippi, **4 to 7** inches in southern Alabama and **2 to 9** inches over the far western Florida Panhandle

Restoration Execution

Restore Power Safely and Efficiently

1. Restore service to key facilities vital to public safety, health and welfare and secure downed power lines
2. Repair major lines and fuses that restore power to greatest number of customers in least amount of time
3. Repair transformers, which typically serve about 10 customers
4. Repair individual electric drops to homes

Impact of Grid Modernization

Benefits of Advanced Metering System (AMS) and Intelligent Grid

CenterPoint Energy

- The Smart Grid, including distribution automation devices such as intelligent grid switches, allowed us to quickly isolate problems on our grid
  - Operated more than **117** of these devices during the event impacting more than **70,142 customers**
  - Were able to avoid almost **36,252,753 outage minutes** for our customers
  - **13.70 SAIDI minutes** saved due to automation
- AMS meters increased efficiency during the storm
  - Executed **30,000 orders** remotely at **99.6% performance**
  - Billed **121,326 accounts** with actual readings at **99.3% performance**
  - Executed remote turn off/on for safety reasons

- Use of real-time analytics to assess, monitor and resolve cases
  - Aided in developing better situational awareness
  - Allowed us to correlate weather and flooding information with outages, providing operations with critical decision-making tools

Impact of Storm Hardening

Activities in place at CenterPoint Energy

CenterPoint Energy

- **Transmission Hardening**
  - Implement cascading tower design to prevent multiple pole failures
  - Strategic replacement of all wooden H-frame structures with steel or concrete in conjunction with system upgrades
- **Substation Hardening**
  - Install flood walls and/or raising elevation of substation equipment or installation of flood walls in certain flood-prone areas
- **Distribution Hardening**
  - Increase size of poles in key locations and reduce span lengths to add strength to system
  - Proactive replacement of broken, damaged or loose downed and span guy wires
  - Large commercial transformer banks installed as pad mounted and no longer installed on poles
- **Major Underground Hardening**
  - Partner with key customers to relocate vaults above ground in flood prone locations (e.g. Texas Medical Center)

Impact of Grid Modernization

Use of Technology during Storm

CenterPoint Energy

- Helicopters and drones helped to assess damage and evaluate work conditions
  - More than **20 locations** were tracked using **9 drones** and **2 helicopters**
  - Enabled real-time situational awareness, accelerating restoration assessments
  - Allowed us to efficiently direct crews to accessible locations
  - Infrared capabilities helped identify equipment that needed further inspection

- Mobile data on each crew kept outage management efficient
- Ability to use **Power Alert Service (PAS)** to keep customers informed
  - AMS meters provide outage information that enables our predictive analytics engine to supply data to PAS and IVR systems, ultimately allowing for better, more detailed customer updates
- Mobile Generator at Lake Jackson Civic Center
  - Brazoria County was one of the hardest-hit areas following Hurricane Nicholas
  - **5,000-watt** mobile generator, fueled by methane gas, installed at Lake Jackson Civic Center for **4** days
  - Provided electricity for a cooling center service to thousands of area residents without power

Hurricane Nicholas by the Numbers

Electric Operations Response

CenterPoint Energy

- **317** total electric circuits locked out and **1,438** total electric fuses out
- More than **3,200** employees and contractors plus **1,400** mutual assistance personnel from **9** states
- **188.74** SAIDI minutes with **705,415** customers impacted
- **499,963,122** total minutes out over **5** days

Hurricane Nicholas by the Numbers

Electric Operations Response

CenterPoint Energy

- **4** staging sites
- **138,673** total hours worked during EOP event (49 hours per employee)
- Approximately **62 crew spokespersons** used
- **62,958** meals served
- More than **2,214** hotel rooms utilized

Hurricane Nicholas by the Numbers

Electric Operations Response

CenterPoint Energy

- More than **705,415** total restorations
- More than **1,800** safety orientations and **120** crew safety observations
- **6** air boats, **9** drones and **2** helicopters

Safety Forward

Hurricane Nicholas by the Numbers

Natural Gas Operations Response

CenterPoint Energy

- Responded to **178** natural gas emergency orders
- **507** natural gas meters assessed for damage
- Approximately **9** natural gas meters submerged under water that required remediation
- Approximately **318** crossings inspected of which **1** required remediation
- Inspected **304** stations
  - None were submerged due to flood waters, no required remediation
    - Relief valves, debris removal, fencing
- More than **183** EOP responders
- **206** meals served

Hurricane Nicholas by the Numbers

Customer Service Response

CenterPoint Energy

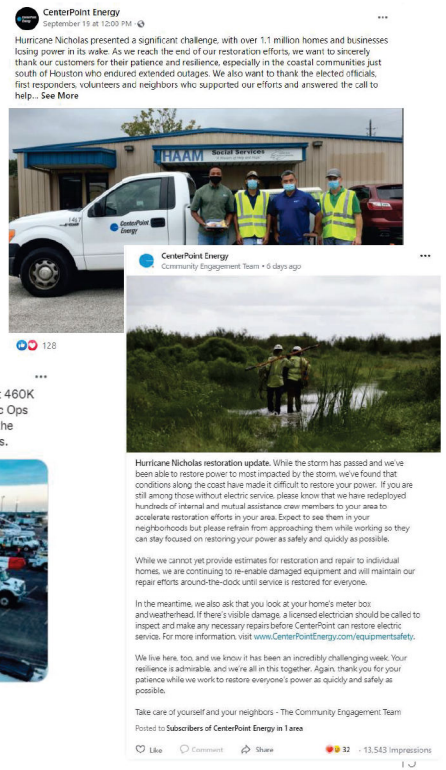
- **~200,000** calls to the call center
- **25%** were answered by agents with IVR handling the remainder
- **290,000** outage notifications delivered through PAS
- Nearly **40,000** new PAS enrollments

Hurricane Nicholas by the Numbers

Customer Communications Response

CenterPoint Energy

- **24** Facebook posts that reached **225,910** people & were shared **687** times
  - **1,289** inbound messages (311% increase from week before)
- **54** tweets that reached **851,670** people & retweeted **818** times
  - **2,314** inbound messages (3300% increase from week before)
- **7** Nextdoor posts that reached **211,840** people
- **2** LinkedIn posts with **41,526** impressions and **4,730** video views
- **8** customer emails sent in English and Spanish with over **4 million** delivered

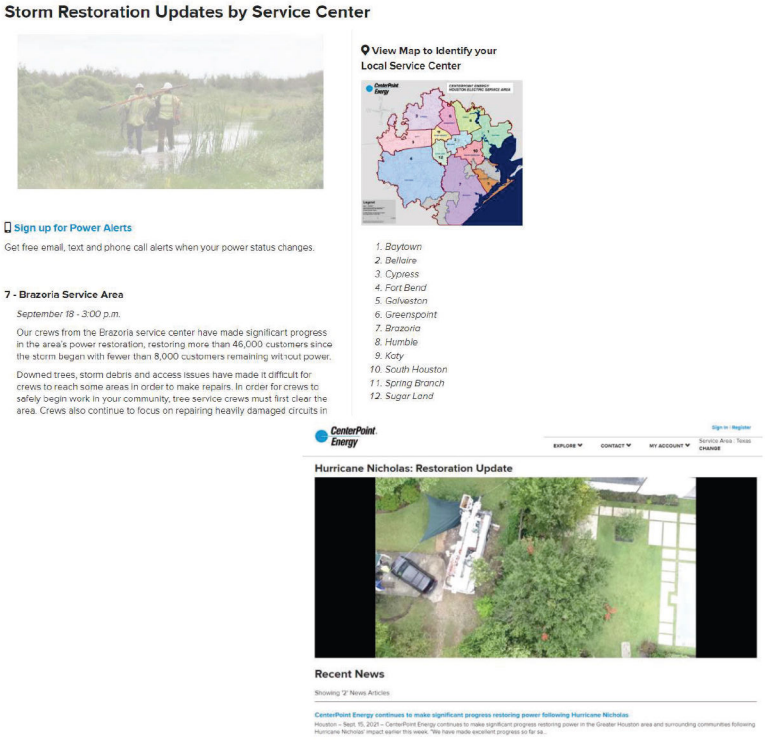


Hurricane Nicholas by the Numbers

Customer Communications Response

CenterPoint Energy

- **1,055,352** visits to CenterPointEnergy.com (9/12-18)
- At the height of the storm, web traffic was more than **867%** higher than average
- **189,107** visits to Outage Center page
- **1.37 million** page views to Outage Tracker



Storm Restoration Updates by Service Center

View Map to Identify your Local Service Center

Sign up for Power Alerts

Get free email, text and phone call alerts when your power status changes.

7 - Brazoria Service Area

September 18 - 3:00 p.m.

Our crews from the Brazoria service center have made significant progress in the area's power restoration, restoring more than 46,000 customers since the storm began with fewer than 8,000 customers remaining without power.

Downed trees, storm debris and access issues have made it difficult for crews to reach some areas in order to make repairs. In order for crews to safely begin work in your community, tree service crews must first clear the area. Crews also continue to focus on repairing heavily damaged circuits in

1. Baytown
2. Bellaire
3. Cypress
4. Fort Bend
5. Galveston
6. Greenspoint
7. Brazoria
8. Humble
9. Katy
10. South Houston
11. Spring Branch
12. Sugar Land

Hurricane Nicholas: Restoration Update

Recent News

Hurricane Nicholas by the Numbers

Community Giving and Employee Support

CenterPoint Energy

- Donated surplus EOP food items from service centers and staging sites to more than **20** nonprofit and first responder organizations throughout Greater Houston and surrounding communities
- **15** calls to the EOP Employee Assistance hotline

Hurricane Comparisons

CenterPoint Energy

Year	Name	Cat.	Winds sustained (mph)	Tropical Storm Wind Field (Miles)	Electric Outages	Restoration
1983	Alicia	3	115	125	750,000	16 days
1992	Andrew	4	160	105	1.4 million	34 days
2005	Katrina	3	125	230	970,000	42 days
2005	Rita	3	115	205	719,000	6 days
2008	Ike	2	110	450	2.15 million	18 days
2017	Harvey	4	130	270	1.27 million	10 days
2021	Nicholas	1	75	120	705,000	5 days

CenterPoint Energy

The following files are not convertible:

HCC RFP 1-4 - Derecho Storm Event Cause Summary (1).xlsx

HCC RFP 1-4 - Hurricane Beryl Event Cause Summary.xlsx

HCC RFP01-09.xlsx

HCC-RFI01-02.xlsx

Please see the ZIP file for this Filing on the PUC Interchange in order to access these files.

Contact centralrecords@puc.texas.gov if you have any questions.