Filing Receipt

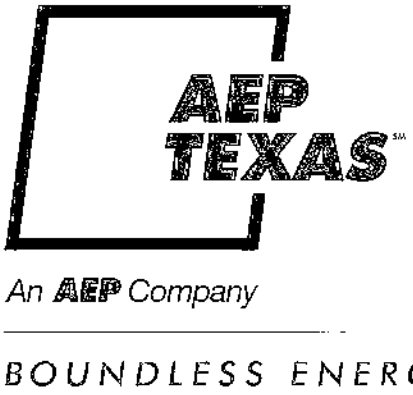
Filing Date - 2023-06-30 02:40:43 PM

Control Number - 54467

Item Number - 20

PROJECT NO. 54467

CY 2022 ELECTRIC UTILITY	**§**	**PUBLIC UTILITY COMMISSION**
SERVICE QUALITY REPORTS	**§**	
UNDER 16 TAC § 25.81	**§**	**OF TEXAS**



AEP Texas Inc.'s Additional Report Related to Electric Service Quality

June 30, 2023

Regulatory Contact: Steven Beaty
AEP Texas Regulatory Service
Phone: (512) 481-4550
Fax: (512) 481-4588
Email: sjbeaty@aep.com

Table of Contents

I. Introduction

AEP Texas Inc. (AEP Texas or the Company) submits this report pursuant to the Public Utility Commission of Texas (Commission) Order of December 15, 2022, in Project No. 54467. Consistent with Commission Staff's December 5, 2022, memorandum in Project No. 52937, the Commission directed AEP Texas to file a report:

- Analyzing the root causes of outages on the top ten percent of AEP Texas's worst performing feeders identified by the Company in its CY 2020 and 2021 electric service quality reports, irrespective of the number of years the feeders exceeded the allowable threshold;
- Addressing the most commonly recurring causes of service interruptions, with sufficient detail of any common circumstances or facts that contribute to the feeders' poor performance; and
- Detailing actions AEP Texas has already taken to address the common causes of interruptions as well as new or potential future actions the Company intends to take that are designed to reduce the number of feeds with poor performance.

The list of feeders are examined collectively to ascertain the most common recurring causes of interruptions and individually to determine the facts that contribute to the feeder's poor service quality performance. The report is organized in two sections, first the collective analysis, and secondly the individual feeder analysis in an addendum.

On January 18, 2023, AEP Texas had an online meeting with the PUC Staff to clarify what was meant by top 10% worst performing feeders, a term that is not defined in Commission rules. The consensus from that meeting was that AEP Texas would be reporting on the top 10% of the 300% over system average SAIDI feeders for the years 2020 and 2021, not limited to the feeders that repeated for two or more years. There were 57 feeders that were 300% over the system SAIDI average in 2020, and the highest six are discussed in this report. There were 76 feeders that were 300% over the system SAIDI average in 2021, and the highest eight (not including the two feeders that were repeats from 2020) are discussed in this report. The fourteen feeders analyzed in this report are summarized in Table 1 below:

Table 1

Station	Circuit	2022 SAIDI	2021 SAIDI	2020 SAIDI	2021 # Cust.
SANTA RITA	97SA1100	96.3	5437.2	33	82
MCCAMEY	97SA2415	777.8	3886.8	43.9	82
SANTA RITA	97SA1105	58.8	3439	483.8	73
BAY CITY	94CN6450	26.7	2728.5	115.8	164
WESMER	94SB6900	52.1	2027	180.7	52
SONORA ATLANTIC	97SA4415	21.5	1997.1	149.2	31
O'CONNER	94CN390	449.9	1946.3	178.1	203
DUNE FIELD	97SA3885	218.6	1857.9	149.2	69
CABANISS	94CS80	51.7	347.7	5933.2	98
CONOCO-CHITTAM	94LA8580	516.9	2221.2	2108.6	26
CARANCAHUA	94CN1875	55.7	2614.9	1982.4	59
LA PRYOR	94LA570	500.2	180.5	1952.4	171
CRESTONIO	94LA270	732.6	1446.5	1582.3	641
ALAZAN	94CS620	652.1	656.1	1561	167
300% Over:		560.6	592.2	586.2	

The blue shading indicates the 2020 feeders over the 300% threshold, and the green shading are the 2021 feeders over the 300% above yearly average.

II. Discussion of Feeder Analysis

The remainder of this report is separated into two sections and an Addendum. The first section identifies and analyzes the causes of outages on the fourteen selected feeders as a group. The second section discusses AEP Texas's approach to reducing outages and the overall SAIDI through programs to prevent outages and minimize duration. Finally, AEP Texas has included an Addendum that provides additional information through an individual feeder analysis that include significant singular contributions to SAIDI, recurring causes, work done to address issues, and future plans.

A. Causes and Analysis of Outages on Selected Feeders

The outage information for all fourteen feeders was grouped together and customer minutes interrupted (CMI) were totaled by cause code. Data observations on all fourteen feeders for years 2020 and 2021 are shown in the following charts. The first is a chart of the customer minutes interrupted by outage cause code:

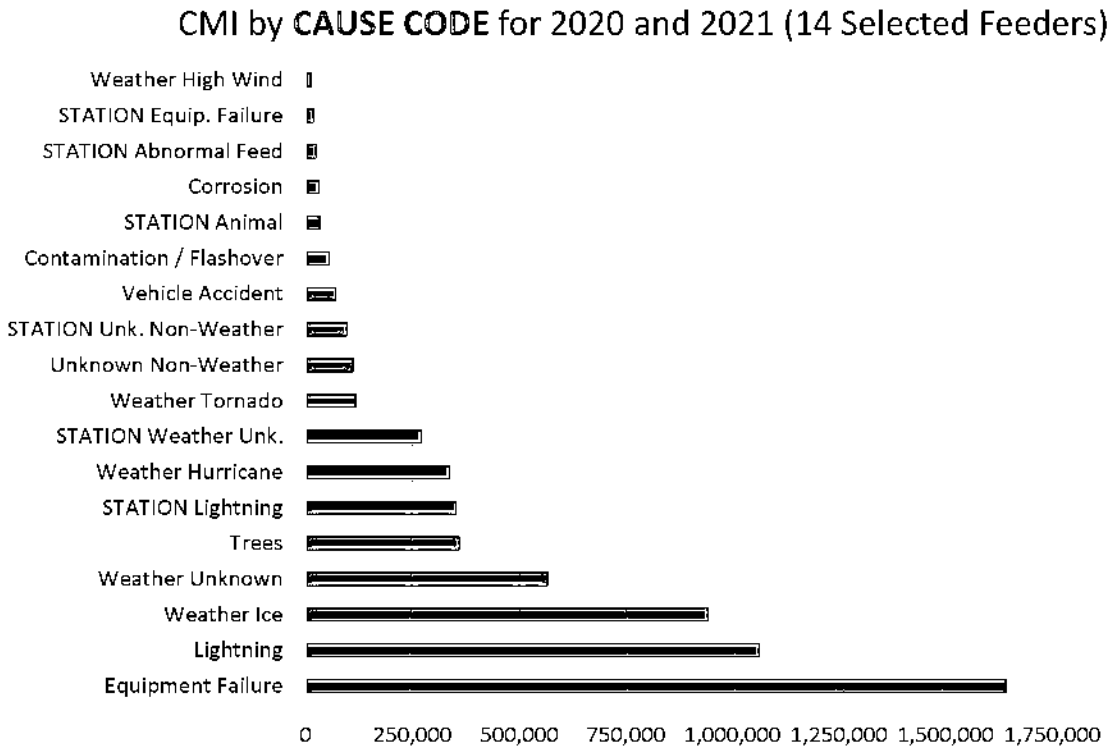


Figure 1

Figure 1 provides an overview of the reported causes of AEP Texas's outages for the fourteen feeders examined in 2020 and 2021. The highest cause is equipment failure at 27% (1,640,913 CMI of the total 6,105,549). Lightning was the second highest cause of outages at 17.4% (1,061,762 CMI of the total 6,105,539 CMI).

i. Equipment Failures

To further explore the equipment failures, Figure 2 below categorizes the equipment failures by equipment type.

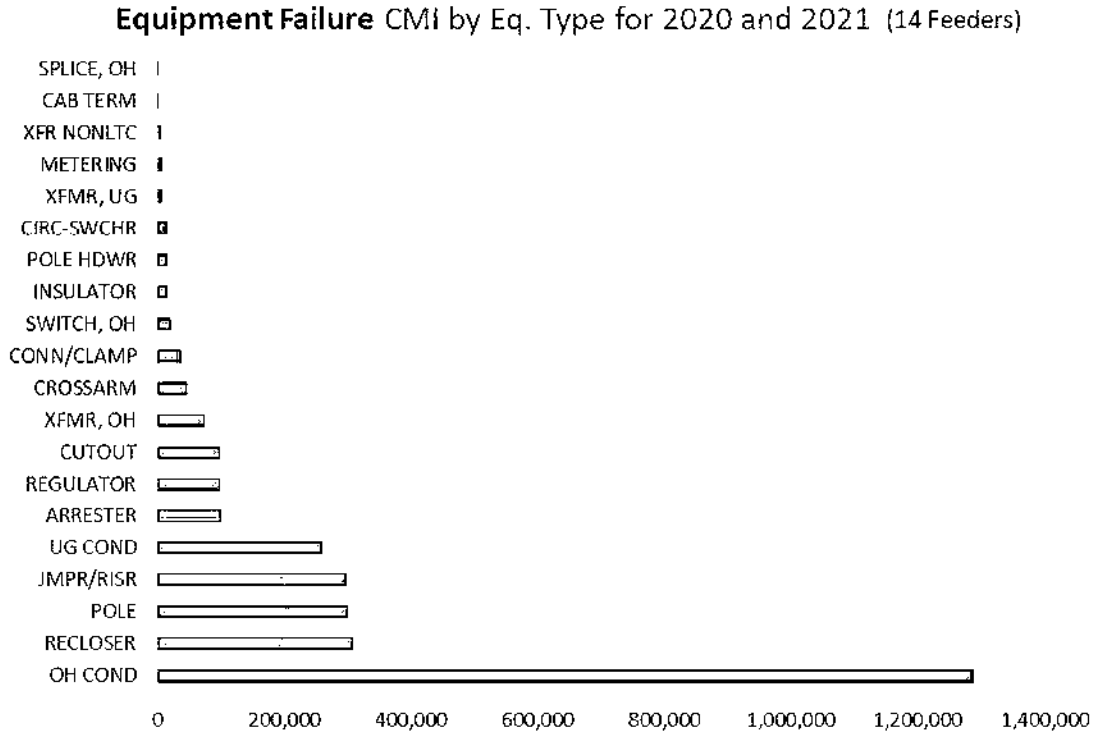


Figure 2

Figure 2 shows that by far, the most common equipment failure is overhead conductor. Further analysis shows that ten of the fourteen feeders had conductor failures with the most common wire size being #2 AA and AAA. The largest conductor size experiencing failures was #4/0AA. All but one of the #4/0AA failures were on Alazan 94CS620, which has undergone several reconductor projects and an automation project.

Figure 3 below provides additional details on the overhead conductor failures by feeder and wire type:

		Circuit	CMI
1	Crestonio	94LA270	350,910
2	Carancahua	94CN1875	98,924
3	Wesmer	94SB6900	82,713
4	Alazan	94CS620	73,881
5	Cabaniss	94CS80	34,772
6	O'Conner	94CN390	28,939
7	Santa Rita	97SA1105	17,351
8	La Pryor	94LA570	9,150
9	McCamey	97SA2415	2,964
10	Sonora Atlantic	97SA4415	1,687
			701,291

Primary Conductor	CMI
#4/0 AA & AL	59,578
#1/0 AA	34,162
#2 AA & AL	528,247
#2 ACSR	44,706
#4 ACSR	351
#4 Copper	3,343
#6 Copper	28,939

Secondary Cond.	
#2 AL TQ	88
#2 AL TT	1,760
#4 AL TT	39
#4 AL TD	78

Figure 3

Based on the age of the conductors that experienced failure, the highest incident of failure is #2AA conductor that was installed in the 1970's. #2A primary conductor makes up 61.2% of the 30,936 miles of overhead primary conductor on AEP Texas's distribution system. Figure 4 below depicts the installation years of the overhead conductor failures for the selected 14 feeders from 2020 and 2021. The conductor failure CMI is plotted by the year that it was installed. The years from 1970 to 1978 show the most failures.

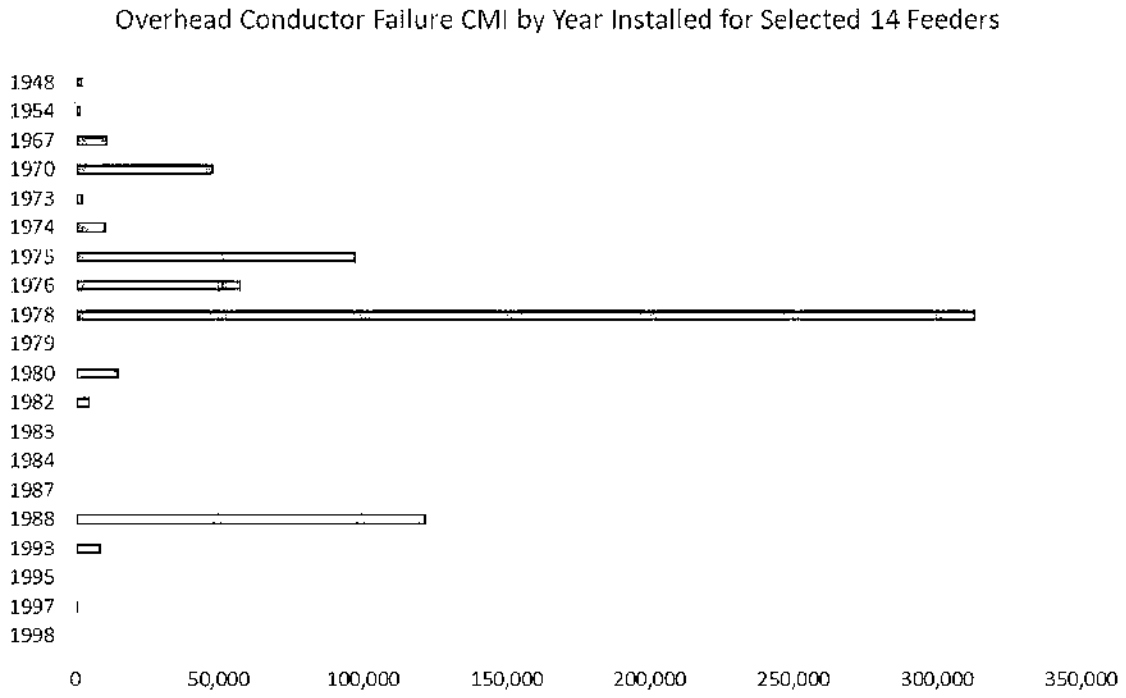


Figure 4

ii. Lightning

Figure 5 explores the second highest cause of outages on the 14 selected feeders, lightning, which accounted for 17.4% of the outage minutes or 1,061,762 CMI from 214 outages. Figure 5 shows the CMI totals due to lightning by clearing device. This gives an indication where AEP Texas could focus our lightning mitigation efforts.

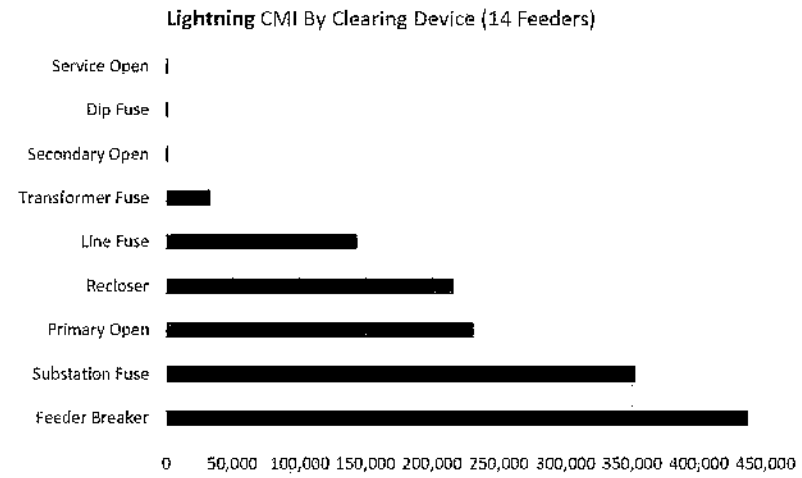


Figure 5

The most outage minutes from lightning occurred at the feeder breaker level. Seven of the fourteen feeders experienced feeder breaker lockouts due to lightning. These circuits were also all in rural areas. Lightning mitigation efforts should first be focused in the feeder breaker zones[1], especially on rural circuits. The second highest cause was lightning in the substation. This was due to one interruption at the Crestonio substation where lightning caused the transformer high-side fuse to blow. Lightning mitigation in the subs is done with the design of the sub using overhead static wire and arresters at different voltages. There were three outages that contributed to the "primary open" category. These were primary jumpers or wire that separated interrupting the lightning faults. These types of failures are addressed in AEP Texas's new design standards, such as including arrester stations at corners or dead-ends. There were fourteen recloser outages on six feeders again in the rural areas such as Alazan, Cabaniss, Crestonio, and La Pryor. In eleven of the fourteen recloser outages, the reclosers were successfully closed after locking out, with no problems found. This indicates that coordination studies are needed to change the type and settings on the reclosers to clear temporary lightning faults. Line fuses cleared sixty-six of the lightning outages on eleven of the feeders:

Fuse outages (lightning)

Refused and held	48
Transformer re-fused	9
Arrester needed clearing	2
Primary wire damage	4
Pole damage	2
Transformer damage	1
Figure 6	66

Of the lightning fuse outages shown in Figure 6 above, 73% were resolved by the fuse being replaced and no other problems found with AEP Texas's equipment. This typically indicates that adding reclosers could help practice fuse-savings. In those situations, the fast timing curve on the recloser is faster than the fuse and will interrupt the fault before the fuse blows. AEP Texas practices this method, but is not always able to protect the fuses because some are located in a protection zone where it would not be prudent to have momentary outages. Lighting protection is not exact because of the proximity of strikes and varying intensity of each strike.

iii. Weather – Ice

The next highest cause code after lightning was weather-ice at 15.4% of the total CMI. This was due to two outages on the Santa Rita feeders where sections of line were purposely delayed because of access issues, but were not a part of the major event exclusion.

iv. Weather – Unknown

The cause code weather-unknown was the fourth highest category at 9.3% of the total CMI. There were 82 weather-unknown outages in the two-year period. There were five feeder outages, twenty-four line fuse outages, eleven recloser outages, and forty-two transformer outages. The most CMI came from the feeder lockouts. These outages occurred during weather events such as thunderstorms, lightning, or high winds, but the specific cause of the outage was not readily apparent.

[1] The breaker zone is all of the distribution facilities between the substation (breaker) and the first automatic sectionalizing device.

v. Other Causes

Other cause codes for CMI in Figure 1, are trees, station lightning, hurricane, and station – weather – unknown. Tree outages, which are monitored by the Forestry group who conduct spot trimming for reliability such as targeting feeders with high SAIDI due to trees. The single station lightning outage was covered in the lightning section above. Hurricane outages were small pockets of outages that were delayed because of access or customer request that were not included in the major event exclusion. The station – weather – unknown CMI resulted from one outage at the Crestonio substation when the station high side fuses blew on an afternoon in May 2020, during a weather event.

B. Reduction of Outages on Worst Performing Feeders

This section provides the requested information related to actions AEP Texas has already taken to address these common causes of interruption and provide specific information about new or future actions the utility intends to take. Generally, AEP Texas's approach for improving performance focuses on two areas: prevention and minimizing duration of outages. AEP Texas intends to continue and expand its successful programs as well as begin new programs to improve overall reliability. Part of those plans include proposing a resiliency plan under recently passed House Bill 2555.

i. Prevention

AEP Texas's existing outage prevention programs include:

- **System hardening**. AEP Texas's system hardening efforts include reliability projects that focus on making specific locations more storm resistant such as converting highway crossings to underground, adding four-way guys to prevent cascading failures due to wind, using insulated tree wire, reinforcing poles at intersections with fiberglass or ductile iron poles, relocating inaccessible facilities, and using new materials such as insulated spacer cable to make designs more resistant to storm conditions. Other system hardening efforts are more global such as changing the design software to use a higher construction standard. See AEP Texas's May 1, 2023 submission in Project No. 39339, Report For Electric Utility Infrastructure Storm Hardening.

- **Vegetation management**. AEP Texas's vegetation management program utilizes a combination of performance-based and cycle-based approaches that is an efficient and flexible process, allowing for improved reliability on a greater number of circuits than either approach alone would offer. The multi-tiered approach functions in the following manner: The first two tiers (Tiers 1&2) focus on long-term reliability by establishing a four-year trim cycle on selected breaker zones and essential services circuits. The remaining two tiers (Tiers 3&4) continue with an established circuit performance approach, focusing on worst performing circuits. More detail on this vegetation management program has been provided to the Commission in Project No. 41381, Report summary regarding Vegetation Management.

- **Inspection programs**. All feeders are inspected every three years from the station breaker to the end of the breaker protection zone. Additionally, every feeder is inspected in its entirety every six years, including the breaker zone and all taps to the end of the circuit. Additionally, AEP Texas is converting the inspection software from a system that uses mobile data computers and Spectrum software to a phone app that will allows much more flexibility and can also be used for storm assessment and storm hazard assessment.

- **Pole replacement program.** AEP Texas identifies poles through periodic inspections and replaced based on a priority determined by the inspection. The inspections identify issues such as ground rotting and allow the company to replace poles proactively before an outage occurs.

- **Cable injection program**. This reliability program targets areas with older cables or areas with higher failure rates and uses the rejuvenation process to extend the life of the existing cables for an additional 30 or 40 years while also avoiding an equipment failure related outage.

- **Sectionalizing program.** AEP Texas targets feeders with high SAIDI indices and look for opportunities to add reclosers, switches, and fuses. Adding protective devices enables the system to automatically remove the fault, thus interrupting less customers. As a part of the sectionalizing program, protective device coordination is reviewed to ensure that only the customers that should be interrupted are interrupted.

- **Lightning Mitigation.** AEP Texas installs lighting arrestors on all equipment, consistent with the standards that require installations at standard intervals on line construction. As AEP Texas conducts other projects on older equipment, lighting arrestors are installed consistent with the new standards.

- **Other Reliability Programs**. AEP Texas conducts other reliability programs such as small wire replacement and open wire secondary replacement. These programs target older types of construction or materials that are prone to failing and causing outages.

AEP Texas's future prevention programs include:

- **TripSaver2 installations.** In 2023 AEP Texas started a TripSaver2 installation program. This program uses electronic reclosers that fit into a fuse disconnect and allow the clearing of temporary faults without causing an extended outage. AEP Texas has already begun seeing success with the use of this new types of fuse replacement technologies.

- **Overheard Conductor Renewal Program.** AEP Texas has engaged an outside consultant to prepare an analysis for AEP Texas's overhead conductor renewal program. Specifically, this analysis is intended to provide a 10-year plan to renew and revitalize AEP Texas's overhead primary distribution system by replacing the aged portion of the system that is past its useful life. Historically, infrastructure has been replaced on an as-needed basis and through worst-performing circuit analyses. Although this method has historically led to good system operation, assets have reached an age where this method is driving operating costs and reliability risk up. In the study phase, the consultant will identify overhead primary conductor for renewal and consider data and condition information from distribution poles and structures. The goal is to allow AEP Texas to be more proactive and efficient by rebuilding the system with a specific investment plan to help prioritize reconductoring investment in a manner that will best serve AEP Texas's customers.

ii. Minimizing Duration

To decrease the time duration of outages, AEP Texas's main focus is on the devices responsible for the highest amount of CMI which are feeder breakers and the associated lock outs. Secondary focus is on areas with a history of outages that are typically smaller like fused taps, recloser zones, or sections of line that operate upstream protection devices.

- The Distribution Automation Circuit Reconfiguration (DACR) program specifically targets reducing the duration of outages by sectionalizing and moving customers to other feeders automatically as outages occur. Sections of line that are experiencing a fault are isolated and identified speeding up the restoration time.
- AEP Texas's sectionalizing program also targets reducing durations by adding switches for isolation and transferring load during outages.
- A program began in 2023 involves the installation of line sensors or automated faulted circuit indicators. These line sensors can help give our dispatch center information on the location of faults, which allows restoration crews to isolate the problem faster and restore as many customers as possible before repairing the damage.

iii. HB 2555 Resiliency Legislation Passed by Texas Legislature.

In 2023, the Texas Legislature passed House Bill 2555 relating to system resiliency planning. This legislation provides a path for utilities like AEP Texas to improve system resiliency and reliability for its customers by filing a specific resiliency plan at the Commission. A utility's plan to enhance the resiliency of the utility's transmission and distribution system can include methods including, but not limited to: hardening facilities, modernizing facilities, lightning mitigation measures, and vegetation management. AEP Texas has begun reviewing the legislation to evaluate how best to leverage this opportunity to address issues on AEP Texas's system.

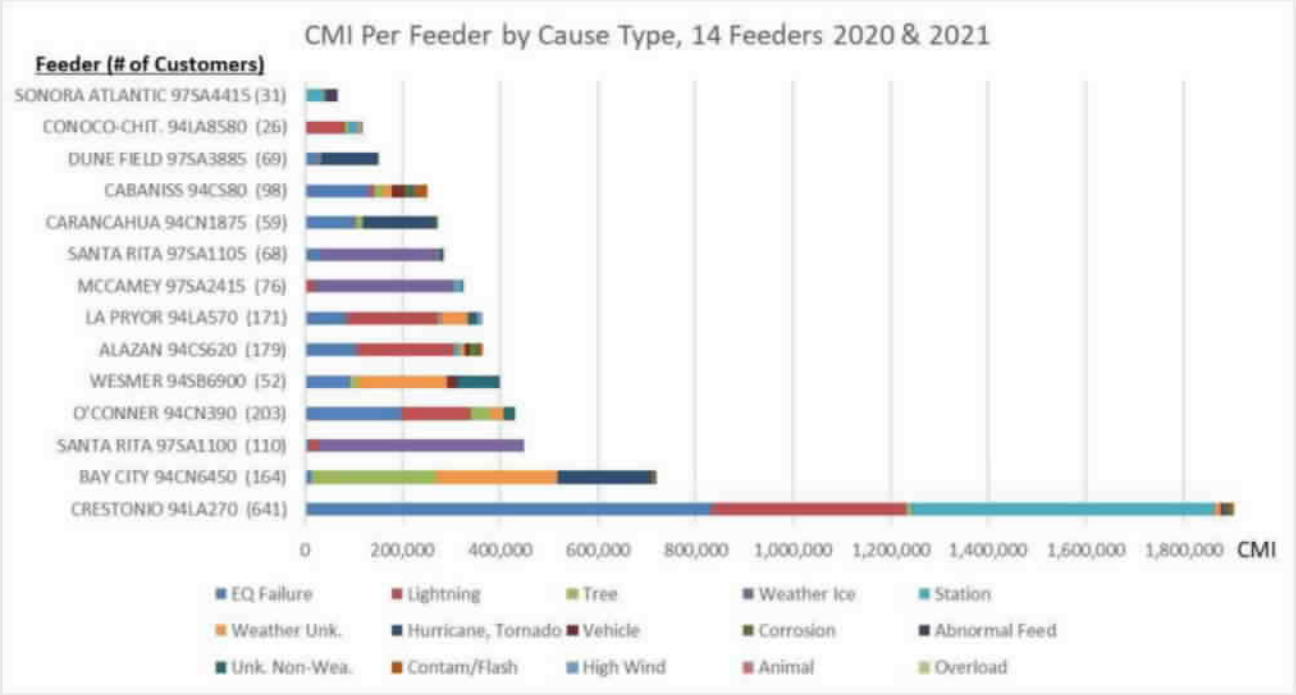
III. Conclusion

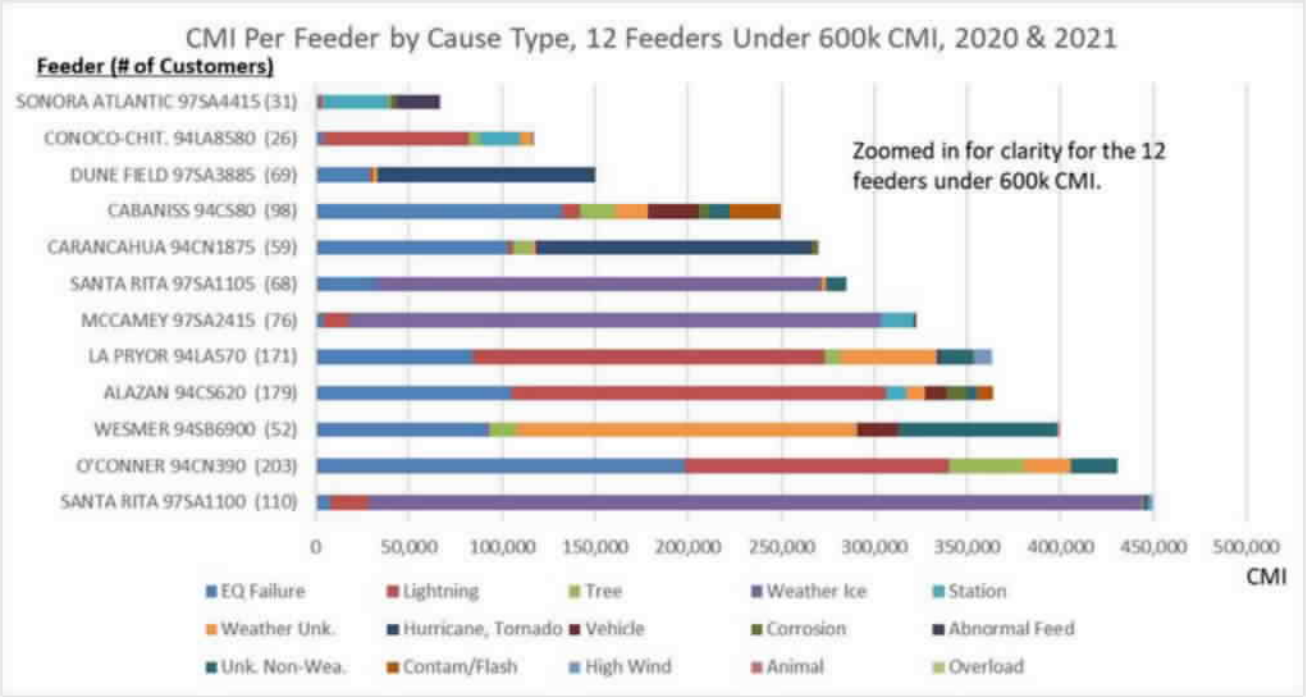
AEP Texas recognizes the importance that the Commission places on reliability and remains committed to providing reliable electric service to the over 1 million end use customers in the AEP Texas service area. Through the use of existing programs that have proven to enhance reliability as well as planned future programs to further improve reliability, AEP Texas is striving to address its common causes of interruption and reduce the number of feeders that fall within the Commission's definition of poor performance. AEP Texas's existing and planned programs should continue to address the common causes of interruption across the system. Although each of the feeders addressed in the following Addendum have presented challenges, they are showing improvement. Of the 14 feeders, 11 have improved performance to no longer reach the 300% threshold, and all 14 have improved performance from their past performance that placed them above the threshold. AEP Texas is available to answer any questions and looks forward to working with Commission Staff to continue improving service to AEP Texas's customers across the state.

ADDENDUM

This addendum provides a more detailed analysis of individual feeders, beginning with a comparison of outage causes in bar graphs, followed by the 2020 circuits on the list, and finally the 2021 circuits.

The following two charts show the CMI per feeder by cause type. The second chart provides the same data as the first chart, on a smaller scale to provide a closer view of the cause type for the 12 feeders with lower CMIs than Bay City and Crestonio.





A. 2020 Individual Feeder Analysis

The individual feeder analysis looks at outage causes, such as recurring causes, tree issues, reasons for abnormally large individual outages, types of mitigation work that has been performed, and future plans. The financial breakdown of expenditures by project type to address reliability on each feeder is included. The information for the 2020 top 10% of feeders above the 300% over system average, 586.2 minutes, is provided in the chart below:

Station	Circuit	2020 # Cust.	2020 Rank	2020 SAIDI	2021 # Cust.	2021 Rank	2021 SAIDI
CABANISS	94CS80	37	1	5933.2	95	160	347.7
CONOCO-CHITTAM	94LA8580	27	2	2108.6	27	6	2221.2
CARANCAHUA	94CN1875	57	3	1982.4	60	5	2614.9
LA PRYOR	94LA570	172	4	1952.4	175	362	180.5
CRESTONIO	94LA270	633	5	1582.3	636	14	1446.5
ALAZAN	94CS620	163	6	1561	167	63	656.1
300% Over:				586.2			592.2

1. Circuit Analysis for Cabaniss 94CS80 (2020)

Cabaniss 94CS80 is a rural 12kV circuit on the south side of Corpus Christi following Hwy. 286 for five miles south to Staples Road. The total circuit length is 19.8 miles with 95 customers in 2021. The peak load is 400kVA. The area is flat farm land with some large-lot rural residentials.

- The substation was originally built in 1972. A double bank, six feeder station built on the 138kV transmission loop in South Corpus Christi.
- Cabaniss had 1,328 customers in 2019 and 713 in 2020. In December of 2020 the count dropped to 37 when part of the circuit was transferred to a new feeder 94CS615. The count in 2021 was 235 in February and 40 in May. If the calculation for SAIDI is done with 713 customers in 2020, the value would have been 307 minutes. Although it is the change in customer count that caused this feeder to appear on the list, AEP Texas recognizes that it does exhibit outage issues that need to be addressed such as equipment failure.
- In 2020, 57% of the outages were due to equipment failure (125,576 CMI), and in 2021, 19% of the outages were due to equipment failure (6,352 CMI). The largest failure by CMI was pole hardware and crossarms. Insulator pins and wood arms were the cause. AEP Texas's focus for repair has been pole replacements from inspections and wire upgrades. The entire main feeder line was replaced in 2020 and 2021, a total of 5 miles. Part of that reconductor was a double circuit rebuild with Cabaniss 94CS615 for a mile. The load on 94CS80 was split with 94CS615.

Equipment Failure	CMI	
Pole Hardware	47,216	57.2%
Crossarm	13,051	15.8%
Pole	6,496	7.9%
Overhead Conductor	5,989	7.3%
Jumper / Riser	4,614	5.6%
Connection / Clamp	2,117	2.6%
Underground Conductor	1,242	1.5%
Transformer Overhead	1,002	1.2%
Metering	519	0.6%
Cutout	187	0.2%
Arrester	59	0.1%

- In 2021, the SAIDI value dropped to 347.7 minutes for the year, taking it off the 300% over system average list. In 2022, the SAIDI value dropped again to 51.7.

Circuit Ranking:

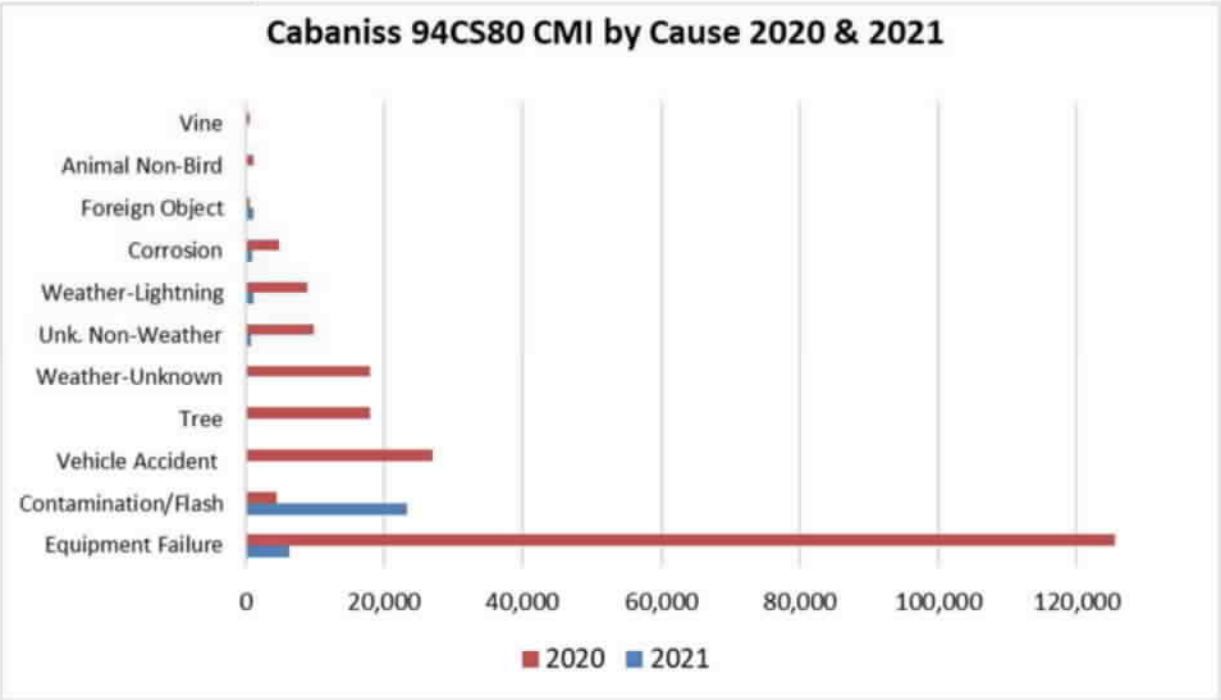
Information	2019	2020	2021
Customer Count	1328	37	95
SAIDI Rank	462	1	160
SAIDI Value	132.6	5933.2	347.7
300% System Avg.	584.6	586.2	592.2
# Circuits @ AEP Texas Inc.	1220	1220	1284

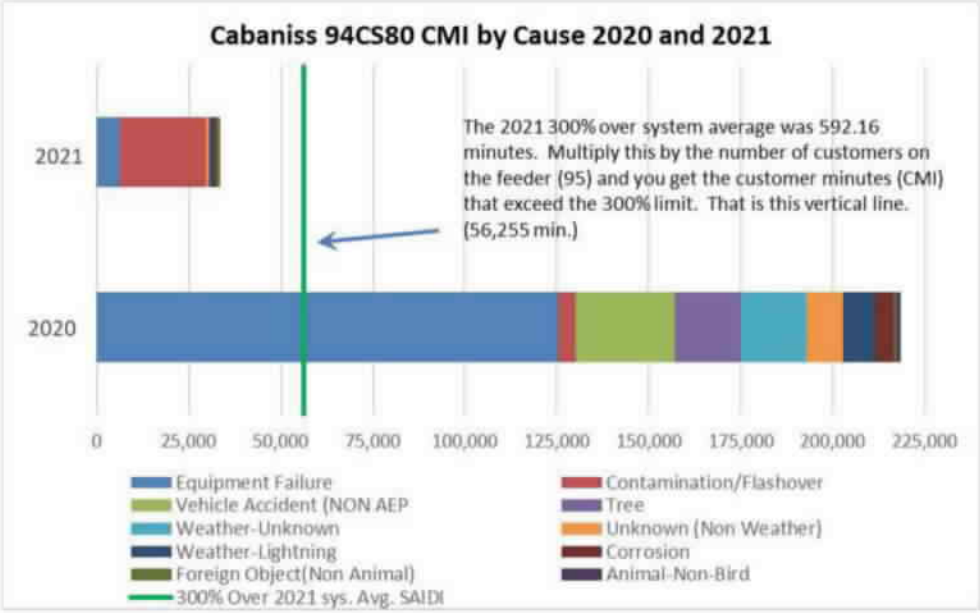
Remediation & Cost:

The reliability work plan for the circuit consisted of the following projects. The cost includes the remediation work as well as any other items done to address reliability on the circuit.

Projects	2019	2020	2021	2022	Total
Sectionalizing Program	$0	$0	$17,052	$0	$17,052
Failed Equip No Outage	$8,196	$2,620	$7,328	$0	$18,144
Small Local Asset Improv	$0	$6,646	$8,029	$0	$14,675
Cabaniss Sub- D line	$248,501	$3,081,319	$267,624	$0	$3,597,444
Pole Reinforcement	$0	$0	$1,535	$0	$1,535
Pole Replacement	$139,037	$87,793	$7,657	$0	$234,487
URD Program	$0	$0	$1,481	$0	$1,481
Small Wire Replacement URD	$731	$2,644	$0	$0	$3,375
Circuit Inspections	$2,427	$0	$0	$0	$2,427
Small Capacity	$92,826	$54,177	$132	$0	$147,135
Incremental Reliability	$0	$0	$202,317	$414,271	$616,588
Total	$493,737	$3,237,219	$515,176	$416,293	$4,662,425

Outage Cause Graphs





The green line on the graph represents the number of customer minutes interrupted it takes for this feeder with 95 customers to exceed the 300% over system SAIDI average. The number of customers (95) times the 300% over system SAIDI average for 2021 (592.16 minutes) gives a total of 56,255 CMI. Customer minutes interrupted past this line indicates a service quality violation if it repeats for consecutive years.

2. Circuit Analysis for Conoco-Chittam Ranch 94LA8580 (2020)

Conoco 94LA8580 is a 65.6 mile long rural 12kV feeder 18 miles east of Eagle Pass. It serves mainly oil wells and a few rural residential customers in Maverick County. Half of the circuit is behind a primary meter serving an industrial oil field customer. The feeder is located north of Highway 277 and follows dirt roads. The area is flat brush with scattered Mesquite trees. The peak load is 1,190kVA and the customer count is 27.

- The substation was built in 1961 and the feeder in 1965.
- There were no tree outages in 2019 or 2020.
- Repeat outages were due to lightning. The percentage of the annual customer minutes out due to lightning was 12% in 2019, 61% in 2020, and 73% in 2021. No individual lightning mitigation work was done in 2020 or 2021. In 2022, lighting arrester stations were added every six spans (or every 1,275 feet) on five reconductor jobs for 3.3 miles of the main feeder along Highway 277. This was on the section of primary behind the recloser that experienced the lightning outages in 2020 and 2021.
- Customer minutes out due to equipment failure was 518 in 2019, 329 in 2020, and 3,452 in 2021. In 2021, there were three equipment failure outages, one underground cable failure, one broken pole, and one failed arrester.
- Reliability work on the feeder in 2020 and 2021 included 17 pole replacements. In 2022, there were three poles replaced and one major 3.3 mile reconductor job completed. The reconductor job focused on an area with poles dated 1969 that are on the main feed to the circuit's largest load. The reconductor cost total was $575,218 in 2022.
- The feeder was on the 300% over list in 2021. In 2022 the SAIDI value dropped below the 300% over limit, taking it off the list.

Circuit Ranking:

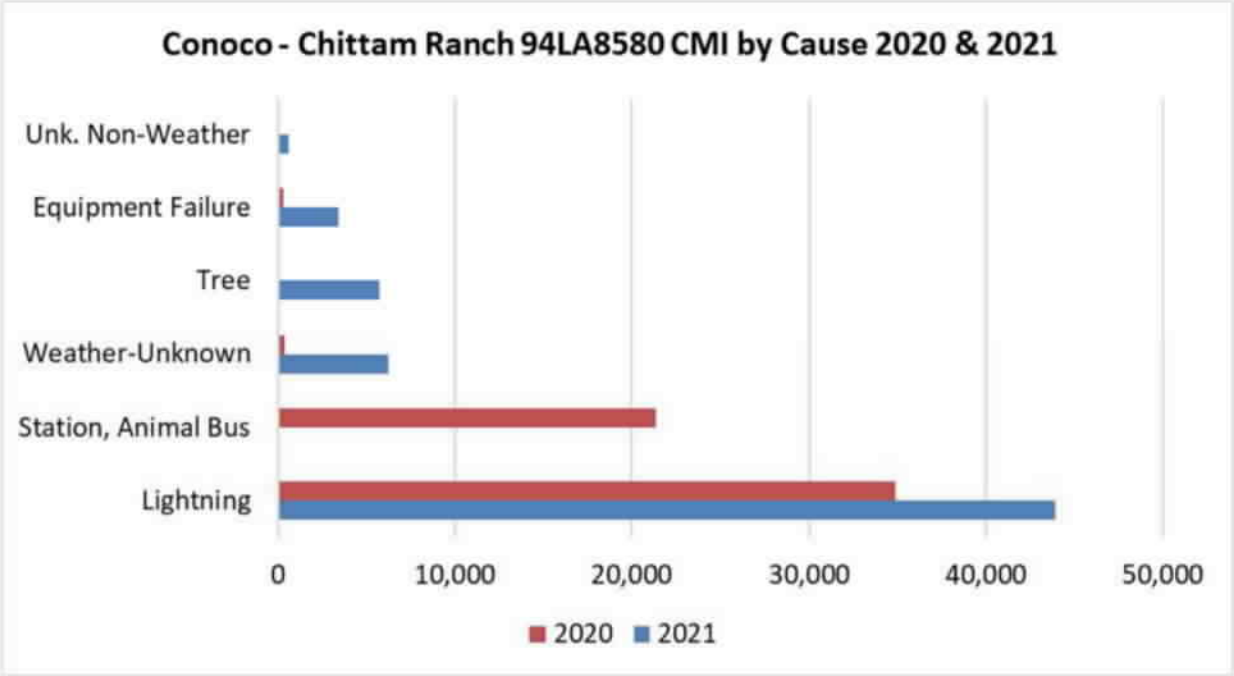
Information	2019	2020	2021
Customer Count	26	27	27
SAIDI Rank	673	2	6
SAIDI Value	71.5	2108.6	2221.2
300% System Avg.	584.6	586.2	592.2
# Circuits @ AEP Texas Inc.	1220	1220	1284

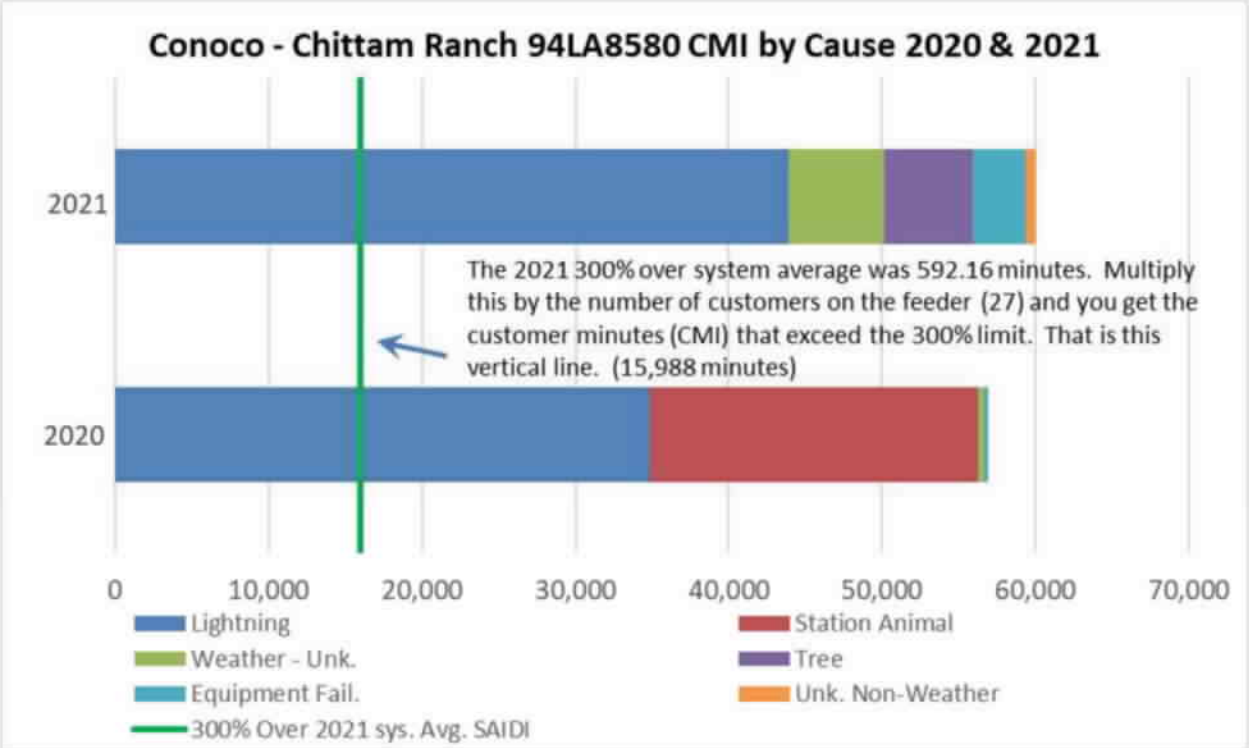
Remediation & Cost:

The reliability work plan for the circuit consisted of the following projects. The cost includes the remediation work as well as any other items done to address reliability on the circuit.

Projects	2019	2020	2021	2022	Total
Failed Equip No Outage	$5,483	$0	$0	$0	$5,483
Small Local Asset Improve	$1,332	$0	$0	$0	$1,332
Pole Replacement	$0	$5,069	$29,931	$0	$35,000
Major Reliability Projects	$0	$0	$0	$575,218	$575,218
Total	$6,815	$5,069	$29,931	$575,218	$617,033

Outage Cause Graphs:





3. Circuit Analysis for Carancahua 94CN1875 (2020)

Carancahua 94CN1875 is a rural feeder along Highway 35 South, north of Cape Carancahua in Vaes Bay. This area is between Point Comfort and Palacios north of Tres Palacios Bay, in Jackson County. After traveling 3.7 miles east on Highway 35, the feeder turns south on County Road 470 and serves some fishing villages. This is flat coastal land with few trees. The 12kV feeder is 14.5 miles long and serves 60 customers. The peak load was 0.16MVA in 2021.

- The substation was originally built in 1985. A single bank, single feeder station built under a transmission H-frame structure to better serve the Cape Carancahua customers that were previously served from the Blessing substation twenty miles away. In 2018, to further increase reliability, the station was rebuilt and a second feeder added. In 2020 the two feeder exits were swapped to straighten out some station exit issues. Some of the outages accredited to this circuit were actually on the previous circuit with a higher customer count.
- The two main outages that caused this feeder to be on the list were a primary wire failure at the Cape Carancahua subdivision entrance in 2020 (now on the adjacent feeder), and a weather outage on September 13, 2021 as hurricane Nicholas was going up the coast. These two outages accounted for 91% of the CMI in 2020 and 2021.
- Two reliability projects are planned for the Carancahua feeder. First rebuilding the original #2Al primary feed into the Cape Carancahua Subdivision for 0.75 miles, and second adding sectionalizing to the #2Al primary feed going south on County Road 470 including a recloser and five tap line fuses. This will resolve the causes of previous outages.
- SCADA was added with the new station in 2018.
- There were some minimal tree outages during 2020 and 2021. Moving forward AEP Teas will assess the need for spot tree trimming.
- Although the circuit did repeat on the list in 2021, in 2022, the SAIDI value dropped to 55.7 minutes for the year, taking it off the repeat list.

Circuit Ranking:

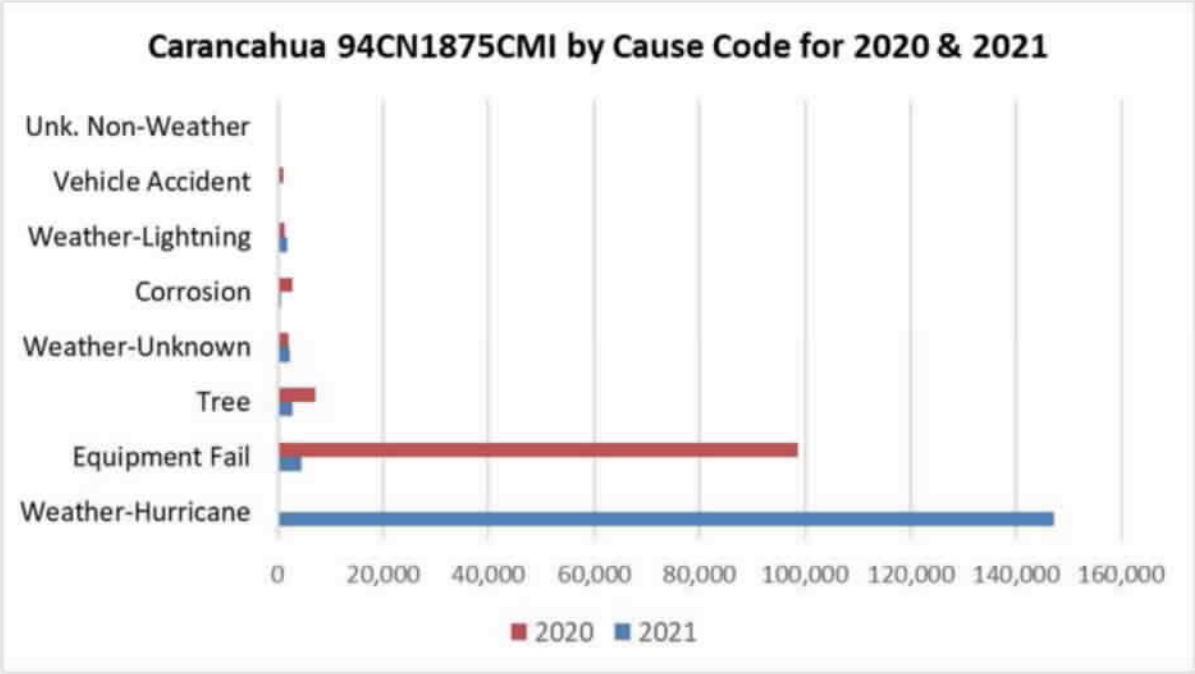
Information	2019	2020	2021
Customer Count	433	57	60
SAIDI Rank	972	3	5
SAIDI Value	23	1982.4	2614.9
300% System Avg.	584.6	586.2	592.2
# Circuits @ AEP Texas Inc.	1220	1220	1284

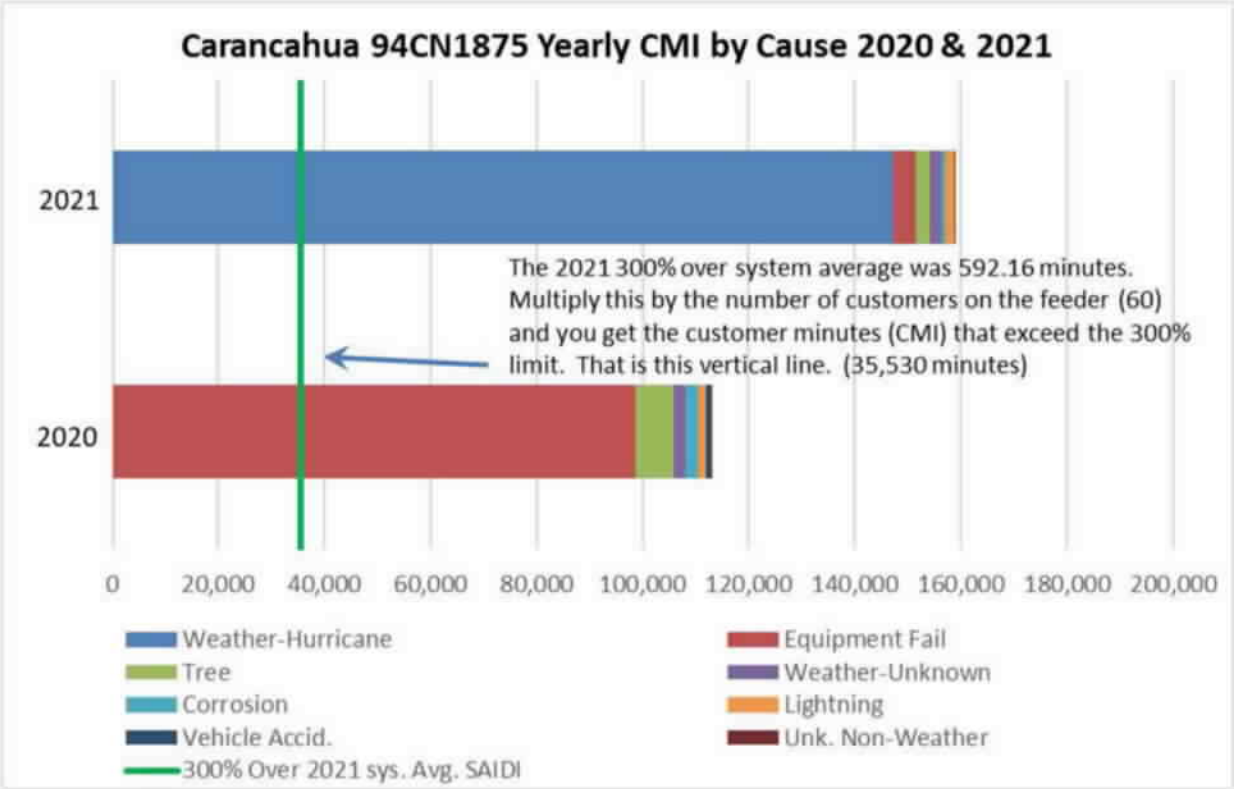
Remediation & Cost:

The reliability work plan for the circuit consisted of the following elements. The cost includes the remediation work as well as any other items done to address reliability on the circuit.

Project	2019	2020	2021	Total
Sectionalizing Program	$0	$0	$10,640	$10,640
Failed Equip No Outage	$0	$0	$12,117	$12,117
System Hardening	$0	$297,947	$21,509	$319,456
Total	$0	$297,947	$44,266	$342,213

Outage Cause Graphs:





4. Circuit Analysis for La Pryor 94LA570 (2020)

La Pryor 94LA570 is a 73.4 mile long rural 12kV circuit south of La Pryor, Texas, in Zavala County. The peak load in 2020 was 2.31 MVA. The majority of the circuit's path takes it through flat farmland and brush. Large parts of the circuit run along the Nueces River. Only a small portion of this circuit is road accessible. The majority of the 145 customers are agricultural lots focusing on year-round vegetable production.

- The feeder was built in 1972. The first 1.5 miles were rebuilt in 2018 with 4/0A conductor.
- The number of customers interrupted from trees was 32% of CMI in 2019, down to 2% in 2020.
- Outage causes have varied. In 2019, the major causes were unknown, field switching error, and trees. In 2020, major causes were weather, lightning, and equipment failure. 37% of the outage minutes for the year 2020 occurred on May 5, 2020 during an after-hours lightning storm where the breaker locked out and the line was picked up from an adjacent circuit.
- Lightning caused 178,675 CMI in 2020, or 53% of the outage minutes for the year. Of those lightning outages, 91% were cleared at the feeder breaker level, 6.8% at line fuses, and 2.5% by recloser.
- Equipment failure caused 67,597 CMI in 2020. The most outage minutes, 52%, came from failed primary jumpers locking out the breaker three times. The second highest cause was arrester failures at 28% of the equipment failure CMI, and third was an outage with a broken pole and two broken crossarms.
- The majority of the feeder work was re-conductor jobs in 2018 and 2019. The system hardening work in 2018 and 2019 was two jobs to reroute crossings over the Nueces River. Thirteen poles were replaced in 2021 and fifteen in 2022.
- Future reliability projects include removing ten miles of distribution underbuild on the transmission line and replacing the underbuild with new distribution in the road right-of-way. This improves accessibility, shortens the span lengths, and hardens the circuit.

Circuit Ranking:

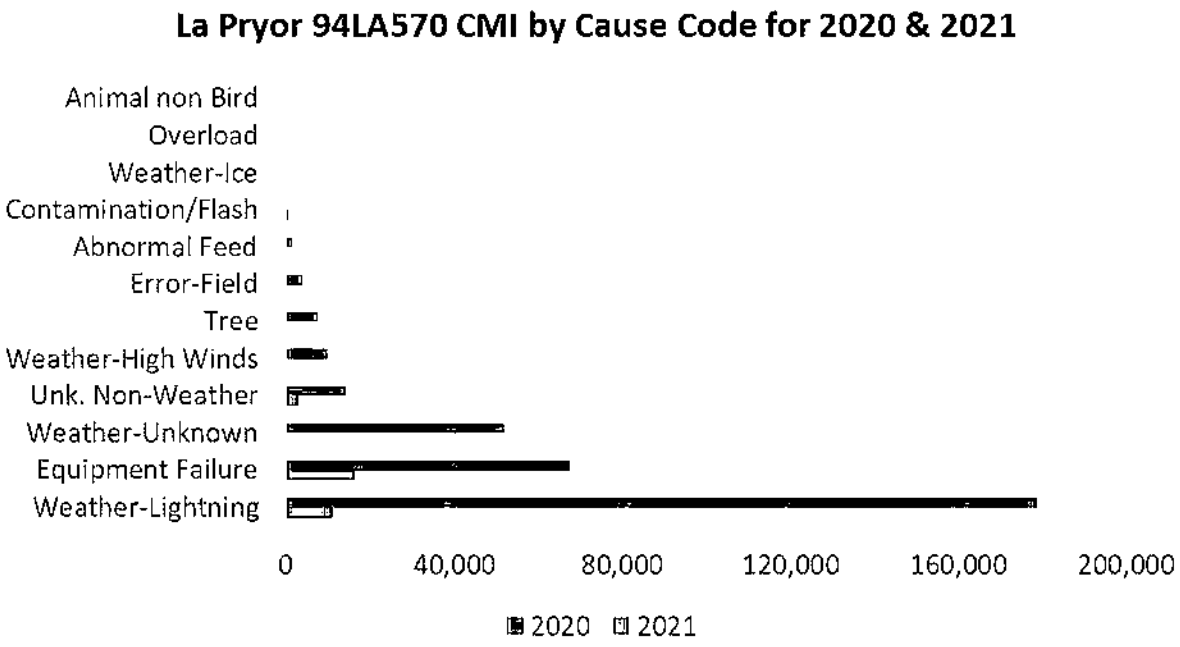
Information	2019	2020	2021
Customer Count	157	172	175
SAIDI Rank	7	4	362
SAIDI Value	1947.3	1952.4	180.5
300% System Avg.	584.6	586.2	592.2
# Circuits @ AEP Texas Inc.	1220	1220	1284

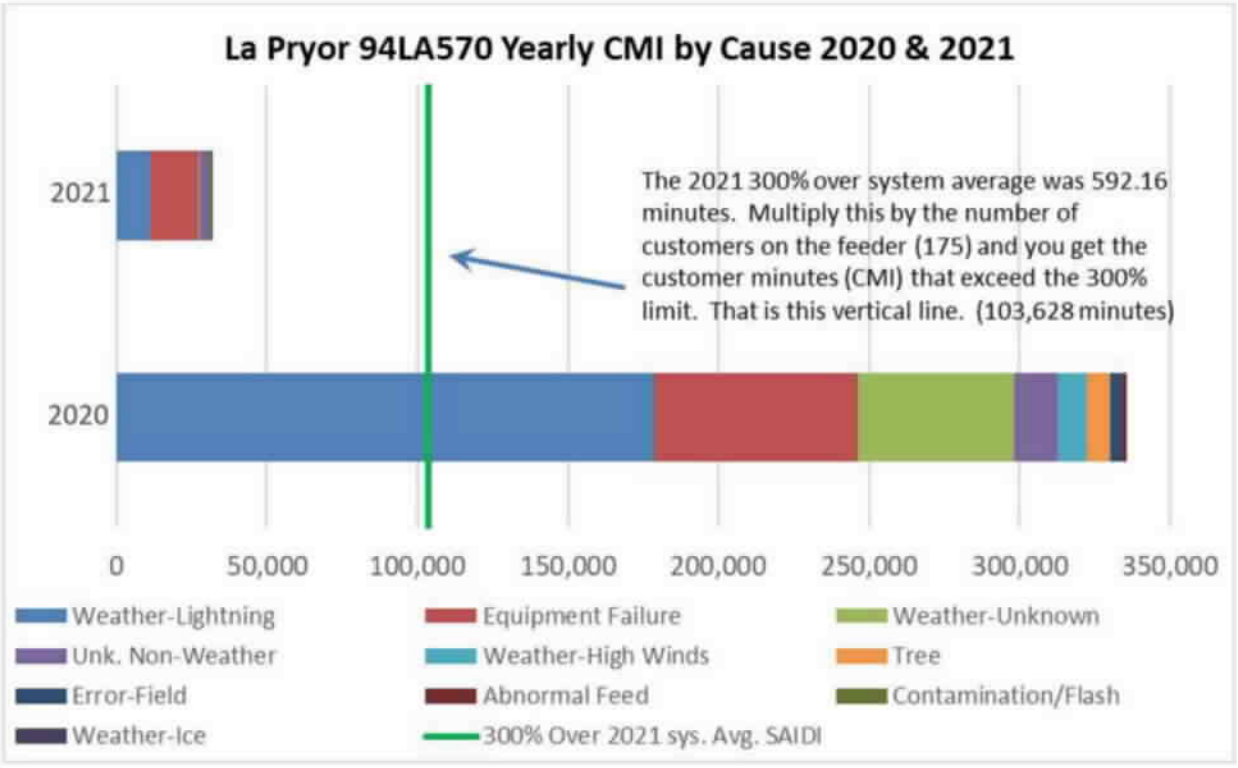
Remediation & Cost:

The reliability work plan for the circuit consisted of the following projects. The cost includes the remediation work as well as any other items done to address reliability on the circuit.

Projects	2019	2020	2021	Total
Sectionalizing Program	$0	$23,834	$6,561	$30,395
Failed Equip No Outage	$0	$19,237	$40,433	$59,670
Pole Replacement	$6,546	$0	$23,837	$30,383
Line Reclosers	$0	$0	$14,409	$14,409
Circuit Inspections	$0	$4,833	$0	$4,833
Distribution Underbuild	$78,745	$90,901	$0	$169,646
System Hardening	$25,192	$0	$0	$25,192
Incremental Reliability	$0	$118,515	$0	$118,515
Total	$110,483	$257,320	$85,240	$453,043

Outage Cause Graphs:




La Pryor 94LA570 Yearly CMI by Cause 2020 & 2021
2021
2020
The 2021 300% over system average was 592.16 minutes. Multiply this by the number of customers on the feeder (175) and you get the customer minutes (CMI) that exceed the 300% limit. That is this vertical line. (103,628 minutes)
0
50,000
100,000
150,000
200,000
250,000
300,000
350,000
Weather-Lightning
Equipment Failure
Weather-Unknown
Unk. Non-Weather
Weather-High Winds
Tree
Error-Field
Abnormal Feed
Contamination/Flash
Weather-Ice
300% Over 2021 sys. Avg. SAIDI

5. Circuit Analysis for Crestonio 94LA270 (2020)

Crestonio 94LA270 is a rural 12kV feeder east of Hebbronville with 636 mainly rural residential customers and ranch buildings in Jim Hogg and Duval counties. Crestonio is the name of a ghost town close to the substation site. The area is flat brush with scattered Mesquite. The circuit length is 225.8 miles. The peak load in 2021 was 1.09MVA.

- The substation was built in 1953 with significant improvements in the years 1973, 2005, and 2017 totaling $2.18M.
- Tree outages accounted for less than 0.5% of the total outages from 2019 through 2021.
- Repeating outages were primarily due to lightning and equipment failure. In the three years between 2019 and 2021 there were 114 individual outages due to lightning (21% of total), and one station outage due to lightning which added another 31%. Over half of the outages for the past three years were due to lightning. The majority of the lightning outages (68%) were cleared by individual transformer fuses which are designed to blow and protect the transformer. The remaining outages were cleared by line fuses or reclosers. Continued coordination studies are done to ensure outages are minimized on these devices.
- Equipment failure caused 45% of the outages in 2019 through 2021. CMI due to equipment failure in 2019 was 65,175 minutes, 2020 was 88,331 CMI, and 2021 was 745,881 CMI. The cause breakdown is shown in the chart below:

Down Primary	45.8%
Solid door or bypass	36.5%
Cutout	7%
Broken Pole	6.4%
Jumper	1.6%
Transformer	1.5%
Other	1.3%

  There were four wire failures on #2A behind switch CS6224L (one mile), three wire failures on CR260 behind recloser B6240 with #2A primary (2 miles), and three #2 primary failures in the City of Realitos area. The wire in these areas is being evaluated for replacement.
- Work in 2020 focused on pole replacement and recloser maintenance. Work in 2021 was focused on pole replacement with some sectionalizing. In 2020 and 2021, 88 poles were replaced, three reclosers replaced, and 39 fused cutouts installed.
- Future projects include six reliability jobs to relocate inaccessible lines (including lighting protection) and jobs for 14 pole replacements in 2023.
- The feeder repeated the 300% over list in 2021 and 2022.

Circuit Ranking:

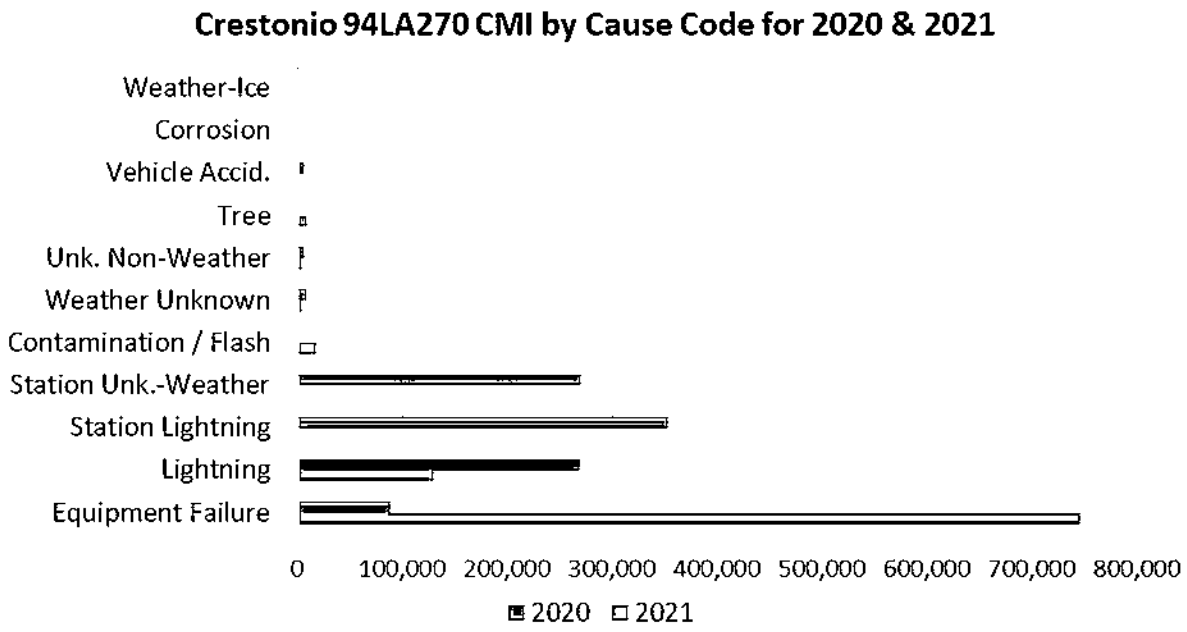
Information	2019	2020	2021
Customer Count	619	633	636
SAIDI Rank	452	5	14
SAIDI Value	137.6	1582.3	1446.5
300% System Avg.	584.6	586.2	592.2
# Circuits @ AEP Texas Inc.	1220	1220	1284

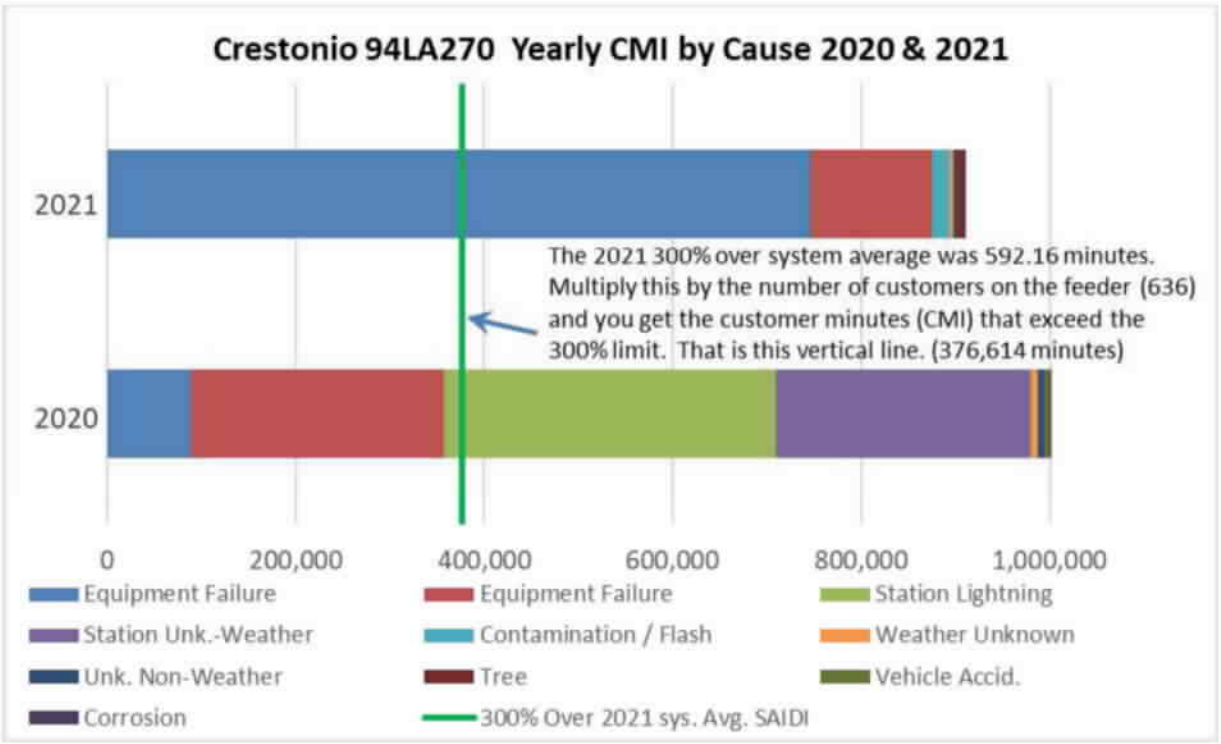
Remediation & Cost:

The reliability work plan for the circuit consisted of the following projects. The cost includes the remediation work as well as any other items done to address reliability on the circuit.

Projects	2019	2020	2021	Total
Sectionalizing Program	$45,524	$25,521	$6,468	$77,513
PQ-QOS Mitigation	$37,598	$0	$55,552	$93,150
Failed Equip No Outage	$1,371	$4,251	$6,141	$11,763
Pole Replacement	$429,548	$55,050	$18,524	$503,122
Line Reclosers	$40,984	$68,084	$20,123	$129,191
Circuit Inspections	$68,099	$10,564	$107,754	$186,417
System Hardening	$97,677	$0	$0	$97,677
Total	$720,801	$163,470	$214,562	$1,098,833

Outage Cause Graphs:




Crestonio 94LA270 Yearly CMI by Cause 2020 & 2021
2021
2020
The 2021 300% over system average was 592.16 minutes. Multiply this by the number of customers on the feeder (636) and you get the customer minutes (CMI) that exceed the 300% limit. That is this vertical line. (376,614 minutes)
0
200,000
400,000
600,000
800,000
1,000,000
Equipment Failure
Equipment Failure
Station Lightning
Station Unk.-Weather
Contamination / Flash
Weather Unknown
Unk. Non-Weather
Tree
Vehicle Accid.
Corrosion
300% Over 2021 sys. Avg. SAIDI

6. Circuit Analysis for Alazan 94CS620 (2020)

Alazan 94CS620 is a 61.5-mile 12kV rural circuit between the City of Corpus Christi and the King Ranch in Nueces County. It serves 167 meters that are mostly residential and agricultural with a small amount of light industrial. The landscape is agricultural, and the overhead lines are mostly built in the road right-of-way. The feeder is eleven miles from the coast and has experienced straight line wind damage and corrosion issues over the years. The peak load in 2021 was 740kVA.

- The Alazan substation and circuit 620 were built in 1955. The substation was rebuilt in 2011. In 2021, five miles of feeder starting at the station were rebuilt with large conductor as part of a feeder tie project with the Cabaniss and Rodd Field substations.
- There was only one tree outage in 2020 and 2021 with 75 CMI.
- Repeat outages were caused by equipment failure in 2020 and 2021. In 2020, the three equipment failure outages that accounted for the most minutes were overhead conductor failures behind the first two reclosers out of the substation isolating the east and west feeds. The east feed on Highway 70 was replaced in 2021. The west feed is part of a DACR project and was reconductored in 2022 for a distance of two miles. In 2021, two equipment failure outages caused 65% of the equipment failure minutes out (17.2% of the yearly total). The first was on Highway 286 going north that should have been attributed to lightning, caused cross-arm and insulator damage. This section is on a future reconductor project. The second outage was a conductor failure on County Road 14. A three-mile conductor replacement project for County Road 14 has been approved to begin in 2023.
- Because the feeder has been on the WPF list, a distribution automation tie has been installed with Clarkwood 94CS5525, which transfers half the circuit in the case of a breaker outage. As previously mentioned, two major feeder upgrade projects were done in 2021 and 2022, replacing seven miles of main feeder with new 556MCM Al conductor for a cost of $1,356,444.
- Future projects for this circuit include a distribution automation tie to Cabaniss 94CS80 on Highway 286 and a reconductor project on Highway 286 that is waiting on a TXDOT road widening project.

Circuit Ranking:

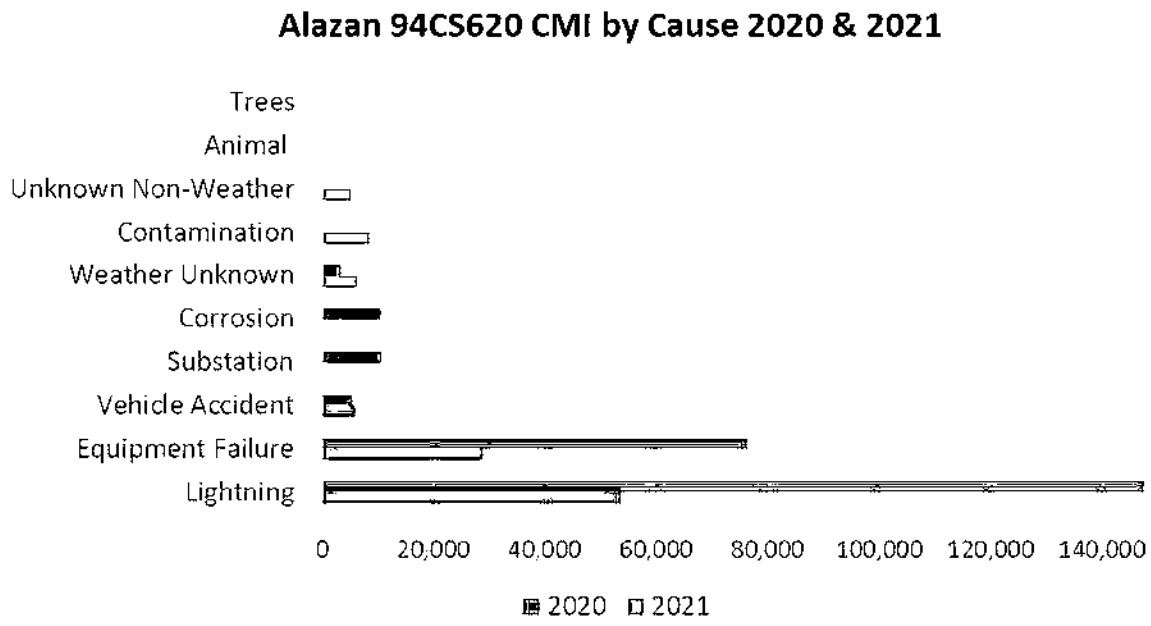
Information	2019	2020	2021
Customer Count	163	163	167
SAIDI Rank	10	6	70
SAIDI Value	1393.4	1561	656.2
300% System Avg.	584.6	586.2	592.2
# Circuits @ AEP Texas Inc.	1220	1220	1284

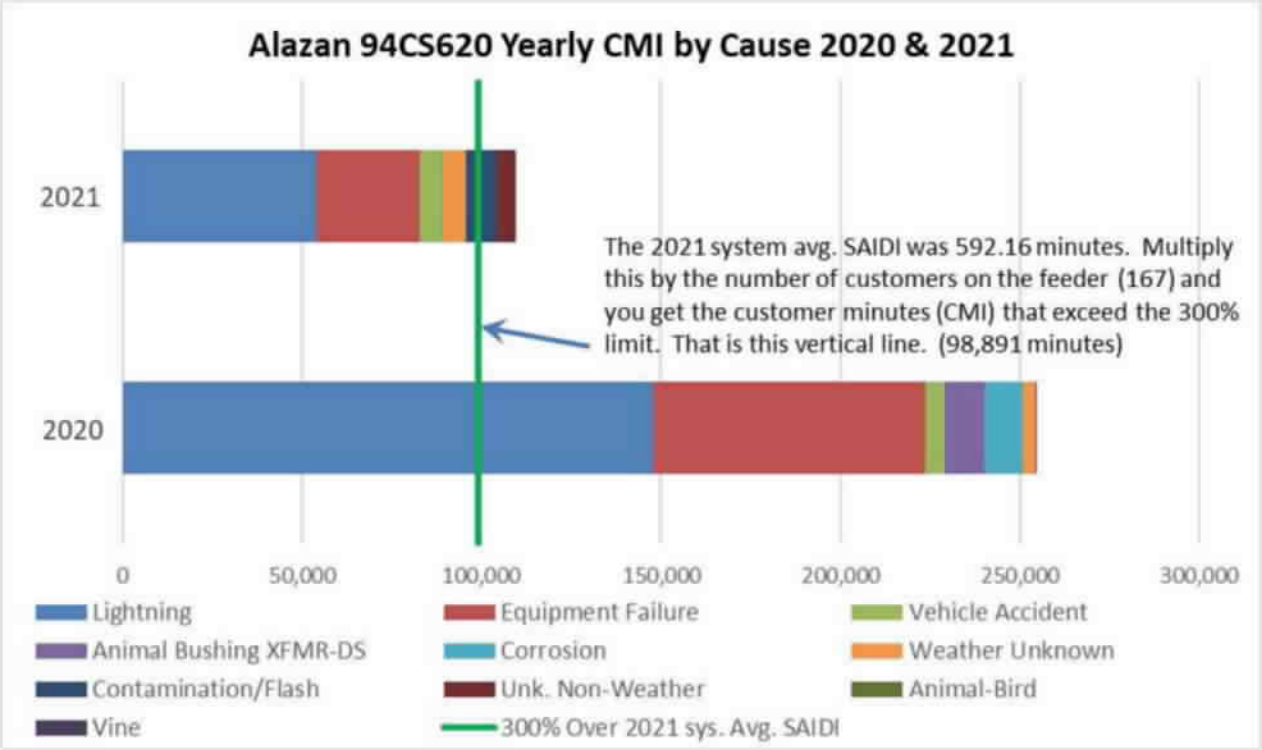
Remediation & Cost:

The reliability work plan for the circuit consisted of the following projects. The cost includes the remediation work as well as any other items done to address reliability on the circuit.

Projects	2019	2020	2021	Total
Sectionalizing Program	$0	$2,938	$0	$2,938
Failed Equip No Outage	$16,084	$43,333	$10,420	$69,837
Small Local Asset Improv	$0	$13,166	$0	$13,166
Pole Replacement	$70,304	$7,438	$4,346	$82,088
Line Reclosers	$27,799	($164)	$0	$27,635
Circuit Inspections	$28,752	$0	$0	$28,752
Incremental Reliability	$0	$0	$926,168	$926,168
Total	$142,939	$66,711	$940,934	$1,150,584

Outage Cause Graphs:





B. 2021 Individual Feeder Analysis

The individual feeder analysis looks at outage causes, such as recurring causes, tree issues, reasons for abnormally large individual outages, types of mitigation work that has been performed, and future work plans. The financial break down of expenditures by job type to address reliability on each feeder is included. The information for the 2021 top 10% of feeders above the 300% over system average, 592.2 minutes, that were not already reported on from the 2020 list (excludes Carancahua and Conoco-Chittam) is as follows.

Station	Circuit	2021 # Cust.	2021 Rank	2021 SAIDI	2022 # Cust.	2022 Rank	2022 SAIDI
SANTA RITA	97SA1100	82	1	5437.2	110	610	96.3
MCCAMEY	97SA2415	82	2	3886.8	76	31	777.8
SANTA RITA	97SA1105	73	3	3439	775	68	58.8
BAY CITY	94CN6450	224	4	2728.5	164	1001	26.7
WESMER	94SB6900	52	7	2027	51	815	52.1
SONORA ATLANTIC	97SA4415	31	8	1997.1	31	1048	21.5
O'CONNER	94CN390	203	9	1946.3	200	103	449.9
DUNE FIELD	97SA3885	69	10	1857.9	69	302	218.6
300% Over:				592.2			560.6

1. Circuit Analysis for Santa Rita 97SA1100 (2021)

Santa Rita 97SA100 is a 50.1-mile 12kV rural circuit in the Texon oil field area between the small cities of Rankin and Big Lake on State Highway 67, in Reagan County. The Santa Rita was the first successful oil well in the Permian Basin. The 110 customers are mostly oil field locations and pipeline companies for

the Big Lake oil field. The area is flat brush crossed by many oil field dirt roads north and south of Highway 67. The peak load in 2021 was 4050kVA. This area is experiencing high load growth.

- The Santa Rita circuit was built in 1969.
- No tree outages during 2020-2021.
- The 2020 outages totaled 3,528 CMI, mainly due to four equipment failure outages (transformer, fuse cutout, meter, and a primary connection), and two unknown events opening a recloser and a line fuse. The SAIDI for 2020 was 58.8 minutes.
- The 2021 outages were due to two main causes: 93% of the CMI was associated with a winter storm ice event on February 13, 2021, and a lightning outage that opened the breaker for 4.5% of the yearly CMI. The ice storm event opened a recloser that was left out for an extended period of time. The oil field customers were notified. Power was restored after working conditions became safe, but the outage went beyond the major event exclusion period and counted with the forced outages.
- The equipment failure outages in 2021 were a primary meter failure, and a bad pin insulator causing a phase to ground fault opening a recloser.
- Load growth in the area has created the need to strengthen feeder ties and install regulators on several Santa Rita feeders. A new substation is planned between the Santa Rita and Rankin substations with an in-service date of third quarter 2025. Major re-conductor projects were done on the feeder in 2022 and 2023. A project to re-conductor 4.5 miles of 4/0A to 556MCM Al was done in 2022. This project created a feeder tie with Rankin 97SA6400. Another project in 2022 reconductored 3 miles of line north to a pipeline company and installed distribution regulators.
- The feeder did not repeat the 300% over list in 2022. The SAIDI value in 2022 was 96.3 minutes.

Circuit Ranking:

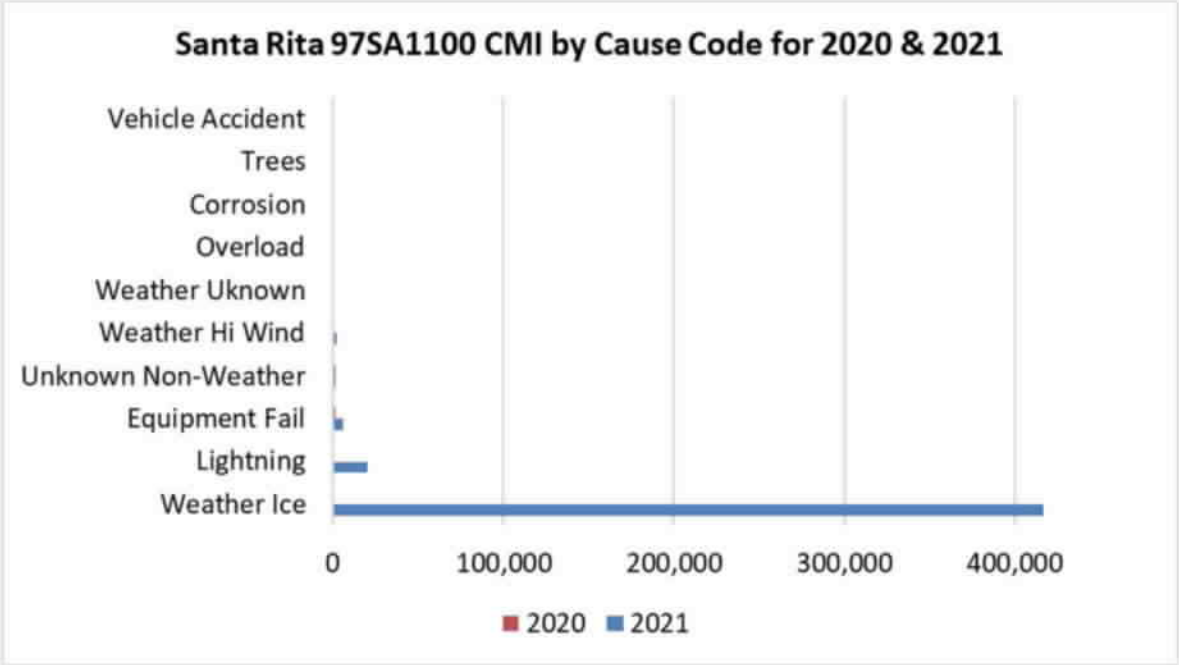
Information	2019	2020	2021
Customer Count	110	107	82
SAIDI Rank	72	903	2
SAIDI Value	514.2	33	5437.2
300% System Avg.	584.6	586.2	592.16
# Circuits @ AEP Texas Inc.	1220	1220	1284

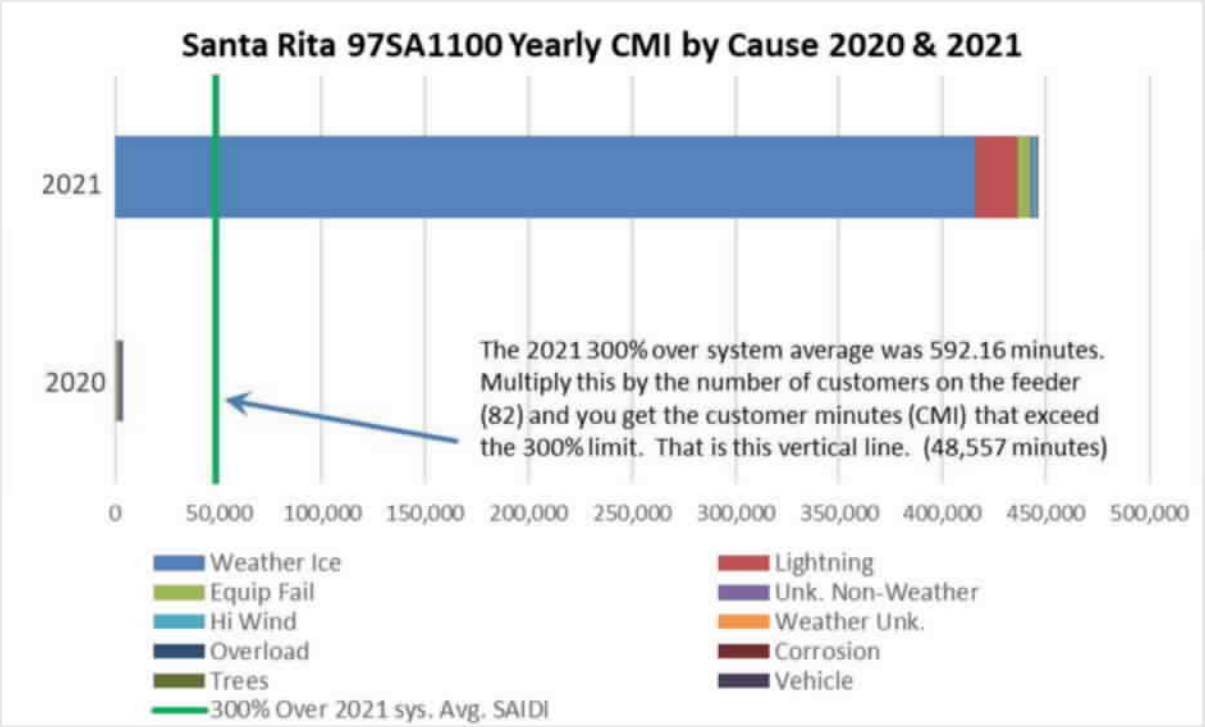
Remediation & Cost:

The reliability work plan for the circuit consisted of the following elements. The cost includes the remediation work as well as any other items done to address reliability on the circuit.

Projects	2019	2020	2021	2022	Total
Failed Equip No Outage	$0	$5,847	$8,967		$14,814
Pole Replacement	$0	$2,621	$0	$9,341	$11,962
Sectionalizing	$0	$0	$0	$10,793	$10,793
Power Qual. (Regulators)	$0	$0	$0	$504,089	$504,089
Feeder Tie	$0	$0	$0	$1,529,258	$1,529,258
Total	$0	$8,468	$8,967	$8,967	$2,064,274

Outage Cause Graphs:





2. Circuit Analysis for McCamey 97SA2415 (2021)

McCamey 97SA2415 is a 56.2-mile 12kV rural circuit feeding the oil fields north of McCamey in Upton and Crane Counties. The 82 customers are oil field accounts with some rural residentials northwest on Highway 385. There are several elevation changes up the mesas, but the area is generally flat with brush. The peak load in 2021 was 230kVA.

- The McCamey substation and circuit 2415 were built in 1955.
- In 2020, the highest outage cause was lightning with 69% of the yearly CMI. The second highest cause was equipment failure with three outages caused by two crossarm failures and one failed fuse cutout assembly.
- In 2021, 90% of the yearly CMI was caused by one outage in the February ice storm where 24 customers behind a recloser were outaged for an extended period. Access and safety issues prevented the oil field accounts from being powered up. The second highest outage cause was equipment failure in the substation. The station transformer was arcing internally. Without these two outages, the SAIDI value for the year would have been 186 minutes.
- The substation issues have been corrected, and sectionalizing is in place for winter events, the next mitigation effort focuses on the third highest outage cause, lightning. There were 14 lightning outages in 2021, four behind line fuses, and 10 behind transformer fuses. All the line fuses were behind reclosers and should have been cleared by the recloser. AEP Texas will do a coordination study in 2023 to correct recloser timing issues. The transformer fuses will blow when overhead transformers are hit by lightning. Each transformer is equipped with a lightning arrester to try and prevent damage to the unit.
- The feeder repeated the 300% over average SAIDI list in 2022 with a value of 777.8 minutes.

Circuit Ranking:

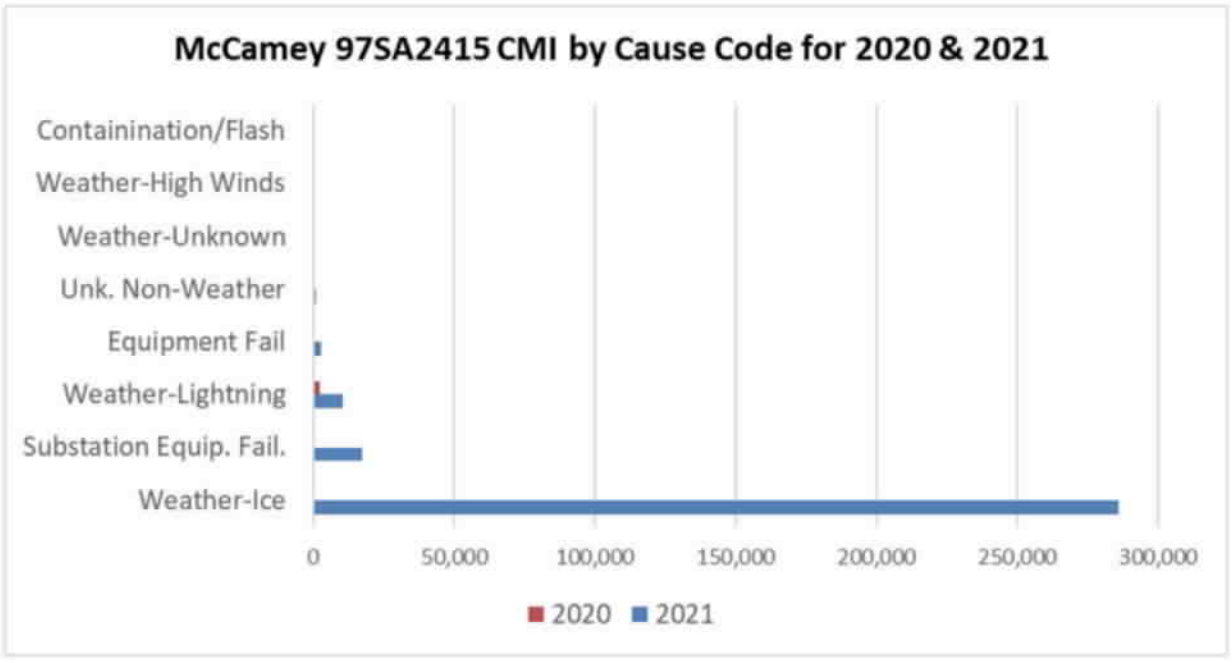
Information	2019	2020	2021
Customer Count	151	88	82
SAIDI Rank	53	835	2
SAIDI Value	624.7	43.9	3886.8
300% System Avg.	584.6	586.2	592.2
# Circuits @ AEP Texas Inc.	1220	1220	1284

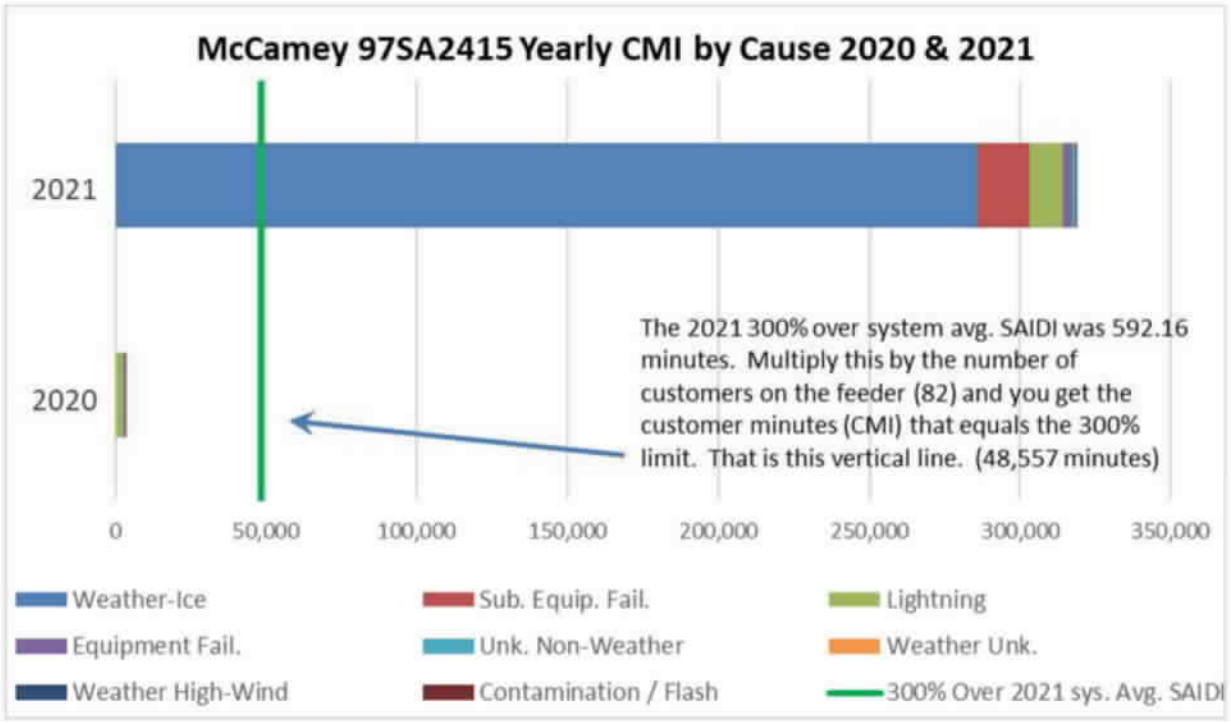
Remediation & Cost:

The reliability work plan for the circuit consisted of the following elements. The cost includes the remediation work as well as any other items done to address reliability on the circuit.

Projects	2019	2020	2021	Total
Sectionalizing Program	$7,966	$0	$0	$7,966
Failed Equip No Outage	$1,984	$0	$0	$1,984
Small Local Asset Improv	$0	$0	$5,077	$5,077
Pole Replacement	$0	$5,605	$6,942	$12,547
System Hardening	$0	$0	$4,366	$4,366
Total	$9,950	$5,605	$16,385	$31,940

Outage Cause Graphs:





3. Circuit Analysis for Santa Rita 97SA1105 (2021)

Santa Rita 97SA1105 is a 40.3 mile long 12kV circuit in Reagan County. It serves the Texon oil field area between the small cities of Rankin and Big Lake on State Highway 67. The circuit heads west on Hyw. 67 for 2.7 miles then goes north on FM1555 for another 5 miles. The 73 customers are mainly oil field accounts. The area is flat brush crossed by many oil field dirt roads. The peak load in 2021 was 6,760kVA.

- The original Santa Rita feeder was built in 1969. The first 7.2 miles of circuit were rebuilt in 2013 and 2016 with 477MCM Al conductor. In 2015 another five miles of feeder was rebuilt with 556MCM Al conductor to tie to Santa Rita 97SA1100.
- In 2020, equipment failure caused 72% of the outage minutes. The majority of these outages happened during feeder re-conductor work when the breaker or recloser was on a non-recloser-order. Feeder 1105 was used to feed sections of feeder 1100 while work was being performed. A new regulator bank was added on the second half of the circuit to help with load transfers. An electronic recloser was also added in 2020 for sectionalizing. The dollars spent on this work can been seen in the Remediation and Cost table below under the categories Quality of Service, and Sectionalizing.
- In 2021, one outage during the February ice storm caused 95% of the outage minutes for the year. Many of the customers were restored, but 28 oil field accounts remained out past the major event exclusion time frame until available crews could safely enter and repair facilities. Other outage causes were equipment failure at 3.5% of the yearly outage minutes. This was due to a broken pole, failed primary jumper, and a bad fuse disconnect.
- In 2021 and 2022, a major feeder tie project was completed that rebuilt five miles of the main line primary with new conductor and poles. This was a tie to Santa Rita 97SA100. This $1.5 million project fixed loading and voltage regulation issues, but also helped with equipment failure mitigation and lightning protection.
- In 2022 the feeder did not repeat the WPF list. The 2022 SAIDI value was 58.8 minutes.

Circuit Ranking:

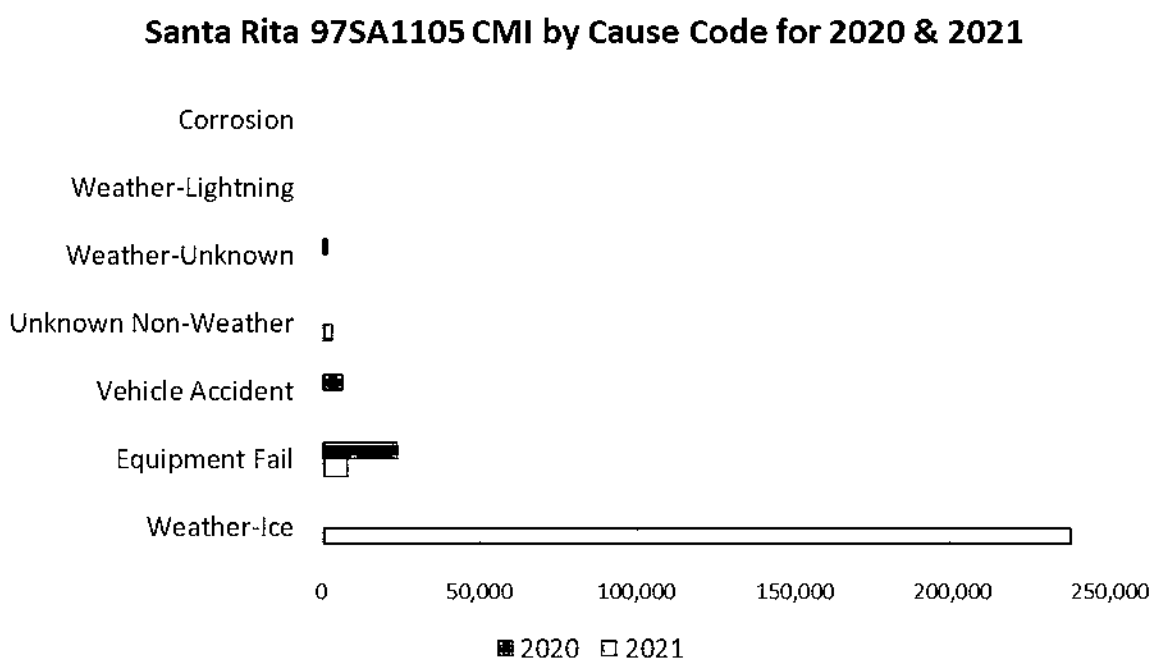
Information	2019	2020	2021
Customer Count	72	70	73
SAIDI Rank	11	81	3
SAIDI Value	1381	483.8	3439
300% System Avg.	584.6	586.2	592.2
# Circuits @ AEP Texas Inc.	1220	1220	1284

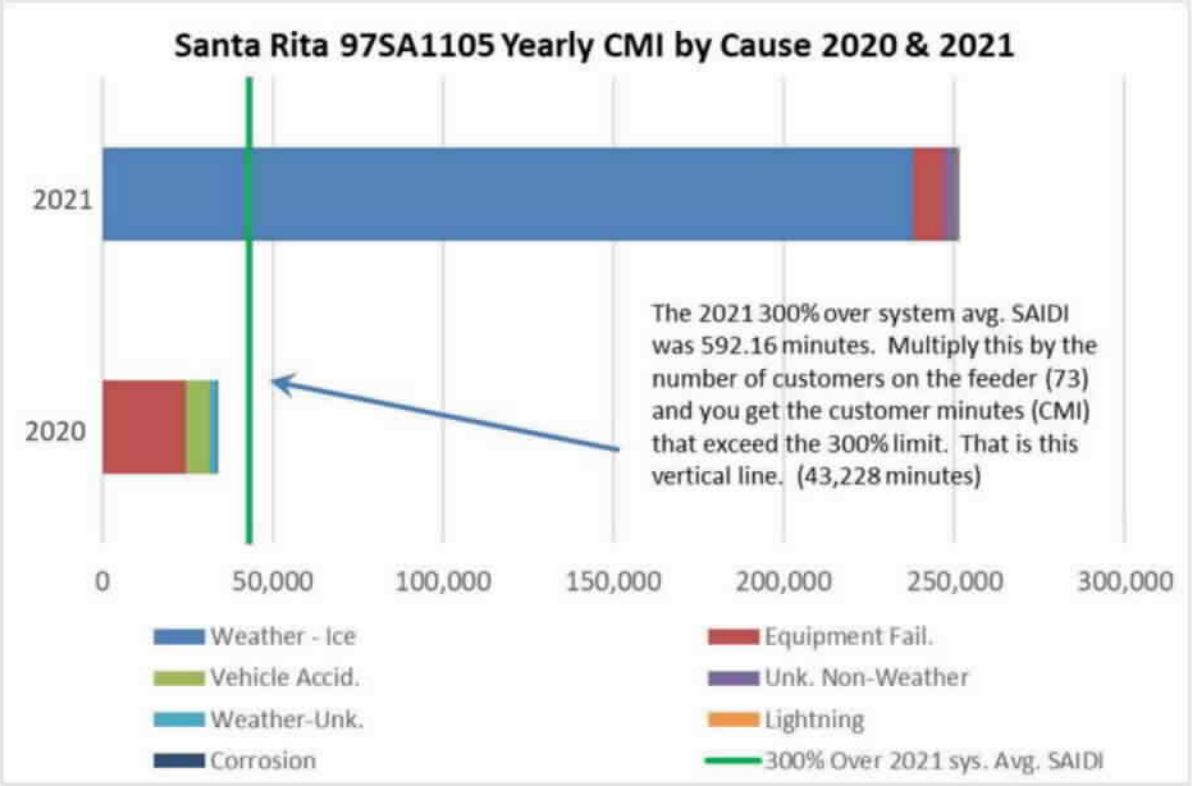
Remediation & Cost:

The reliability work plan for the circuit consisted of the following elements. The cost includes the remediation work as well as any other items done to address reliability on the circuit.

Projects	2019	2020	2021	2022	Total
Sectionalizing Program	$0	$161,606	$0	$10,793	$172,399
PQ-QOS Mitigation	$0	$28,386	$168,940	$504,089	$701,415
Failed Equip No Outage	$5,354	$0	$5,231	$0	$10,585
Small Local Asset Improv	$0	$1,695	$0	$0	$1,695
Pole Replacement	$1,321	$19,877	$746	$9,341	$31,285
Feeder Ties	$0	$0	$0	$1,529,258	$1,529,258
Total	$6,675	$211,564	$174,917	$2,053,481	$2,446,637

Outage Cause Graphs:




Santa Rita 97SA1105 Yearly CMI by Cause 2020 & 2021
2021
2020
The 2021 300% over system avg. SAIDI was 592.16 minutes. Multiply this by the number of customers on the feeder (73) and you get the customer minutes (CMI) that exceed the 300% limit. That is this vertical line. (43,228 minutes)
0
50,000
100,000
150,000
200,000
250,000
300,000
Weather - Ice
Equipment Fail.
Vehicle Accid.
Unk. Non-Weather
Weather-Unk.
Lightning
Corrosion
300% Over 2021 sys. Avg. SAIDI

4. Circuit Analysis for Bay City 94CN6450 (2021)

Bay City 94CN6450 is a 5.9 mile 12kV circuit in central Bay City. It goes south of the substation and crosses Hwy. 35 following Avenue F (Hwy. 60). The 224 customers are primarily commercial businesses on Hwy. 35 and Ave. F with some residential meters on the side streets. Bay City is 24 miles from the coast in Matagorda County. The peak load in 2021 was 1,940kVA.

- The original Bay City Substation was built in 1960. It underwent a major rebuild in 1983. The original 4/0 Al primary feeder was built in 1964.
- In 2021, the new Black Cat substation in Bay City was completed. Several upgraded feeder ties were constructed, including one to Bay City 94CN6450. The large dollar amount spent in 2021 was a feeder upgrade on 3 miles of primary line which was later switched over to the Black Cat 94CN3175 feeder. 1,686 customers were moved in this load transfer. The outages associated with those customers stayed with Bay City 94CN6450, causing the SAIDI calculation to increase from 659 minutes (611,194 CMI / 927 cust.) to 2,728.5 average minutes. The circuit would have still been over the 300% threshold, but not as severe as the reported average indicates.
- Tree interruptions accounted for 83% of the outage minutes in 2020, and 25.4% of the outage minutes in 2021. Mitigation efforts to correct these issues have been to incorporate tree trimming in 2021 along with the feeder tie upgrade. 95% of the tree outages occurred on the 3 mile section of feeder that was transferred to Black Cat Sub circuits 94CN3000 and 94CN3175.
- In 2021, 41% of the yearly outage minutes were due to unknown-weather. The cause was two outages on April 6, when a wind storm tangled conductors as contract crews replaced the wires.
- The other large contributor to outage minutes in 2021 was a hurricane causing 31% of the outage minutes for the year. There was one feeder breaker lockout on September 15th due to Hurricane Nicholas. The breaker was later closed by SCADA with no problems found. This was not part of a major event exclusion.
- In 2022 the feeder did not repeat. The 2022 SAIDI value was 58.8 minutes.

Circuit Ranking:

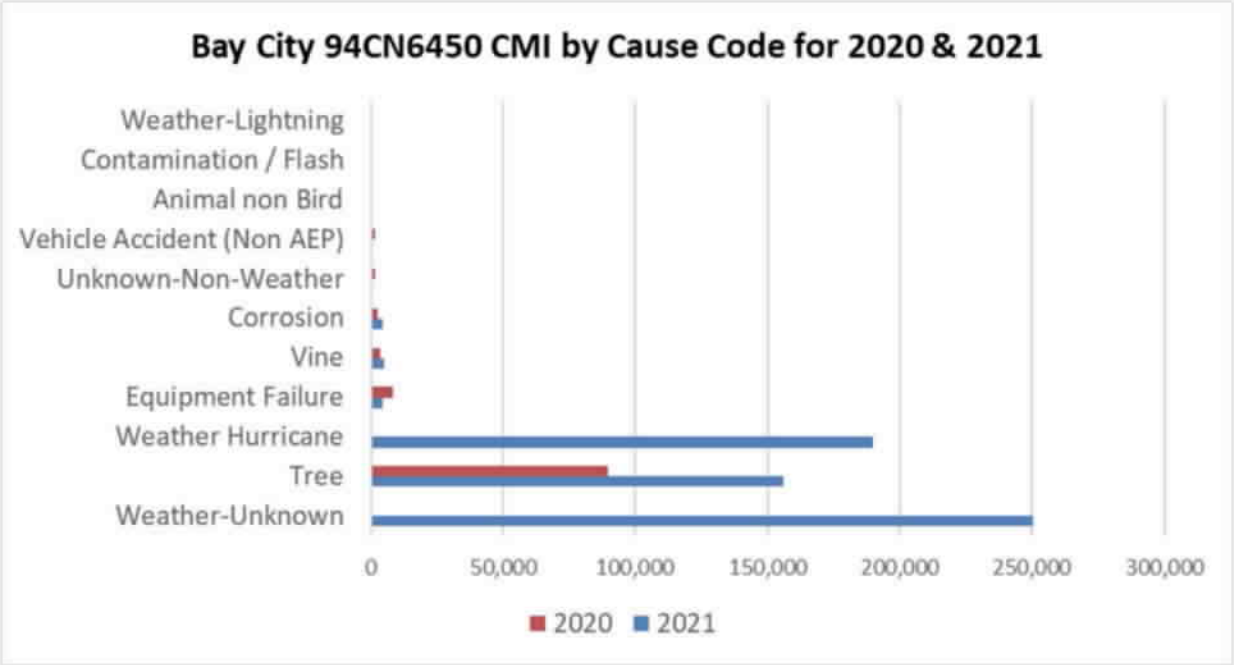
Information	2019	2020	2021
Customer Count	937	927	224
SAIDI Rank	271	541	4
SAIDI Value	224.5	115.8	2728.5
300% System Avg.	584.6	586.2	592.2
# Circuits @ AEP Texas Inc.	1220	1220	1284

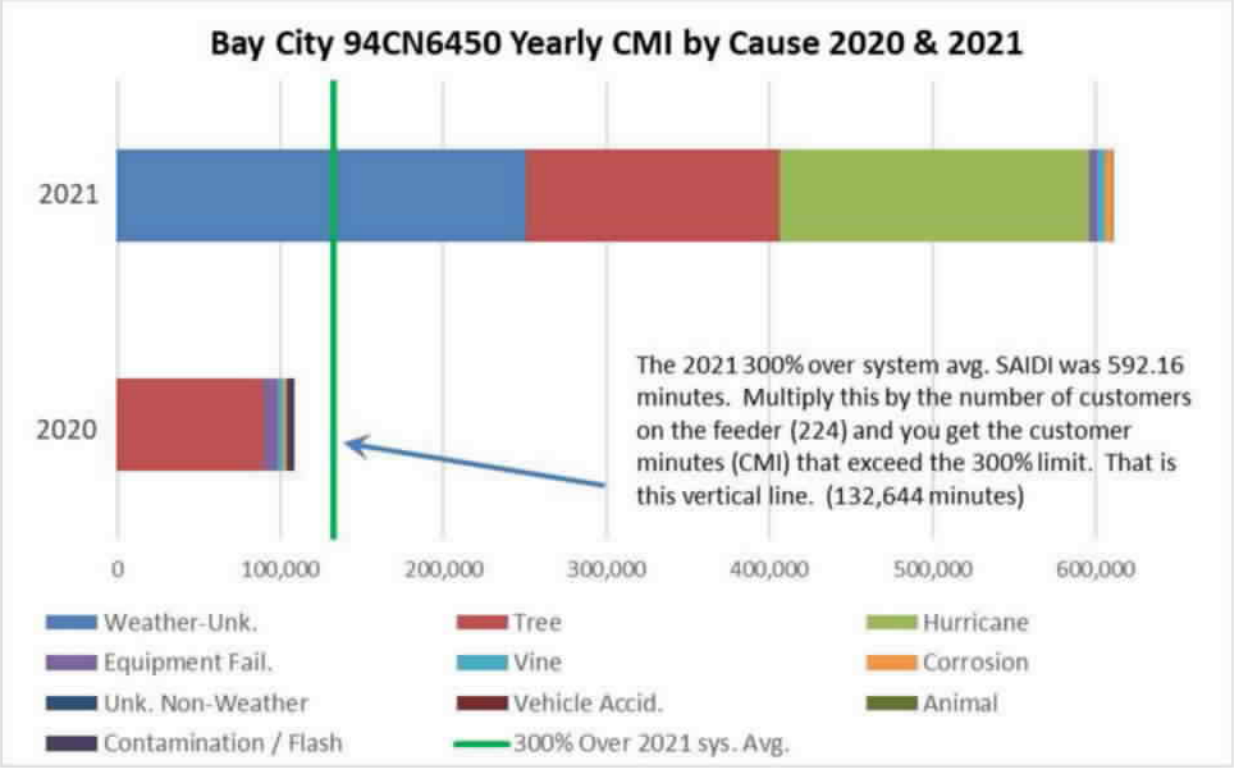
Remediation & Cost:

The reliability work plan for the circuit consisted of the following projects. The cost includes the remediation work as well as any other items done to address reliability on the circuit.

Projects	2019	2020	2021	Total
Failed Equip No Outage	$10,987	$18,056	$0	$29,043
D-Line, Feeder Upgrade	$0	$0	$875,484	$875,484
Circuit Inspections	$0	$71,913	$0	$71,913
Total	$10,987	$89,969	$875,484	$976,440

Outage Cause Graphs:





5. Circuit Analysis for Wesmer 94SB6900 (2021)

Wesmer 94SB6900 is a 2.1 mile 12kV rural circuit in Hidalgo County. The 52 customers are residential and small commercial loads following Camino de Verdad Road on the east side of Weslaco. The substation is located in a rural area between Weslaco and the City of Mercedes. The peak load in 2021 was 600kVA.

- Wesmer Substation was built in 1972. Feeder 6900 was built in 1977. In 2021, a new substation was built two miles to the west and the feeder was split with circuit Pantera 94SB1765 to relieve loading on the Wesmer substation.
- The weather-unknown outages in 2020 were due to four small outages and one major outage that caused a breaker lockout for 114 minutes and 60% of the CMI for the year. There were hazard reports of wires down, but after a successful safety patrol the breaker was closed.
- Equipment failure outages in 2020 accounted for 30% of the yearly outage minutes. The largest outage was a primary wire down behind a recloser. That recloser has since been removed, and the entire primary feeder rebuilt and transferred to the new Pantera Substation. Other failures were a fuse disconnect on an underground riser and several transformer connection failures.
- The 2021 outages were due to unknown-non-weather causes, and a vehicle accident. The unknown causes came from two outages, a breaker lockout while the relay was on one shot and working crews reported no problems, and the second was a line fuse outage where the fuse was replaced and no problem found.
- Four miles of primary feeder was upgraded in 2021. New poles and wire along with some spot tree trimming mitigated most of the issues on this circuit, but the majority of the circuit and 1,580 of the customers were moved to the new Pantera Substation feeders. The remaining feeder had few outages in 2022.
- The feeder did not repeat on the 2022 list. The 2022 SAIDI value was 52.1 minutes.

Circuit Ranking:

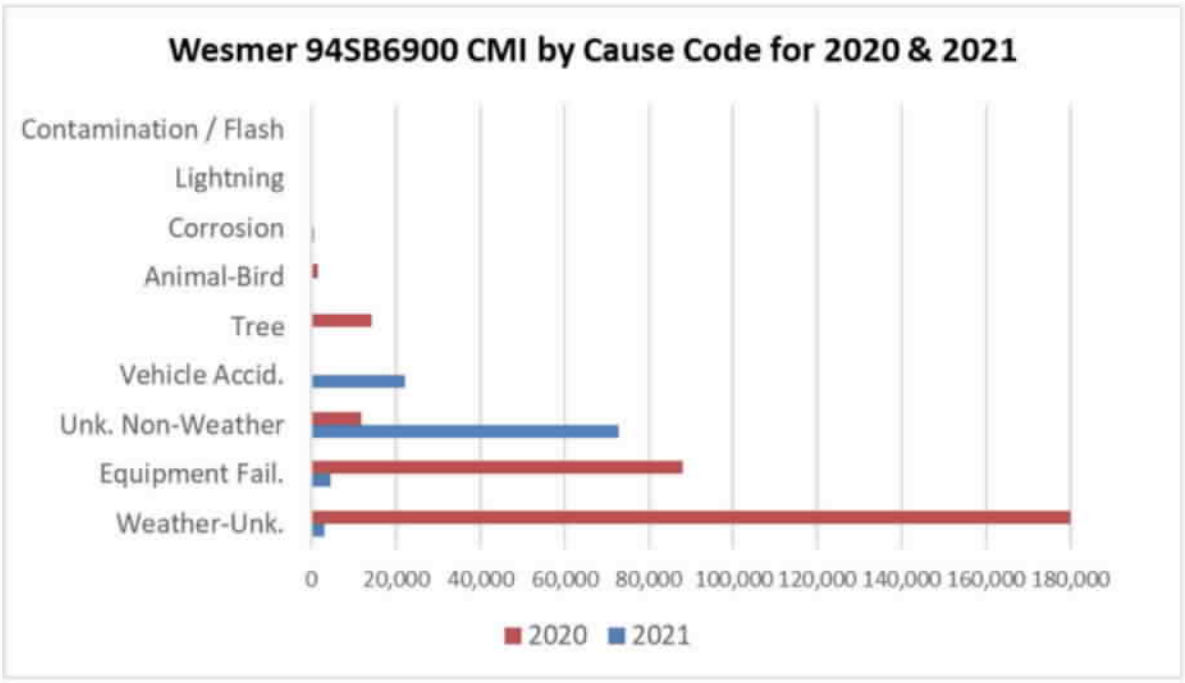
Information	2019	2020	2021
Customer Count	1633	1638	52
SAIDI Rank	298	376	7
SAIDI Value	206.7	180.7	2027
300% System Avg.	584.6	586.2	592.2
# Circuits @ AEP Texas Inc.	1220	1220	1284

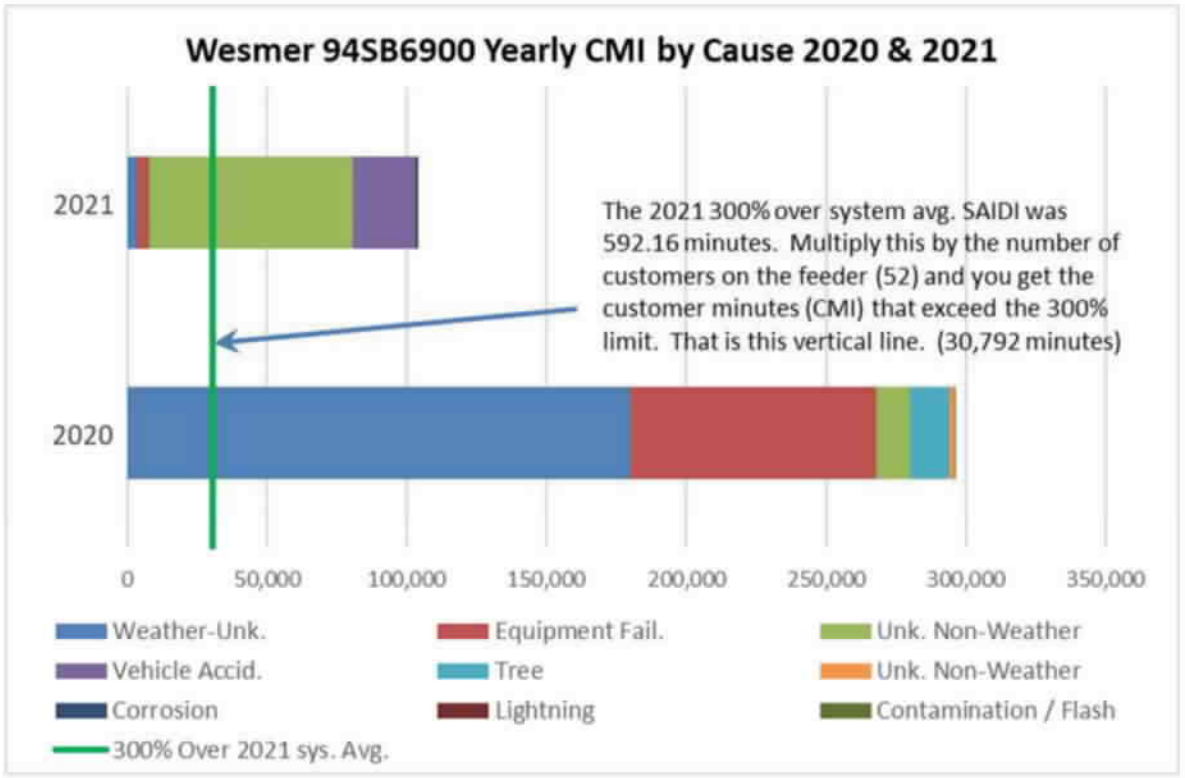
Remediation & Cost:

The reliability work plan for the circuit consisted of the following elements. The cost includes the remediation work as well as any other items done to address reliability on the circuit.

Projects	2019	2020	2021	Total
Failed Equip No Outage	$6,357	$7,285	$1,297	$14,939
Pantera D-Line	$0	$246,532	$1,057,229	$1,303,761
Pole Replacement	$44,282	$40,010	$8,104	$92,396
Line Reclosers	$787	$0	$10,799	$11,586
Circuit Inspections	$1,074	$2,655	$75	$3,804
Phase 3 D Line	$0	$0	$88,254	$88,254
Total	$52,500	$296,482	$1,165,758	$1,514,740

Outage Cause Graphs:





6. Circuit Analysis for Sonora Atlantic 97SA4415 (2021)

Sonora Atlantic 97SA4415 is a 17.6 mile 12kV rural circuit in Sutton County, 10 miles west of Sonora. The feeder travels 4.5 miles south of I-10 and 8 miles north of I-10 up into Schleicher County. It serves 31 oil field customers in the Savell Ranch and Mayer Bryden Ranch areas. The peak load in 2021 was 80kVA.

- The Sonora Atlantic Pipeline station was built in 1950 with upgrades in 1971 and 1982. Feeder 4415 was built in 1970.
- The main outage cause in 2020 was one interruption to seven customers behind a recloser that locked out due to down conductor resulting in 52% of the CMI for the year. The cause was corrosion failing a primary connection. The install year of the #2Al was 1996.
- The two main outages in 2021 were due to issues at the substation. A 12.5 hour outage happened at the substation while a mobile substation was being installed to cover for a failed station transformer. The second outage in May, was a station transformer high side fuse blown for unknown reasons. After the fuses were replaced, there were issues trying to close the breaker. The outage lasted 16 hours and started at 3am. This feeder ties to a cooperative, and there was several hours of patrolling and isolation trying to find the cause. These two outages made up 95% of the yearly CMI.
- Two poles were replaced on the circuit in 2019 There was $12,660 spent on maintenance, and $867 spent on small repairs after inspection.
- In 2022, the feeder did not repeat. The 2022 SAIDI value dropped to 21.5 minutes.

Circuit Ranking:

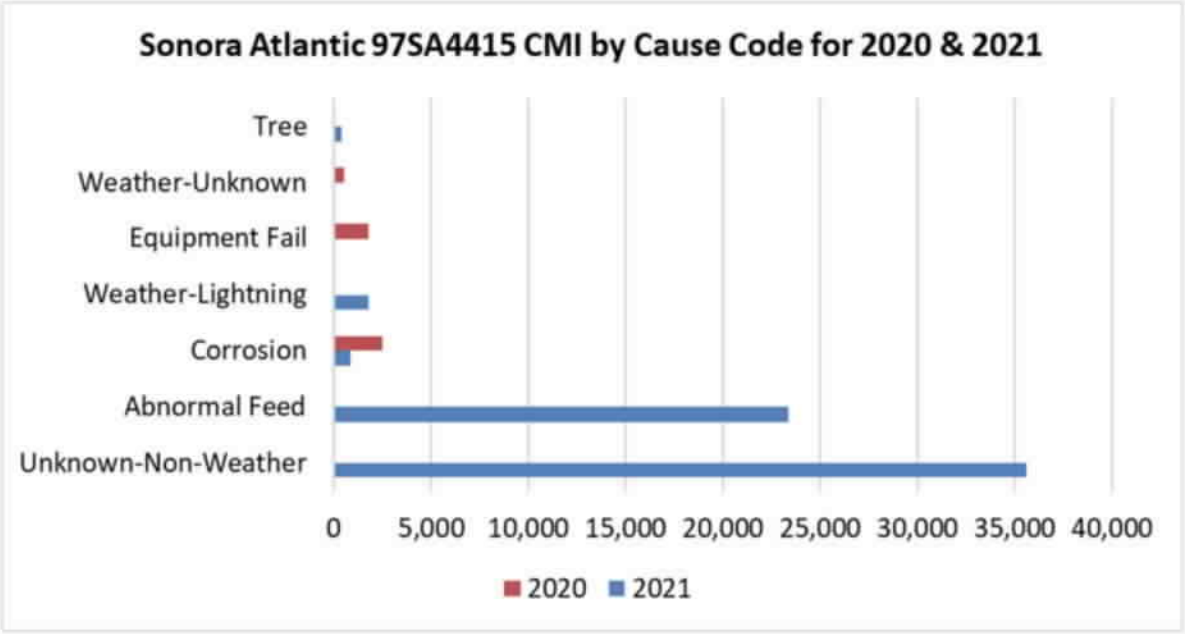
Information	2019	2020	2021
Customer Count	31	32	31
SAIDI Rank	58	442	14
SAIDI Value	611.5	149.2	1997.1
300% System Avg.	584.6	586.2	592.2
# Circuits @ AEP Texas Inc.	1220	1220	1284

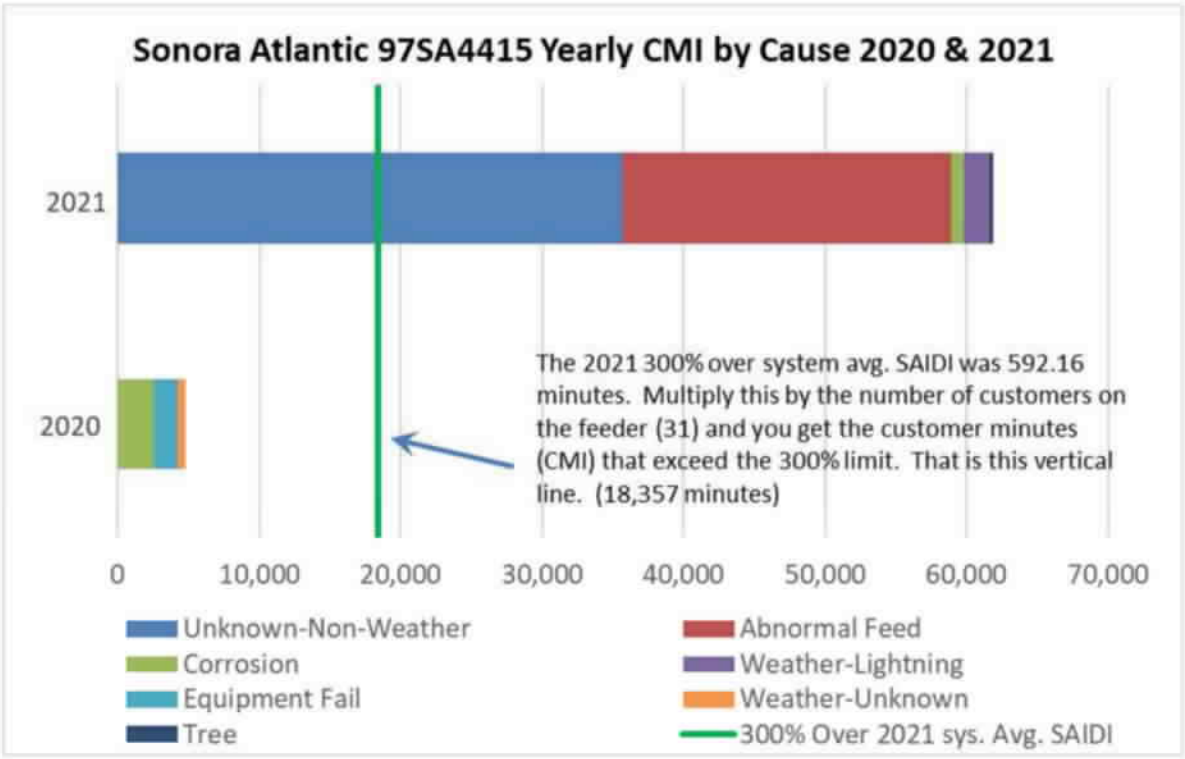
Remediation & Cost:

The reliability work plan for the circuit consisted of the following projects. The cost includes the remediation work as well as any other items done to address reliability on the circuit.

Projects	2019	2020	2021	Total
Failed Equip No Outage	$0	$9,474	$3,186	$12,660
Pole Replacement	$2,636	$0	$0	$2,636
Circuit Inspections	$0	$0	$867	$867
Total	$2,636	$9,474	$4,053	$16,163

Outage Cause Graphs:





7. Circuit Analysis for O'Conner 94CN390 (2021)

O'Conner 94CN390 is a 41.2 mile 12kV feeder on the northern edge of Refugio County. The substation is on Hwy. 77 at Hwy. 239 and travels ten miles east to serve the small community of Tivoli, and some rural residences along Hwy. 35 south. The end of the circuit is three miles from Hynes Bay which ties to San Antonio Bay and the Aransas Wildlife Refuge. This is a coastal flat brushy area subject to storm damage. The peak load in 2021 was 1,400kVA.

- The O'Conner substation was built in 1950. The first 1.2 miles of feeder outside the station was rebuilt in 2015 with 556MCM Al primary wire. The remaining 1/0Al primary feed to Tivoli was built in 1970.
- The main outage cause in 2020 was one interruption due to a bad transformer that caused the breaker to lock out June 4th at 6am. The outage lasted less than 2 hours. The transformer protection failed to clear the fault.
- In 2021, the largest outage was a breaker lockout due to lightning which caused down primary behind a recloser. The recloser failed to open causing the breaker to open. This was 35% of the CMI for the year. The recloser was replaced. Distribution reclosers are replaced on an eight-year maintenance cycle.
- The second largest outage in 2021 was caused by a failed line regulator. This accounted for 27% of the CMI for the year. Regulators are inspected yearly for operational and maintenance issues.
- Future projects include evaluating the smaller #2Al primary conductor and #4 copper primary for replacement and adding lightning arresters in the feeder breaker zone.
- This feeder did not repeat the 300% over average SAIDI list in 2022.

Circuit Ranking:

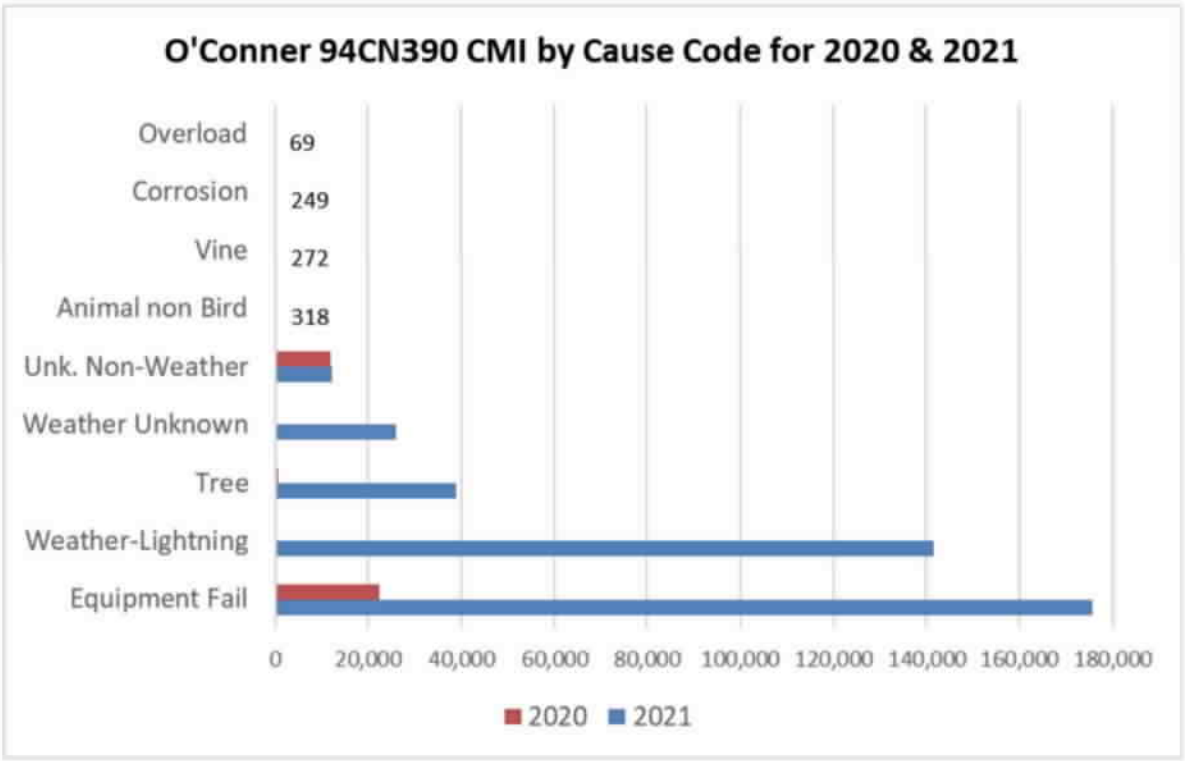
Information	2019	2020	2021
Customer Count	197	199	203
SAIDI Rank	492	385	9
SAIDI Value	122.7	178.1	1946.3
300% System Avg.	584.6	586.2	592.2
# Circuits @ AEP Texas Inc.	1220	1220	1284

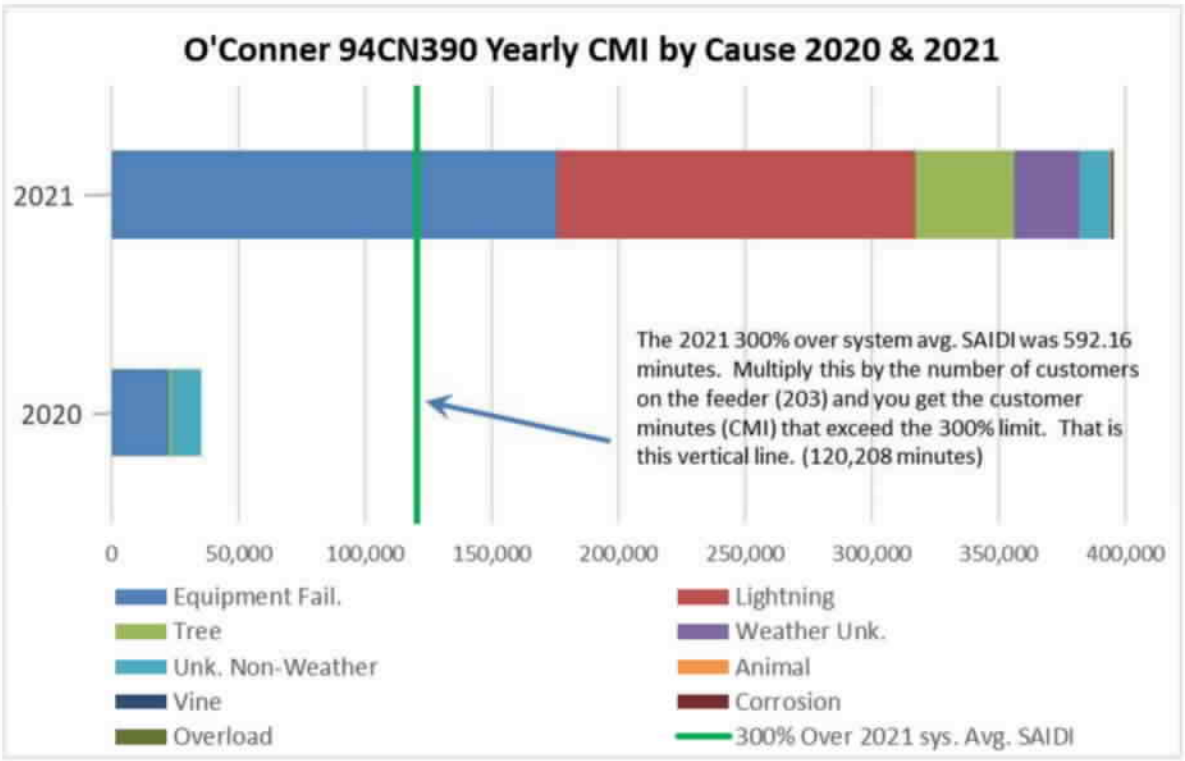
Remediation & Cost:

The reliability work plan for the circuit consisted of the following projects. The cost includes the remediation work as well as any other items done to address reliability on the circuit.

Projects	2019	2020	2021	Total
Failed Equip No Outage	$0	$0	$52,295	$52,295
Pole Replacement	$0	$19,923	$0	$19,923
Line Reclosers	$0	$0	$13,958	$13,958
Circuit Inspections	$0	$18,485	$0	$18,485
Total	$0	$38,408	$66,253	$104,661

Outage Cause Graphs:





8. Circuit Analysis for Dune Field 97SA3885 (2021)

Dune Field 97SA3885 is a 31.4 mile 12kV rural circuit in Crane County, 6 miles north of Crane and 19 miles south of Odessa. The area is flat brushy oil fields along FM 1233 and University Road west of US Hwy. 385. The 69 customers are mainly oil field tank batteries and 12kV primary meters to oil operating companies. The peak load in 2021 was 430kVA.

- The Dune Field Substation was built in 1966. The 2/0Al primary feeder was also built in 1966.
- In 2020, two equipment failure outages accounted for 89% of the yearly CMI. Both outages were caused by failed wooden crossarms.
- On June 29, 2021, at 8pm, a tornado moved through the area and opened up both reclosers just outside the substation. The area was inaccessible and caused a delay in the restoration. Many customer facilities were also damaged. One outage lasted 68 hours, and the other 42 hours. This event accounted for 91% of the yearly CMI. To repair damage after the tornado, 10 poles and 30 crossarms were replaced.
- One of the distribution reclosers failed in 2021, causing 6.7% of the yearly CMI.
- In 2020, two automated reclosers were installed just outside the substation where the primary splits two different directions. This was to give SCADA visibility, and some remote-control functions. Dune Field is a non-SCADA substation. Dune Field and McElroy substations are on the Distribution Automation Circuit Reconfiguration (DACR) plan.
- Crossarm mitigation is planned for the near future. Focus is also on pole replacement and increasing the wind loading capability of the poles.
- In 2022 the feeder did not repeat. The 2022 SAIDI value was 218.6 minutes.

Circuit Ranking:

Information	2019	2020	2021
Customer Count	73	72	69
SAIDI Rank	80	196	10
SAIDI Value	478	303.4	1857.9
300% System Avg.	584.6	586.2	592.2
# Circuits @ AEP Texas Inc.	1220	1220	1284

Remediation & Cost:

The reliability work plan for the circuit consisted of the following projects. The cost includes the remediation work as well as any other items done to address reliability on the circuit.

Projects	2019	2020	2021	Total
Failed Equip No Outage	$2,350	$47,759	$0	$50,109
Small Local Asset Improv	$0	$0	$2,346	$2,346
Pole Replacement	$5,874	$125,316	$224,139	$355,329
Total	$8,223	$173,075	$226,486	$407,784

Outage Cause Graphs: